ZOOLOGICAL GARDEN
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CALCUTTA

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BAUHINIA GALPINI N. E. BROWN

(93·4 per cent nat. size)

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SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

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PART V.

(*Continued from Vol.* xli, *No.* 4 (1940), p. 690).

(*With* 1 *coloured and* 3 *black and white plates, and* 7 *text-figures*).

Bauhinia Linn.

The genus *Bauhinia* was created in honour of the brothers Jean and Caspar Bauhin, French herbalists of the sixteenth century, in consequence of most of the species having their leaves composed of two lobes, which are either quite separate, or, more frequently, joined by a portion of their inner margins. This arrangement of the leaves was considered to be symbolic of the great services the two brothers had rendered to science.

The genus belongs to the family *Caesalpineae*, which was formerly considered to be a subsection of the *Leguminosae*, or sweet-pea family. The flowers are, however, not papilionaceous and the *Caesalpineae* is considered to be distinct from, though closely allied to, other sections of the *Leguminosae, Papilionatae* and *Mimoseae*, and like them has been given full family rank.

Blatter and Millard in *Beautiful Indian Trees* have treated two tree species, *B. variegata* and *B. purpurea*, but the genus contains a number of other species, shrubs and climbers, which are cultivated in gardens in this country on account of their showy flowers or handsome foliage.

The characters of the genus are as follows:—

Trees, shrubs or climbers, the latter with tendrils. Leaves alternate, compound, usually consisting of two leaflets which are

joined together by the lower part of their inner margins, simulating a 2-lobed leaf. The top of the common rib or nerve between the 2 leaflets is produced as a small spur; a vestigial structure which represents the remains of the rhachis of the compound leaf. The flowers are showy and are arranged in simple or panicled, terminal or axillary racemes. Calyx tube sometimes long and cylindrical, sometimes short and turbinate, with the disk produced to the top; limb entire or spathaceous or cleft into 2 or 5 teeth. Petals 5 in number, slightly unequal, usually narrowed at the base into a claw, variously coloured, ranging from red to purple, white or yellow. Stamens 10 or reduced to 5 or 3, if less than 10 with sterile filaments absent or present; filaments free, filiform. Anthers versatile, dehiscing longitudinally. Ovary seated on a stalk (gynophore); ovules usually many. The style is long or short and usually curved, ending in an oblique or terminal stigma. The fruit is a linear pod, dehiscent or indehiscent.

In many species the flowers are fragrant, and this characteristic combined with their showy appearance points to pollination through the agency of insects.

It is well known that the cotyledons of dicotyledonous seedlings, which are widely spread during the day, press their inner surfaces together during the night in order to prevent loss of heat and to protect the tender first leaves. This phenomenon is particularly well seen in the seedlings of all Bauhinias. The cotyledons, moreover, seem to function as ordinary foliage leaves to some extent, as well as performing their role of reservoirs of food.

Bauhinia Vahlii, a climber, often reaches a length of over 100 yards and scrambles over the tallest trees. The exceedingly tough and fibrous bark of this particular species had, and still has, a great reputation as a suitable material for making strong ropes. Before steel came into use, ropes made from this species were used to carry suspension bridges. About the middle of the 19th century the ropes for the suspension bridge over the Jumna at Kalsi were made from the bark of *B. Vahlii.*

The bark of certain Indian species smoulders very slowly when set alight. This property was made use of in bygone days to construct the slow matches whereby primitive artillery were discharged. Now-a-days such torches are often carried by cattle-boys to free themselves from the attention of sandflies and other insects.

Key to the Species.

Erect or prostrate shrubs.
- Stems spiny. ... ... *B. candicans.*
- Stems not spiny.
  - Stamens 10.
    - Flowers usually in axillary pairs ... ... *B. tomentosa.*
    - Flowers in axillary racemes. ... ... *B. acuminata.*
  - Stamens 3 ... ... *B. Galpini.*

Climbers.
- Stems flattened and undulate ... ... *B. anguina.*
- Stems cylindrical.
  - Leaves very large, 4 in. to 18 in. long ... ... *B. Vahlii.*
  - Leaves small not longer than 1.5 in. ... ... *B. corymbosa.*

Bauhinia candicans Benth.

(*candicans* means hoary, covered with white hairs).

Fig. 1.—*Bauhinia candicans* Benth. × 2/3.

Description.—A shrub or small tree with zigzag, very hoary, tomentose branches. Leaves compound, 2-3 in. long, ovate or somewhat oblong, shallowly cordate at the base, 2-lobed for one-third or almost to the base, with the common midrib produced as a short spur, 11-13-nerved from the base; glabrous on the upper surface, very hoary below, petiolate, stipulate; lobes obtusely rounded at the top; petioles hoary, up to 1 in. long; stipules represented by a pair of stout thorns.

Flowers few, in axillary racemes. Pedicels short. Calyx tube short, turbinate, hoary. Calyx-limb spathaceous; segments valvate and connate in the bud, shortly 5-lobed at the apex, up to 2.5 in. long, densely and shortly hairy outside. Petals 5, free, long-clawed, with a pronounced midrib, spathulate, creamy-white in colour, opening at night. Stamens 10; 5 on short, 5 on long filaments; filaments bound together at the base by a short membrane which is apparently a prolongation of the disk. Ovary seated on a long gynophore, hairy, glabrescent, ending above in a long style and

capitate stigma. Pod dehiscent, very leathery, polished, 3-4 in. long.

Flowers.—June-July. *Fruits.*—Oct.-Nov.

Distribution.—A native of Brazil, now commonly cultivated throughout the plains of India.

Gardening.—An almost evergreen shrub with large creamy white flowers which usually open in Dehra during the night and last only for a day. Easily raised from seed.

Bauhinia tomentosa Linn.

St. Thomas-Tree.

(*tomentosa* is a Latin word meaning hairy and refers to the hairness of the leaves and pods).

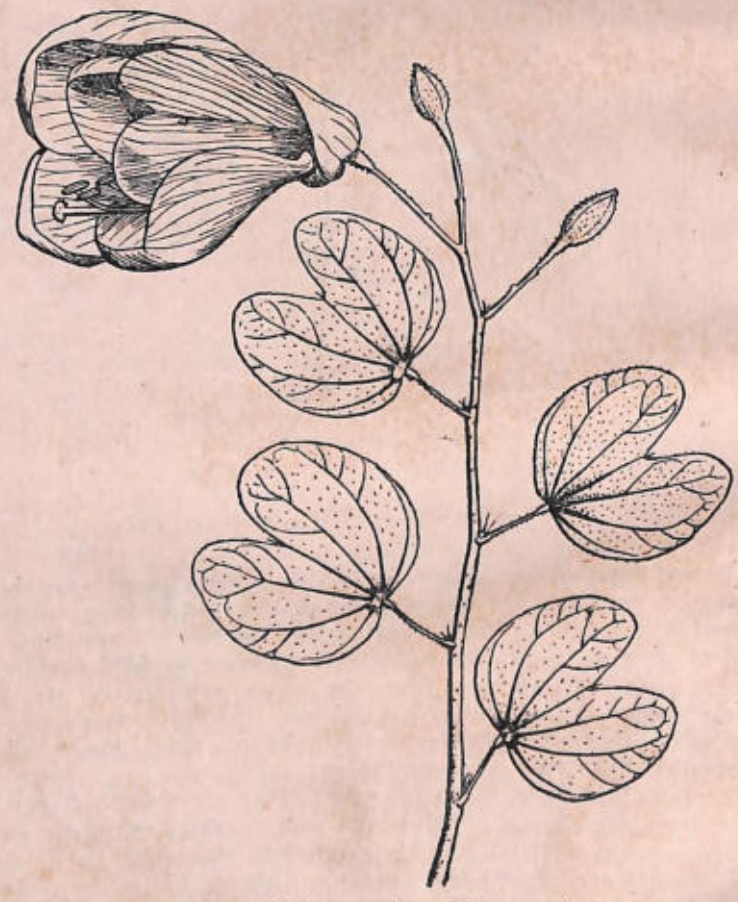

Fig. 2.—*Bauhinia tomentosa* Linn. × 1/1.

Description.—A handsome shrub which sometimes grows into a small tree. Leaves compound, on slender petioles up to 1 in. long, stipulate; stipules long, subulate, hairy. Leaf-blade of two

Photo by *M. N. Bakshi*

Bauhinia acuminata Linn.
New Forest, Dehra Dun.

connate leaflets, coriaceous, 1-2 in. long, broader than long, 7-9-nerved from the base, glabrous on the upper surface, tomentose below, 2-lobed; lobes rounded at the apex; reticulation conspicuous.

Flowers axillary in pairs (sometimes 1 or 3) on pedicels bearing a pair of subulate persistent bracteoles. Calyx tube short, covered with appressed pubescence; limb spathe-like with 2 small teeth at the apex in bud, splitting down one side when the flower opens, about .5 in. long. Corolla of 5 distinct petals. Petals obovate in shape, .75-2 in. long, not clawed, yellow in colour, conspicuously veined, one with a red blotch on the inner surface. Stamens 10 in number arising from the lip of the calyx tube; anthers sagittate. Ovary on a gynophore; style nearly .75 in. long. Pod dehiscent, stalked, 4-5 in. long, 6-10-seeded, tomentose or glabrous.

Flowers.—August-Oct. *Fruits.*—Dec.-Feb.

Distribution.—Throughout India, wild or cultivated, extending to China and tropical Africa. Now commonly cultivated in the tropics of both the old and the new worlds.

Gardening.—A handsome shrub. New foliage and young parts downy brown. Flowers sulphur-yellow, drooping. Easily raised from seed sown in April. This shrub is partially deciduous in Dehra. According to J. D. Hooker it was introduced to the Royal Gardens, Kew, in 1860.

Medicinal and economic uses.—The wood of this species is tough and the heartwood black. It was formerly used in Java for the handles and sheaths of krises (Burkill).

The bark, root and leaves are said to be efficacious as poultices for boils. The plant is also said to be anti-dysenteric, anthelmintic and of value in liver complaints.

Bauhinia acuminata Linn.

(*acuminata* is a Latin word meaning sharp pointed, and refers to the lobes of the leaf).

Description.—An erect shrub with reddish-brown branches covered with minute hairs. Leaves alternate, stipulate; stipules lanceolate-subulate, covered with short hairs. Petioles 1-1.5 in. long, swollen at the base and apex, downy. Compound leaf-blade 9-11-nerved from the base, the common midrib being produced as a very short spur, orbicular in shape, acuminately 2-lobed, thinly coriaceous in texture, glabrous above, pubescent on the nerves beneath, 3-6 in. long.

Flowers a pure white, close, shortly peduncled, in axillary, corymbose racemes. Calyx tube about .3 in. long; limb spathe-like up to 1.5 in. long in the bud, ending above in 5 short subulate hairy lobes. As the flower opens the calyx splits along one side, becomes reflexed and eventually divides into five segments below. Petals 2 in. long, .75 in. wide, oblong-obtuse, white, not clawed but rounded at the base, seated on the margin of the calyx tube. Stamens 10, filaments white, of various lengths; anthers yellow, versatile, hairy. Ovary on a gynophore at the base of the calyx tube. Style short, .5 in. long; stigma a 2-lobed disk. Pod pendent

from a .5 in. stalk, 4-5 in. long, .9 in. broad, firm, glabrous, 8-12-seeded, with a rib on each side of the upper suture.

Fig. 3.—*Bauhinia acuminata* Linn. × 2/3.

Flowers.—March-May. *Fruits.*—Cold season.

Distribution.—Indigenous to Central India, Ceylon, Malaya and China. Very frequently cultivated in gardens all over the country.

Gardening.—This is one of the most satisfactory species of *Bauhinia* for cultivation in the open. It is quite frost hardy and starts flowering when the plants are only a few months old and but a foot or so high. According to Aiton's 'Hortus Kewensis' it was introduced from India into England by Dr. Francis Russell and flowered at Kew in the month of May and June. It grows readily from seed and bears its numerous, large, snow-white flowers practically all the year round but chiefly during March-May.

Photo by *M. N. Bakshi*

Galpin's Bauhinia.
Bauhinia Galpini N. E. Brown.
New Forest, Dehra Dun.

Bauhinia Galpini N. E. Brown.

Galpin's Bauhinia.

(This plant was named in honour of E. E. Galpin, who was one of the earliest collectors of the species).

Description.—A rambling prostrate shrub with hairy stems. Leaves alternate, stipulate, consisting of two leaflets connate by their inner margins, with the common midrib produced as a minute spur, obtusely 2-lobed, 7-nerved, broader than long, up to 3 in. broad, minutely pubescent with white hairs on the lower surface; margins and under surface thickly or sparsely covered with yellow glandular exudations; petiole about .5 in. long.

Flowers brick-red or crimson in colour, borne in 2-10-flowered axillary racemes. Peduncles very short. Calyx tube up to 1 in. long, rather stout, somewhat striate, dark red in colour, sparsely covered with yellowish glandular exudations. Calyx limb at first spathe-like, reddish but appearing to be striped with yellow from the production of a glandular yellow substance, becoming reflexed after the flower opens and splitting down one side, subsequently dividing into 5 segments at the base which remain connate at the top. Petals 5, inserted at the top of the calyx tube, 1-1.5 in. long, clawed, the claw being as long as the limb. Limb orbicular in shape, cuspidate, rather undulate on the margins. The inner surface of the petals is clear red, the outer surface being dotted all over with yellow particles. Stamens 3 in number, inserted at the top of the calyx tube, together with seven very short, subulate staminodes. Filaments red, anthers versatile. Ovary linear, seated on a gynophore 3 in. long, covered with short white hairs and yellow glandular exudations. Style thick; stigma globose. Pod 3-5 in. long; seeds dark brown.

This plant will often be found to be covered with ants which come to feed upon the yellowish product of the glands.

Flowers.—Sept.-Oct. *Fruits.*—Cold season.

Distribution.—Indigenous to the Transvaal and adjacent tropical Africa; commonly cultivated in gardens in the plains throughout India.

Gardening.—This fine species, which in its native country is said to be a climber is found only as a straggling or prostrate shrub in India. It thrives better on a well-drained soil and bears its bright scarlet flowers profusely during Sept.-Oct. Propagated by seed which germinates rather sparingly. The seedlings are liable to damp off during the rains if not properly looked after. This beautiful shrub is well worth growing in spite of the initial difficulties of propagation.

Bauhinia anguina Roxb.

Snake Climber.

(*anguina* means snake-like and refers to the peculiar stems of this species).

Description.—A woody cirrhose climber with very peculiar compressed flattish stems, alternately concave and convex in the central

portion, with stout margins. This is an adaptation to take strain. The majority of the sap vessels are in the corrugated part so that if tension is applied the strain is taken by the margins and

Fig. 4.—*Bauhinia anguina* Roxb. × 2/3.

the ascent of sap is not impaired. Leaves alternate, densely tomentose when young, glabrous when old, thin, 2-5 in. long, shortly lobed or with 2 very long acuminate lobes. On old plants the leaves are often quite entire and acuminate.

The flowers are very small for the genus and are arranged racemosely in lax, pubescent, terminal panicles. Individual flowers seated on very short pedicels. Calyx very small about .05 in. long, broadly campanulate, with 5 deltoid teeth. Petals 5, oblong-lanceolate in shape, about .1 in. long. Fertile stamens 3. Pod thin flat, oblong or elliptic, glabrous, indehiscent, 1.5-2 in. long, 1-2 seeded.

Flowers and fruits.—Cold season.

Distribution.—Sikkim Tarai, ascending to 2,000 ft., Khasi hills, Chittagong, Martban, Malabar and Travancore.

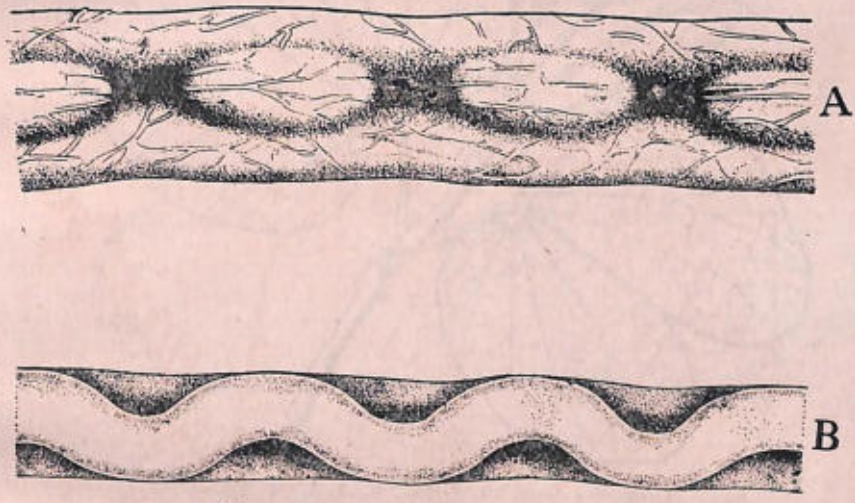

Fig. 5.—Stem of *Bauhinia anguina* Roxb.

A.—A surface view of the strap-shaped stem.

B.—A longitudinal section of the stem seen sideways to show the sinuous centre portion.

Gardening.—A large evergreen climber having a curious stem and small inconspicuous white flowers. According to Roxburgh 'the most regularly serpentine pieces of the stems and large branches are carried about by our numerous mendicants to keep off serpents'. Easily propagated by seed or layers.

Bauhinia Vahlii W. & A.

Camel's foot Climber.

(This species was called after Martin Vahl, a Danish botanist, 1749-1804).

Description.—A gigantic climber, with densely pubescent branches and abundant circinate tendrils, mostly leaf-opposed. Leaves compound, alternate, petiolate, deeply cordate at the base, lobed at the top, 11-15-nerved from the base, almost orbicular in shape,

up to 18 in. long, sparsely hairy on the upper surface, densely ferrugineous-tomentose on the lower surface; petiole 3 in. long.

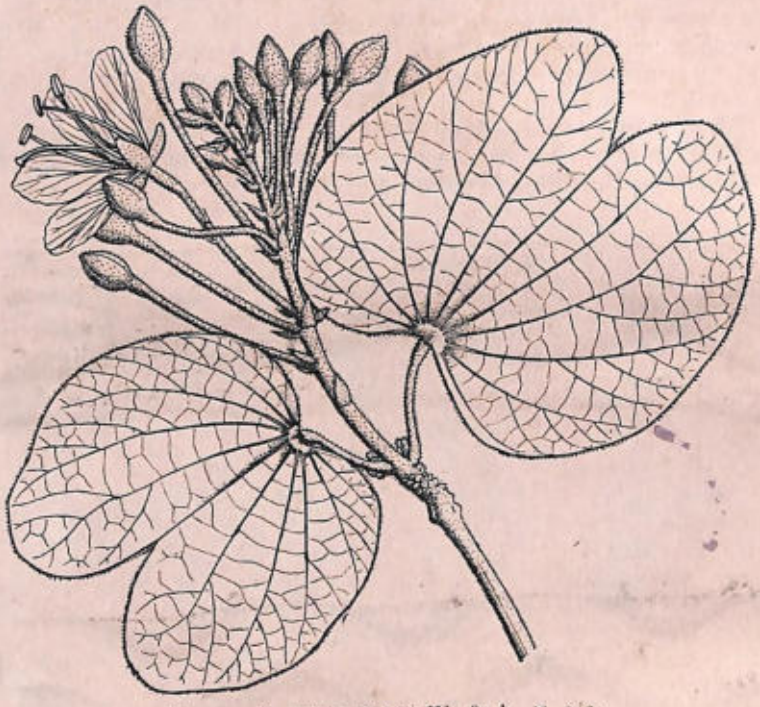

Fig. 6.—*Bauhinia Vahlii* W. & A. × 2/3.

Flowers numerous, arranged in long-peduncled, terminal, dense, subcorymbose racemes. Individual flowers seated on pedicels 1-2.5 in. long, with persistent bracteoles at the base. The whole inflorescence is covered with a dense rusty tomentum. Calyx tube short, it and the limb very hairy; limb splitting into 3-5 valvate segments when the flowers open and becoming reflexed. Petals 5, white fading to yellow, shortly clawed, broadly spathulate in shape, spreading, glabrous within, covered on the outside with rusty villae. Stamens 3, fertile; a number of staminodes may be found on the lip of the calyx tube. Ovary on a short gynophore, very densely hairy as is also the style. Pod woody, up to 12 in. long finally dehiscent, velvety, 8-12-seeded.

Flowers.—April-June. *Fruits.*—Cold season.

Distribution.—Subhimalayan tract and outer valleys ascending to 3,000 ft. from the Chenab eastwards, chiefly in sal forests; Assam, Bihar, Western Peninsula.

Gardening.—This gigantic woody climber needs plenty of space for its growth. It is useful for covering unsightly embankments and the like. Easily raised from seed. It is one of the most distinctive climbers in the Indian forests. The trunk may reach a girth of 4 feet and is often deeply fluted. When cut down shoots more

Photo by *M. N. Bakshi*

Bauhinia corymbosa Roxb.
New Forest, Dehra Dun.

than 50 feet long may be produced in one season, and for this reason it is difficult to eradicate this plant which is considered a pest by forest officers.

It is known as Camel's foot Climber as the leaves are very much the size and shape of a camel's footprint.

Medicinal and economic uses.—The large leaves are used as plates by the local inhabitants, who also value the seeds as a source of food. To extract the seeds the pods are placed in the fire. The bark yields a strong fibre which is used for making ropes. The stem produces a valuable tanning material. The seeds are said to possess tonic and aphrodisiac qualities.

Bauhinia corymbosa Roxb.

(*corymbosa* refers to the arrangement of flowers in the inflorescence which are described as corymbose, but in Dehra they are decidedly racemose).

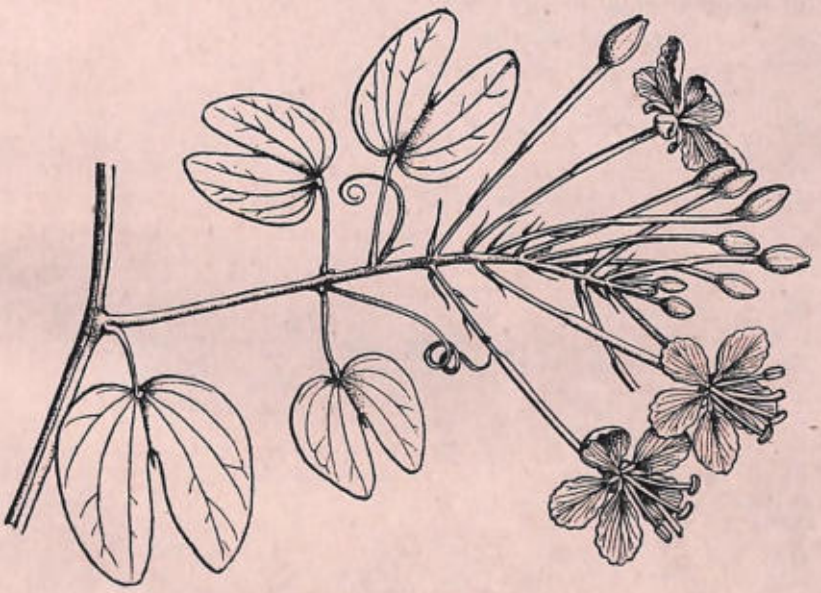

Fig. 7.—*Bauhinia corymbosa* Roxb. × 1/1.

Description.—A woody climber, branching from the ground, with grooved branches and circinate tendrils. Leaves compound, 1-2 in. long, divided almost to the base; common midrib very short, produced into a short spur; lobes rounded. The two leaflets fold together at night. Petiole up to 1 in. long, swollen at base and apex, often covered with appressed brownish hairs.

The fragrant flowers are borne in terminal long-peduncled racemes or corymbs. The individual flowers are seated on pedicels up to 1 in. long and are supported by bracts and bracteoles. The calyx tube is ·75 in. long, green in colour, with 10 well-marked red ribs covered

with brownish hairs. Calyx-limb short, .25 in. long, red, 5-lobed; lobes valvate, splitting into 5 segments, which turn downwards as the flower opens. Petals white, with pink nervation, rather crumpled, seated on the margins of the calyx tube. Fertile stamens 3, on pink filaments, posterior; staminodes 5, pink, anterior, all seated on the calyx tube. Ovary on a gynophore arising from the calyx tube, red in colour, produced into a short style and globose stigma. Pod 4-5 in. long, .7 in. broad, thin, smooth, dark brown.

Flowers.—April-June. *Fruits.*—Cold season.

Distribution.— Native of China. Commonly cultivated in gardens throughout India.

Gardening.—*Bauhinia corymbosa* is one of the most beautiful of climbing Bauhinias; and even with its rather small flowers, it is a most charming plant with exceedingly slender stems and very small, pretty, dark green shiny foliage. The rosy-white, fragrant flowers appear in great abundance during April-June. Easily raised by layers. It has long been cultivated in Indian gardens for its ornamental foliage alone.

THE POMEGRANATE.

BY

J. F. CAIUS, S.J., F.L.S.

Alphonse de Candolle sums up the results of his painstaking investigation into the origin and distribution of the pomegranate (*Punica Granatum* Linn., the sole genus with only two species within the family *Punicaceae*) as follows:—

'To conclude, botanical, historical, and philological data agree in showing that the modern species is a native of Persia and some adjacent countries. Its cultivation began in prehistoric times, and its early extension, first towards the west, and afterwards into China, has caused its naturalization in cases which may give rise to errors as to its true origin, for they are frequent, ancient, and enduring.'

In fact, many of these errors, if errors they be, are being perpetuated with effusion of much good ink and not a little bad blood. But there is no apparent reason why the question should ever be satisfactorily settled, because the pomegranate has been so long under cultivation that it is impossible to say with any degree of certainty whether the plant is really native in any particular region.

The antiquity of the tree as a cultivated plant is evidenced by the references to the fruit in the Old Testament—

'Why have you made us come up out of Egypt, and have brought us into this wretched place, which cannot be sowed, nor bringeth forth figs, nor vines, nor pomegranates . . . '—.

and in the Odyssey where it is spoken of as cultivated in the gardens of the kings of Phaeacia and Phrygia. In the villa garden of king Amenhotpou IV, of the Eighteenth Dynasty, may be seen painted on the wall of a tomb at Tell-el-Amarna, ten pomegranate trees easily recognizable from the shape of the fruits and the leaves. The fruit is, indeed, frequently represented in ancient Assyrian and Egyptian sculptures, and it figures prominently among the offerings made to the gods by Ramses IV, a Pharaoh of the Twentieth Dynasty. As a design it has been used in architecture and needlework from the earliest times. It formed part of the decoration of the pillars of King Solomon's Temple, and was embroidered on the hem of the High-Priest's ephod. It had a religious significance in connection with several Oriental cults, especially the Phrygian cult of Cybele, and it is still used by the Jews in some ceremonials.

The pomegranate was well known to the Greeks and Romans, who were acquainted with its medicinal properties and its use as a tanning material. The name given by the Romans, *malus punica* or *malum punicum*, indicates that they received it from Carthage, as indeed is expressly stated by Pliny—'but the territorie of Carthage challengeth to itself the punicke apple' (Holland)—; and this circumstance has given rise to the notion that the tree was indigenous in northern Africa.

The pomegranate-tree was introduced into India from Persia or Afghanistan, presumably in the first centuries of our era. The tree is not mentioned in Vedic, Pāli, or early Sanskrit literature; and the word *dālima* or *dāḍima* is traceable to the Iranian *dulim*, as reconstructed by Berthold Laufer[1] on the basis of the Chinese transcription. According to the Agnipurana 'dadima' is to be planted in the garden adjoining one's house; and, on the authority of the Brihat-samhita, it is to be propagated by means of cuttings besmeared with cowdung. Varahamihira mentions the pomegranate as one of the trees growing in the Anupa region, Susruta gives it as one of the plants which act as cordials and increase the appetite, and Charaka recommends it for the wholesomeness of its fruit.

Characteristics.

The pomegranate is a large deciduous shrub or small tree. As a tree it rises to a height of fifteen to twenty feet; it is covered with a desquamating greyish or pale brownish bark, and is divided into many slender, twiggy, nearly cylindrical branches, which are armed with spines. The buds and young shoots are red.

The leaves are opposite, or ternate, about three inches long, sessile, wavy, entire, oblong or lance-shaped, pointed at both ends, glossy green and with red veins.

The flowers are large, raised on a short stalk, of a rich scarlet colour, solitary, or in twos or threes or fives at the extremities of the young branches. The calyx is turbinate, thick, fleshy, of a fine red colour, and divided into five acute segments, which are valvate in aestivation. The corolla is composed of five, or seven, large roundish crumpled petals, inserted on the throat of the calyx alternate with the sepals, rather spreading, and of a bright scarlet colour. The stamens are indefinite, many-seriate, perigynous, inserted at different levels below the petals; the filaments are capillary and free, furnished with ovoid yellow anthers, 2-celled, dorsifixed, and bursting in front by two chinks. The ovary is inferior, roundish, many-celled, with a slender simple style—the length of the stamens, and capitate papulose stigma.

The fruit is as big as a common orange, and not unfrequently much larger. It is globular, somewhat compressed, obscurely six-sided, and indehiscent. It contains numerous oblong or obconical, many-sided exalbuminous seeds, each enveloped in a distinct very juicy rose-coloured pulp enclosed in a thin skin, so that the inside of the pomegranate appears to be made up of a large number of reddish berries packed tightly together. The rind, which is the calycine tube, is smooth, hard, leathery and, when the fruit is ripe, of a brownish yellow tint, often finely shaded with red. The interior is divided into two chambers by some six spurious transverse membranous dissepiments meeting in the axis of the fruit. The upper chamber is 5- or 9-celled, the lower 3-celled. The placentas

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[1] Sino-Iranica. *Chicago Field Museum of Natural History*, publication 201; Anthropological Series, Vol. xv, No. 3.

of the upper division reach from the walls to the centre; those of the lower proceed irregularly from the bottom of the fruit.

The embryo is oblong with a short straight radicle, and foliaceous, spirally convolute cotyledons.

As a botanical entity the pomegranate has been placed by various authorities in different orders wherein, for want of close relations, it has always occupied an anomalous position. Though nearly allied to the myrtles it differs from them in the absence of aromatic principles in the green parts, in the absence of dark dots and marginal veins in the leaves, and in the typical conformation of the fruit. It is chiefly owing to the singular structure of its fruit, a *balausta*, that the genus *Punica* has finally been formed into a separate order, *Punicaceae*.

The family consists of only one genus with two species: *P. Granatum* Linn. (=*P. florida* Salisb., *P. grandiflora* Hort., *P. nana* Linn., *P. spinosa* Lam.), and *P. protopunica* Balf. discovered by Balfour in the island of Socotra.

Cultivation.

The pomegranate is a favourite in the East, and is grown both for its beautiful flowers and for its edible fruits. It is not particular as to soil, though it enjoys a deep calcareous ground and prefers a dry situation to one that is surcharged with wet. Native gardeners in India recommend that the soil be mixed with a large proportion of bricks broken fine, together with old, decayed cowdung.

The trees may be planted eight or ten feet apart, and the ground cultivated with irrigated crops until the trees occupy the soil. They can also be grown as a hedge. They are usually raised from seed, but are also multiplied by hardwood and softwood cuttings, or by layers. As the plant forms many shoots, these are often used, as they are usually provided with rootlets. For latitudes higher than the 35th degree North, the plant ought to be cultivated in tubs, and given a conservatory during winter.[1]

Under cultivation there are several forms differing more or less in the colour of the flowers, both single and double, and only of ornamental value. The double-flowered varieties are specially desirable for the beauty and long duration of their flowers. The better known are: *double red*, with a very large calyx, from which protrude numerous large bright scarlet petals, larger than those of the common single type, which give the flower the appearance of a bright scarlet pompon; *double dwarf*, specially desirable for growing in pots, with bright scarlet flowers borne in clusters; *double variegated*, with very large flowers, the petals being striped and mottled with yellow and scarlet—as this is a sport of the Double Red it frequently reverts to type, and consequently double red blooms are often to be found on the same stem with variegated blooms; *double yellow*, similar to the Double Variegated in the shape of the flower; *double white*, with a pure white flower similar in shape to Double Red.

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[1] L. H. Bailey.—The Standard Cyclopedia of Horticulture; 1916.

Although of such ancient origin and cultivation, there are but few varieties of fruit-bearing trees, and the various kinds of pomegranate may be reduced to three: one very sour, the other two moderately sweet or very sweet. The distinction between a sweet and a sour pomegranate is already made by Theophrastus and, though Pliny distinguishes five varieties—*dulcia, acria, mixta, acida, vinosa*—, ancient authors discriminate between only two.

The emperor Jahangir mentions in his Memoirs the sweet pomegranates of Yazd and the subacid ones of Farrah, and says of the former that they are celebrated all over the world. Crawford remarks in his History of the Indian Archipelago: 'The only good pomegranates which, indeed, I have ever met with are those brought into upper India by the caravans from eastern Persia.' And Firminger[1] states: 'The Pomegranate tree is common in all parts of India, but never produces fruit at all to be compared with that brought down annually by the Afghan traders from Kabul.'

The seedless pomegranates so highly prized by Akbar's household came from Kabul; and the sweet, pure, and full-flavoured pomegranates with white and very transparent seeds were from Baluchistan. In course of time the seeds of these high class fruits found their way from Afghanistan to Bengal, where there is made mention of several fine varieties of local growth: seedless[2], very sweet, deliciously perfumed, the size of an ordinary human head or as large as a small shaddock.

'A tree that bears fruit of good flavour with as few seeds as possible should be grafted on seedlings, and none but the grafted plants grown. Such trees need no more manure, water, or land than common seedlings, yet the value of their fruit is very great in comparison.' Woodrow's[3] recommendation to graft from trees of a superior kind is sound, but not all superior varieties will thrive away from their natural surroundings. Thus, says Burns, the Kabul Pomegranate, both in its own roots and when grafted on Poona stocks, has done very badly in Poona, making little growth and producing few fruits.

In North America, where pomegranates are grown commercially in several of the southern states, the following varieties are cultivated for fruit:—

Acid or *Wild*—with a sharp acid pulp; fruit often very large, from 3 to 4 inches diameter and with a bright-coloured rind.

Dwarf—a form of the Acid variety, of very low and bushy growth; flowers single; fruit from 1½ to 2 inches diameter; pulp very acid. This can be grown in a pot, as it fruits very abundantly.

Paper Shell—very large, juicy, very sweet, and of excellent quality; skin thin, pale yellow with crimson cheek; sides crimson; fine grower, good bearer, and ships well.

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[1] W. Burns.—Firminger's Manual of Gardening for India, 1918.

[2] 'I do not know any seedless variety is growing in Bengal.' (N. Mitra, Curator, Royal Botanic Garden, Shibpur; 5th December 1939).

[3] G. M. Woodrow.—Gardening in India, 1889.

Rhoda—fruit crimson, of large size; skin thin but tough; crisp, sweet, and of exquisite flavour.

Spanish Ruby or *Purple-seeded*—is cultivated in Louisiana, seems to be only a form of the subacid. Fruit large and bright-coloured with deep crimson pulp. It is considered the best of its class.

Subacid—differs only from the sweet in the more acidulated pulp.

Sweet—fruit usually somewhat smaller than the Acid and with a darker-coloured rind; pulp sweet.

Wonderful—said to be the largest of all pomegranates; fruit sometimes 5 inches in diameter, bright crimson; pulp highly coloured; very juicy; fine flavour; ripens early; good shipper.

All these varieties are very ornamental from their abundant yield of bright scarlet flowers, which are produced upon the extremities of the young branches of the same year's growth. When the plant is grown in a tree form, the branches should be annually cut back after the leaves drop.

A great many shoots spring from the base of the plant; these should from time to time be cut clean out, as it is contended that they withdraw the nutriment which should go to the fruit-bearing stems. To yield fine fruit the plant must be manured each year.

Writing about 'Tropical and Subtropical Fruits in California,' F. W. Popescoe notes[1]:—'The Pomegranate is produced commercially in a small way, the demand for the fruit being limited. The shrub succeeds best, and is most commonly grown, in the interior valleys. The inferiority of the varieties cultivated in the State has led to an attempt to secure superior ones; among those which have been introduced the variety 'Wonderful' has proved to be choice, and is now offered by the trade.'

Pomegranate ripening fruit on a wall at Trewarthenic, Tregony, was reported[2] as one of the effects of the fine summer of 1911. And in 1912, R. Irwin Lynch wrote[3]:—'I have seen this [*Punica Granatum*, North Africa, West Asia] fruiting on the side of a house in East Cornwall; it has fruited at Henley-on-Thames, and should fruit generally without much assistance. The double form flowers on my house at Cambridge, and for some years a stool of it grew in the open, quite without protection, dying down in winter and coming up in spring like a Fuchsia.'

The longevity of the tree is said to be remarkable.

Cultivation in India.

In India the Pomegranate is cultivated in various places: North Kanara, Bijapur, Sholapur, Satara, Poona, Ahmednagar, Ahmedabad, Sind, Baluchistan, Muzaffargarh, Delhi, and Jodhpur.

Bombay.—In the Bombay Province about 2,000 acres are under pomegranate. More than half the area is claimed by the Poona district, where most is grown in the Haveli, Bhimthadi and Purandhar talukas. The Dholka taluka of the Ahmedabad district

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[1] *Journal of the Royal Horticultural Society*; xxxix, part II, 1913.
[2] *Ibid.*; xxxviii, part I, 1912.
[3] *Ibid.*; xxxviii, part II, 1912.

claims 15 per cent. of the total area in the Bombay Presidency. The Ahmednagar district grows about 15 per cent., mostly in the Pathardi, Rahuri, Ahmednagar, and Sangamner talukas. Except in a few places like the Dholka taluka, and a few villages in the Poona district, the fruit is not of a superior quality.

1. *Sangamner*[1].—Pomegranates require a porous soil containing much lime; and generally farmers choose such soil. Sound and big fruits are selected for seeds. These fruits are kept longer than usual on the tree, and are plucked only when they begin to rot; they are then allowed to rot still further; the seeds are taken out, well mixed with ashes, and dried in the shade.

A plot, about two or three gunthas in area, near a well is ploughed and dug out deeply down to 1 foot. The soil is made fine by breaking clods, and about a cartload of farmyard manure and household ashes is mixed with it. The seeds are then thinly broadcasted in *walas* about one hundred feet square. The seed is covered, and the plot is watered on the same day. The second watering is given on the sixth day, and then further waterings once in ten or twelve days as required. No weeds are allowed to grow in the plot.

Generally the seedlings are transplanted in the early part of the monsoon, when six or twelve or even eighteen months old. The field into which the seedlings are to be transplanted is twice ploughed and harrowed, and the soil is mixed with about ten or twelve cartloads of farmyard manure. This ploughing and manuring is done to prepare the ground to receive onions, garlic, chillies, or any other plant which may be grown without injury to the young pomegranate. These sub-crops are cultivated during the first two or three years, that is up to the time when the fruit plants cover the ground and begin to yield.

Pits, about eighteen inches square and two feet deep, are then dug out. The distance between two pits cross-wise as well as length-wise varies from twelve to fifteen feet. In one acre about two to three hundred plants can easily be grown this way. Of late, however, some farmers have reduced the distance between the pits to ten feet.

The earth that is dug out of the pits is separated into two portions, the upper layer being kept apart from the lower one. The earth of the upper layer, which is well weathered and contains ready plant food, is put first in the pits; it is then covered with a basketful of farmyard manure. When the plant has been fixed in the pit the earth from the lower layer mixed with household ashes is thrown over the manure. About a cartload of ash is sufficient for one acre of land.

Ring-like bands of three to five feet in diameter are then made round the plants and moderately filled with water. A second watering is given on the fourth or fifth day, and afterwards once in a week or ten days according to the season.

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[1] Mirza Niazbeg—Pomegranate Cultivation at Sangamner. *The Poona Agricultural College Magazine;* March 1914.

The pomegranate plants begin to flower when they are three years old; but this first flowering brings very little fruit, and it is not until the fourth year that the garden is earnestly taken in hand. During those first four years the plants are manured once a year with farmyard manure and whenever possible, with fish manure also. The ringed area is dûg out once in three months to give a better circulation of air. No weeds are allowed to grow. In the fourth year the rings are widened up to eight feet in diameter.

Pomegranate plants flower thrice a year :—in February or March, *ambe-bahar;* in June, *mrig-bahar;* and in September, *hatti-bahar.* Five or six months after the flowering the fruit is ready for marketing.

Except for the time of the first watering, which varies with every *bahar,* the routine is always the same. Let us take, for example, the *mrig-bahar,* since preference is generally given to it by the farmers for reasons of economy, the cost of watering being very much lessened on account of the rainy season. In April the ringed portion is dug out and the roots in the upper layer are exposed to the air for a week or two—the leaves that fall off are often used as manure for the same plants. A basketful of farmyard manure is given to each tree, and if fish manure is available a handful of it per plant is given in addition to the farmyard manure. The manure is thoroughly mixed with the soil. The first watering is given in *Akshattritiya,* which is generally in May, and further waterings are given once in a fortnight. Flowers appear one month after the first watering. When the ovary is developed and fruits as big as small lemons are formed the ringed portion is lightly dug out every month before watering.

Each plant bears about forty fruits in the first year, and each year the number increases even up to four hundred when the tree is fully grown up. If good care is taken of them the trees bear fruit up to from twelve to fifteen years. When a plant does not bear a sufficient number of fruits it is pruned leaving the stem only from six to twelve inches above the ground. The cut surface is plastered with cowdung, and the plant is heavily manured and watered. New shoots come out and grow into trees which bear fruit for another ten years.

Generally the garden is rented to *Bagwans* who pay Re. 1 to Rs. 1-4 per plant. The Bagwan takes care of the garden, but the farmer supplies him with water for irrigation. As a rule the Bagwan makes a net profit of Rs. 200 on one acre. His expenses are Rs. 150, and he pays Rs. 250 to the owner. So the gross income on one acre of land is Rs. 600.

2. *Ganeshkhind.*[1]—Seven varieties of pomegranate were under trial from the year 1905. Three of these were local, two from Sangamner, and two foreign (Kabul and Muscat). All were grown from seeds of specially selected fruits. The foreign varieties made

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[1] S. H. Prayag—The Ganeshkhind Botanical Garden, Kirkee. Its genesis and development. *Department of Agriculture, Bombay;* Bulletin No. 104 of 1920.

poor and stunted growths, and failed to bear fruit even after eight years' growth. Grafts of Kabul variety on local stocks also failed to fruit even after seven years' growth. The following trials were conducted for nearly four years:—(i) The comparison of different methods of irrigation, viz., Basin, Trench, and Ring systems. The trench system proved to be unsatisfactory as the trees began to show signs of drought, reacting on the yield, which was consequently very low. The ring method showed the advantages of economy in the amount of water given and the avoidance of any rot of the stem at the collar.—(ii) Comparison of grassed and cultivated lines of fruit trees. In this experiment the weeds as they grew were cut and kept as a mulch three to four times during the year. The difference between the two plots was not appreciable.

3. *Gokak.*[1]—As evidenced from the growth of the plants and the quality of the fruits in one of the gardens at Gokak a limy or phosphatic soil seems to suit the pomegranate very well. Medium black soil with murum as sub-soil is fairly suitable, but black soil is no good.

Before digging the pits the land is well ploughed, harrowed and clod-crushed, and the soil brought to a fine state of tilth. The pits are 3 ft. deep and 3 ft. square, and the distance between them is 13 to 14 ft. each way. To economize space the hexagonal system based on equilateral triangles is adopted, whereby all adjacent trees are equally distant from each other. The pits are dug in the summer months of April and May so that the earth, both in and out, may be thoroughly exposed to the action of the daily hot air for a space of two or three months. When the pits are to be filled up bone meal, if available, is spread at the bottom; this is then covered with the surface portion of the excavated earth; and this in its turn is covered with the bottom soil, if not too bad. When the bottom soil is too bad it is rejected, and good soil or fine silt brought from outside.

Seedlings one year old are the best for planting; others take more time to establish themselves. July-August is the proper time for planting, preferably late in the afternoon. The ideal conditions are a cool weather and light drizzling rains. The pits are watered one or two days before planting. When the young plant has been firmly fixed a small basin is made to hold the requisite quantity of water. At first the plant is watered lightly every day in the evening or at least once in two days. After the appearance of fresh sprouts the watering is given only twice a week for some time, and then gradually the interval is increased to once in a week or ten or even twelve days.

After the seedlings have established themselves two or three handfuls of farmyard manure may be given. Three or four days after each watering, the basins are kept loose by stirring and all the weeds are removed. When the plants are one year old they

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[1] I. S. Kulkarni—Notes on the cultivation of Pomegranates as experienced on the Gokak Canal Farm. *The Poona Agricultural College Magazine*; January 1920.

are manured with about half a basketful or 10 lbs. of farmyard manure per plant. In the second and third years, twice as much manure is applied. No further care need be taken except pruning, weeding, and watering at intervals, the interval varying with the nature of the soil and the time of the year. If the soil is good and if proper care is taken the plants will become fit for bearing even as early as the third year.

For the first three years intercrops such as onion, garlic, groundnut, gram, chilly, cabbage, pea, tomato, brinjal, knolkol may be grown; and the net income accruing from these will more than make up for the initial and the running expenditures involved in the cultivation of the pomegranates during the early stages.

The flowering periods are (i) January-February, *ambebahar;* (ii) June-July, *mrigbahar;* and (iii) August-September, *hastabahar.* On this farm the period selected for treatment is either *ambebahar* or *mrigbahar,* preferably the former when the plants are less subject to attacks from insect and fungus pests. Watering is stopped two months before the time of flowering; one month after, the roots are exposed and the branches pruned; then the roots are covered again, the beds renewed, and the plants manured and watered. It takes from four to five months for the fruits to ripen. When the fruiting season is over all flower-buds, flowers, and stray fruits are removed and the trees left to themselves till the next year's treatment.

At Gokak the pomegranate is propagated from seeds. The fruit is allowed to ripen completely on the tree and to fall down to the ground of itself; it is then picked up and kept for some time to allow rotting. Then the seeds are squeezed out, mixed with earth or ashes and kept ready for sowing.

"SIND[1].—Shikarpur is famous as a centre for fruit-growing. There are altogether some 150 orchards, with an area of 868 acres, of which 139 are under pomegranate.

With the advent of spring, mature branches are pruned out and cut in pieces nine to twelve inches long. These cuttings are buried two-thirds deep in the soil of the nursery bed, and their tops are covered with fresh cowdung. The beds are irrigated at intervals of three to four days, till the cuttings have sprouted, which they usually do in about a month's time. The cuttings stand in the nursery bed for full two years, during which period they receive hoeings once a month regularly. They are planted in rows nine to twelve inches apart. This is by no means too close a planting because, while there are always some cuttings which do not germinate, the white ants do a good deal of thinning work. The cuttings are raised in gardens for sale and fetch Rs. 2-8-0 to Rs. 3 per hundred.

The field operations begin during the inundation season. The plantation is irrigated, ploughed twice, levelled, and laid out in small

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[1] Mahomed Umarkhan F. Barokzai.—Fruit Culture as practised near Shikarpur, Sind. *Department of Agriculture, Bombay;* Bulletin No. 98 of 1920.

plots measuring from one quarter to one half of an acre each. Parallel channels or furrows, twelve inches by eighteen inches, are made twelve feet apart. Along each channel, but on one side of it only, circular holes are dug at a distance of twelve feet. After an exposure of a week to ten days, the excavated earth is mixed with fifty pounds of cattle manure and returned to the pits. The plants to be used are carefully lifted from the nursery beds and carried to the field some time about the 11th March, at the *Mahashivaratra*.

Irrigation during the first few months after the transplantation is given about twice a week, but when the plants are fairly established watering is limited to once a week throughout the year. In case of white ants proving a serious pest, the interval is shortened to suppress the attack.

For the first three years the soil round the plants is stirred and weeds removed twice a month. The channels are also cleaned in order to grow sub-crops: brinjals, chillies, karela (*Momordica Charantia*), turi (*Luffa acutangula*), bhindi (*Hibiscus esculentus*), chuka (*Rumex acetosa*), methi (*Trigonella Faenum-graecum*), etc. With the fourth year, when the fruit plants cover the ground and begin to yield, the weedings cease altogether and the growth of natural grasses is encouraged as these provide an excellent green feed for cattle and consequently are readily sold. Cattle, camel, and horse owners purchase standing crops of weeds for the season. The weeds commonly found in pomegranate and other fruit plantations are dubh (*Eragrostis cynosurioides*), gandheer (*Eleusine flagellifera*), chhabar (*Cynodon Dactylon*), savri (*Panicum Colonum*), kabah (*Cyperus rotundus*), lulur (*Digera arvensis*), and dinuhi (*Andropogon annulatus*).

Pruning of dead branches on the top and fresh growth at the roots of full-grown plants is effected in November. Manure is applied once a year in February when the trees are leafless; one *jholi* (cloth load) of manure weighing about thirty pounds is applied to every two plants. This costs about two annas. Before applying manure, the soil round the roots is dug out and replaced by fresh canal earth.

The pomegranate has two flowering seasons, the first commencing from early *Phalgun* (March to April), and the second from *Bhadra* (September to October). The fruit of the former lasts till the *Dassera* (October) festival, and that of the latter till *Margashirsh* (January-February). Of these two seasons the Phalgun flowering is always the better. In addition to these distinct flowering seasons the plant is said to put on all the year round one or two flowers locally termed the *Chorgul* (thief flower).

From the fifth to the fiftieth year of their age the trees produce excellent yields. The average number of fruits per plant is 70, the range being from 40 to 100, each weighing from half to three quarters of a pound. This gives an average yield of 30 pounds per tree, the maximum amounting to as much as a maund (80 lbs.) of fresh fruit. Calculating at the average price of Rs. 4-8-0 per maund, each plant produces Rs. 1-11-0 on the average, and each acre of about 250 plants returns roughly Rs. 420.

Another product of the trees is the quantity of fallen flowers obtained from the *Phalgun* flowering. These are gathered, dried, and sold at Rs. 4 per maund of 80 lbs. Ten to twelve maunds are collected per acre fetching from Rs. 40 to Rs. 50.

The third product consists of the rotten fruits which have been damaged by insects or by birds. The seeds are dried and sold as *khat* (sour substance used in curries), while the rind goes to the dyer to yield a yellow dye. The quantity collected is not large but, nevertheless from Rs. 10 to Rs. 15 per acre are usually obtained.

There are twelve varieties of pomegranate commonly grown in the locality: *bedaho, kandhari, vanga, chiho, sona, dandan, multani chiho, sehwani, green sehwani, sindi sehwani, jesalmeri, sindi jesalmeri.* Of these *sehwani, kandhari, sindi sehwani, sindi jesalmeri,* and *bedano* are sweet-pulped varieties, while the rest have an acid sour taste. But all the twelve varieties, whatever their taste, command a ready sale in the market. *Bedano* (the seedless) is a rare variety; it is not altogether free of seeds as the name would indicate.

BALUCHISTAN[1].—Pomegranate is cultivated commercially in Baluchistan. It is also imported from Kandahar in fairly large quantities through Chaman. There are four varieties of commercial importance in this Province, viz.:—

1. *Kandhari.* Grown in Pishin sub-division, mostly in Killa Abdulla and Gulistan. It is slightly acid in taste, very juicy and large in size. Its skin is of brick red colour.
2. *Metha.* Grown in Loralai district. 75 per cent. of the total area in this district is under this variety. It is thick skinned, juicy, less acid in taste, and medium in size.
3. *Khata.* Grown in Loralai district. It is sour in taste, small in size, thick skinned, and less juicy.
4. *Jhalari.* Grown in Loralai district. Big size, soft skin, a little acid in taste, and juicy.

The so-called *Bedana,* or seedless variety has no commercial importance. It is grown in Loralai district, but only a few plants are seen here and there in the orchards, which are kept for home consumption. It is a shy-bearer, which seems to be the chief reason for its limited cultivation. It is sweet and juicy, and a very small residue is left after the juice is extracted.

PUNJAB.—The following information was supplied by the Fruit Specialist, Punjab, Lyallpur: 'Pomegranate is not a very important crop in the Punjab. It is grown in a tract known as Alipur in Muzaffargarh district of the Punjab. No separate figures of area are available, but the area in that tract as well as small patches of pomegranates found here and there in the Punjab would not exceed more than a few thousand acres. In Muzaffargarh district an average yield of 1 maund of fruit is obtained per tree which sells in the market at retail sale of annas 2 to annas 4 per seer depending upon the quality.'

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[1] From the Agricultural Officer in Baluchistan; 1940.

JODHPUR.—The area under Pomegranate cultivation, and also the estimate of the yield of Pomegranates per bigha in Jodhpur is shown in a statement sent by the Superintendent, Hawala Department[1]:—

Village	Area under Pomegranate	Estimate of yield per bigha
Bagan	3 bighas 10 biswas ...	10 maunds
Gavan	30 ,, — ...	90 ,,
Suthla	7 ,, — ...	21 ,,
Umaidsagar ...	2 ,, — ...	6 ,,
Mandore	12 ,, — ..	36 ,,
	54 bighas 10 biswas ...	163 maunds

PESTS AND DISEASES.

The different varieties of pomegranate have been found to suffer from attacks of birds and insects, and from fungus infections.

Birds.—Parrots are the only birds attacking pomegranates. They visit the plantation especially in the morning and in the evening and should be regularly watched.

Insects.—In addition to white ants which do much damage to cuttings in the nursery bed, various other insects are known to injure the pomegranate tree; they are fruit-borers, stem-borers, and sucking insects.

'An insect, says Firminger, which I have detected to be a certain hairy caterpillar, penetrates the hard rind when the fruit is a little more than a quarter grown, and by devouring part of the interior, causes the remaining part to canker and rot. To obviate this, the fruit, when as yet small, should have the large fleshy calyx by which it is surmounted cut cleanly off, and then be tied up loosely in a piece of linen cloth.' Woodrow recommends 'to gather every fruit that is infested even to a slight degree and burn them. If the cultivators of a district will unite to do this for several years, the stock of that particular insect will greatly be reduced and fair crops during some years may repay the trouble.'

Woodrow quotes the following account of the pest from the *Catalogue of Indian Lepidoptera in the British Museum.*—'The larvae of this butterfly reside in the interior of the pomegranate, seven or eight at least having been reared in the interior of a small specimen of this fruit. Of the mode in which the eggs are deposited by the female in the interior of the pomegranate no information has been received; it is, however, probable that this is effected whilst the fruit is in its very young state. The caterpillars feed upon the seeds and the inner part of the fruit, which is thus weakened, and

[1] 10th February 1940.

rendered unable to support its own weight, and consequently liable to have its stem broken, and to fall to the ground with the first wind. This, however, would be destruction to the inclosed insects; since, in all probability, they would find it impossible to make their escape were the fruit to be suffered to lie rotting on the ground. To obviate this evil, the caterpillars, when full fed, have the instinct to bore a hole about a quarter of an inch in diameter through the hard shell of the fruit whilst it remains on the tree; through this hole they then creep to the stem of the fruit, and spin a white web, which they attach to the basal part of the fruit as well as to the stem for about the distance of an inch along the latter. This web is sufficiently strong to support the pomegranate from falling after the wind has broken the stem near to the fruit.'

The fruit-boring insect is *Virachola isocrates* Fabr. (known as *sursa* in the Deccan), the most important economically of the butterflies, perhaps the only one that is constantly and regularly injurious, and sometimes a serious pest of pomegranate. 'As is well known, writes Aitken in this *Journal* (Vol. I; 1886), the larva feeds inside the fruit of the pomegranate and, some time before becoming a pupa, eats its way through the tough rind and fastens the fruit with silk to its stalk, thus preventing it falling off in case it should wither before the butterfly escapes, as it generally does. I have taken a pomegranate infested with these larvae (several usually inhabit each fruit) and made it stand in an egg-cup, in the morning it was so securely fastened, that in taking up the fruit I lifted the cup.'

The treatments mentioned by Firminger and Woodrow are effective but expensive when applied to large gardens. Bainbrigge-Fletcher has suggested catching of butterflies by hand-nets; but they are difficult to catch, being exceedingly swift, wary, and given to sitting on high trees. Burns thinks that a spray of contact poison when the fruits have just set is more likely to be effective; for it is highly probable that the eggs are laid in the calyx of the flower of the young fruit. 'At the time the pomegranate is in flower,' says Downes, 'and at a very early period, the Hair Streak may be seen very busily occupied about the flowers, and I have little doubt that the eggs are deposited at the bottom of the calyx, from the position in which I have seen the abdomen of the butterfly placed; as the fruit enlarges the eggs are enclosed, and in this situation matured'.

At the Botanical Garden of Ganeshkhind, Kirkee, attempts were made to prevent insect attack by bagging the fruits immediately after fertilisation. Paper bags proved most unsatisfactory as they tore badly. Even paper bags soaked in paraffin wax were not found to be of much use as water entered the bags along the fruit stalk and caused rotting of the fruits. Cloth bags were effective and the cost came to 4 pies each. If carefully used, each bag served for two years. Comparison was made with crude oil emulsion versus tobacco water. This resulted in favour of the crude oil emulsion.

At Sangamner the *bagwan* puts about a pound of asafoetida in the main water channel or in a small water reservoir which is

generally built near wells and through which the water passes. This is done twice or thrice from the second or third watering. Thereby the attack is said to be much lessened.

Mr. M. A. Wynter-Blyth mentions the larva of *Dendoryx epijarbas ancus* Fruhs. as feeding inside the fruit of the pomegranate on the lower slopes of the Simla Hills.[1]

2. A hairy caterpillar (*Euproctis fraterna* Moore) sometimes appears on the pomegranate plant and does some damage to the foliage, but is not as serious a pest as the fruit borer.

3. Another serious pest is the stem borer *Arbela tetraonis* Moore, which bores into the stem and causes the branches to wither. The larva may be known by the peculiar patches of excrement and silk found on the bark of the trees near the bore of the caterpillar, which comes out at night, feeds on the bark, and makes the peculiar covering on the part it eats. The caterpillars may be destroyed by probing them with a piece of thin wire, or by syringing into the burrows either rock oil or a mixture of 2 parts chloroform and 1 part creosote. A good preventive remedy is not to grow shevari (*Sesbania aegyptiaca* Pers.) anywhere in the vicinity, for this is the plant from which the pest generally comes on to the pomegranates.

4. Occasionally small sucking insects, such as aphides, thrips, and mealy wings may become a nuisance in the pomegranate plantation. Mealy wings are of very little moment. Aphides and thrips are easily kept under control by spraying twice or thrice with crude oil emulsion (1 part of crude-oil stock emulsion to 66 parts of water), or better still with incosopal emulsion (1 part of incosopal to 80 parts of water).

Fungi.—Fruit rot is so very common in the pomegranate gardens of the Deccan that the gardeners, far from looking upon it as a calamity, welcome it as a sign of the high yielding capacity of their trees. It is more particularly severe in low situations, in crowded gardens, and in gardens that are neglected and unclean. The loss due to it amounts to about 15-20 per cent. Every garden seems to be attacked and, during the monsoon, every plant in the orchard.

This disease is recognised[2] by the appearance of brown or orange-black round pustules on the surface of the fruits, usually near the stalk-end. These pustules appear in regular patches, which may in some cases, extend to even half or more of the fruit surface. This discolouration of the surface extends slowly to the inner tissues and even the seeds, which, consequently, remain immature, small, and pale in colour. Rotting now sets in, especially in the case of young fruits, and the whole fruit becomes dried up and hollow. The fruit loses in weight, and shallow depressions occur on the discoloured portion.

Flowers may also be affected and drop down in large numbers. The fungus may be seen even on the dried up twigs where it remains in the shape of small round pustules ready to infect the succeeding

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[1] *Journ. Bomb. Nat. Hist. Soc.*; vol. xli, p. 737.

[2] M. N. Kamat—Fruit Rot of Pomegranates. *The Poona Agricultural College Magazine*; xv, 3; December 1923.

crop of flowers and fruits. It is a weak parasite, and it has been found to be a species of *Phomopsis*. It is capable of living as a saprophyte on the dead branches and twigs of the trees. And this accounts for its yearly reappearance; for the amount of fruits, flowers, leaves, branches, and twigs that are allowed to decay on the ground all around the trees is enormous.

It is difficult and perhaps uneconomic to devise any direct method of controlling or treating this disease. The nature of the garden and the growth of the plants will not permit of any such operation. The only effective way of checking the infection is to regularly pick out all diseased fruits and flowers and burn them. No dead part of the tree, whether it be fruit, flower or twig should be allowed to remain in the garden, whether on or near the tree; and all those parts ought to be buried. Nor should any diseased part be allowed to rot in the manure pit, as is generally done by the cultivators.

Specimens of pomegranates were received from a garden in Bombay[1], in which the fruit, though of excellent external appearance, were blackened and rotting inside. The fruit appears perfectly healthy on the outside, but when cut open, the seeds and pulp are found blackened either wholly or in part. In the more advanced stages there are cavities inside, filled with a brown powdery substance, composed of the spores of the fungus. The rot was found to be due to a fungus known as *Sterigmatocystis castanea* Patterson, first observed in the United States in 1910.

Domestic Uses.

In his account of the Voyages of the Ambassadors of the Great Duke of Muscovy and the King of Persia (1633-39), Olearius writes: 'The wild pomegranates, which you find almost everywhere, especially at Karabag, are sharp or sowrith. They take out of them the seed, which they call *Nardan*, wherewith they drive a great trade, and the Persians make use of it in their sauces, whereto it gives a colour, and a picquant tast, having been steep'd in water, and strain'd through a cloath. Sometimes they boyl the juyce of these Pomegranates, and keep it to give a colour to the rice, which they serve up at their entertainments, and it gives it withall a tast which is not unpleasant.'

In the East the pomegranate is universally eaten and much esteemed as dessert. The fruit is cut open, seeded, strewn with sugar, and sometimes, as it is particularly the case in Syria, sprinkled with rose water. The Portuguese prefer wine to rose water. The seeds are also much used in syrups and conserves.

The fruit is greatly valued in warm countries on account of the delicious, cooling, and refreshing pulpy seeds which, with the addition of water and sugar, make a very pleasant cooling drink known as *granadine* or *pomegranate-water*. This is much used, not only in the East but also in certain parts of Europe and in the southern states of North America. In India pomegranate *sherbet* is highly esteemed, and justly appreciated by all who have tasted it.

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[1] *The Agricultural Journal of India*: vol. ix, 1914; p. 205.

It is but one step, one very short step, from the sweet juice to the 'Pleasant liquor that distils from the pomgranet fine' (Drayton), and man was not slow in taking that step.

Pomegranate-wine was known throughout the Near East at an early date. In the Canticle of Canticles the bride, when urging the groom to come to her mother's house, says: 'and I will give thee a cup of spiced wine and new wine of my pomegranates'. And in Papyrus Anastasi IV the fellah is advised to refrain from the alcohol of the pomegranate. Ye-lu Ch'u-ts'ai, in the account of his journey to Persia (1219-1224), speaking of the pomegranates of Khojand, which are as large as two fists and of a sour-sweet taste, says that the juice of three or five fruits is pressed out into a vessel and makes an excellent beverage.

A jet-black smooth writing ink is made of the bark of the root. This is much used by Algerian scribes, and in particular by the 'sopherim' when copying the text of the sacred Mosaic books. The barks of both the root and the fruit enter into the composition of popular preparations used by Annamites to lacquer their teeth, or by Moroccans to dye their hair.

The bark is of real value as a tan and dye for leather; it is largely employed in preparing the morocco leather of Tangiers.

The flowers stain the saliva; they are used in various parts of India to impart a light-red colour, said to be fleeting, to cloth. The inhabitants of the Chinese province of Hainan make use of them for fermenting their wine.

The astringent rind of the fruit is a valuable tan, and is also employed as an auxiliary to colouring agents, generally turmeric or indigo, in dyeing. Alone, it imparts to cloth the greenish colour known in the North-West Provinces of India as *kakrezi*. When used for this purpose the rind is boiled in water till three-fourths of the latter has evaporated; and the cloth then dipped in the concentrated infusion. Samples of the rind have been found to contain a small amount of yellow colouring matter, readily given up to boiling water, which imparted colours varying from a dull-yellowish green to a bright reddish-drab with tussur and corah silk, and cotton; and which with salts of iron produced an almost black dye on wool.

In North Africa selected branches or young plants are used for making walking-sticks.

The wood is light-yellow, with a small dark-coloured, irregularly-shaped heartwood, compact and close-grained; it is used for roofs in some parts of India.

The plant makes a good fence, and for this purpose is established by sowing seeds in position, putting in stout cuttings, or transplanting from the nursery.

Medicinal Uses.

According to the *Castel of Helth* 'pomegranates be of good iuyce and profytable to the stomacke, specially they which are sweete.' Their nourishing and digestant properties have been proverbially nutshelled by the Arabs: 'If hungry, eat pomegranate;

if sated, eat pomegranate'. And they had to be eaten at the conclusion of royal banquets in order to facilitate the digestion of fatty viands.

Tobaiah Rofé distinguishes between the properties of the two varieties, sweet and acid. The sweet pomegranate rejoices the heart; and its bark, boiled with water or with wine, promotes the cicatrization of wounds. The acid fruit stops sanguinolent diarrhoeas, allays thirst, and reduces the congestion of the liver and the stomach.

The ancients valued the pomegranate fruit as a stomachic. Whether in the form of a sherbet or of a syrup, it has been used with advantage in typhus, gastric and asthenic fevers, inflammations of the urinary tract, haemorrhages, and colliquative sweats. Hippocrates prescribed it for heartburn, and van Swieten for dysentery and diarrhoea.

Hindu physicians prescribe the juice of the ripe fruit combined with saffron as a cooling drink in dyspepsia and in fevers. The seeds are considered to be stomachic, the pulp cardiac and stomachic; by some it is said to be diuretic and antibilious.

Locally the acid juice is used as drops for the eyes in ophthalmia.

In the Konkan the juice of the green fruit, rubbed with galls, cloves and ginger, is given in honey as a remedy for piles.

In Cambodia the unripe fruit is used in the treatment of diarrhoea and dysentery. For diarrhoeas a small ball of kino is introduced into the fruit, green and about the size of a walnut, and the whole heated over a slow fire until it becomes burning hot; it is then cut and infused in 200-300 grammes of boiling water; the infusion is to be administered in two doses in one day. For dysentery a small pill of opium is used instead of kino, and the burning hot fragments are boiled in a tumblerful of water until two-thirds of it has evaporated; the decoction is to be administered in one single dose.

According to the rabbi Maimonides the pomegranate taken internally with wine is an excellent remedy for the stings of wasps and hornets.

The rind of the fruit, and the flowers were recognized as medicinal by the ancients. They are both powerfully artringent, and were employed in diarrhoea and similar diseases. They were also given for relaxation of the gums and throat, mucous discharges, prolapsus of the rectum or uterus. They are still used as an injection in leucorrhoea, as a gargle in sore throat in its early stages, and in powder form in intermittent fevers. 'A decoction of them, says Culpeper, stops bleedings and purgings of all kinds, and is good for the whites . . . A strong infusion cures ulcers in the mouth and throat, and fastens teeth.'

In India the rind and the flowers in decoction with opium and an aromatic, such as cloves, cinnamon, coriander, or pepper, are used as an astringent in bowel affections unaccompanied with ineffectual and painful straining at stool.

In Madeira an infusion of the flower buds and the rind of the fruit is given for inflammation of the throat, and also for dysentery.

In Guiana the decoction combined with lime juice is used as a gargle. When taken internally the decoction is sweetened with

honey and administered with the juice of the sorrel and of the water cress.

The rinds of three wild pomegranates are said to be used in Java: the red-flowered *merah*, the white-flowered *poetih*, and the black-flowered *hitam*.

The rind of the pomegranate is official in Holland under the name of *cortex fructus granati*.

The juice of the flowers mixed with the root juice of Bermuda grass (*Cynodon Dactylon* Pers.) is used to stop bleeding from the nose. The flower-buds powdered, in doses of 4 to 5 grains, are useful in bronchitis; they are also much used in dysentery and diarrhoea.

The Hausas use a tea-like infusion of the young flowers as a vermifuge. The Arabs rank the flowers of the male plant among their styptics, and the blossoms amongst their cicatrizants.

In Shikarpur, Sind, unripe flowers are dried and pounded, to make a snuff, which is considered to be the best astringent in nasal haemorrhage while internally it is very effective during infantile diarrhoea and dysentery. Green leaves are made into a paste and applied on the eyes during conjunctivitis.

In some parts of India the expressed juice of the leaves and the young fruit is used in dysentery. In other parts the juice expressed from the leaves and flowers is sniffed to stop bleeding from the nose.

In Ceylon the leaves are boiled and used as an eye-wash. In the Philippine Islands the decoction is used as a gargle in all affections of the buccal cavity. In Jamaica the leaves are beaten with oil of roses, and applied to an aching head.

The efficacy of the bark of the root of the pomegranate tree, as a remedy for the tape-worm, has long been established in India.[1] It is given in decoction prepared with two ounces of the fresh bark, boiled in a pint and a half of water, till but three quarters of a pint remain; of this, when cold, a wineglassful may be drunk every half-hour till the whole is taken. This quantity occasionally sickens the stomach a little, but seldom fails to destroy the worm, which is soon after passed.

Pomegranate root is known to have been long used by the Chinese for the expulsion of the tape-worm. And a decoction of it was recommended for a similar purpose by Celsus, Dioscorides, and Pliny. That the Egyptians knew the taeniacide properties of the root bark is evident from their mention in the Ebers and Berlin Papyri: the bark was bruised with beer, mixed with water, and allowed to stand overnight—a mode of preparation which is still followed in Egypt.

While the efficacy of the root-bark as a taeniacide is admitted by every one, opinions differ as to the relative values of the root-bark and the stem-bark, the fresh bark and the dried bark, the bark of the wild pomegranate and the bark of the cultivated plant.

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[1] Udoy Chand Dutt, who made a thorough study of the *Materia Medica of the Hindus* compiled from Sanskrit medical books, remarks that he has not been able to find any notice of pomegranate root-bark in Sanskrit works.

According to Sheikh Abd Erzeraq the flowers, the fruits, and the bark of the pomegranate have anthelmintic properties. The decoction of the root-bark is a common remedy for roundworm in Bengal; while in Bombay the flowers and the pericarp are prepared as ascaricides. In Europe the flowers, either in decoction or in the powder form, are used for roundworms and worms of the genus *Strongylus*. Caius and Mhaskar have shown experimentally that the bark is ineffective against hookworms.

In Cambodia a handful of toasted roots is given in infusion for colic accompanied with diarrhoea.

The Arabs credit the seeds with stomachic properties. In India the seeds are considered cooling and useful in fevers; ground to a paste with milk they are a Tamil cure for renal lithiasis during pregnancy.

The bark and fruit combined with other drugs are prescribed in India for the treatment of snake-bite (Sushruta, Vagbhata, Rasa-ratnakara); the bark is also prescribed for scorpion sting (Sushruta). Caius and Mhaskar have demonstrated that neither bark nor fruit are an antidote to either snake or scorpion venom.

Pharmacognosy.

Pomegranate bark has a place in many pharmacopoeias. The bark of the root is official in Italy, Mexico, Portugal, and Yugoslavia; the bark of the root and stem in Belgium, Brazil, Denmark, France, Germany, Russia, Spain, and Turkey; the bark of the root, stem, and branches in Austria, Hungary, Japan, and Switzerland; the bark of the root and stem, and the rind of the fruit in Holland.

The rind is in irregular, more or less concave fragments, some of which have the toothed, tubular calyx still enclosing the stamens and style. It breaks easily with a short corky fracture. Externally it is rather rough of a yellowish brown or reddish brown colour; internally it is more or less brown or yellow, and honeycombed with depressions left by the seeds. It has hardly any odour, but has a strong astringent taste.

The middle layer of the rind consists of large thin-walled and elongated, sometimes even branched, cells, among which occur thick-walled cells and fibro-vascular bundles. Both the outer and the inner surface are made up of smaller, nearly cubic and densely-packed cells. Small starch granules occur spraringly throughout the tissue, as well as crystals of calcium oxalate.

The root bark occurs in transversely-curved pieces; externally brownish-yellow with conchoidal depressions and dark brown irregular patches in the cork; internally dark yellow, the medullary rays extending to the outer surface. The odour is light, the taste astringent, somewhat bitter and nauseous.

The stem bark occurs in pieces of variable length and thickness. The outer surface is yellowish or greyish-brown, with patches of greyish lichens, broadly elliptical lenticels and yellow-brown furrows or abraded patches of cork; longitudinally wrinkled. The inner surface is light yellow or yellowish-brown, finely striate. It breaks short, with dark green phelloderm and yellowish-green inner bark.

The stem bark differs from the root bark by the presence of a broader cortex whose outer cells contain chloroplastids, and by possessing shorter medullary rays. A transverse section of the bark exhibits the following structure: cork thin, of alternating rows of thin-walled suberized cells and lignified cells with greatly thickened inner walls; cortex of parenchyma with a few large stem cells isolated or in small groups; medullary rays mostly one-cell wide; rosette aggregates of calcium oxalate very numerous in the parenchyma.

The powder is from yellowish-brown to dark brown. It contains calcium oxalate crystals in rosette aggregates or monoclinic prisms; numerous starch grains, spherical, ellipsoidal, biconvex or irregular, and single or compound; fragments of whitish cork with prominent, thickened, lignified walls; stone cells with very thick and strongly lamellated walls; occasional long wood fibers associated with tracheae possessing simple and bordered pores.

In the Dutch East Indies the local product, which mostly consists of small pieces and scrapings, is used instead of the European article. But, as the alkaloidal contents of the Indian bark, more especially that of the white-flowered variety, are relatively much higher than those of the European bark, the Dutch Pharmacopoeia rules that when Indian pomegranate bark is to be prescribed in Holland it shall be as *Cortex Granati indicus*.

Adulteration.

The commercial drug frequently consists partly or entirely of the bark of the stems or branches, characterized by its (less abundant cork-formation, with longitudinal bands or ridges of light brownish cork, but not conchoidal exfoliations. Such bark is considered adulterated in countries which recognize only the root bark as official.

The pomegranate bark is sometimes substituted by the bark of other plants. Among these are *Berberis vulgaris* Linn., which is bitter and not astringent; *Buxus sempervirens* Linn., which is also bitter and free from tannin; and *Strychnos Nux-vomica* Linn., or false Angostura bark which has a dark inner surface and a very bitter taste. None of these barks have the characteristic checkered appearance of the transverse surface of genuine pomegranate bark.

Chemistry.

The inner surface of the bark, steeped in water and then rubbed on paper, produces a yellow stain, which by the contact of ferrous sulphate is rendered blue, and by that of nitric acid acquires a slight rose tint, which soon vanishes. These properties serve to distinguish this bark from those of the box root and barberry.

The root bark yields over 22 per cent. of tannin, and a considerable amount of mannitol. It contains five alkaloids, which bear a close relationship to the hemlock alkaloids. The active constituent is believed to be 'pelletierine', which is highly toxic to tapeworms, and explains the use of the bark, and the mixed alkaloids in the form of the so-called, 'pelletierine tannate' and 'pelletierine

sulphate' as anthelmintics. The 'tannate' is official in the Pharmacopoeias of Brazil, Great Britain, Italy, Mexico, and United States of America, and the 'sulphate' in the French Codex.

The bark of the stem usually contains slightly less alkaloid than the bark of the root. The amount in the stem bark has been determined by various investigators to range from 0.35 to 0.6 per cent., and in the root from 0.6 to 1.0 per cent. Stoeder, in 1890, found out that of the root bark of three varieties of the wild pomegranate recognized and used by the natives of Java, the red-flowered *merah* yielded 2.43 per cent., the white-flowered *poetih* yielded 3.75 per cent., and the black-flowered *hitam* yielded 1.71 per cent.

Popular Beliefs.

In various parts of India the flower and the fruit of the pomegranate are given to women to eat, so that they may conceive sons.

Among the Arabs, the bride, when dismounting before the tent of the bridegroom, receives a pomegranate, which she smashes on the threshold, and then flings the seeds into the interior of the tent. The Arabs would have a man like the pomegranate: 'bitter-sweet, mild and affectionate with his friends in security, but tempered with a just anger if the time calls him to be a defender in his own or in his neighbour's cause.'

In China the pomegranate is regarded as a symbol of fertility. We read in the 'Pei si' that two pomegranates were presented to king Nan-te of Ts'i on the occasion of his marriage to the daughter of Li Tsu-sou, who explained that the fruit encloses many seeds, and implies the wish for many sons and grandsons. Thus the pomegranate is still a favourite marriage gift and plays a part in the marriage festival. The same obtains in modern Greece.

In ancient Greece the pomegranate was one of the plant remedies for sterility. In cases of difficult labour the Romans gave the parturient woman pomegranates and a decoction of fenugreek.

Mythology.

The pomegranate was one of the attributes of Aphrodite or Venus, the goddess of love and beauty; of Demeter or Ceres, the goddess of agriculture and vegetation; and of Dionysus or Bacchus, the youthful, beautiful, but effeminate god of wine.

The attribute of Persephone or Proserpina as the wife of Hades or Pluto was the pomegranate, and her votaries had to abstain from this fruit. When carried off to the under-world Persephone resisted, begged, and implored gods and men to help her, but Zeus approving the transaction let it pass. Although she had been thus carried off by force she loved her husband, and when her mother, Demeter, implored her to come back to earth, her answer was that she had accepted from him the half of a pomegranate, or apple of love, and had eaten it. Persephone, who has eaten of the pomegranate, is the fructified flower that returns in spring, dwells in the region of light during a portion of the year, and nourishes men and animals with the fruits.

Religion.

The pomegranate is one of the fruits offered to the deity by a Hindu woman taking the 'Saubhagya Vrat', that cruel death may not snatch away from her the husband she loves.

It is also one of the nine plants that make up the 'Navapatrika' worshipped on the occasion of the Durgapuja, as carried in some districts of Bengal.

There is abundant proof that the ancient Egyptians offered pomegranates to the gods and to the dead, and that the tree was sacred both to the Semites and to the Greeks.

The pomegranate figures in the New Year ceremonies of the Jews, and the blessing is as follows: 'May your approbation be granted, O Lord, our and our forefathers' God, to be full with good deeds as a pomegranate[1].'

According to the Koran there are fruits in paradise: the date and the pomegranate.

There is current among the Arabs a 'hadi' or traditional saying that: 'whosoever eats pomegranates when he is hungry, his heart will be illumined for forty days and he will be immune from the temptations of the devil—and, therefore, will not sin, and, therefore, will enter heaven.'

Another saying is that: 'whenever the Imam Ali wanted to eat pomegranates he would spread a cloth. He was asked the reason for it; and he answered that every pomegranate contains a grain of the heavenly pomegranate and that whenever infidels want to eat that grain, by God's command angels take it to prevent them from eating it.'[2]

Art.

The pomegranate tree and its fruit occupy a prominent place in Egyptian and Assyrian decorations and works of art: ivory, metal, pottery. They may also be seen on preserved specimens of pottery from Jerusalem and on some Jewish coins.

Among other details relating to the making of the ephod of the High Priest, the Exodus prescribes the following: 'And beneath at the feet of the same tunick round about, thou shalt make as it were pomegranates, of violet, and purple, and scarlet twice dyed, with little bells set between: so that there shall be a golden bell and a pomegranate, and again another golden bell and a pomegranate.'

In 1408, Quercia executed in Ferrara various sculptures, notably the 'Madonna of the Pomegranate.'

Heraldry.

The pomegranate appears in the escutcheons of the South American Republic of Colombia, and of Bogota, its capital. It is also found in the arms of the Spanish city of Granada, and in the seal of its University; in those of the towns of Granadella and

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[1] Dr. David Judah, M.D.
[2] Prof. K. Dehdashti, B.A. (Hons.)

Santafé, in the Spanish province of Granada; and of Tregoney, in Cornwall.

The arms of the Sassoon family are: 'or, a palm tree eradicated proper between *on the dexter a pomegranate, also proper,* and on the sinister a branch of laurel fructed, vert, both proper, on a chief azure a lion passant of the first, in the dexter paw a rod erect, gold.'

Literature.

One of the most familiar of the Rabbinical interpretations designed to expound the symbolism of the priestly decoration prescribed in Exodus is that it indicates 'something like an alternation or mixture of music with discoursing, sound with sense, poetry with thought.' And this is what Robert Browning meant to convey to the minds of his readers when he chose as a title for his poems *Bells and Pomegranates*[1].

Mrs. Browning refers to her husband's successive pamphlets in her poem *Lady Geraldine's Courtship*:—

Or from Browning some 'Pomegranate', which
If cut deep down in the middle,
Shows a heart within blood-tinctured, of a veined humanity.

Sanskrit poets often compared the redness of the cheeks or lips to the colour of the red seeds of the pomegranate. A simile not altogether unknown in the West:—

Her cheeks like . . . faire pomegranade kernels washt in milke (*Greene*).
Her temples, peices of Pomegranates seeme (*Robinson*).
That small pomegranate-like mouth (*Ouida*).
As a pomegranate, cut in twain,
White-seeded is her crimson mouth (*Oscar Wilde*).
The young pomegranate's blossoms strew
Their blooms in blushes ever new (*Byron*).
As rosy as a half-opened pomegranate (*Flaubert*).

In the *Journal* of the Malayan Branch of the Royal Asiatic Society (vol. xvii, part III, January 1940) Mr. R. O. Winstedt gives the following as an example of a Malay quatrain (*pantun*).

Satu tangan bilangan lima,
Dua tangan bilangan sa-puloh.
Sahaya bĕrtanam biji dĕlima,
Apa sĕbab pĕria tumboh?
I find one hand has fingers five,
I count up ten upon the two:
What is the matter, man alive,
Pomegranate planted and gourd grew!

Apparently the conundrum is about a gardener who counts his plants and finds their tale complete, but is astonished to discover a gourd growing where he had planted a pomegranate. However, to the Malay mind the *pantun* conveys much more than meets the ear; for in the Malay language of fruits a pomegranate stands as

[1] Prof. C. D. Pinto, M.A., L.L.B.

a simile for the purple lips of the Eastern beauty and the bitter gourd as a symbol of disappointment.

And here is a delightful little Marathi tale:—'In the house of learned men, who were profusely rewarded by king Bhoja, women, while playing in the yard got their pearl-necklaces broken and the pearls were scattered on the ground. These pearls were tinged by the lac-dye that was stamped on the floor, while the women were playing on the ground. The pearls thus coloured *red* by the lac-dye of the soles of the women's feet attracted parrots who mistook them for pomegranate grains and began to pick them up.'[1]

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THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART V.

(*Continued from Vol. xli, page* 320).

RHOPALOCERA.

PAPILIONIDAE.

Polydorus hector L.

Moore, *Cat. Lep. Mus. E.I.C.*, i, 93, pl. 2, figs. 4, 4a, 4b. 1857.
Moore, *Lep. Ceyl.*, i, 152. 1880-81.
Moore, *Lep. Ind.*, v, 173, pl. 435, figs. 1, 1a, 1b. 1901-03.
Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 19. 1907.
Bell, *Journ. Bomb. Nat. Hist. Soc.*, xx, 1130-32. 1911.
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Head black, the clypeus outlined in crimson. Body blackish purple. 1st somite with a short sublateral and a long lateral orange red tubercle, a black dorsal plate with four orange red spots anteriorly and two posteriorly. 2nd somite with a short lateral and sublateral and two longer subdorsal orange red tubercles. 3rd somite similar. 4th and 5th also similar but the outer subdorsal tubercle obsolescent on the 4th and absent on the 5th somite. 6th to 11th somites with a very low set sublateral short tubercle and a longer lateral and subdorsal. 12th and 13th somites with subdorsal tubercles only. 5th somite with a pale orange red spot above and posterior to the lateral tubercle and another anterior to the subdorsal, an orange red transverse dorsal band. 6th to 8th somites each with a pale orange red spot anterior to the subdorsal tubercle, a pair of oval dorsal spots on the anterior margin and with traces of a transverse dorsal band. There is some variation in the amount of marking. Legs and spiracles black. Prolegs blackish purple. Osmeterium orange.

Pupa suspended by a girdle and tail pad of black silk. Head flattened frontally and expanding into a slight lobe on each side. Thorax with a double keel and a slight lateral lobe. Wing cases expanded laterally and developing into a lateral lobe. 4th to 7th abdominal somites each with a pair of subdorsal rounded lobes. Colour pinkish russet, the wing cases slightly darker and mottled. The prothorax with two white subdorsal streaks, the abdomen marked with white above the wing cases. The pupa is very similar to that of *P. aristolochiae* F. (mihi, *Journ. Bomb. Nat. Hist. Soc.*, xl, 392), but the cephalic lobes are slightly smaller and those on the abdomen are smaller and more erect. The colour is more pinkish, that of *aristolochiae* being slightly tinged with olive.

Food-plant—*Aristolochia* spp.

Described from a full fed larva found at Gopalpur (Dist. Ganjam) 8-iii-40, pupated 14-iii-40, and a male emerged 1-iv-40.

SATYRIDAE.

Ypthima hubneri Kirby, *hubneri*.

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Moore, *Lep. Ind.*, ii, 77, pl. 111, fig. 1. 1893-96.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 143. 1905.

Ovum spherical, the base slightly flattened. Pale bluish green. Minutely punctate. Laid singly on the blades of grass. Deposited 30-vi-40. Hatched 6-vii-40.

Newly hatched larva pale buff marked laterally with purplish and clothed with short hairs. The body colour changes to green as soon as it has fed but the head remains buff. Resting attitude with the head and fore-part of the body curved downwards. Moulted 10-vii-40.

2nd instar—Head and body pale green. A darker green dorsal line, a slightly waved white subdorsal and lateral line with a third line between them. Ventral surface paler. Anal plate divided into two points. Body clothed with short hairs. Moulted 14-vii-40.

3rd instar—Similar but with a pale subspiracular stripe. Moulted 18-vii-40.

Final instar—Head green. Body green, pubescent. A dark green dorsal stripe, becoming whitish on the 1st and 2nd somites. A slightly waved whitish subdorsal line with two more below it. A pale subspiracular stripe. Legs and prolegs green. Anal plate ending in two short pinkish processes. Length about seven-eighths of an inch. Two larvae in a batch of fifty bred from ova were pale purplish instead of green, with a dark purplish dorsal stripe and with the white lines more distinct. Pupated 24-vii-40.

Pupa suspended by the cremaster. Yellowish green in colour, the thorax and wing cases less tinged with yellow. A brownish black stripe along the dorsal edge of the wing case and a series of black specks along the outer margin. Thorax humped and slightly keeled, in some specimens the keel outlined in brownish black. A very few examples have the wing cases shaded with black. A female emerged 31-vii-40.

Food-plant—Grasses.

The larvae usually hang up for pupation during the night and change late the following evening. The imagines usually emerge between eight and ten in the morning.

Described from material bred from a female caught at Calcutta.

de Niceville, quoted by Bingham, writes :—'About one inch in length, with two divergent processes from the anal segment pointing backwards. Colour entirely green with a dorsal line somewhat darker green, which becomes white at the fourth segment, and extends right through the crown of the head; there is also a paler green lateral line below the spiracles. Pupa green or brown, with the head rounded, the edges of the wing-cases raised and angled anteriorly; the thorax humped and marked like the abdominal segments, with some dark brown waved lines and spots.'

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NYMPHALIDAE.

Atella phalanta Drury.

Moore, *Lep. Ceyl.*, i, 62, pl. 31, fig. 1a. 1880-81.
de Niceville, *Butt. Ind.*, ii, 30. 1886.
Davidson & Aitken, *Journ. Bomb. Nat. Hist. Soc.*, v, 269. 1890.
Moore, *Lep. Ind.*, iv, 197, pl. 360, figs. 1, 1a-1f. 1899-1900.
Bingham, *Fauna Brit. Ind.*, Butterflies, i, 412. 1905.

Head black with a small white pear-shaped central spot. Body grey, minutely speckled with white, the dorsum paler with a black dorsal line. A zig-zag sublateral cream coloured stripe. 1st and 2nd somites each with a lateral and subdorsal longish black branched spine, 3rd somite with the subdorsal spine only. 4th to 11th somites with a subdorsal, lateral and sublateral spine, 12th and 13th with subdorsal spines only. Legs black. Prolegs greyish. Spiracles black ringed with white. Venter tinged with yellow. One specimen had the upper half of the head pale reddish brown. Before pupation the dorsum becomes tinged with yellow, the whole body finally turning green with the bases of the spines ringed with white.

Pupa with the head square in front with a pair of very small horns. Thorax slightly humped with a pair of short subdorsal spines on the pro- and meta-thorax. 4th, 6th, 8th and 9th abdominal somites each with a pair of subdorsal spines, 1st and 3rd each with a pair of raised subdorsal spots, 5th and 7th each with a pair of very small subdorsal spines. Suspended by the cremaster from a pad of white silk and hanging at an angle of about thirty degrees from the horizontal. Ground colour mother-of-pearl tinged with pink and with the following black and metallic silver markings. Black—three small spots on the front of the head, a circle round the eye, the cephalic horns, the base of the prothoracic spines, the anterior portion of the metathoracic spines and an irregular blotch in front of them, the thorax along the junction with the wing cases, an irregular triangular costal mark a third of the way from their base, a series of lanceolate spots on the outer margin of the wing cases, the antenna and proboscis cases, the anterior part of the spines and raised spots on the 1st, 3rd, 4th, 6th and 8th abdominal somites and the whole of the spines on the 5th, 7th and 9th, a minute speck next to the spine on the 7th somite, a series of short transverse dashes on the venter, a lateral blotch on the 3rd, 4th and 5th abdominal somites and the cremaster. These black markings vary considerably in size. Metallic silver—the centre of the eye, the back of the prothoracic and metathoracic spines and also of the spines and raised spots on the 1st, 3rd, 4th, 6th and 8th abdominal somites, the inner margin of the wing cases and a streak along the outer edge.

Described from a number of full fed larvae found at Gopalpur (Dist. Ganjam) 16-iii-40, one of which pupated 19-iii-40, and a female emerged 24-iii-40.

Moore gives a very bad figure of both larva and pupa in *The Lepidoptera of Ceylon* and the following description:—'Larva purple-brown; head armed with two delicate branched spines, each

segment with two dorsal rows of similar spines and two lateral rows of shorter spines. Feeds on *Flacourtia, Salix,* etc. Pupa pale green, tubercular along the back.' Bingham quotes Davidson and Aitken as follows.—'Larva cylindrical, moderately thick, very smooth . . . . bears six longitudinal rows of branched spines. The head is unarmed. The colour varies from dark brown to pale yellowish-green, with a white or yellowish spot at the base of each spine. It feeds on one or more species of *Flacourtia*. Pupa colour very variable, some specimens being almost white and some bright green, the markings are usually silver soled, or tipped with red.' He also quotes de Niceville's description of the pupa 'A beautiful green with a subdorsal series of five acutely pointed tubercles, marked with red between each pair of very small blunt ones, the upper edge of the wing-covers and a spot on each side of the head also marked with red.'

LYCAENIDAE.

Rapala schistacea Moore.

Head brown, very small and retractile. Body flattened, pale yellowish green. Somites deeply cut and with a subdorsal and sublateral series of slight humps. Skin pubescent, the subdorsal humps bearing short black bristly hairs, the sublateral humps white ones. Gland fairly large. The larva is well concealed by its appearance when resting among a bunch of the flower buds of its food-plant.

Pupa formed in captivity on the bottom of the box under a leaf, resting on a very thin mat of silk and held in place by a slight girdle and the cremaster. Head and anal end obtuse, the abdomen rather swollen laterally, thorax and abdomen domed dorsally with a slight depression between the two, ventral surface flat, but this may be due to the situation in which the pupa was formed. Colour pinkish speckled with black, the wing cases tinged slightly with olive green, and with a blackish subdorsal stripe edging the thoracic dome and then running along the abdominal somites. Under a lens the body is seen to be covered, with the exception of the wing cases, with short whitish hairs. Wing cases minutely punctate.

Food-plant—*Quisqualis indica* Linn.

Described from a full-fed larva found in Calcutta 19-x-39, pupated 23-x-39, and a female emerged 31-x-39.

HETEROCERA.

LYMANTRIIDAE.

Euproctis subfasciata Wlk.

Head very dark brown, the bases of the antennae white. 1st somite black with two subdorsal white streaks, a smaller lateral white streak and a black subdorsal wart tufted with greyish hair. The rest of the body blackish grey, a double white dorsal line from the 6th to 10th somite and a very faint whitish lateral line. 2nd and 3rd somites each with four brownish warts across the

dorsum and a reddish lateral wart, all tufted with brownish hair. 4th and 5th somites each with a dorsal black hump, a subdorsal black wart and a reddish lateral wart, all tufted with brownish hair. 6th to 11th somites each with four black warts across the dorsum and a reddish lateral wart, all tufted with brownish hair. 12th somite with four small greyish warts tufted with brownish hair. The dorsal glands on the 9th and 10th somites pinkish red. Legs black. Venter and prolegs grey.

Pupa olive brown, the thorax more chestnut, the wing cases greener. Enclosed in a cocoon of thin whitish brown silk mixed with larval hairs.

Food-plant—*Quisqualis indica* Linn.

Described from a full-fed larva found in Calcutta 26-v-40, spun 1-vi-40, and a male emerged 16-vi-40.

Arctiidae.

Creatonotus transiens Wlk.

Moore, *Lep. E.I.C.*, 290, pl. 13, fig. 5. 1857-59.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 29. 1894.

Ovum very pale yellow, spherical, flattened at the base, without sculpturing. Laid in large batches, each individual ovum touching the ones next to it. Hatched on the fourth day.

Young larva greyish with transverse black bands on the 3rd, 4th and 10th somites. Hair grey. Head black. Later with a white dorsal stripe edged with black between the transverse bands, the anal somite orange and a series of orange sublateral warts.

Full-grown larva—Head black, marked with white above the jaws and with a pale inverted V-shaped mark outlining the clypeus. Body greyish black minutely speckled with white on the lateral areas. A broad white dorsal line interrupted on the 3rd, 4th, 10th and 11th somites by wide black transverse bands. A pale cream lateral streak on the 2nd and 3rd somites. 5th to 9th somites with double oblique pale ochreous lateral streaks, and with traces of similar streaks on the 11th and 12th somites. Hairs blackish brown. Spiracles white. Legs black. Prolegs deep purplish pink.

Pupa in a thin cocoon of whitish silk mixed with larval hair. Pale chestnut brown, the intersegmental areas and a dorsal stripe on the abdomen darker. Not quite as dumpy as the usual Arctiine pupa.

Food-plant—Various Composites, and probably many other species of low plants.

Described from a number of larvae bred from ova in Calcutta, one of which pupated 29-viii-39, and a male emerged 5-ix-39.

Hampson's description, which is apparently based on that of Moore, is 'black, blotched with red-brown and with tufts of red-brown hair, the lateral tufts arising from ferruginous tubercles; a dorsal broad white line; head black, marked with white.'

Asota caricae Bsd. (*alciphron* Cr.).

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xl, 402. 1938.

The colouring of the head in this species is variable. Out of

a batch of larvae found in Calcutta in August 1939, the majority had the head red, as recorded by Hampson and Moore. A smaller number had the head black with the vertex marked with red, as previously recorded by me, and there were a very few intermediates.

SPHINGIDAE.

Cephonodes hylas L., *hylas*.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xli, 315. 1939.

Head grey. 1st somite swollen, black with minute whitish tubercles. Ground colour very pale grey, the secondary segmental lines darker. A pale lavender subdorsal line edged below with white and with a small black spot immediately below it in the middle of each somite from the 2nd to the 10th. Legs purple. Prolegs purplish. Anal flap and claspers purple with minute whitish tubercles. Horn black and tuberculate. Spiracles white with a transverse orange bar and with an ill-defined grey blotch immediately behind each. Another specimen had the subdorsal line and black spots obsolete and a third a black streak centred with white in place of the spots. In some cases the ground colour was considerably darker than in others.

Described from a full-fed larva found at Gopalpur (Dist. Ganjam) 12-iii-40, pupated 16-iii-40, and a male emerged 30-iii-40.

The dark forms were considerably commoner than usual and outnumbered the green by about two to one. Three larvae found when in the first instar were green but became almost jet black after ecdysis, and finally developed into the form with the broad black dorsal stripe.

NOCTUIDAE.

Prospalta capensis Guen.

Moore, *Lep. Ceyl.*, iii, 29, pl. 147, fig. 2a. 1884-87.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 211. 1894.

Warren Seitz, *Indo-Austr. Noctuidae*, xi, 346.

Head brownish green with a broad black stripe on either side running from the outer edge of the mandibles to the vertex, where it is slightly broader. Ground colour pale brownish green, an interrupted white dorsal line edged with dark crimson and ending on the 11th somite in a white spot. A very fine white subdorsal line, between which and the dorsal line there are three minute crimson-ringed white spots on each somite from the 4th backwards, of these the central one is nearest the dorsal line and the anterior one is the smallest. 2nd and 3rd somites with a transverse series of four similar dots on each side of the dorsal line. A spiracular stripe, white and fairly broad and tinged with crimson, immediately above which there is a white dot broadly ringed with crimson over each spiracle from the 4th to 11th somite. 6th to 8th somites each with a pair of sublateral white crimson-ringed dots. Legs black. Prolegs and the whole area below the spiracular stripe very pale greenish. 11th somite slightly humped dorsally. Spiracles white ringed with black.

Pupa in an earthen cell. Red brown, the thorax and wing cases tinged with olive green, a dark dorsal stripe and the intersegmental areas of the abdomen darker. Cremaster ending in two sharp spines.

Food-plant—Found on Marigold, but fed up on Cosmos, preferring the flowers.

Described from a full-fed larva found in Calcutta 12-i-40, pupated 17-i-40, and a male emerged 1-ii-40.

All the published descriptions that I have seen are based on that of Moore. This is: 'Larva smooth, pale green, anal somite conical; with a dorsal and lateral series of purple-brown blotches dotted with white, and a sublateral row of white dots. Pupa greenish, with reddish segmental bands. Feeds on Acanthads.' Moore's plate shews a pupa with the head, thorax, wing cases and intersegmental abdominal areas bright green, the rest almost scarlet.

(To be continued).

A REPTILE AND AMPHIBIAN MISCELLANY.

BY

CHARLES MCCANN, F.L.S.

PART II

(*Continued from Vol. xli, p. 764*).

(*With 6 plates*).

SUBORDER: SAURIA (*contd.*)

FAMILY: *Agamidae*.

Draco dussumieri Dum. & Bibr. Flying Dragonet.

On the 10th June, 1938, Mr. A. R. Hughes and I saw a specimen of this species in the forests of Gersoppa Falls, N. Kanara. The animal parachuted from one tree to another, a distance of some 60 feet. As soon as it alighted, it ran up the trunk for a foot or so, much after the fashion of a Tree-creeper (*Certhia*). Though I stoned it in an attempt to secure it, it made no attempt to parachute again, but just moved round the trunk climbing a little higher each time, just as a Bloodsucker (*Calotes versicolor*) would do under similar circumstances. It eventually dropped after being hit, but was lost in the undergrowth. The upper surface was entirely black, like the bark of the tree, with no indication of markings.

Habits.—Apparently nothing is known of the habits of *Draco dussumieri*, but under the heading of the genus the *Fauna* (vol. ii, p. 137, 2nd Ed.), referring to the gular appendage, states, 'The gular pouch is usually much larger in the males than in the females'. In *dussumieri* the males always possess the larger appendage. Continuing the *Fauna* adds, 'Both it (appendage) and the wattles are distensible, or erectile, and are utilized by the males during courtship.' Though the gular appendage may be used during courtship, this does not appear to be its only use. As parachuting is under control, the triangular lateral expansions on the sides of the neck assist in flight, and the gular appendage acts as a possible 'rudder'. Further, I am of opinion that the appendage plays a part in attracting insects. The appendage is flicked up and down and, at the same time, the lateral neck expansions are spread out: the three appendages forming a badly shaped T. The dorsal surface of the neck expansions is coloured like the back, but the lower is a metallic bluish green with some scattered dark spots. The appendage is intermittently brought into play when the animal is travelling up a trunk or immediately after alighting. The appendage, when fully exerted, describes almost a semicircle, from the resting to the exerted position, and when at its fullest exceeds the length of the snout, in males. During the performance the animal stands high on its forelegs. Agitation, caused by

disturbances, also make the animal perform. All three appendages are brought into play when the animal assumes a threatening attitude. The lateral expansions are spread, the gular appendage is deflexed (not to its fullest) and the mouth is opened. Actually, the whole effect produced is that of a queer-looking orchid flower. In flight the animal appears like a highly coloured grasshopper.

Breeding.—Referring to the breeding in *Draco*, the *Fauna* states, 'The young are produced from eggs, from two to five being laid at a time. These are buried in the ground'. Thanks to the kindness of Dr. M. Suter, whose guest I was during a fortnight's trip to Kanara, I was able to observe and collect some of these interesting lizards. The period of the trip extended from the 3rd to 15th September 1940. The breeding season of this lizard is undoubtedly during the monsoon months. While at Karwar, I saw many young and secured four gravid females, one of which contained large eggs in the oviducts almost ready for laying. These eggs measured 15×9 mm. The other females contained smaller eggs still in the body cavity. The normal number of eggs in a clutch appears to be four. The condition of the male genitals in mature males indicated that the animals were passing out of the breeding season.

Sexual differences.—The females are larger than the males. The gular appendage is not as long as in the males, but displays the same colouring.

Food.—The food of *dussumieri* is apparently composed largely of ants, particularly the Red Tree-Ant (*Oecophylla smaragdina* Fabr.). The stomachs of some were packed exclusively with this species.

Colouring.—In May 1939, Mr. D'Souza of our office brought in a living example which he had caught at Yellapore, N. Kanara. Apparently the colouration of this species from life has never been recorded (*vide Fauna*). Now I attempt to describe the difficult colour pattern, but this is by no means constant as it keeps changing within certain limits. The colouration, as I saw it, was as follows:—Head and dorsal portion of body (excluding parachute membrane), limbs and tail mottled with dark and light browns, buff and grey. On the nape there is a transverse ellipsoid, buffish patch. Along the vertebral column, from between the forelimbs to the region of the pelvis, there are four longitudinal narrow ellipsoid patches, the mid-dorsal patch being the largest. Each patch consists of a buffish ellipse with dark brown lineal ellipses within—these patches under certain conditions turn almost white, and the rest of the body black. The tail is irregularly banded at intervals, with the same tones as the body.

The dorsal surface of the parachute; the peripheral margin is radially streaked with thin lines of brown and buff; within this margin which has a depth of about 5 mm. it is very strongly blotched with black and gold or dull yellow, the blotches often confluent. The yellow gradually passes into the body colours. The reverse has fewer black blotches, no margin as above and the entire area suffused with pale blue. The chin and throat are metallic yellow-green with a few brown markings near the mouth,

**Measurements of* Draco dussumieri *Dum. & Bibr. in millimetres.*

Species	Sex	Date	Locality	Snout to Vent	Vent to tip of Tail	Size of Testes	Size of eggs	Remarks
D. dussumieri ...	♀	Sept. 1940	Karwar, N. Kanara	97	155	.....	8	Ova in body cavity (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	93	144	.. ...	15×9	Eggs in oviduct (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	91	141	.....	5	Ova in body cavity (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	90	146	.....	.....	Abdomen damaged.
Do. ...	♂	,,	,, ,, ,,	82	125	4×3	.....	
Do. ...	♂	,,	,, ,, ,,	84	127	.....	.....	Damaged.
Do. ..	♂	,,	,, ,, ,,	85	.....	5×?	.....	,,
Do. ...	♂	,,	,, ,, ,,	80	105 (B)†	.....	.....	,,
Do. ...	♂	,,	,, ,, ,,	83	127	4×?	.....	,,
Do. ...	?	,,	,, ,, ,,	41	65	.....	.....	Young.

* Measurements taken after animals had been in spirit some days.
† (B) = Broken.

this passes imperceptibly into the bright chrome yellow of the gular appendage. The chest, abdomen, under-surfaces of the limbs and a part of the ventral of the tail are metallic blue-green. The eyes are almost black, surrounded by bluish eyelids. The inner margin of the upper jaw is strongly demarked in pearly white.

Sitana ponticeriana Cuv. Fan-throated Lizard.

A female measuring from snout to vent 45 mm. and from vent to tip of tail (broken) 55 mm. was captured at Sutgutti, 16 miles north of Belgaum, on the 5th June, 1938. Two days later she laid eleven eggs. The *Fauna* records that this species lays six to eight eggs. The average measurements of the eleven eggs is 7·96 × 5·76 mm. The largest measured 8 × 6 mm.; the smallest 7·5 × 6. The shape is ellipsoid, tapering somewhat towards both poles.

Calotes versicolor (Daud.) Jerdon. The Bloodsucker.

In volume xxxix of the *Journal* I described some of the habits of this lizard. With regard to the egg-laying period, the latest date on which eggs were discovered was the 22nd August (1937). A fresh clutch was unearthed in a flower pot on the 17th September, 1938. Late clutches may explain the appearance of a few immature animals after the aestivating period.

Copulatory organs.—An anatomical detail which has puzzled me much is the 'dual' copulatory organs of certain reptilian groups, namely, the lizards and snakes. One can hardly resist asking, Why are these reptiles provided with a bifid, others with a single copulating organ? Dr. Smith [*Fauna British India* (Reptilia), vol. ii, p. 4, 2nd Ed.] referring to these organs in lizards writes:—

'Each organ consists of a tube of erectile tissue, which can be everted like the finger of a glove. **Only one organ is inserted, but which one is immaterial, and depends upon which side the male happens to be at the time of copulation.*'

Referring to Gadow (*Camb. Nat. Hist.*, Amphibia and Reptiles, p. 499) we find the same statement: '**Only one organ is inserted at one time.*'

On the other hand we have the view proposed by Jones [*The Animal Kingdom*, p. 758, para (2025)] discussing the copulatory organs of reptiles:—

'The earliest appearance of copulatory organs is seen in Serpents and Lizards tribes: and in such reptiles it will be observed that **the penis is rather a provision for securing the juxtaposition of the sexual apertures of the male and female than an instrument of intromission.* The two lateral halves of the penis (or *corpora cavernosa* as we shall have to call them hereafter, when they become conjointed in the mesial line) are as yet quite separate, and placed on either side of the cloacal fissure, from which they protrude when in a state of erection, so that there appears to be two distinct organs of excitement, or, more properly speaking, of prehension; for each division, being of course imperforate, is covered with sharp spines†, **and is obviously adapted to take a firm hold of the cloaca of the female than to form a channel for the introduction of the seminal fluid.*'

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* The italics are mine.

† There are no spines in *Calotes* nor in *Hemidactylus*.

If the copulatory organs of snakes and lizards are organs of prehension, as suggested by Jones, then such prehension, to be effective, implies the use of both organs. In such lizards, as I have observed, i.e. *Hemidactylus, Calotes* and *Mabuya,* the male at first holds the female in its jaws, but the grip is released as soon as the copulatory organs are inserted. In these lizards the limbs are employed in securing a stance on vertical walls or the surface of a branch, and cannot be used for holding the female, and, once the grip of the jaws is relaxed, hold is maintained solely by the copulatory organs. In these conditions it is difficult to accept the contention that only one organ is employed; and one is inclined to the conclusion that security and effectiveness of hold depend upon the use of both organs.

Fat bodies.—Before the gonads become active there are two large, ovate-oblong, yellow fat bodies present in both sexes, one on either side of the vertebral column. With the increase in the size of the gonads there is a relative decrease in the size of these bodies and eventually become totally absorbed. In some specimens taken on the 16th June (1940) at the Tulsi Lake, the fat bodies had been absorbed though the ova were not mature, but still in the body cavity (see table). The main function of these bodies appears to be to ensure the proper development of the gonads at a time when the food supply is precarious, i.e., during the dry months when few insects are about.

Food.—In my previous paper on this lizard, I dealt with the question of food in somewhat general terms, but further observations have enabled me to give more details. The following is a list of the stomach contents of several lizards:—

Dysdercus cingulatus Fb. These bugs though very common at certain times of the year are only eaten in small numbers.

Cremastogaster sp.
Camponotus compressus Fb. } Both species are eaten in large numbers, and in the dry months appear to form the main source of food, particularly, *Cremastogaster* sp.

Plagiolepis sp. (*Hymenoptera*). This ant is very common in Salsette Island and at first looks very much like *Oecophylla smaragdina* Fabr. but the former is slightly smaller and does not bite, while the latter bites viciously.

Scolopendra sp. occasional.

Parasa lepida Gam. (*Limacodidae*). Three larvae of this moth were taken from a single *Calotes.* This find is interesting in that these larvae are armed with strongly irritant spines which are sufficient to deter most enemies. The spines are believed to contain formic acid.

Small *Coleoptera* are taken in plenty, and various caterpillars frequently. Numerous other insects were found but too far decomposed to identify with certainty.

Apart from the above list I have found the seeds of a grass, *Coix Lachryma-Jobi* Linn. These seeds were evidently taken in error for insects on account of the peculiar shape. Mr. H. Ali informs me that he found the fruit of *Lantana* in the stomach. Other curious finds were a piece of clear glass about 6 mm. square:

Measurements of Calotes versicolor *in millimetres.*

Species	Sex	Date	Locality	Snout to vent	Vent to tip of Tail	Size of Testes	Size of eggs	Remarks
Calotes versicolor.	♂	28-4-40	Andheri, Salsette Isl.	122	290	11×7	.....	Fat bodies large. Lungs infested with Nematodes.
Do. ...	♂	29-4-40	,, ,, ,,	118	277	14×7	.....	Fat bodies reduced.
Do. ...	♂	29-4-40	,, ,, ,,	117	274	9·5×5	.....	Fat bodies large.
Do. ...	♂	29-4-40	,, ,, ,,	125	276	12×6·5	.....	,, ,,
Do. ...	♂	26-5-40	,, ,, ,,	128	272	14×9	.....	Fat bodies fairly large. Lungs heavily infested with Nematodes.
Do. ...	♂	1-6-40	,, ,, ,,	139	293	12·5×8	.....	Fat bodies considerably reduced. Lungs slightly infested with Nematodes.
Do. ...	♂	2-6-40	,, ,, ,,	126	291	15×9	.....	Fat bodies absent.
Do. ...	♂	2-6-40	,, ,, ,,	118	270	14×8·5	.....	Fat bodies reduced. Lungs infested with Nematodes.
Do. ...	♂	9-6-40	,, ,, ,,	129	126 (B)*	17×9	.....	Fat bodies absent.
Do. ...	♂	9-6-40	,, ,, ,,	118	275	14×7·5	.....	Fat bodies reduced.
Do. ...	♂	9-6-40	,, ,, ,,	121	265	14×8	.....	Fat bodies small. Lungs slightly infested with Nematodes.
Do. ...	♂	9-6-40	,, ,, ,,	119	272	15×7·5	.....	Fat bodies absorbed. Lungs heavily infested with Nematodes.
Do. ...	♂	16-6-40	Tulsi Lake ,, ,,	137	310	15×9	.....	Fat bodies absorbed. Lungs infested with Nematodes.
Do. ...	♂	16-6-40	,, ,, ,,	109	268	12×6	.....	Fat bodies absorbed. Lungs infested with Nematodes.
Do. ...	♀	30-4-40	Andheri, ,, ,,	89	210	.....	2	Fat bodies large. Ova in body cavity.
Do. ...	♀	30-4-40	,, ,, ,,	92	132 (B)	.....	2	,, ,, ,, ,,
Do. ...	♀	30-4-40	,, ,, ,,	83	193	.....	1	,, ,, ,, ,,
Do. ...	♀	30-4-40	,, ,, ,,	104	240	.....	3	,, ,, ,, ,,
Do. ...	♀	15-5-40	,, ,, ,,	93	235	.....	4	Fat bodies reduced. ,, ,,
Do. ...	♀	26-5-40	,, ,, ,,	88	202	.....	6	Fat bodies large. ,, ,, (right ovary 6, left 6).

Do. ...	♀	26-5-40	,,	,,	,,	97	230	.....	8·5	Fat bodies small. Ova in body cavity (right ovary 7, left 8).
Do. ...	♀	26-5-40	,,	,,	,,	99	101 (B)	.....	12·5 × 7·5	Fat bodies small. Eggs in oviducts (right 8, left 6).
Do. ...	♀	26-5-40	,,	,,	,,	118	145 (B)	.....	14·5 × 8	Fat bodies small. ,, ,, (right 11, left 12).
Do. ...	♀	1-6-40	,,	,,	,,	106	235	.....	12·5 × 7	Fat bodies small. Eggs in oviducts (right 9, left 8). Abdomen infested with large Nematodes.
Do. ...	♀	16-6-40	Tulsi Lake	,,	,,	86	101 (B)	.....	7	Fat bodies absorbed. Ova in body cavity (right 6, left 5).
Do. ...	♀	16-6-40	,,	,,	,,	89	230	.....	9	Fat bodies absorbed. ,, ,, ,, (right 12, left 11).
Do. ...	♀	16-6-40	,,	,,	,,	82	210	.....	5	Fat bodies absorbed. ,, ,, ,, (right 5, left 5).

*(B) = Broken.

a valve of a bivalve shell. As there is no muscular pyloric region in *Calotes*, hard substances would serve no useful purpose, hence the only conclusion is that hard substances, such as these, are swallowed in error.

Parasites.—In my paper referred to above, I mentioned the occurrence of some internal parasites taken from *Calotes*, but could not mention them specifically at the time. Since then some of the worms were identified. They are as follows:—

Polydelphis rotundicaudatus (v. Linst., 1904) Baylis, taken from the stomach.

Strongyluris calotis Baylis & Baubney, infesting the rectum.

A Pentastomid was taken from the lungs, one in each.

On the 26th May 1940 I removed 65 small worms, similar to *Strongyluris*, from the lungs of a single male—40 in one and 25 in the other! Another male (on 16-6-40) yielded 55 Nematodes, 36 in one lung and 19 in the other! In spite of such heavy infections the lizards appeared healthy and behaved quite normally. The upper half of the lungs was seriously inflamed and the inner walls of the lower half were covered with nodular outgrowths. The Nematodes lie free in the lung cavity. It does seem curious that though these lizards are often heavily infected, externally, they appear healthy and normal. On the 1st June (1940) I recovered seven large worms measuring 60 mm. long from the body cavity of a female. These worms moved among the viscera and the eggs. Though the animal harboured these worms she seemed perfectly fit and contained 17 eggs in the oviducts.

Besides the above-mentioned parasites the following have been recorded from *Calotes versicolor* (*vide* Baylis, *F.B.I.* Nematoda):—

'Ascaris' brachyura (v. Linst., 1904) from Ceylon.

Thelaudros maplestoni (Chatterji 1930) from Burma and Ceylon.

Conispiculum flavescens (Castellani & Willey, 1905) India & Ceylon.

Thubunaea dactyluris Karve 1938, India.

Physaloptera archari Mirza 1935 (=? *P. paradoxa* v. Linst. 1908), India.

Calotes rouxi Dum. and Bibr. The Forest Bloodsucker.

Colour.—The Forest Bloodsucker is smaller than the common Bloodsucker (*C. versicolor*). In non-breeding garb it may be mistaken sometimes for juveniles of *versicolor*, but in the breeding season it is very distinctive. At that season both males and females are black in tone throughout, except for the head and a narrow patch along the vertebral column which are bright scarlet, the scarlet gradually lessening in intensity posteriorly. In the females the scarlet markings are far less pronounced than in the males. In this phase of colouring the animal does not look unlike some bark fungus from a distance. In the non-breeding season the general colouring consists of sober browns, but like other lizards they are able to change colour considerably according to the ground they are on. On the top of the head there are four characteristic black dots in both sexes throughout the year. The breeding colours are

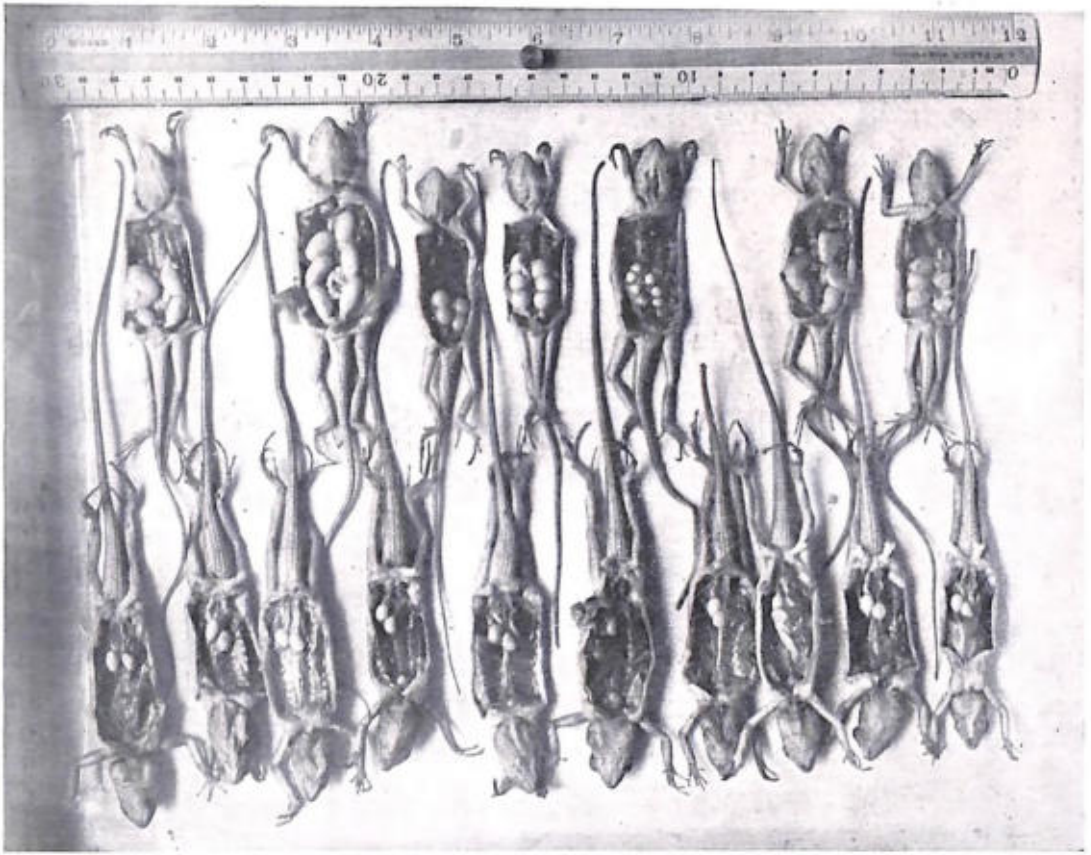

Photo : C. McCann.

Dissections of the Forest Bloodsucker (*Calotes rouxi* Dum. & Bibr.) showing the condition of breeding organs. (Top row females ; bottom males).

Photo: C. McCann.

The Common Skink (*Mabuya carinata* Boulenger) at home.

controllable and their intensity depends on the temperament of the animal at the time. Under disturbed conditions, such as handling, the colours almost disappear.

Sexual difference.—The males are larger than the females.

Habits.—Dressed in the contrasting breeding colours the males sit watching for females, and from time to time bob their heads and shoulders up and down just as the common Bloodsucker does. This form of display possibly serves a dual purpose; one as a challenge to other males who respond in the same manner before approaching each other to fight; and the other, to distinguish the females which do not adopt the same performance. Fights between males are not uncommon and some lizards may be seen with scars. Rival males may be seen going from tree to tree to chase one another away. The courtship is apparently short; the male will chase a female round a trunk, she will dodge, often arch her back and meet the male in an 'aggressive' attitude, then suddenly take to flight again. This sort of play continues for a time before actual copulation takes place. Many of the habits of the species are not unlike those of the Bloodsucker (*C. versicolor*).

These lizards spend much of their time low down on the trunks of trees coming to the ground frequently to catch insects. They are inhabitants of deciduous forests. Their numbers have been considerably reduced in Salsette since the wholesale deforestation of certain parts of the island. Owing to this state of affairs large numbers were congregated where a few trees were available in June 1939, but since then, the trees have been demolished!

Breeding Season.—The breeding season commences during the hot weather, i.e. the middle of May and reaches its height in June when the eggs are laid. The clutch numbers from 4 to 9, but 6 or 7 appears to be the general rule. The accompanying table gives the size of the eggs.

In Kanara the breeding season appears to be somewhat later than in Salsette Island. While at Karwar during the early part of September (1940) I noticed several males in breeding colour and secured a single female with fully matured eggs in the oviducts. At the same time there were a number of young about.

Food.—This lizard is insectivorous. On one occasion I found it feed on a red Pyrrhocorid bug. The bugs are avoided by most other lizards. At the breeding season the bugs appear in large numbers.

FAMILY: *Scincidae*: Skinks.

Mabuya carinata Boulenger. The Common Skink.

The Common Skink, is often referred to as the 'Snake-leader' or 'Snake-ant (or aunt)'[1]—Snake-leader, because popular belief has it that this inoffensive creature is a forerunner of snakes. There is, of course, no real foundation for this belief, but it must be remembered, that this lizard, like so many others, forms the chief

[1] 'Snake-ant' is a literal and mutilated translation of the Marathi name *Surpā chi mousi* (=snake's aunt).

Measurements of Calotes rouxi *in millimetres.*

Species	Locality	Date	Sex	No. of Pores	Size of Testes	No. of Eggs	Size of Eggs	Head & Body	Tail	Remarks
Calotes rouxi Dum. & Bibr.	Kanari Caves, Salsette Isl. ...	8-6-39	♂	...	7×4	...	...	72	143	
Do. ...	Do. ...	Do.	♂	...	8×4	...	...	65	128	
Do. ..	Do. ...	Do.	♂	...	7×4	...	...	66	143	
Do. ...	Do. ...	Do.	♂	...	7×3	...	...	65	131	
Do. ...	Do. ...	Do.	♂	...	7×5	...	...	68	131	
Do. ...	Do. ...	Do.	♂	...	7×4	...	...	71	127	
Do. ...	Do. ...	Do.	♂	...	7×5	...	...	67	(broken)	
Do. ...	Do. ...	Do.	♂	...	7×4	...	...	71	132	
Do. ...	Do. ...	Do.	♂	...	7×4·5	...	...	66	118	
Do. ...	Do. ...	Do.	♂	...	6×4	...	...	61	98 (broken)	
Do. ...	Do. ...	Do.	♀	...	...	6+M	10·5×6	62·5	128	Eggs in uteri.
Do. ...	Do. ...	Do.	♀	...	...	6+M	12×6·5	68	136	Do. almost mature.
Do. ...	Do. ...	Do.	♀	...	...	6+M	12×6	60	119	Do. Do.
Do. ...	Do. ...	Do.	♀	...	..	6+M	7·5	58	122	Egg in body cavity, Spherical
Do. ...	Do. ...	Do.	♀	...	...	6+M	7	57·5	111	Do.
Do. ...	Do. ...	Do.	♀	...	...	4+M	7	57	109	Do.
Do. ...	Do. ...	Do.	♀	...	...	9+M	4	60	(broken)	Do.

M = many small eggs.

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Do.	Do.	Do.	♂	...	7×3	...	...	65	131	
Do.	Do.	Do.	♂	...	7×5	...	...	68	131	
Do.	Do.	Do.	♂	...	7×4	...	...	71	127	
Do.	Do.	Do.	♂	...	7×5	...	...	67	(broken)	
Do.	Do.	Do.	♂	...	7×4	...	...	71	132	
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Do.	Do.	Do.	♂	...	6×4	...	...	61	98 (broken)	
Do.	Do.	Do.	♀	...	...	6+M	10·5×6	62·5	128	Eggs in uteri.
Do.	Do.	Do.	♀	...	...	6+M	12×6·5	68	136	Do. almost mature.
Do.	Do.	Do.	♀	...	...	6+M	12×6	60	119	Do. Do.
Do.	Do.	Do.	♀	...	..	6+M	7·5	58	122	Egg in body cavity, Spherical
Do.	Do.	Do.	♀	...	...	6+M	7	57·5	111	Do.
Do.	Do.	Do.	♀	...	...	4+M	7	57	109	Do.
Do.	Do.	Do.	♀	...	...	9+M	4	60	(broken)	Do.

M=many small eggs.

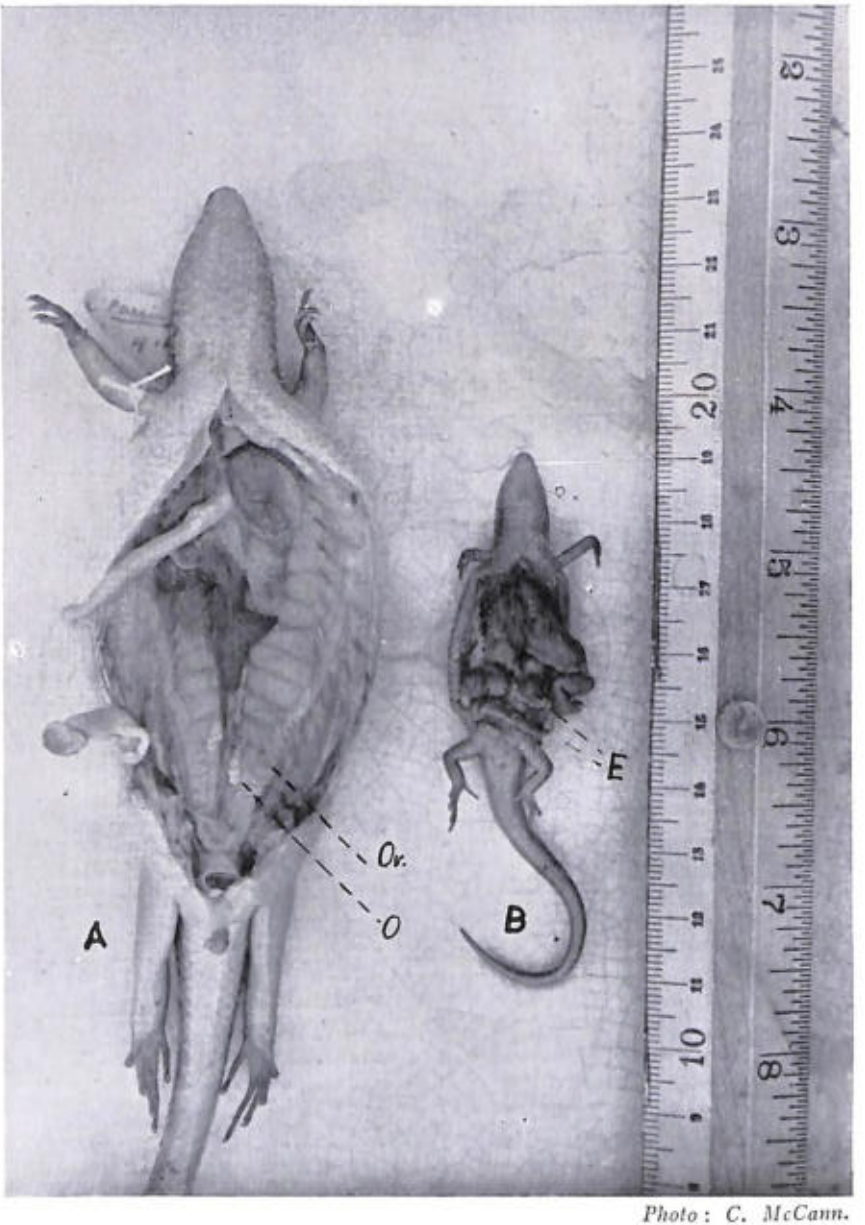

Photo: *C. McCann.*

A. The Common Skink (*Mabuya carinata* Boulenger).
B. The Little Skink (*Mabuya macularia* Boulenger).
E. eggs; O. ova; Ov. oviduct.

food of certain snakes, such as the Wolf-Snake (*Lycodon aulicus*), which is a frequent inhabitant of dwellings. There is, in the Society's collection, an interesting specimen of a *Lycodon*, which had eaten a skink 'too large' for it, with the result that the skink forced all four legs through the body wall of the snake giving it the appearance of some prehistoric monster.

In district bungalows this lizard is a frequent visitor, where it may be seen gliding about in corners and under furniture in search of insects. If not molested it often becomes quite tame, paying no attention to the inmates of the house. In forests it is frequently seen streaming in and out of fallen leaves, and under stones and rocks, its snake-like head peeping out now and again, looking very 'snakish' indeed. In the early hours of the morning, particularly in the cold weather, it may often be seen basking in the sun, either on rocks or on the trunks of trees (it never climbs into the thin branches). When possible, it will also climb on to the roof and hunt among the tiles or thatch.

In habit it is purely diurnal, resting at night in any suitable place. They are so attached to their resting places that they return to them in spite of disturbance. In my bungalow one always returned to a cloth-covered box, where it slept under the cloth. Mr. C. King, a neighbour of mine, always had one in his bed every night during the monsoon months (at no other season). The lizard would either get under his pillow or under the folded blanket at the foot of the bed. Here it would return night after night in spite of being rudely ejected at bed time. I can vouch for this statement as I have seen the lizard in question on many occasions.

The young are numerous among the fallen leaves during the months of June and July.

It is perhaps unnecessary to say that this creature is perfectly harmless and even when handled rarely bites, but old beliefs die hard. In captivity it does well and lives for several years. The food consists chiefly, if not exclusively, of insects. I have kept several in captivity, feeding them largely on cockroaches, when other insects were not available. Recently I had two large lizards in the same box. I put in a large green mantis, one of them got hold of it and dusted it vigorously on the floor. The other tried to join in the meal but each time the second lizard approached, the one with the mantis would turn its hind portion towards the other to ward it off. After the mantis had been beaten to pulp it was swallowed. The skink drinks water occasionally (noted in captivity).

Mabuya macularia Boulenger. The Little Skink.

This is quite common in the Island of Salsette, and may at first glance be mistaken for a young *M. carinata*. A pair was found on the 22nd June (1935) in copulation. I was only able to secure the female. It measured from snout to vent 48 mm.; vent to tip of tail 59 mm. On dissection it was found to contain four eggs, approximately 5 mm. in diameter. On 8th June 1939, I secured a female measuring from snout to vent 52 mm., tail 74 mm.

She contained three, almost mature eggs in the uteri (2 in the right and one in the left) measuring 9×6 mm. Besides these large eggs there were numerous other small ones in the body cavity. The normal clutch appears to be four.

It is more of a forest dweller than the Common Skink.

FAMILY: *Varanidae*: The Monitors.

Varanus monitor (L.) The Common Indian Monitor.

The Common Monitor is frequently referred to by many Europeans and Anglo-Indians as the Iguana. It is well known that true Iguanas are American, though *Chalaradon* and *Hoplurus* occur in Madagascar. To most Indians it is known as *Gor, Gorpad,* or variations of the name. The young, owing to its very different markings from the adult, is referred to by other names, one of which is the mythical *bis-cobra*. In ancient wars and in criminology in India this monitor is said to have figured frequently, as a means of scaling walls. A rope was tied round the waist, and the animal allowed to ascend the wall. Once over, pulling on the rope forces the animal to secure itself. The owners would then climb up the rope. The well-known Marathi surname, *Gorpade,* arose from the belief that some ancestor of the family used this lizard effectively for scaling a fort wall. Be this as it may, to my mind this story is quite possibly true. From my own experience, I have found it exceedingly difficult to extract a monitor from a crevice once it has wedged itself in. The following will suffice to show the great strength with which it can hang on:—In Mt. Abu (5,000 ft.) I once caught one of these lizards just as it was disappearing into a crevice. It was about 30 inches long. Only the tail remained out. I hung on to it with my feet planted against the rock, I pulled and pulled, but the animal would not give way an inch. As I was close to our bungalow I called for assistance and a rope. The rope we managed to tie just ahead of the hind limbs. With the aid of three servants I tried again to dislodge the animal but it would not move. As this plan failed, I got some straw, lit it, and put it near the tail, thinking the heat would make it release its hold, but no. Later I discovered that I had unintentionally burnt the tail a bit. In spite of this it still held out. Eventually, I slackened the rope slightly and as the animal tried to go further in, I suddenly jerked the rope and out it came. It stood at bay until captured.

As the monitor has such extraordinary strength, is it any wonder that it was used as a means of scaling? One man's weight would be nothing, once the animal wedged itself into a crevice, or got down a hole. After such experiences as I have had with this lizard, I, for one, cannot discredit the probable use of these lizards as an aid to scaling rough walls. Anyone who has handled a fair sized, vigorous animal must have been impressed with its extraordinary strength.

Though this monitor is perhaps commoner in dry districts, it is also found in dense forest. It swims and dives well, and often takes to water for safety, and remains submerged for a considerably

long time. When pursued over flat ground it runs exceedingly fast, but for a short distance only; it soon shows fatigue and stands at bay when overtaken, blows itself up, hisses and lashes out with its tail. Having recovered itself, it takes to flight once more at the first opportunity. The monitor climbs trees with great ease, and may sometimes be seen up the tallest palms in search of birds' nests. The young appear to climb more easily and oftener than the adults.

Young.—In Salsette most young appear during the hot weather and the early part of the monsoon. Only once have I found eggs with well-developed embryos. Unfortunately, I did not keep a record at the time. A recently hatched young was caught by Mr. D. B. Barretto at Kurla in the month of February 1939. On the 24th May (1939) I caught an older one at Andheri. It was perhaps three weeks to a month old. The young are very variable in colouring and are able to modify their colour to a certain extent, generally they are strongly banded. These markings disappear with age. Growth during the early period is fairly rapid, but beyond a certain size it slows down.

Food.—The food is varied and consists of rats, birds, frogs, and perhaps any animal that can be overpowered. In captivity, adults live for many years when fed on raw meat, rats, birds and eggs. The food is generally swallowed whole, but when it is too large it is torn to pieces with the aid of the forelimbs. Living prey is soon killed by vigorous dashing against the ground. In the process of swallowing, if portions of the prey protrude, the animal brushes them into its mouth by rubbing the jaws against the ground.

The Common Monitor is purely diurnal. Captive specimens, due probably to confinement, get extremely fat and frequently suffer from a fusion of the vertebrae.

The Monitor is often destructive to poultry, feeding both on the eggs and the birds. The meat is eaten by the local people.

Order: Ecaudata.

Family *Ranidae*: Frogs and Toads.

Rana hexadactyla Lesson. The Six-toed Frog.

In volume xxxvii (p. 742) of the *Journal* I mentioned the occurrence of this species in the Bombay Presidency, but unfortunately omitted to record the measurements. They are as follows: females, from snout to vent 60 mm. and 65 mm.; no males were obtained.

On the 12th March 1939, Mr. H. Ali and I secured a male and female living in one of the dry cisterns at the Kanari Caves, Salsette Island. These two specimens I kept in an aquarium. As the female showed signs of being gravid, I lived in hope of being able to trace the life cycle, but it escaped just before the monsoon broke. It was last seen in the aquarium on 30-5-39. The male called frequently both day and night. The call is not unlike that of *R. cyanophlictis*. In the note referred to above, I mentioned, 'It is curious that these frogs should be gravid at this time of the

year,' (25-2-34) and concluded by saying, 'they may possibly breed all the year round'. The present instance indicates that though the females may be gravid early in the year the eggs are not laid till the beginning of the rains, as do most other frogs.

Together with this species we also found *R. tigrina*, *R. leithii*, and *R. malabarica*, all living together under the same stones.

Rana cyanophlictis Schneid. The Skipper.

During the latter part of May and early June I have often taken specimens full of ova. This indicates that the breeding season commences with the monsoon. Two females measured 62 mm. and 59 mm., respectively. The males are smaller. Amplexus takes place in lakes and not in small puddles as in the case of *R. tigrina*.

Rana tigrina Daud. The Bull-Frog.

Voice.—About the middle of May 1938, I heard a single Bull-Frog calling. As it was some time before the rains actually broke, it seemed rather unusual. Then again, I heard several croaking in the fields, at Andheri, during the month of August (1938), long after the general breeding season was over. Usually croaking in this species ceases after amplexus which occurs during the first week, or couple of weeks, of the rains, depending on weather conditions. The question naturally arises: Are these 'croakers' late comers in the season, or are they males that were unsuccessful in finding mates during the general breeding period? Whichever the reason, the sexual urge must have still lasted, though the frogs had lost their yellow garb—a characteristic of males during the breeding season. Perhaps the croaking is intimately associated with the sexual urge and the condition of the testes, the croaking only ceasing after the testes are voided, or in the case of unsuccessful males till the contents have been absorbed and diminished to non-breeding condition. Here I must leave this interesting point.

Colour.—In my paper, *Notes on Indian Batrachians* (*J.B.N.H.S.* xxxvi, 158), I dealt at some length on the life-history of the Bull-Frog. In that paper I made several references to the remarkable colour displayed by the males at the breeding season, but did not venture to offer any explanation for it, nor do I intend to do so here, but merely record some further observations. On page 160 of the paper I wrote, 'Another curious point arises here. The males which remain above ground during the dry season, according to my observations, retain their normal colouring. Specimens kept in captivity by me exhibited no change . . . ' In the light of further observations one is frequently compelled to alter a previous statement, and this I must do here. During May 1937, I collected several adult specimens at the Powai Lake, for dissection and observation. Around the lakes in Salsette, this frog is found all the year round.

An examination of the specimens caught on the 7th May showed that the males were in the 'normal' attire—brown—but the insides of the forelegs were suffused with yellow, and the same tint extended along the flanks of the thighs. Dissection revealed that the

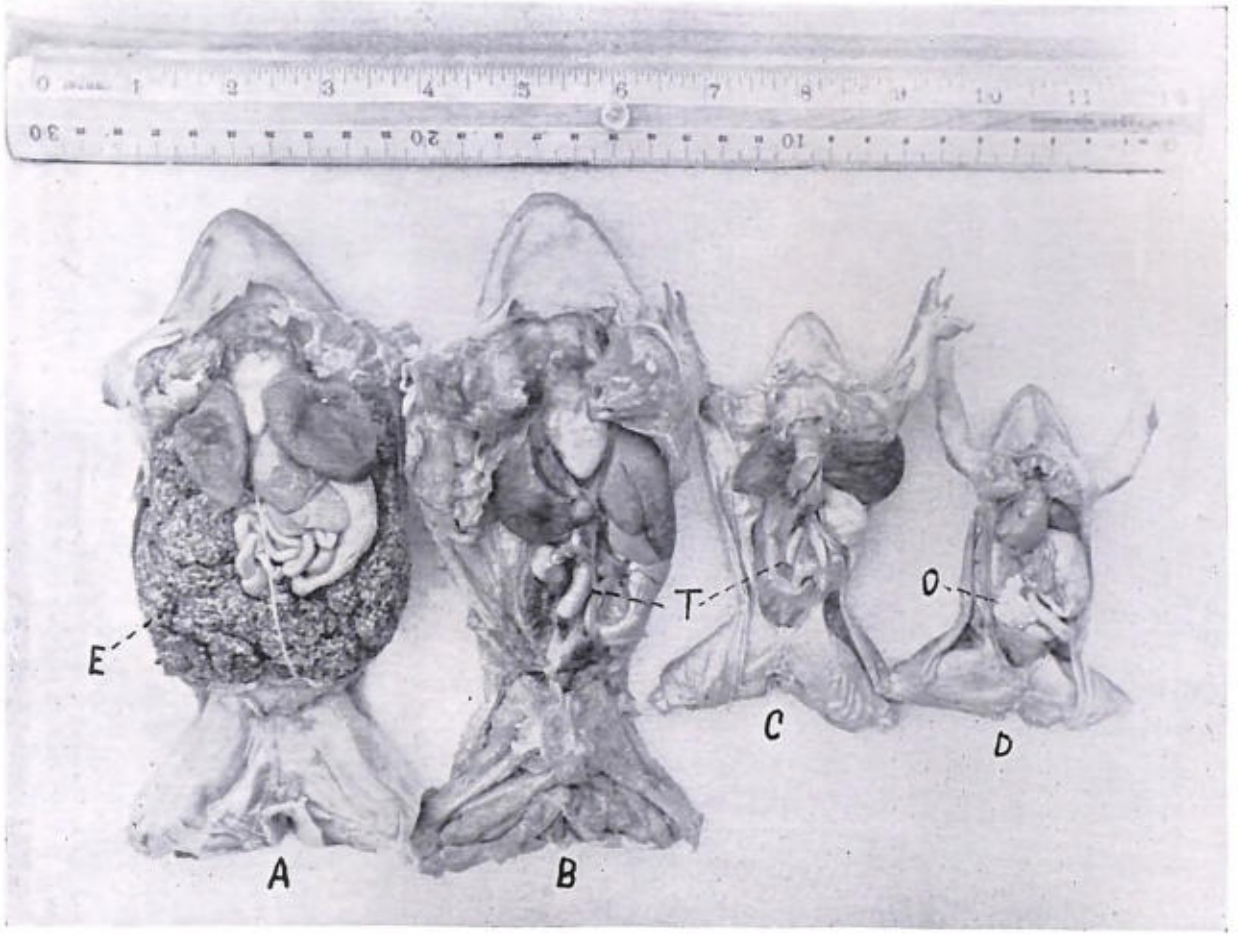

Photo: C. McCann.

Two couples of the Bull Frog (*Rana tigrina* Daud.) taken in amplexu, A and B sexually mature; C and D immature; E. eggs; O. ovaries; T. testes.

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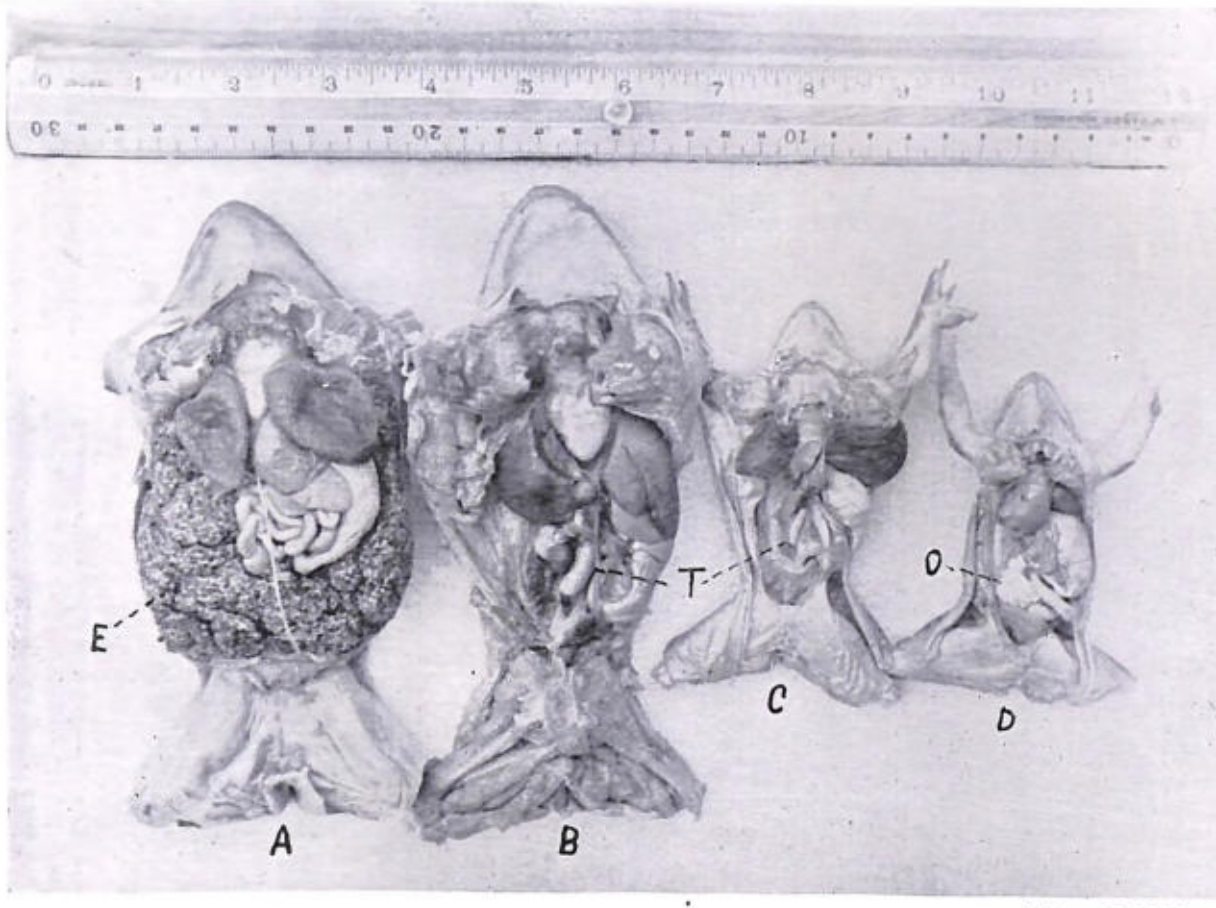

Photo : C. McCann.

Two couples of the Bull Frog (*Rana tigrina* Daud.) taken in amplexu, A and B sexually mature; C and D immature; E. eggs; O. ovaries; T. testes.

testes were distinctly enlarged, almost in breeding condition. Females were laden with almost mature ova. Specimens collected on the 21st May showed no appreciable difference from those collected earlier. But on the 24th May the males showed distinct signs of becoming yellow and by the 26th had become completely so. The yellow colouring appears to be under control, and the animal is able to vary it under certain conditions. A yellow frog, if handled, will change to greenish brown, but when at rest again will return to the yellow phase. Disturbances react on the colouring of the animal.

In a subsequent paper on the Bull-Frog (*Precocity in young Bull-Frogs, J.B.N.H.S.* xxxviii, 409), I pointed out that young males also turn lemon yellow at the breeding season, in spite of the fact that the genitals are immature. It seems clear from these observations that the condition of the genital organs, namely, whether they are in breeding condition or not, does not directly influence the colouring of the males at the breeding season, if at all.

A breeding male in amplexus measured from snout to vent 149 mm.; testes 20 mm. long. A breeding female 122 mm. Non-breeding male in amplexus: snout to vent 88 mm., testes 11.5 mm.; female 76 mm.

Rana rufescens Boulenger. The Rufescent Frog.

A female measuring from snout to vent 31 mm. and containing almost mature ova was taken on the 10th June 1938, at the Gersoppa Falls. Its general colouring was brick-red almost throughout the dorsal surface, and a slight mottling on the hind portion of the thighs. The ventral surface was greyish-white. Other specimens taken at the same time varied from light brown to dark brown with hardly any indication of the brick-red.

Rana leithii Boulenger. Leith's Frog.

On the night of 10th June 1938, a female containing almost mature ova was taken in the compound of the Gersoppa Bungalow (British side). It measured from snout to vent 37 mm. A curious point about it was that at some time she had received a severe abdominal injury which tore open her left flank near the base of the foreleg for about half the distance to the middle of the abdomen. The wound was an old one and had healed up by the formation of a translucent stretch of skin over the once gaping area. Through this 'window' the ova could be seen easily. The piece of flesh which had been torn out at the time of the accident now formed a conical protuberance adhering to her side.

On the 12th March 1939, Mr. H. Ali and I secured several specimens in a cistern at the Kanari Caves, Salsette. Here the frogs were living under stones in the dry cisterns. In this situation the animals were almost black in colour, corresponding with the dark rock of the cistern, but later assumed a sandy colour.

On the 6th April 1939, I caught several specimens which were living under stones and among leaves in the dry bed of the stream

leading to the Lingmala Falls, near Mahableshwar (4,000 ft.). In this locality the animals were slate-black with just a slight indication of marbling, but later became sandy in tone.

These three records constitute a further extension of the range of this species. The type came from Matheran (3,000 ft.). Since then it has been found at Khandala, 1,600 ft., Poona District; Gersoppa Falls, > 1,800 ft., N. Kanara District; Kanari Caves, 1,300 ft., Salsette Island, and Lingmala Falls, 4,000 ft., near Mahableshwar.

Rana malabarica Dum. and Bibr. The Fungoid Frog.

After years, I was able to fix the author of a very peculiar metallic call in the Salsette jungles. It was made by this species, and may be said to be the breeding call. It can only be likened to the noise made by a tin rattle. It is audible a long way off, but as soon as one tries to locate it, though ever so near, it suddenly ceases—the frog has spotted the intruder and stopped.

In a former bungalow at Andheri several of these frogs took up their residence in a corner of the house, both during the rains and the dry weather. They would come out at dark and return with daybreak. They would frequently call on dull days and could be induced to do so repeatedly with a tin rattle, which imitated their call very closely. The cook slept in the same room and frequently complained of being disturbed during the night, either by calls of those that had not left, or because they jumped on him while he was asleep. He had orders not to kill them; so, frequently, there was a search during the night, and the frogs, when discovered, were rudely shot out into the compound. Naturally they returned later—such forcible ejections did not disturb their 'homing instinct'!

Breeding.—The frogs are evidently late breeders as I have taken females with ova in July. A breeding male measured from vent to snout 51 mm.; testes 6 mm. A breeding female 62 mm. The males are smaller than the females.

Rhacophorus maculatus Boulenger. The Chunam Frog.

In volume xxxvi, p. 172 of the *Journal*, I described some phases from the life-history of the Chunam Frog (*Rh. maculatus*). On page 172 I wrote, 'It appears at the break of the rains,'. This sentence must be modified in the light of further observations. The statement is certainly true of animals living under unfavourable conditions, but near perennial water and in houses, where water is at hand, they may be seen all the year round.

In my bungalow, at Andheri, this frog is a common resident throughout the year, except for a brief period during the rains, but even then it sometimes comes in. At the break of the rains they go afield to return when the rains stop and conditions are too dry outside. As many as six or seven reside with us annually. During the day, in the dry weather, they hide in vases, among clothes, behind bottles and the like with the limbs drawn up under the body as close as possible. Two regularly hide between the battens of my cot! The resting places are more or less regularly occupied, but sometimes two or three places are selected and these

are occupied on different days. Once their haunts are discovered one is sure to find them there. As soon as it is dark they emerge and first of all make for places where they are likely to get water. In such places they sit for a considerable time absorbing water under the skin, before starting on the night's adventures. Early morning, just before it gets light, they return to their respective retreats, but belated frogs, like nocturnal revellers, are not uncommon.

Before proceeding further, I would like to make a few remarks on the peculiar habit of absorbing water under the skin. It is well known that frogs do absorb water through the skin, what is more, they are also able to breathe through the skin! but in this species it appears to be developed to a remarkable degree. When the animal first emerges from its retreat it appears thin, but after a time at the water supply it has increased in bulk. The water accumulates partly under the abdomen, and partly under the skin between the hind legs, the spine forming a dividing line between the two 'reservoirs'! As soon as sufficient water has been absorbed, the animal moves off. In this case we see a special provision for water transport for the next twenty-four hours during the dry season! Hence, perhaps it is that this species is able to remain active throughout the year in favourable localities. I have not observed this provision in any of our terrestrial species. During the rains such a provision would of course, be unnecessary.

On arrival at the diurnal retreat, each frog goes through a process of 'self-massage', a somewhat ludicrous performance. The head is first rubbed down from the top over the snout, by the forelegs, and then down the throat and thorax as far as the limbs will reach. This is followed by a 'massage' of the back, flanks and abdomen, by the hindlegs. The hindlimbs then massage one another. When all this 'toilet' is over, the limbs are collected under the body and the frog 'retires'. I have tried to figure out the reason for this performance and can only ascribe it to the possibility that the animal tries to clear its body of foreign matter adhering to its skin, perhaps also, an even coating of slime, when dry, acts as a sort of film, to prevent further evaporation of moisture.

During the resting period, the body looks like a large chrysalis and the animals are very reluctant to move, even when disturbed. It takes quite a lot of provocation to make them jump. The pupils are reduced to a narrow horizontal slit, scarcely wider than a fine silk thread, but when on the move at night, the margins of the pupils coincide with the margins of the eyes—hence the entire eye appears black. Though, generally speaking, the size of a pupil is automatically controlled by the intensity of the prevailing light in most animals, in this frog, I have noticed that light is not entirely the controlling factor, but also the activity of the animal at the time. I have often seen 'late-comers' in bright daylight with the pupils fully dilated. Only on assuming the resting attitude do the pupils begin to diminish in size.

Further, close observations of several animals, both during the night and during the day showed the following results. At

night, when they leave their resting places the pupils gradually enlarge to full size, even in bright lamp light, but when they sit about, in the resting attitude, for hours, as they are wont to do, in the same place, the pupils become mere slits once more. When I have found them in this condition, I gently ran a pin-point over the skin, at once the pupil began to open slightly, with a little harder treatment the pupils expanded still more, but as soon as the animal became active and jumped about the pupils opened to the fullest. Even the light of a powerful electric torch had no effect. During the day, similar experiments evinced the same behaviour, except that the pupils in bright sunshine did not open to their fullest, but about half to three quarters. Hence it appears that the dilation of the pupils is closely associated with the activity of the animal and not entirely with the intensity of light.

A frog that lived behind some books on my writing table got on the wrong side of a pane of glass on its way 'home'. It made frantic efforts for several minutes to get through, as it could see its usual haunt, but the window-pane baffled it completely. It climbed up and down the pane, tried to force its head through, but eventually jumped on a neighbouring chair and thence to its usual retreat.

During the cold weather, though the frogs were about the house every night, they did not appear to be as active as when the weather got warmer. In the winter season they often sit about for hours in the same spot in a 'semi-dose'. Incidentally, the chance of finding insects is then remote. Towards the middle of April the males in the house began to call now and then. The calling became more frequent with the approach of the rains. No frogs called outside. As soon as the rains commenced the frogs in the house disappeared. *Rh. maculatus* is heard occasionally throughout the rains in the neighbouring vegetation. On the 15th September (1938) the first frog was seen again in the house, the rains were diminishing. This arrival was followed by others as the season wore on and once more we had our full complement of tree-frogs.

Food.—The food, like that of most frogs consists chiefly of insects, but certain insects are definitely avoided, such as *Cantharids,* garden bugs, water beetles, fire-flies, and some carabids. In common with its fraternity, it will only 'lap up' moving objects. Once I saw a Chunam Frog 'lap up' a fire-fly, the very next moment it 'spat' it out; a peculiar performance. The frog flapped its tongue out with the insect adhering to it, backed a bit, dragging its tongue along the floor till the insect was free of it. This experiment did not teach it that the fire-fly was distasteful, for a little later as the insect moved off the frog lapped it up again. The same ludicrous performance was repeated as before and the insect released. Eventually it left the fire-fly to go its way.

Microhyla ornata Boulenger. The Black-throated Frog.

This frog is not uncommon at Andheri during the rains. Even during the dry weather it may be found occasionally in the earth of watered flower-beds. On the 11th July (1937), I secured a gravid

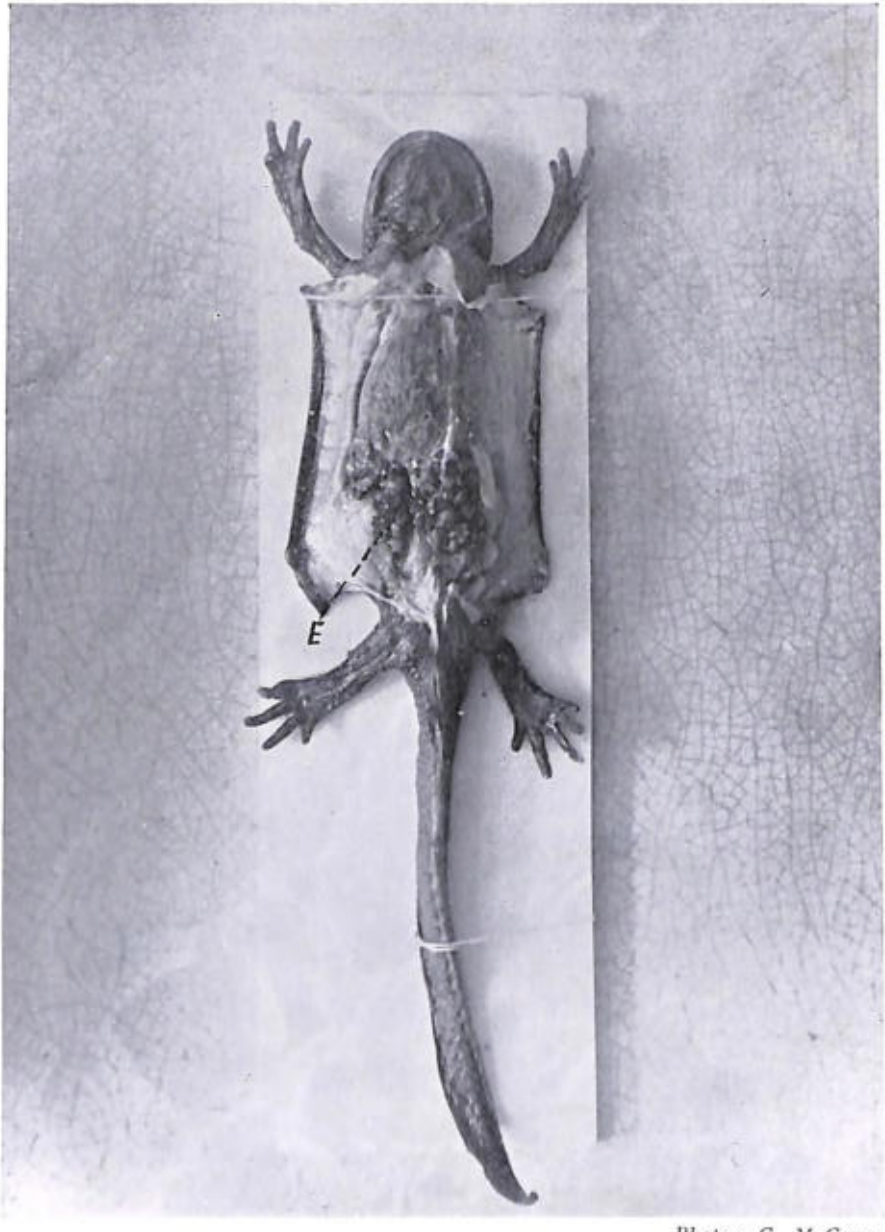

Photo : C. McCann.

The Indian Salamander (*Tylototriton verrucosus* Anders.)
E. eggs.

female measuring 20 mm. from snout to vent. Another female caught on the 5th June 1940 at Andheri showed the ovaries to be active, but the ova were far from mature, were creamy yellow and did not occupy the entire abdominal cavity as in the previous specimen with almost mature, pigmented, ova. This apparently indicates a later breeding season than is the case with other frogs. In my paper in the *Journal* (xxxvi, p. 177) I wrote, 'The number of eggs laid is comparatively few—30-40'. This in the light of the specimen mentioned above must be modified as it contains a lot more—perhaps a couple of hundred at a rough estimate. As the mature specimen I have is the only one, I cannot give the exact number without destroying it.

An examination of the stomach contents of the animal caught on the 5th June (1940) indicated that the animal fed on small *Coleoptera* and small ants.

Philautus bombayensis. The Bombay Philautus.

This species I was surprised to find some years ago during the dry months in fairly large numbers under stones in the bed of the stream leading to the Lingmala Falls, near Mahableshwar, 4,000 ft. It is most elusive during the rains, when it is more often heard than seen. During the Easter holidays of 1939 (April) I visited the same area and again found them to be very plentiful. The colour and markings are very varied.

ORDER: CAUDATA

FAMILY: *Salamandridae*: Salamanders.

Tylototriton verrucosus Anders. The Indian Salamander.

Mr. C. M. Inglis, Curator of the Darjeeling Museum, sent some living specimens of this interesting amphibian to the Society for casting. After casting I dissected one specimen to find that it was a gravid female. The date was 11th November 1937. The specimen measured from snout to vent 88 mm. and from vent to tip of tail 94 mm. I made an attempt to keep the remaining specimens alive under observation, but failed completely, they soon died away. The correct food was the main difficulty, I tried insects, snails and some aquatic insects, but nothing seemed to tempt their appetites, they would just lie about on the floats placed in the tank. Out of water they were extremely clumsy, water is their true element.

ORDER: APODA.

FAMILY: *Caeciliidae*.

Ichthyophis glutinosus Fitz. The yellow-striped Blind Worm.

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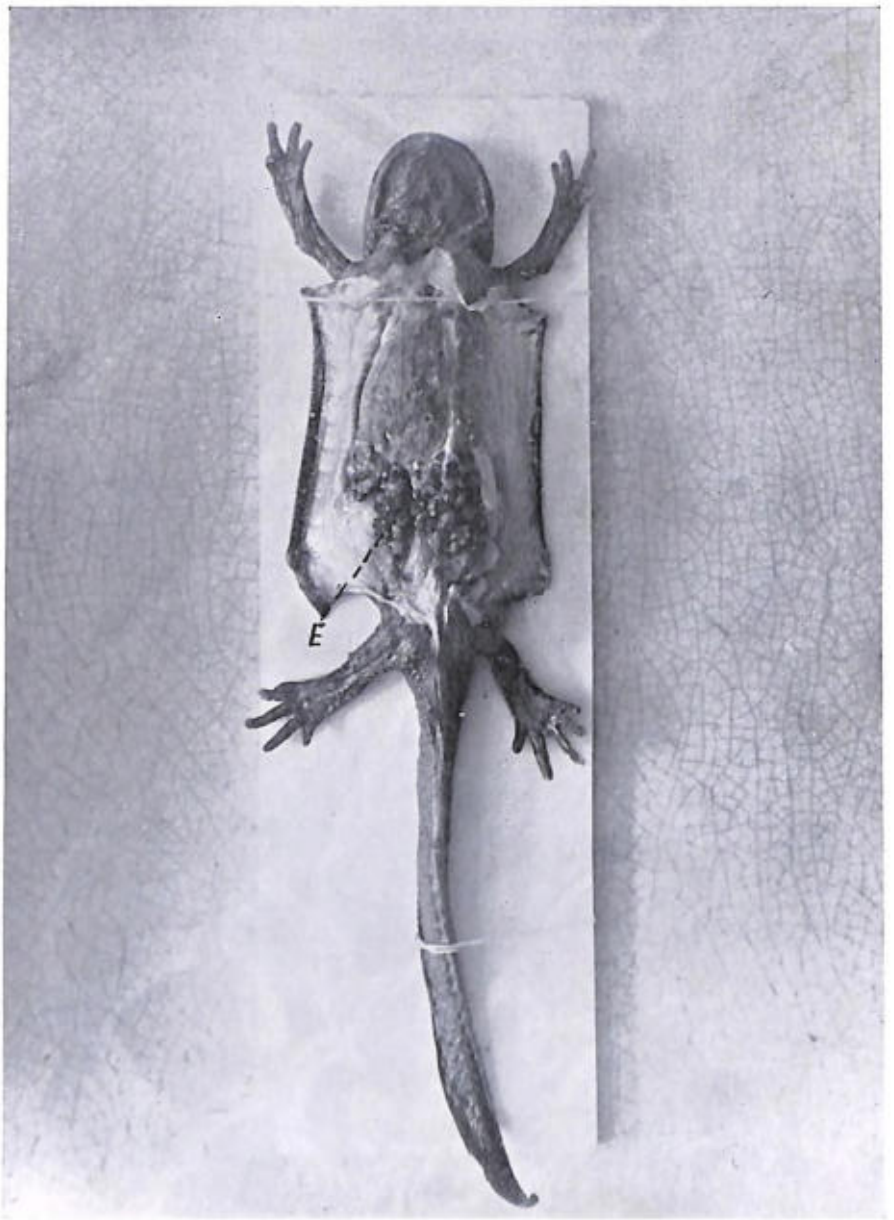

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them, a female measuring 310 mm. It proved to be gravid and besides 22 large eggs measuring 10 mm. across, it contained 2-4 smaller ova adhering to each of the larger ones. The undissected second one measured 330 mm.

Ichthyophis monochrous Boulenger. The Brown Blind Worm.

In volume xxxi, p. 1039 of the *Journal* I recorded the occurrence of this species from Khandala, Western Ghats. On the 6th September 1931 while collecting frogs, I discovered another specimen living under a stone on the banks of the lake behind a range of hills, locally called the 'Sausages'. I have repeatedly hunted for this animal since its first discovery at Khandala, but without much success. The 1931 specimen measured 232 mm. Though the *Fauna* gives the diameter of the body as half an inch my specimens measured considerably less.

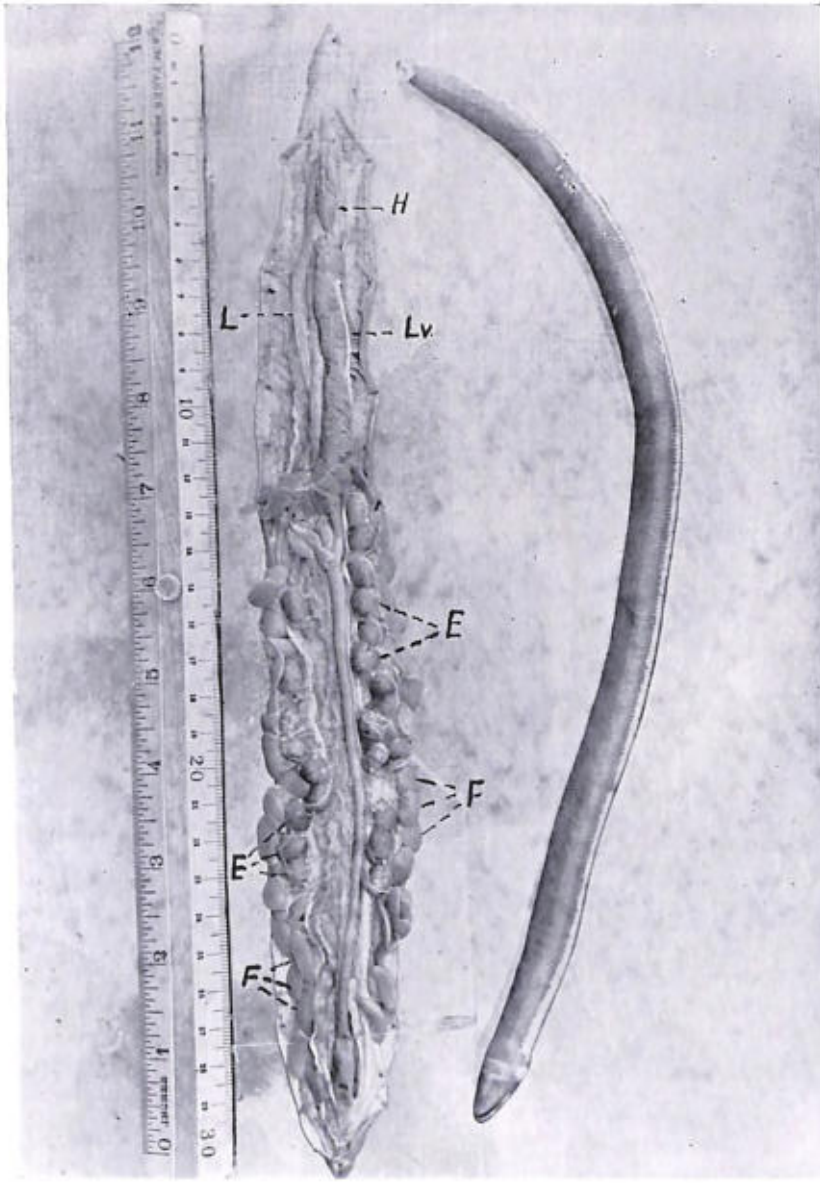

Photo: *C. McCann.*

The Yellow-striped Blind Worm (*Ichthyophis glutinosus* Fitz).
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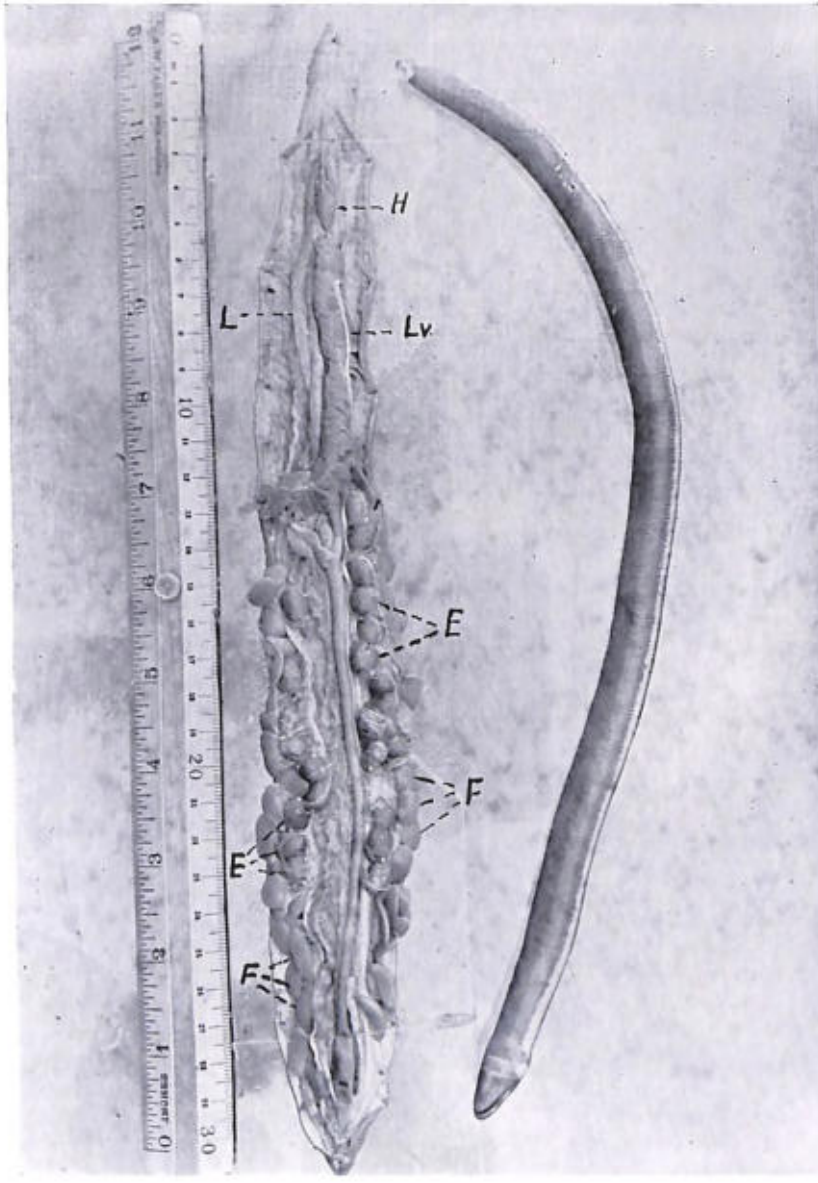

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The Yellow-striped Blind Worm (*Ichthyophis glutinosus* Fitz).
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THE ECOLOGY OF A TEMPLE TANK CONTAINING A PERMANENT BLOOM OF *MICROCYSTIS AERUGINOSA* (KUTZ) HENFR.[1]

BY

S. V. GANAPATI, M.SC., A.I.C.,

Water Analyst, Municipal Corporation of Madras

(*From the Health Department of the Corporation of Madras*).

There are in the city of Madras some five hundred ponds or tanks, of which about a hundred or so are dry from June to September. The remaining contain water at all seasons of the year, but differ from one another in several important respects. They may, however, on the basis of their aquatic vegetation be broadly classified into three groups: (i) those containing abundant macrophytic vegetation without phyto- and zoo-plankton, (ii) those containing abundant phyto- and zoo-plankton without any macrophytic vegetation, and (iii) those containing both macrophytic vegetation and phyto- and zoo-plankton.

All these tanks or ponds are, in one way or another, sources of serious trouble to the health authorities of the Municipal Corporation. Many of them afford breeding places for the larvae of malarial mosquitoes, and also produce a foul odour during the south-west monsoon season (July to September), when numerous complaints are received every year by the Corporation. Whether these tanks are really inimical to the health of man and animals drinking their waters remains a problem for investigation.

In the case of the first group of ponds remedial measures are easily taken by dredging or removing physically all the aquatic weeds and plants. But the problem is not so simple in the case of the second and third groups. The second group are ponds of 'artificial origin and often of very ancient date', which consist absolutely of one or several species of a blue-green alga, *Microcystis* sp. These algal forms are present at all seasons of the year and in such abundance as to exclude almost all others; they may be said to have formed a permanent water bloom. By their death and decay, they not only affect the taste of the water but also produce a characteristic foul smell, which the health authorities of the Corporation are unable to prevent. These minute algal forms float freely in the water, so that it is not possible to remove them easily and completely unless all the water is pumped out. Such a procedure would be uneconomical. So, ways and means have to be found for the eradication of the algal pest.

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[1] Abstracted from a paper read before the Indian Academy of Sciences at the meeting held in Madras in December 1938.—*Eds.*

Studies of the physical, chemical and biological conditions of the many *Microcystis* ponds in the city, under their natural conditions and during the different seasons of a year, will most probably throw light on the causes responsible for the permanent water bloom and for the production of the foul smell during certain seasons of the year.

These studies, besides being of great significance from the health point of view are also of great scientific interest; for the ecology of lakes or ponds with a permanent water bloom is unknown in the temperate regions. Lakes or ponds with permanent water bloom are known only in the tropics, and the ecology of such waters, as far as the author is aware, has not been studied. In this paper, it is therefore proposed to put on record the changes noticed in the physical and chemical conditions of one of these ponds, during a year.

The pond in Krishnappa Naicken Tank St. attached to Kasi Viswanather Temple has been selected for this purpose as numerous complaints have been received about it, from the residents of the locality. It is used by the people of that division for all religious purposes. It is a rectangular pond measuring 285 ft. by 230 ft., and 10 ft. deep. It is situated in the midst of a thickly populated part of the city, and is surrounded on all sides by rows of houses belonging to middle class people. On all four sides, perpendicular walls rise up to about twenty feet above the surface of the water. They are intended as a protection against falling into the tank, but they also prevent the wind from disturbing the surface water. The tank never runs dry, as the existence of a perennial spring somewhere near the centre is reported to be present. There are no trees in the neighbourhood, so that the rays of the sun fall directly upon the tank between 8 a.m. and 4 p.m. every day.

Samples of water were collected, usually between 8 a.m. and 9 a.m., once a fortnight from one and the same place near the northern *ghat* or entrance into the tank. Bottles and the reagents required for the determination of the dissolved gases and hydrogen-ion concentration were taken in a carriage and the analyses for the same were done on the spot. A Winchester quart full of water was taken to the laboratory for the other chemical tests. The investigation was begun on the 22nd February 1934 and continued upto the 30th January 1935.

Physical Conditions.

(*a*) *Colour*:—The water was greenish throughout the year on account of the thick growth of *Microcystis aeruginosa*.

(*b*) *Transparency*: This was measured by means of an aluminium Secchi's disc of 20 cm. diameter. The figures varied from a minimum of 8 cm. in August and September to a maximum of 33 cm. in October.

The records show that (i) the water was least transparent during the south-west monsoon and most transparent during the hot weather period; (ii) the figures increased from February to May; decreased thereafter till the minimum was reached in September; increased again from October to December; and finally began to decrease in January.

(*c*) *Temperature*:—The temperature of the surface water was measured by means of an accurate thermometer graduated from 0.0 to 50°C., each degree being sub-divided into a fifth of a degree. It was found to vary between a minimum of 25°.1 in December and a maximum of 30°.8 in May.

The records show that (i) the temperature of the water was highest during the hot weather and least during the north-east monsoon; (ii) it increased from February to May when the maximum was reached, and later on decreased till September; increased again in October, only to decrease gradually till December when the minimum was reached. Finally from December to January, it increased again.

Thus the temperature of the surface water in the tank follows closely the changes in the temperature of the atmosphere.

Chemical Conditions.

(*d*) *Dissolved oxygen* :—The dissolved oxygen content of the surface water was estimated according to Rideal and Stewart's modification of the Winkler method. It was found to vary between a minimum of 0.0 cc. in September and October and a maximum of 8.49 cc. in July.

The results show that (i) the content of dissolved oxygen was greatest during the hot weather period and least during the latter half of the south-west monsoon season; (ii) it was found to increase generally from February to May, and to decrease thereafter till September or October, and again to increase from October to January.

The surface water was found supersaturated with dissolved oxygen on 8-3-34, 14-7-34, and 23-11-34; it was in maximum (151.5%) on 14-7-34 and in minimum (103.4%) on 23-11-34. There was practically no oxygen present in the water in September, October and December; and during the remaining months, it was found to fluctuate between 23.9% and 84.3%.

The oxygen content in any piece of water is dependent upon such factors as (i) solubility of oxygen, depending upon the temperature at the time of sample collection; (ii) intensity of illumination; (iii) photosynthetic process; (iv) respiratory process; (v) wind action; and (vi) abundance of vegetation. The amount of oxygen at any time of the year therefore will be the resultant of the several factors mentioned above.

(i) Taking the first factor into consideration, it will be seen from a few of our findings that the content of dissolved oxygen in the tank does not depend upon the physical factor of solubility. For according to the law of solubility of gases, periods of high temperature should be periods of low oxygen content and *vice versa*; but that it is not so in this case, is evident from the following: (*a*) from February to 8th March there was no change in temperature (29°.4c), but the oxygen content increased from 3.72 cc./1 to 6.6 cc./1; (*b*) from April to May, when the temperature increased from 29°.5 to 30°.6, the dissolved oxygen also increased from 1.34 cc./1 to 4.12 cc./1; (*c*) from May to June, the temperature decreased from 30°.8 to 29°.8, and the dissolved oxygen also decreased from 4.12 cc./1 to 2.87 cc./1; from June to July, the temperature decreased from 29°.8 to 29°.6, while the dissolved oxygen increased from 2.87 cc./1 to 8.49 cc./1; from July to August there was a fall in temperature from 29°.2 to 28°.2, and the oxygen content also decreased from 8.49 cc./1 to 1.75 cc./1; and finally from August to September there was an increase from 28°.1 to 29°.1, while the oxygen decreased from 1.7 to zero. So, it will be apparent from the above that the controlling factor was not the temperature of the water.

(ii) The oxygen content of the tank, though the water be taken nearly at the same time of the day, varies greatly; and this variation appears to depend largely upon the intensity of illumination as measured by the hours of bright sunshine. Generally, the oxygen content was comparatively high in February, March, April, May, June, July, November, and January when the sky was clear and cloudless. The oxygen content decreased considerably from August to October, when the sky was cloudy with frequent rainfall. During the period when the sky was bright and clear, the algal vegetation of the pond carried on active photosynthesis and thus increased the oxygen content of the water. Thus the tank water was supersaturated on three occasions: 8-3-34, 14-7-34, and 23-11-34. The maximum amount of supersaturation of 151.5% was recorded on 14-7-34, and this can be explained only as being due to the photosynthetic activities of the dominant alga, *Microcystis aeruginosa* which was found in abundance. On those dates when there was no bright sunshine, and at night, the algal and animal forms consume the oxygen present in the water. During August to October, there was practically no

oxygen in the water, and its absence might be due to the absence of bright sunshine and to the presence of plenty of dead algal slime floating near the place of sample collection. In November, the cloudy weather cleared up temporarily and the alga was able to resume its photosynthetic activities with the result that the amount of oxygen increased considerably. Again in December there was a great fall in the content of oxygen due to lack of bright sunshine when the respiratory activities were greater than the photosynthetic activities. So, the amount of oxygen in a pond of this type depends largely upon the intensity of illumination, and the consequent photosynthetic processes, and also upon respiratory activities of the animal and vegetable life, and organic matter.

(iii) Another important source of oxygen is the atmosphere, and it is of particular importance in large and shallow lakes which are exposed to the action of the winds. Waves are formed and thereby different layers of water are exposed to the air, so that the water is oxygenated by mechanical admixture of air and water particles. Such a condition does not exist in the case of this tank, for its sides are steep and it is protected on all sides by high walls and rows of houses. So there is no possibility for the formation of big waves which alone can expose different layers of water for oxygenation to the atmosphere.

(iv) During photosynthesis, carbonic acid is split up by the aquatic vegetation in a piece of water whereby assimilation of carbon takes place and also liberation of oxygen to the surrounding water. The greater the abundance of vegetation, the greater the assimilation and consequently the greater the liberation of oxygen. So, in our tank which contains abundant algal vegetation, the quantity of oxygen also must be great. The tank water being supersaturated to the extent of 151% can be due only to the presence of abundant algal growth.

(e) *Free carbon dioxide*:—This was not detected at any time during the period of investigation. Its absence can be explained in two ways: either free CO_2 was utilised during photosynthesis by the profuse algal growth as soon as it was formed or the carbonates were found in great quantities so that the free carbon dioxide formed during respiration and oxidation of organic matter was not sufficient to convert all of them into bicarbonates. The exact cause for its absence can be ascertained only after a further detailed study of its diurnal variations during the different seasons of the year.

(f) *Hydrogen-ion concentration* (pH):—The hydrogen-ion concentration of the surface water expressed in terms of pH was found to vary from a minimum of 8.8 in January to a maximum of 9.7 in May. It was determined with a Hellige comparator, using thymol blue as an indicator.

The records show that (i) the pH values were highest during the hot weather period and south-west monsoon, and lowest during the north-east monsoon; (ii) they were nearly constant or increased by a narrow margin of 0.1 or 0.2 units from February to September, and decreased gradually to the minimum thereafter in January.

The hydrogen-ion concentration expressed in terms of pH depends upon the amount of carbonates of calcium and magnesium and the carbon dioxide tension in the water. The latter in its turn is influenced by the photosynthetic activities of the aquatic vegetation and the animal life present. In the case of this tank, animal life is poor (fish is totally absent) but the algal vegetation is extraordinarily great, so that the chief factor responsible in controlling the pH is the alga. The pH values during the year under investigation may be divided into five periods:—from February to May, when the pH rose up from 9.3 to 9.7; from May to June, when it decreased slightly from 9.7 to 9.5; from June to September, when there was no change (9.6); from September to October, when it decreased from 9.6 to 9.1; and from October to January 1935, when it decreased further from 9.1 to 8.8. The tank water was therefore extremely alkaline throughout the period of investigation.

(i) It is well known that during photosynthesis the carbonates of calcium and magnesium are precipitated from their respective bicarbonates due to rapid carbon assimilation from the dissolved bicarbonates, and the water becomes more alkaline. So, if in a piece of water the pH values exceed 8.1, then it may be inferred that the photosynthetic activities are greater than the respiratory processes, for a 'saturated calcium bicarbonate solution in

equilibrium with air containing about 3 parts per 100,000 of carbon dioxide is close to pH 8.1' (Atkins and Harris 1924). In the case of our tank, the water became more and more alkaline (pH 9.3 to 9.7) from February to May when the temperature and hours of bright sunshine were higher. A value of pH = 9.0 is usually recorded for a saturated solution of pure calcite (Atkins and Harris). And pH values higher than 9.0 have to be attributed to the presence of magnesium salts, for the pH value of a saturated solution of magnesium carbonate is close to pH = 10' (Atkins and Harris). Therefore the period during which the pH values reached 9.7, may be construed as being due to intense photosynthesis and to the resulting precipitation of magnesium salts.

The high pH values of the tank water (8.8 to 9.7) which are far above 8.1 would seem to show therefore that the photosynthetic activities are generally great; and that the period from February to September is one of intense photosynthesis, while that from October to January is one of mild photosynthesis.

(ii) It was suggested from the high pH values that the photosynthetic activities must be very high at all times in the tank, so that one would expect the water to be always saturated or supersaturated. Atkins and Harris have taken 8.1, or any value above, to be a sure indication of supersaturation. The water of our Madras tank ought then to have been supersaturated with oxygen. Nevertheless this was not the case. Except on three occasions, the water was generally undersaturated or did not contain any dissolved oxygen. The presence of considerable quantities of organic matter may perhaps be responsible for this strange behaviour.

(*g*) *Total and fixed solids*:—The figures for the total solids varied from a minimum of 126.0 parts per 100,000 in December to a maximum of 180.4 parts in September; and the fixed solids varied from a minimum of 104.6 parts in February to a maximum of 139.2 parts in August.

The records show that (i) the figures for total solids were highest during the south-west monsoon and least during the north-east monsoon; and (ii) they increased gradually from February to September when the maximum was recorded, and decreased thereafter till the minimum was reached in December.

The fixed solids increased from February to August, when the maximum was reached and decreased thereafter till December, and increased again in January. Therefore, the fixed solids were highest during the south-west monsoon season and lowest during the cold weather period instead of during the north-east monsoon.

Atkins and Harris have found the electrical conductivity (a measure of the dissolved solids) to vary inversely with the pH changes noticed in the ponds studied by them. The explanation for this relationship has to be sought in the gradual decrease in the quantity of bicarbonates dissolved in a water resulting from the carbon assimilation and the consequent precipitation of the less soluble carbonates of calcium and magnesium. In the case of our pond, measurements of the electrical conductivity of the water were not made, but only of the total and fixed solids present in the original water. These were found to increase with the increase in pH. The total solids represent not only the suspended matter but also the dissolved matter. It is therefore quite likely that the presence of the abundant suspended matter has masked the true relationship. A measure of the total dissolved solids alone would probably have portrayed a true picture, but unfortunately that was not done.

(*h*) *Hydrocarbonates and Bicarbonates*:—The hydrocarbonates were found to vary from a minimum of 3.8 mg. per 100 cc. in December to a maximum of 21.2 mg. The bicarbonates were found to vary from a minimum of 6.1 mg. in May to a maximum of 31.4 mg. in January.

The records show that (i) the hydrocarbonate ions were found to be highest during the hot weather and south-west monsoon, and least during the north-east monsoon and cold weather periods; and (ii) they increased gradually from February to July when the maximum was reached, and decreased thereafter to the minimum in December, and increased again finally from December, to January.

The curve for bicarbonates runs almost opposite to the hydrocarbonates curve. The findings are that (i) the bicarbonates were least during the hot weather and south-west monsoon, and highest during the north-east monsoon and cold weather periods; and (ii) they decreased gradually from February to May when the minimum was reached; increased from May to July; decreased

again from July to September and increased thereafter till the maximum was reached in January.

Generally, in the absence of 'free carbon dioxide' the bicarbonates are decomposed by algal vegetation which abstract the carbonic acid from them, precipitating the less soluble carbonates of calcium and magnesium. In this tank water, the bicarbonates appear to constitute the chief source of carbonic acid for the alga *Microcystis aeruginosa*. A study of the figures recorded shows that the whole period of investigation can be roughly divided as below: from February to May when the general trend of the bicarbonates was to decrease gradually (except on 27-4-34 when there was a spurt) and the carbonates to increase; from May to June there was a big increase in bicarbonates and a decrease in carbonates; from June to 8th August there was a decrease in bicarbonates and an increase in carbonates; from 8th August to 25th October there was a gradual increase in bicarbonates and a decrease in carbonates; from October to November there was a slight decrease in carbonates and bicarbonates; from November to December there was a slight increase in bicarbonates and a decrease in carbonates and finally from December to January there was an increase in both carbonates and bicarbonates. Normally the decrease or increase of bicarbonates may be respectively ascribed to the photosynthetic or respiratory process of the alga in the pond. There were however, a few occasions when both the carbonates and bicarbonates decreased or increased and the reasons for this behaviour are not known.

(i) During the periods February to May, June to 8th August, and October to November the atmospheric conditions were conducive to intense photosynthesis, so that the carbon dioxide from bicarbonates was utilised for assimilatory purposes by the alga, resulting in the increased precipitation of the less soluble carbonates. Under these circumstances one would have expected a progressively increasing amount of dissolved oxygen in the water tending towards super-saturation. But that was not always the case. Excepting 8th March, 14th July, and 23rd November, on all other dates the water was very much undersaturated. This indicated therefore that there was some other factor operating against an increase in the oxygen content of the water. This will be discussed later under 'organic matter'.

During the other periods (from 8th August to 25th October and from November to December) when the bicarbonates increased and carbonates decreased, there was very little or no oxygen in the water. This condition was most probably due to the prevailing weather conditions, which prevented the photosynthetic activities of the alga, but increased its respiratory activities, so that free carbonic acid was added to the water instead of oxygen. It may have been due also to its absorption by dissolved organic matter resulting in the liberation of carbon dioxide and also available nitrogen (Pearsall 1923).

In spite of the interfering factor an intimate relation between the hydrogen-ion concentration and the several factors mentioned above has been noticed on some occasions in this tank. On 8th March and 14th July there was an increase in oxygen content, a fall in bicarbonates, and an increase in carbonates and pH, over the corresponding figures of 22nd February and 21st June, respectively. Again, on 25th October, there was a decrease in oxygen content, an increase in the amount of bicarbonates, a decrease in carbonates and in pH, over the corresponding figures for 22nd August.

(*i*) *Phosphates*:—Phosphates were present in small quantities and were found to vary from a minimum of 0.012 mg. in May to a maximum of 0.040 mg. in August. They were in minimum during the hot weather period and in maximum during the south-west and the north-east monsoon; and (ii) they were found to decrease gradually from January to June and to increase thereafter till they were present in maximum on 22nd August. From August to January they were found to be nearly constant generally.

Phosphates are among the important nutrient substances found in lakes or ponds. They are utilised by algae during the process of photosynthesis, so that they are usually reported to be absent or present in very small quantities during summer months and to be present in large amounts during winter months. In the pond under investigation, however, they were found in fairly large quantities throughout the year. Even during the period of intense photosynthesis they were not entirely absorbed by the profuse growth of *Microcystis aeruginosa*. The sources of phosphates may be either due to constant and daily contamination of the tank water by human agencies, or

to the diurnal chemical stratification by day and circulation at night, so that phosphates are brought to the upper region of photosynthesis from below, where they are regenerated from the dead algal cells by bacterial action.

(*j*) *Silicates*:—The quantity of silicates varied from a minimum of 2.0 mg. in November, December and January to a maximum of 3.604 mg. in May.

The quantity of silicates was high during the hot weather and south-west monsoon, and low during the north-east monsoon; and (ii) it fluctuated between very narrow limits (3.0-3.6 mg.) between February and September, decreased thereafter, and reached a minimum in November, December and January.

Though found in fairly large quantities in the tank water, the silicates do not seem to have any biological significance in view of the absence of diatoms.

(*k*) *Chlorides*:—These were found to vary from a minimum of 40.2 parts in November to a maximum of 63.0 parts in July. They were very high during the south-west and low during the north-east monsoon; and (ii) they increased gradually from February to July when the maximum for the year was reached, and decreased later till November when the minimum was reached. From November onwards they increased again.

The content of chlorides was very high in the tank and, therefore, showed that it was highly polluted.

(*l*) *Hardness*:—The total hardness varied from a minimum of 4.0 parts in April and May to a maximum of 8.0 parts in February, June, August, September, October, December, and January. It was least during the hot weather period and highest during the rest of the year; it decreased from February to May, increased thereafter generally and varied between narrow limits from June to January.

Although no relationship was evident between pH and total solids, a distinct relationship could be traced between the pH and the total hardness of the water. The pH increased from February to May from 9.2 to 9.7, while the total hardness showed a general decline from 8 to 4 parts per 100,000. The decrease in hardness has to be attributed to the precipitation of the less soluble carbonates of calcium and magnesium owing to the equilibrium being upset by the algal assimilation of carbon from the bicarbonates dissolved in the tank water.

(*m*) *Organic substances and their decomposition products*:

(i) *Ignitible matter*: This was found to vary from a minimum of 15.6 parts per 100,000 in December to a maximum of 48.0 parts in August. The records show that (i) the content of ignitible matter was lowest during the hot weather period and highest during the south-west monsoon; and (ii) it was found to decrease from February to 27th April, and thereafter to increase till the maximum was reached on 22nd August, when it gradually decreased till December, reached a minimum, and again increased from December to January.

(ii) *Oxidisable organic matter* (*Tidy's 4 hours' Test*):—This was found to vary from a minimum of 1.431 parts in February to a maximum of 2.327 parts in July. The content was least during the cold weather and hot weather periods and highest during the south-west monsoon; it was found to decrease gradually from February to 27th April and to increase later on till July when the maximum was reached; from July onwards it decreased till a second minimum was reached in November, when it again increased till January.

(iii) *Ammoniacal Nitrogen*: This was found to vary from a minimum of 0.003 in March to a maximum of 0.216 part in October. The content was lowest during the hot weather period and highest during the south-west monsoon; it was found to decrease from February to May (when the minimum was reached) and to increase thereafter till October when the maximum was recorded; it decreased again from October to January.

(iv) *Albuminoid Nitrogen*: This was found to vary from a minimum of 0.120 in August to a maximum of 0.280 in September. It was lowest during the hot weather and the first half of the south-west monsoon and highest during the latter half of the south-west monsoon and the north-east monsoon; it was found to increase gradually from March to June when the first maximum was reached; it thereafter decreased till 8th August, and increased till December when the second maximum was reached; from December decreased again.

(v) *Nitrites and nitrates*: Except for one occasion in October when they were present in traces, they never were detected.

(*a*) The relationship that exists in a piece of water between the oxidisable organic matter and dissolved oxygen has been admirably portrayed by Knauthe (1898), Kolkwitz (1914), and Pearsall (1923). Similar observations have been made in this tank. Briefly stated, they are: (1) during bright sunny days, oxygen is liberated in such abundance that the water becomes supersaturated; (2) during nights and on dark cloudy days (which are few and far between) the tank water is depleted of its oxygen content; (3) depletion of oxygen is also caused by the oxidation of organic matter dissolved in the water; (4) the second and third processes result in the liberation of carbon dioxide, thereby increasing the content of bicarbonates, and in the formation of free ammonia and other nitrogenous substances: and (5) thus extreme variations in the dissolved oxygen content result.

(*b*) Normally, waters containing a large number of *Myxophyceae* are distinguished by a high content of organic matter and nitrogenous substances (Pearsall 1923). Although the tank is populated almost entirely by a form of *Microcystis* and contains also high organic content, nitrogenous substances like nitrites and nitrates are absent. Their absence may be explained in two ways. They are probably utilised during photosynthesis as soon as they are formed daily, leaving practically nothing behind, or they are acted upon by the denitrifying bacteria which are very active at higher temperatures (Pia 1934). But Atkins (1932-33) believes that this second reason is not so satisfactory as the first, in view of the fact that denitrifying bacteria do not act in the presence of an abundant supply of oxygen in the surface waters of the tropical seas. According to him their absence in tropical seas is due to their rapid utilisation by algae in the well-lighted upper layers of water during long and intense photosynthesis. In any case, their absence from this tank water is not the only one on record. Hutchinson *et al.* (1932) have reported mere traces or total absence in all the ponds and lakes of South Africa, and Beadle (1932-34) has found the same to be the case with the Rift Valley lakes of East Africa. Kolkwitz (1914) has recorded their absence in Lietensee under conditions almost identical with those found in our tank water. Harold (1934) has stated that a marked reduction in nitrites and nitrates is usually observed in cases of abnormal algal development. In their absence, therefore, free ammonia seems to have been utilised by the alga in the pond, as will be evident from its low figure from February to May. On other dates, the free ammonia is considerably higher, especially when the content of dissolved oxygen is low, indicating the oxidation of the organic matter present in the water.

(*c*) As for albuminoid nitrogen—this was found in large quantities, and proved indirectly the presence of abnormal quantities of algal development in the tank water (Harold 1934). According to Drew (1914) the presence of a large quantity indicates the corresponding presence of a large amount of organic matter in solution; and a gradual rise from February to September indicated that a greater amount of decomposition was going on in the water; and the time when it was in maximum was when the bacteria were decomposing the organic matter into soluble substances.

Seasonal Variations.

Summarising briefly the changes which occurred in the physical and chemical conditions of the pond during the four seasons of 1934, the following observations may be made.

(*a*) *The cold weather period* (*January* 1935, *and February* 1934).

This period was characterised by a large number of hours of bright sunshine, small percentage of cloudy days, low wind velocity, low temperature, and very little rainfall.

The tank water was greenish with plenty of leaves, flowers, and other vegetable debris, floating upon the surface. A thick green scum was seen moving slowly on the surface near the middle of the pond. The transparency of the water was rather moderately low, so that the rays of the sun could penetrate to a depth of 21-27.5 cm. below the surface. The total and fixed solids were moderately low, and the nutrient substances like phosphates, silicates, ignitible and oxidisable organic matter, ammoniacal nitrogen, albuminoid nitrogen were also moderately low. Nitrites and nitrates were absent. The temperature

of the water was low and its dissolved oxygen content was fairly great, carbonates low, bicarbonates high, pH low, the total hardness and chlorides moderately low.

The heleoplankton was composed almost exclusively of *Microcystis aeruginosa*, in abundance throughout the period.

(*b*) *The hot weather period* (*March to May*).

A conspicuous feature of this period was its high temperature with practically no rainfall, maximum hours of bright sunshine, low percentage of cloudy days, and moderate wind velocity.

The tank water was generally coloured greenish, with a large area of thick green scum floating near the corner adjoining the place of sample collection. The depth of visibility as measured by means of a Secchi's disc was slightly more than during the previous period. The total and fixed solids, silicates, and chlorides, were higher while the phosphates, ammoniacal nitrogen, albuminoid nitrogen, oxidisable and ignitible organic matter were lower than during the previous period. Nitrites and nitrates continued to be absent. The dissolved oxygen content was uniformly high, the water occasionally being even supersaturated in spite of the higher temperature of the water.

The heleoplankton was quantitatively well developed with abundant water-bloom of an almost pure growth of *Microcystis aeruginosa*.

(*c*) *The south-west monsoon season* (*June to September*).

The outstanding features of this period were very small hours of bright sunshine, high percentage of cloudy days, moderately high temperature, lowest velocity of wind, and a moderate amount of rainfall.

The colour of the water continued to be greenish due to the large quantities of dead and living *Microcystis aeruginosa* present in suspension. The water surface was covered in several places with a thick coagulated green mass of *M. aeruginosa* which was being driven slowly by a slight breeze. The depth of visibility was minimum.

As for the chemical characteristics of the water, it was found to contain the maximum amount of total and fixed solids, phosphates, silicates, chlorides, oxidisable and ignitible organic matter. Ammoniacal nitrogen was high while albuminoid nitrogen was low. Nitrites and nitrates were absent.

The oxygen content was high during the first half of the period, when the carbonates were high, bicarbonates low, and pH high. The oxygen content was least (practically nil) during the second half of the above period, with low carbonates, high bicarbonates, and high pH.

The heleoplankton consisted almost wholly of *Microcystis aeruginosa* in abundance, but in a poor condition.

(*d*) *The north-east monsoon season* (*October to December*).

This period was notably wet with maximum amount of rainfall, smaller hours of bright sunshine, greater percentage of cloudy days, lower temperature, and higher velocity of wind.

The tank water continued to be greenish; it was covered with a floating green scum in all the corners and gradually spreading to the middle with the blowing of a gentle wind. The algal scum was not so dense as in the previous season.

The chemical conditions of the tank water had profoundly changed during this period. The total and fixed solids, chlorides, phosphates, silicates, oxidisable and ignitible matter were lower than during the previous season. Nitrites and nitrates were either present in traces or were absent. The content of dissolved oxygen varied, being greater or less, carbonates lower, bicarbonates higher, pH lower, and the total hardness higher.

The character of the heleoplankton was unchanged, containing an abundant growth of *Microcystis aeruginosa*.

Factors influencing the development of a permanent bloom of *Microcystis aeruginosa* in Krishnapta Naicken Tank water.

The phenomenon known as 'water bloom' is usually brought about in lakes and ponds by the rapid multiplication of some member of the *Myxophyceae*, *Chlorophyceae*, *Heterokontae*, or *Bacillariophyceae* on calm bright days, when the organism can concentrate in the upper layers of the water. Generally,

this phenomenon occurs in temperate regions for a few days only in August, and is caused by a member of the *Myxophyceae*, notably *Microcystis aeruginosa*. In the tropics, on the other hand, the *Myxophyceae* are known not only to dominate the algal flora of lakes and ponds, but also to dominate the entire plankton of a considerable number of ponds [Fritsch 1907, Geitler and Ruttner 1936]. In the pond under investigation, *Microcystis aeruginosa* is found in abundance at all seasons of the year almost to the exclusion of other forms of the same group.

For a mass production of an alga to take place in any piece of water at all seasons, optimum conditions for its development must obtain. These are light, heat, and nutrient substances; and they are found in plenty in the water of Krishnappa Naicken Tank.

The chief physical factors contributing to the prolific growth of the alga in a tank are temperature, intensity of illumination, absence of movement of water by wind action, colour, and transparency, and no inlet or outlet. (Fritsch 1907). In the tank under investigation the temperature of the surface water undergoes seasonal and diurnal variations from 25° to 32°C.; usually it is very low early in the morning, but as the day advances, the full heat of the sun is received from 8 a.m. to 4 p.m. during which time the intensity of illumination varies ordinarily from a minimum of 5 to a maximum of 10 hours every day; the maximum temperature of the water is attained in the afternoon.

The diurnal increase in temperature is confined only to the upper surface layers of the water on account of the colour and transparency of the water. The colour of the water is greenish almost throughout the year, and the algal masses floating upon the surface of the water are so dense that a Secchi's disc becomes invisible within about 30 cm. from the surface. This means therefore that the depth to which the sun's rays can penetrate is very small, so that the zone of photosynthesis is extremely small compared with the zone of reduction extending towards the bottom.

If the sun's rays cannot penetrate into the lower layers of the water on account of its low transparency, then the temperatures of the lower layers also will be considerably less than those of the upper layers, and thermal stratification must result. The formation of a thermal stratification is also helped by the highly steep and perpendicular walls rising on all sides of the tank. The walls prevent strong winds from blowing over the surface of the water and forming big waves. In lakes and ponds which are exposed to the action of wind, big waves are formed which prevent the formation of a permanent thermal stratification (Worthington and Beadle 1932, Ruttner 1931). In this pond where there is no such possibility a permanent thermal stratification is possible. The tank water remains undisturbed excepting for occasional bathers disporting in a limited area near any of the three entrances to the tank. The conditions are therefore ideal for an intense photosynthesis whereby rapid reproduction of the alga takes place in the upper well-illuminated layers of the water at all times of the year.

That the thermal stratification is only temporary and of daily formation may be gathered from the facts observed by the author and the reports of persons who take their bath in the tank. People who bathe early in the morning or late at night feel the temperature of water to be homogeneous, while in the afternoon bathers distinctly appreciate the difference between a warm upper and a cold lower layer. These observations go to show that the thermal stratification formed in the tank is only temporary; a view further supported by the studies in the diurnal variations in temperature and dissolved gases of a similar, but smaller, pond in the Madras Horticultural Garden (Unpublished thesis of Miss Mercia Janet), and by the absence of fish life in the tank. Further, the duration of day and night being nearly equal 'the diurnal period of radiation is substantially equal to that of insolation', so that considerable heat cannot be stored up in the upper layers (Juday 1915-1916).

The temporary thermal stratification appears to be accompanied by temporary chemical stratification in oxygen, bicarbonates, carbonates, hydrogen-ion concentration, phosphates, silicates, ammoniacal nitrogen, albuminoid nitrogen, and oxidisable organic matter. This is also an inference, which has to be verified by further work. This inference is drawn from the low figures for transparency. As has been already stated, the limit of photosynthesis is confined to the top

few centimetres of water. Consequently in the deeper bottom portion of the tank, bacterial action must be at work in decomposing the dead algal matter which has settled there. As a result of reduction processes, there will be a lowering of the oxygen content, and an increase in bicarbonates, phosphates, ammoniacal and albuminoid nitrogen, and oxidisable organic matter. All these nutrient substances are formed in the lower layers and used up in the upper layers into which sun's rays easily penetrate; they are brought to the surface at night when the different layers of water attain the same temperature. The processes of consumption and regeneration of nutrient substances are daily taking place so that there is no dearth of foodstuffs for the alga at any time. It is therefore able to multiply in enormous numbers.

Among the chemical factors which are essential for plant growth may be mentioned phosphates, nitrogenous substances, and salts of calcium and magnesium. Phosphates are always present in the water in considerable quantities, so that they do not seem to constitute a limiting factor, but permit of continued growth. Their occurrence in fairly large amounts is an additional proof for the existence of a temporary thermal and chemical stratification. If that were not the case, the phosphates would have been consumed in no time during the intense photosynthetic processes going on daily undisturbed in the tank water, and this would have resulted in shortage or complete exhaustion at a certain period of the year. But the fact that they are available in fairly large quantities and at all seasons of the year can be explained only by our inference of daily formation of thermal stratification by day and of its destruction by night. Phosphates result most probably from the decomposition of the abundant algal cells which sink continuously to the bottom, where they are decomposed by bacterial agencies. A study of the diurnal variations in the vertical direction of the tank water will be most interesting and may afford an insight into the exact mechanism of their formation at all seasons of the year in the tank water.

As for nitrogenous substances, the absence of nitrites and nitrates may appear to be an extraordinary feature in a water of this type, which contains abundant algal vegetation and is subjected also to heavy contamination. But excepting one occasion when they were found in traces, their presence was never detected. In their absence the alga seems to utilise the ammoniacal nitrogen present in the water, and this fact is easily seen from the very low figures during the hot weather period compared with those for the rest of the year.

Besides phosphates and nitrogenous substances, the tank water contains also at all seasons of the year fairly large quantities of the salts of calcium and magnesium, and organic matter. Therefore the chief factors such as high temperature, long hours of bright sunshine, large quantities of phosphates, free ammonia, oxidisable organic matter, and salts of calcium and magnesium are always available and they are known to be quite favourable for the luxuriant growth of *Myxophyceae* (Pearsall 1923, Thienemann 1925, Fritsch 1907).

Another important factor 'aiding' the development of this alga to the exclusion of other generic forms is 'the presence of a second colouring matter (phycocyanin) side by side with the chlorophyll'. The presence of this additional pigment acts as a screen and also 'plays some other important part in adapting the blue-green group to varying types of illumination' (Fritsch 1907).

Summing up, the conditions of life favouring the development of a permanent bloom of *Microcystis aeruginosa* in the tank water, are high temperature, intensity of illumination, stagnation, large amounts of phosphates, ammoniacal nitrogen, albuminoid nitrogen, organic matter, salts of calcium and magnesium. Gaseous solutes do not seem to have any influence. But it is not known exactly why the tank water should favour the exclusive development of *Microcystis*. This requires further detailed study of all other Microcystis ponds in the city, and further work is in progress.

Krishnappa Naicken Tank and Lietensee compared.

It is now proposed to make a brief comparison between the physical and chemical conditions of our tank water with those of Lietensee in Germany where the phenomenon of water bloom has been reported to occur with great regularity every year during the warm summer months from 1908 to 1914 (Kolkwitz). During this period—April to September—a mass production of

the blue-green alga, *Oscillatoria Agardhii* Gom. has occurred to the exclusion of almost all other forms of algae.

Lietensee resembles our tank in being shallow and having no outlet or inlet. It is 810 metres long, 75 metres broad, and 2 metres deep. It is surrounded on all sides by sloping walls of brick and mortar, which rise high above the surface of the water. These walls protect its water against strong winds, and thus tend to maintain an approximate tranquillity.

The water is greenish, and has a very low transparency due to the abundant algal growths which prevent the sun's rays from reaching the bottom. The temperature of the surface water consequently becomes higher, but it appears to be only slightly higher than at the bottom. A thermal stratification also seems to develop in it; but it is not known whether it is daily forming by day and breaking at night or is permanent during the period of summer stagnation.

Chemically it resembles our tank water almost in all respects. The oxygen content of the surface water is very high due to vigorous carbon assimilation, and the latter is accompanied by a reduction of bicarbonates; free carbon dioxide, nitrites and nitrates are absent. Free ammonia is either absent or very low, while organic nitrogen and oxidisable organic matter are considerably high. Phosphates and silicates are also present.

In short, the Lietensee at the time of summer resembles our tank in its high surface temperature and low transparency; in the absence of water movement; in its high oxygen content, and low bicarbonate content; in the absence of free carbon dioxide, nitrites and nitrates; in the absence of or a low free ammonia; in the abundance of organic nitrogen, oxidisable organic matter, and chlorides; and in the luxuriant growth of a blue-green alga.

Summary.

1. Very little is known about the ecological conditions of ponds containing a permanent bloom of *Microcystis aeruginosa*, and the conditions of existence for a year in one such pond at Madras is described.

2. The most important factors favouring its development seem to be the high temperature of the water, absence of water movement, high organic content, and phosphates. Nitrites and nitrates are absent. Gaseous solutes do not appear to exert any influence.

3. It is suggested that a diurnal temporary thermal stratification takes place in the pond, and it is destroyed at night. The nutrient substances required for the growth of the alga are brought up daily to the surface from the bottom, where the dead algal cells are decomposed by bacterial action.

4. The tank may be designated as an extreme eutrophic type of water, usually associated with the tropics.

Acknowledgment.

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ZOOLOGICAL GARDEN
CALCUTTA

THE GAME FISHES OF INDIA.[1]

BY

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(With one colour plate and four text-figures).

(Continued from page 794 of Vol. xli, No. 4).

XI.—THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

4. THE BOKAR OF THE ASSAMESE AND KATLI OF THE NEPALESE, *Barbus (Lissochilus) hexagonolepis* McClelland.

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INTRODUCTION.

After Hamilton (3, pp. 303-307)[2], McClelland (10, pp. 333-338) in his account of the Indian Cyprinidæ dealt with the large-scaled barbels of India and described 5 species, *viz.*, *B. hexastichus*, *B. progeneius*, *B. macrocephalus*, *B. hexagonolepis*, and *B. megalepis*. The first four were described from Assam, while the last species was obtained in the river Kosi. As McClelland's descriptions are brief and inadequate, and his illustrations inaccurate, an attempt was made in an earlier paper (7, pp. 324-331) to define the specific limits of his species, but in the absence of authentic material from Assam, the conclusions reached could only be tentative. With a view to study good series of specimens from Assam, a short visit was paid to the Darrang District in November 1939, and the fish fauna of the Brahmaputra and some of its tributary streams

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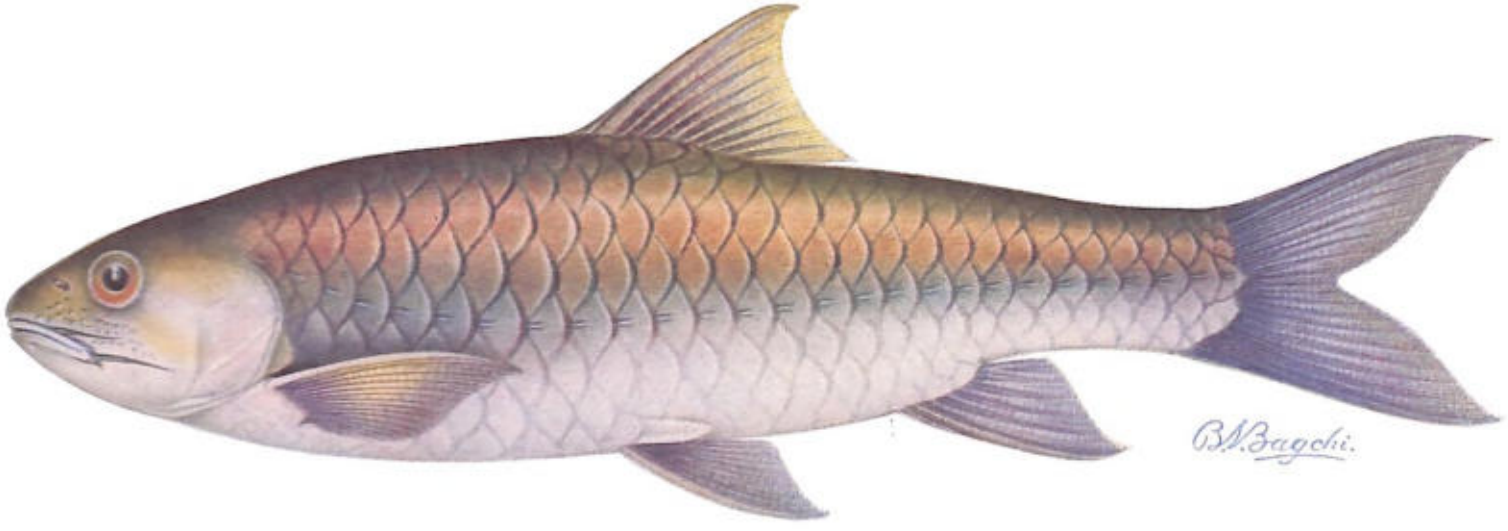

The Bokar of the Assamese and Katli of the Nepalese,
BARBUS (LISSOCHILUS) HEXAGONOLEPIS McClelland.

THE GAME FISHES OF INDIA.[1]

BY

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(With one colour plate and four text-figures).

(Continued from page 794 of Vol. xli, No. 4).

XI.—THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

4. THE BOKAR OF THE ASSAMESE AND KATLI OF THE NEPALESE, *Barbus (Lissochilus) hexagonolepis* McClelland.

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INTRODUCTION.

After Hamilton (**3**, pp. 303-307)[2], McClelland (**10**, pp. 333-338) in his account of the Indian Cyprinidæ dealt with the large-scaled barbels of India and described 5 species, *viz.*, *B. hexastichus*, *B. progeneius*, *B. macrocephalus*, *B. hexagonolepis*, and *B. megalepis*. The first four were described from Assam, while the last species was obtained in the river Kosi. As McClelland's descriptions are brief and inadequate, and his illustrations inaccurate, an attempt was made in an earlier paper (**7**, pp. 324-331) to define the specific limits of his species, but in the absence of authentic material from Assam, the conclusions reached could only be tentative. With a view to study good series of specimens from Assam, a short visit was paid to the Darrang District in November 1939, and the fish fauna of the Brahmaputra and some of its tributary streams

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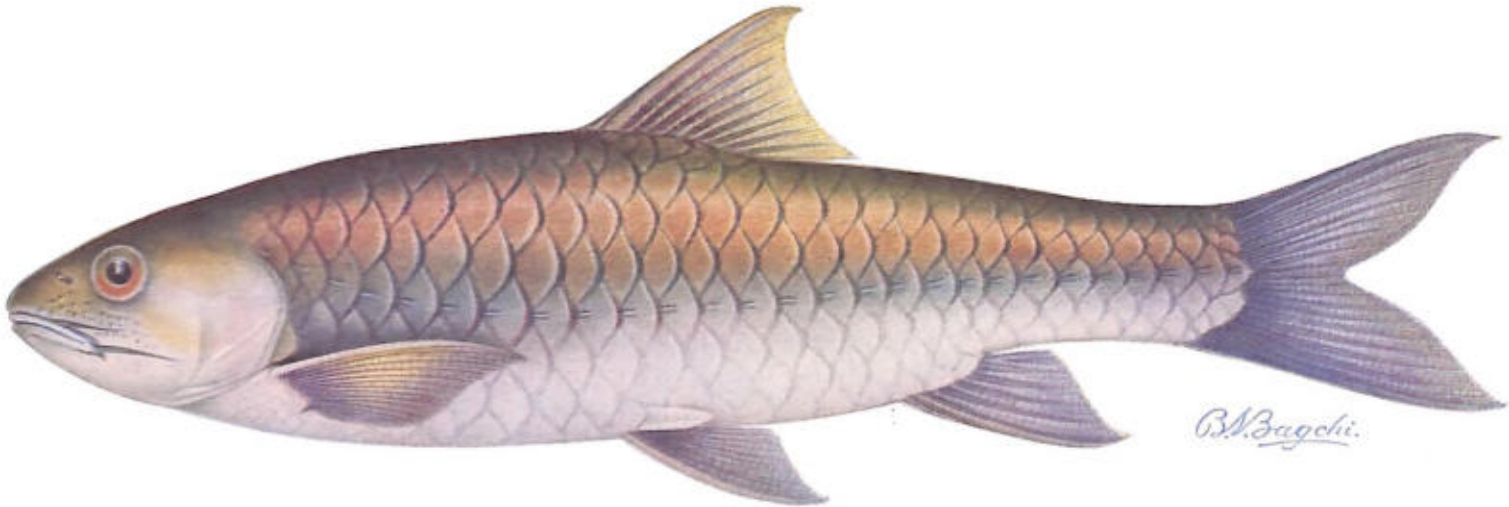


The Bokar of the Assamese and Katli of the Nepalese,
BARBUS (LISSOCHILUS) HEXAGONOLEPIS McClelland.

was investigated. Unfortunately, examples of only two species of the large-scaled barbels were obtained, and the systematic position of the remaining forms, therefore, still remains uncertain. For the sake of convenience of reference, I give below in a tabular form the conclusions reached so far regarding the identity of McClelland's five species:

McClelland's determination	Assamese name.	Present position.
1. *Barbus hexastichus*, pl. 39, fig. 2.	*Lobura.*	*Barbus* (*Tor*) *tor* (Ham.).
2. *Barbus progeneius*, pl. 56, fig. 3.	*Jungha.*	*Barbus* (*Tor*) *progeneius* McClelland.
3. *Barbus macrocephalus*, pl. 55, fig. 3.	*Burapetea.*	*Barbus* (*Tor*) *putitora* (Ham.)
4. *Barbus hexagonolepis*, pl. 41, fig. 3.	*Bokar.*	*Barbus* (*Lissochilus*) *hexagonolepis* McClell.
5. *Barbus megalepis.*	—	*Barbus* (*Tor*) *mosal* (Ham.).

I have not examined any examples of the specimen known as *Lobura* to the Assamese, but it may be noted that McClelland himself regarded his *Barbus hexastichus* as a synonym of Hamilton's *Cyprinus tor*. Similarly he considered his *B. megalepis* identical with Hamilton's *C. mosal*. Of the other three species, I have examined specimens of *Burapetea* and *Bokar;* the former is undoubtedly the same as *Cyprinus putitora* Hamilton—the species with the large head. The *Bokar* belongs to a totally different group of *Barbus* known as *Lissochilus,* which has not yet been recorded from the Western Himalayas; its range extends over Indo-China, Siam, Malay Peninsula and Archipelago, Burma and the Brahmaputra Drainage System. The first three species have been dealt with in the earlier articles of this subseries, while the *Bokar* Mahseer forms the subject matter of the present article. It is hoped that some specimens of *Jungha* from Assam will reach the author's hands by February, 1941, so as to enable him to deal with this species in a subsequent article.

History and Nomenclature.

The *Bokar* of the Assamese was described by McClelland as *Barbus hexagonolepis* and characterised as follows:—

'Length of the head to that of the body is as one to four; twenty-seven scales along the lateral line, and seven in an oblique line from the base of the ventrals to the ridge of the back. On the anterior part of the body the exposed surfaces of the scales represent hexagonal outlines, the fins are placed as in the preceding species, but the rays of the ventrals as well as those of the pectorals are small. The fin rays are,

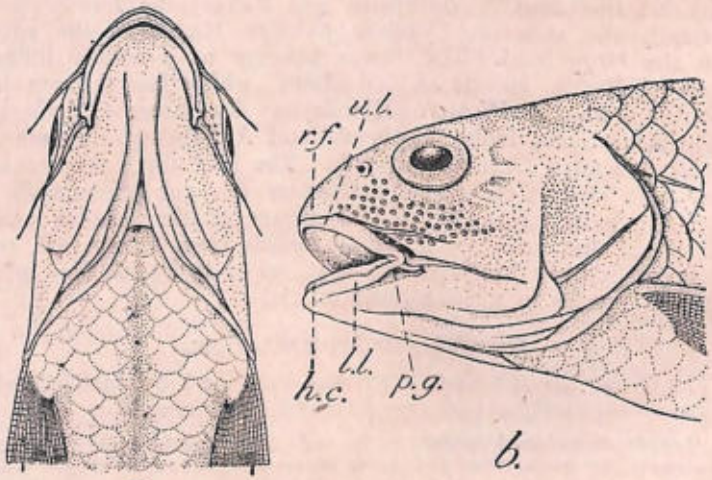
D.12: P.16: V.9: A.7: C.10/9.

'The head is small and little compressed, the snout smooth and slightly rounded, and the postorbitan plates less expanded in this than in any of the other species, having a smooth dorsal spine and large scales. In large-sized individuals the back and head, base of the fins and scales are blackish grey; but the opercular plates, scales, and fins are tipt with yellow. In young ones a leaden hue supplies the place of yellow, and the fins are tipt with black.'

Günther (**2**, p. 129) considered *B. hexagonolepis* as a synonym of *B. hexastichus*, but his description of the latter shows that he was dealing with a species of the *Tor*-type and not of the *Lissochilus*-type. Day (**1**, p. 564) recognised *B. hexagonolepis* as a valid

species and stated that 'The character of the interrupted groove behind the lower lip at once distinguishes this species from *B. hexastichus.*' He gave as its habitat 'Assam in the large rivers, and those from the Himalayas.' All the specimens referred to *B. hexagonolepis* by Day and now preserved in the collection of the Indian Museum possess pores on the cheeks though in most of the specimens the wart-like tubercles have fallen off. However, this tuberculated condition of the snout impressed Day to such an extent that he separated a few young specimens from the Tista river below Darjeeling into a separate species—*Barbus dukai.* I have examined large series of specimens from Assam and the Darjeeling Himalayas, and have not been able to separate them specifically. *B. dukai*, however, has been recorded from Siam (**6**, p. 155) and the Indo-Australian Archipelago (**12**, p. 168). Several species have since been described in the genus *Lissochilus*, but their systematic position is somewhat doubtful, and will form the subject matter of the next article when I hope to deal with the specimens of *Lissochilus* from Burma and the neighbouring areas.

In their treatment of the fishes of the Indo-Australian Archipelago, Weber and de Beaufort (**12**) recognised several genera



Text-fig. 1.—*Barbus* (*Lissochilus*) *hexagonolepis* McClelland.

a. Ventral surface of head and anterior part of body of a specimen from the Tista River, showing the interrupted post labial groove and the structure of the lower lip. *Nat. size.*

b. Ventro-lateral view of same, showing horny tubercles and the structures associated with the mouth. *Nat. size.*

h.c. Horny covering of lower jaw; *l.l.* Lower lip; *p.g.* Post labial groove; *r.f.* Rostral fold; *u.l.* Upper lip.

among the fishes hitherto grouped under *Barbus* Cuvier and proposed the genus *Lissochilus* for *B. dukai* and a new species from Sumatra. The most salient features of this genus, which distinguish it from the true Mahseers of the *Tor*-type, are :—(i) The post labial groove, though continuous round the corners of the mouth, is interrupted

in the middle (*versus* continuous); (ii) the lower lip is conspicuously separate from the jaw, which is provided with a horny covering (*versus* lower lip covering the jaw, which is devoid of a horny covering); and (iii) the snout is provided with horny tubercles or series of open pores (*versus* smooth snout). The horny covering of the lower jaw sometimes becomes inconspicuous in specimens preserved in formalin. In all other respects, these fishes are similar to those assigned to the subgenus *Tor*. For reasons detailed in an earlier article (**9**, p. 276) I think it will be useful to regard *Lissochilus* as a subgenus of *Barbus* till such time as this assemblage of forms is thoroughly monographed and the taxonomic limits of the various genera properly defined.

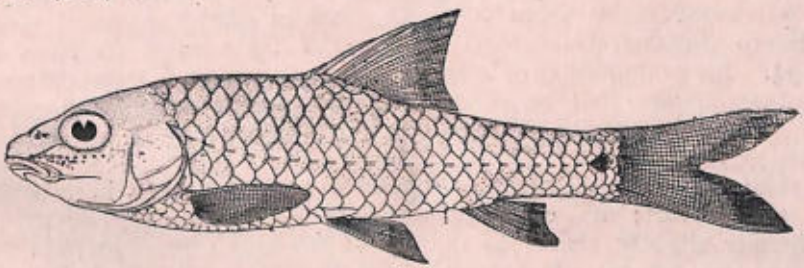
Synonymy[1] and Description.

1839. *Barbus hexagonolepis*, McClelland, *As. Res.*, XIX, pp. 270, 336, pl. xli, fig. 3.
1878. *Barbus hexagonolepis*, Day, *Fish. India*, p. 564, pl. cxxxvii, fig. 4 (pores on snout not shown, present in the specimens).
1878. *Barbus dukai*, Day, *Fish. India*, p. 564, pl. cxliii, fig. 3.
1889. *Barbus hexagonolepis*, Day, *Faun. Brit. Ind. Fish.*, I, p. 305.
1889. *Barbus dukai*, Day, *Faun. Brit. Ind. Fish.*, I, p. 306.
1913. *Barbus hexagonolepis*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 249.
1913. *Barbus hexastichus*, Chaudhuri (*nec* McClelland), *Rec. Ind. Mus.*, VIII, p. 249.
1921. *Barbus hexastichus*, Hora (*nec* McClelland), *Rec. Ind. Mus.*, XXII, p. 186.
1924. *Barbus hexastichus*, Hora (*nec* McClelland), *Rec. Ind. Mus.*, XXVI, p. 27.
1935. *Barbus hexagonolepis*, Hora & Mukerij, *Rec. Ind. Mus.*, XXXVII, p. 389.
1936. *Barbus hexagonolepis*, Hora, *Rec. Ind. Mus.*, XXXVIII, p. 330.
1937. *Barbus hexagonolepis*, Hora, *Rec. Ind. Mus.*, XXXIX, p. 334.
1937. *Barbus (Lissocheilus) dukai*, Shaw & Shebbeare, *Journ. Roy. Asiat. Soc. Bengal. Science*, III, p. 37, pl. v, fig. 6, text-fig. 33.

Vernacular Names.—*Bhorkol* and *Buluk* (Bengali), *Katli* (Nepali), *Mirpunia* (Lepcha), *Kantasi* (Mechi), *Boka* or *Bokar* and *Boolooah* (Assamese).

D.4/9; P.1/13-15; V.1/8; A.3/5; C.19; L.l.22-31.

In general facies, *Barbus* (*Lissochilus*) *hexagonolepis* is similar to *B.* (*Tor*) *mosal* and has a graceful form in which both the dorsal



Text-fig. 2.—A juvenile specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from the Kalimpong Duars, showing relatively larger head and eyes, and the development of horny tubercles at this young stage. ×2.

[1] In the synonymy I have included Indian references only. References to extra-Indian records will be dealt with in the next article.

and ventral profiles are more or less equally arched. The head is relatively shorter and broadly rounded in front. The length of the head is contained from 4.5 to 5.6 times in the total length and from 3.5 to 4.3 times in the length without the caudal. The height of the head at the occiput is considerably greater than its width. The most conspicuous feature of the head is the possession of several rows of horny tubercles on the sides in front of and below the eyes. These tubercles are present in smaller numbers in specimens even below 50 mm. in length. The number and arrangement of tubercles vary in different individuals, and when the tubercles are rubbed off or fall away series of open pores are present instead. The eyes are lateral in position and are of moderate size; they are relatively larger in young specimens and are situated mainly in the anterior half of the head; the diameter of the eye is contained from 2.6 to 4.2 times in the length of the head, and according to the size of the specimen it may be greater or smaller than the length of the snout or the interorbital width. The snout is, however, shorter than the interorbital width. The mouth is of moderate size, horizontal and subterminal; it is slightly overhung by the snout. The lips are thick, continuous round the angles of the mouth, but the labial groove is widely interrupted in the middle. The posterior lip is not produced into a flap in the middle. The lower jaw is covered by a sharp, horny covering which enables the fish to rasp off encrusting organic matter from rocks. The barbels are longer than the diameter of the eye.

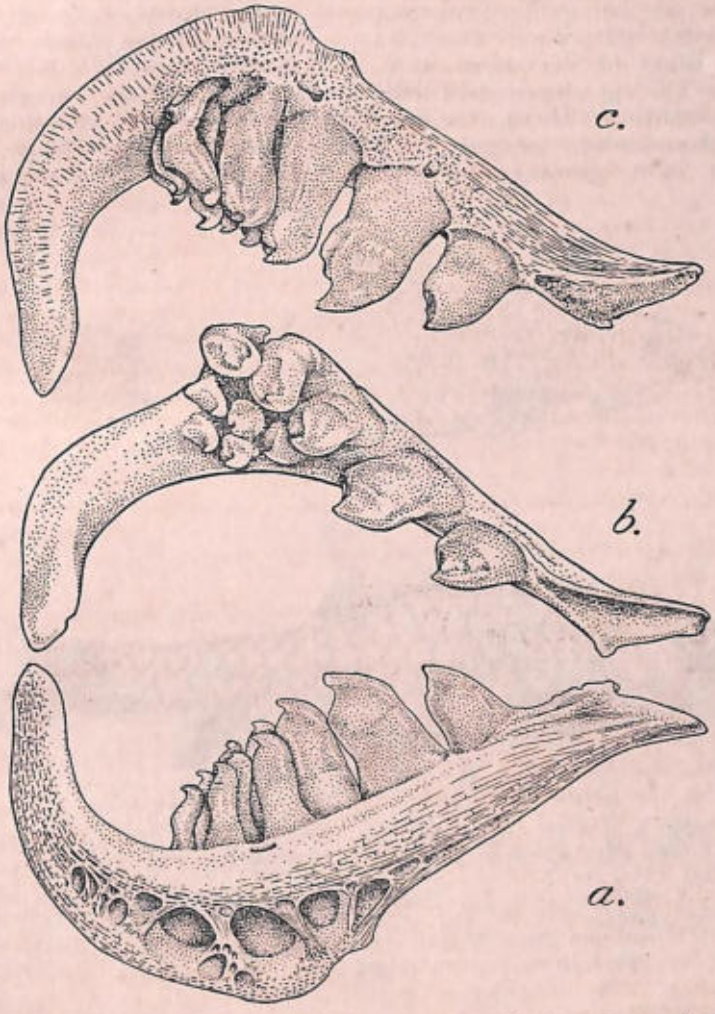
The pharyngeal teeth (5. 3. 2/2. 3. 5) are relatively shorter but more massive than those of the *Tor*-type.

With the exception of a few specimens from Pegu, I have found that the depth of the body is somewhat greater or less than the length of the head; the depth of the body is contained from 4.0 to 5.3 times in the total length and from 3.0 to 4.6 times in the length without the caudal. The caudal peduncle is well formed but narrow; its least height is contained from 1.2 to 1.7 times in its length. The scales are large and well-set; the lepidosis varies considerably even in specimens from the same locality. The number of scales along the lateral line may vary from 22 to 31, of predorsal scales from 8 to 11, and of the transverse series between the lateral line and the base of the ventral fin from $2\frac{1}{2}$ to $3\frac{1}{2}$. An examination of a large series of specimens from different localities shows that no reliance can be placed on this character for separating species. There is a scaly appendage in the axil of each pelvic fin.

The dorsal fin commences opposite to or slightly in advance of the pelvics; its commencement in half-grown specimens is generally slightly nearer to the tip of the snout than to the base of the caudal fin. The position of the dorsal varies with the size of the individuals.

The size and strength of the dorsal spine is also very variable and it has been found that specimens from streams running through lime rocks have better developed spines. The pectoral fin is low and pointed; in young specimens it may extend to the pelvic fin,

but in somewhat grown up individuals the two fins are separated by a considerable distance. The pelvic fins are also sharp and do not extend to the anal fin which latter may or may not reach

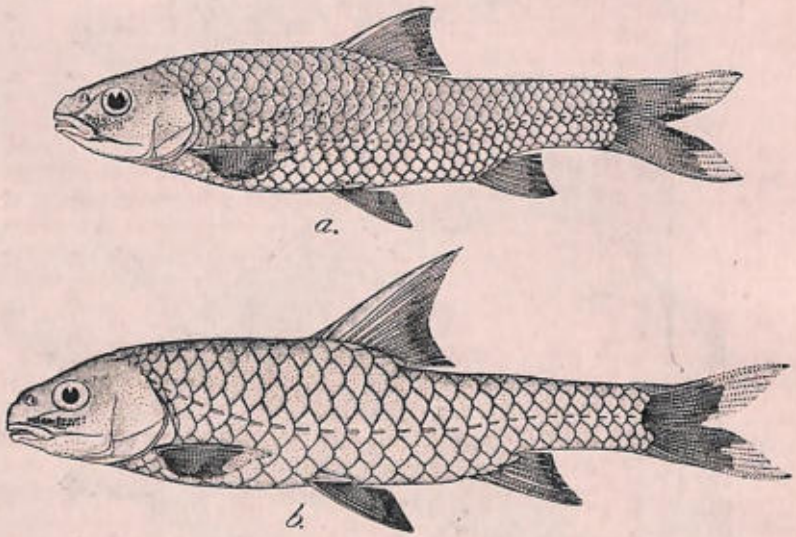


Text-fig. 3.—Right pharyngeal bone and teeth of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from below Darjeeling. ×4.
a. Dorso-lateral view, showing the pitted surface; *b*. Lateral view, showing arrangement of teeth in three rows; *c*. Ventro-lateral view.
The teeth are shorter and more massive than those of the Mahseers of the *Tor*-type.

the base of the caudal fin. The caudal fin is deeply forked with both the lobes pointed.

From the observations so far recorded, it seems that the colouration varies considerably according to the nature of the

water inhabited by the fish. The colour sketch reproduced here was made from a living specimen kept in a katchha tank at the Rungli Rungliot Tea Estate, Darjeeling District. The dorsal surface of the head and body was bottle green, the lateral band above the lateral line was yellowish brown followed by an area of king's blue colour which was replaced below by silvery white. The edges of the scales were marked with light bluish neutral tint. The tip of the snout was stone green, and the barbels had a neutral tint. There were two oval patches of a light yellow colour before and behind the eyes; the iris was yellowish brown and the gill-cover light alizarine pink. The dorsal fin had a citron green



Text-fig. 4.—Lateral view of two specimens of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland to show marked variations in lepidosis and nature of dorsal spine. *ca* ½.

a. A specimen from the Naga Hills, Assam, with weak dorsal spine, 32 scales along lateral line and 3½ rows between it and base of the ventral fin; *b*. A specimen from Nepal, with strong dorsal spine. 25 scales along lateral line and 2½ rows between it and base of ventral fin.

colour, while the pelvic, anal and greater part of the pectoral and caudal fins were of a slate gray colour. There was a patch of buff colour on the pectoral and the margin of the caudal was of a light greenish neutral tint.

According to Shaw and Shebbeare (**11**, p. 38), the colour is 'Olive green on back; each scale above the lateral line copper-coloured at the end deepening to bronze-green at the base. Below the lateral line the scales are pale slate-coloured fading to pure white on the belly. Fins deep slate-colour paling towards their margins. Iris bright coppery red.'

MEASUREMENTS IN MILLIMETRES

	Eastern Himalayas, Duars and Terai							Nepal	Assam															
									Garro Hills					Naga Hills									Suddya	Lokra
Total length ...	268·0	...	207·0	...	...	80·0	50·0	215·0	253·0	144·0	137·0	100·0	73·0	298·0	277·0	190·5	185·5	...	158·5	153·0	...	...	...	140·5
Standard length ...	208·0	194·0	146·0	100·0	90·5	59·0	39·0	166·0	202·3	108·5	100·5	77·5	55·5	230·0	210·0	150·0	141·0	127·0	126·0	118·0	106·0	102·0	179·0	105·5
Length of head ..	48·0	48·0	36·7	26·5	24·0	16·5	11·0	42·0	50·0	28·5	26·5	21·0	14·5	59·5	57·0	38·0	39·0	35·0	34·5	32·0	29·0	29·0	44·0	29·0
Height of head ...	37·5	40·0	28·0	20·0	18·0	13·0	8·5	30·0	34·5	22·0	20·0	16·0	10·0	41·5	41·0	27·5	29·5	24·0	23·0	22·0	21·5	19·0	31·3	21·5
Width of head ...	30·0	32·5	23·0	15·0	13·0	11·0	6·0	25 0	28·5	18·5	17·0	12·5	9·0	34·0	36·5	23·5	23·5	20·5	20·0	18·5	18·0	15·0	25·0	18·0
Diameter of eye ...	13·6	13·5	11·0	8·5	8·0	6·2	4·0	13·0	13·5	8·5	8·4	6·9	5·0	15·0	15·0	11·0	11·0	10·5	10·5	10·0	8·5	8·2	12·0	8·5
Length of snout ...	12·3	13·0	12·0	8·5	7·0	5·0	3·0	12·0	16·4	8·3	8·0	6·9	4·0	19·0	20·0	11·0	12·0	11·5	10·3	9·0	9·0	8·8	14·0	8·5
Interorbital distance.	18·5	17·0	13·9	9·5	7·5	5·0	3·0	16·0	17·0	8·5	9·0	6·5	4·5	24·0	21·0	14·0	14·0	11·5	11·0	10·0	10·0	8·8	15·5	10·3
Depth of body ...	55·0	51·0	44·0	28·0	28·3	15·0	9·5	42·0	50·0	30·5	30·0	21·7	15·5	69·0	55·0	41·0	39·0	35·0	34·5	32·0	27·0	26·0	38·5	33·0
Width of body ...	32·5	28·7	25·0	14·0	13·0	9·0	5·0	22·0	26·3	16·5	16·0	12·3	9·0	35·5	35·0	21·5	22·0	18·0	18·3	17·0	16·0	14·5	21·0	17·0
Length of caudal peduncle ...	33·5	35·0	25·5	14·5	14·5	9·2	7·0	26·0	32·5	19·5	18·0	14·0	9·3	39·0	34·0	27·0	25·5	24·0	22·0	21·0	17·0	16·5	32·5	16·5
Least height of caudal peduncle ...	24·5	23·5	18·5	10·5	10·5	7·5	4·9	18·0	22·5	13·0	12·7	10·0	6·5	26·0	24·0	18·0	16·5	14·5	14·0	13·0	11·0	12·5	20·0	13·0
Length of dorsal fin.	40·5	41·8	35·5	D.	22·0	15·0	10·0	47·0	38·5	27·5	24·0	21·0	13·0	50·5	42·0	32·5	28·0	28·5	26·5	25·5	22·0	22·3	37·0	26·0
Length of pectoral fin ...	46·0	39·3	31·5	20·5	20·0	13·6	7·5	D.	43·0	25·0	21·0	17·3	11·0	50·0	50·0	31·5	32·0	27·5	27·5	27·5	23·5	21·0	35·0	23·0
Length of pelvic fin.	39·0	34·0	26·6	19·5	16·0	12·5	6·5	31·5	37·5	20·5	18·5	14·0	9·0	40·5	35·0	25·2	27·0	22·5	20·5	19·0	18·5	18·0	28·5	18·5
Length of anal fin. ...	47·0	34·0	27·0	17·5	14·0	12·0	6·5	35·0	38·0	23·0	20·0	13·0	9·5	38·0	40·5	25·0	30·0	24·0	23·0	18·5	18·0	18·0	32·5	21·5
Length of rostral barbel ...	14·5	13·5	11·9	7·0	5·5	5·3	2·5	12·0	17·0	10·0	9·0	7·8	4·5	12·0	13·5	11·0	12·5	11·5	10·5	10·0	8·0	7·0	12·0	10·5
Length of maxillary barbel ...	17·5	18·0	13·0	9·0	7·0	7·5	2·9	13·0	18·0	10·5	10·0	7·0	4·3	14·0	15·0	13·0	14·0	13·0	11·5	12·0	10·5	8·0	12·0	12·0
Number of predorsal scales ..	10	10	9	9	9	8	9	8	9	9	10	10	10	11	10	11	10	10	10	10	8	10	11	9
Number of scales along lateral line.	27	27	25	27	25	25	26	25	27	27	27–28	28	28	30	30	32	30	30	30	28	25	27	31	26
Number of scales between lateral line and v. ...	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3½	3	3½	3	3	3	3	2	2½	3	2½

Distribution and Size.

Though the final distribution of the species will be discussed in the next article after an account of the extra-Indian material, it may be noted that *B. hexagonolepis* is perhaps the commonest large-scaled Barbel of Assam and of the Eastern Himalayas. In the collection of the Indian Museum there are numerous specimens from the Eastern Himalayas, the Garo Hills, the Khasi Hills, the Naga Hills, and several other places in Assam. There is also a specimen from Nepal. The species has not hitherto been recorded from the Ganges River System or any other part of India.

Both McClelland and Day have noted that this species grows to upwards of two feet in length. Shaw and Shebbeare state that 'Rarely, if ever, exceeding 10 lb. in our area, but W. Nelson records a *Katli* of 25 lb. caught by him in the Champamoli near Gorubasha (Assam).'

In a recent note Holt (**4**, p. 154) recorded the capture of a *Katli* weighing 21 lbs. from Jaldacca, so it would appear that in Duars also the fish grows to a fairly big size. Mr. S. J. Duncan informed me (*vide* **8**, p. 334) that this was the mighty Mahseer of the region traversed by him and that it was found in almost all the rivers of the hills.

Bionomics and Fishing Notes.

McClelland (**10**, pp. 336, 337) made the following observations regarding the bionomics of *B. hexagonolepis*:—

'The stomach is about the length of the body, gradually contracting till it joins the intestines, which are thrice the length of the stomach, but of great capacity, expanding in size from their commencement, to about the middle of their length, and again gradually contracting until they reach the vent. In the stomach and intestines I found numerous minute bones of small fishes. Instead of the intestines of this species being disposed in transverse or longitudinal folds, they are convoluted transversely. Mr. Griffith remarks that the *Bokar* is to be found in all large rivers on the eastern frontier, from the base of the mountains to the situation at which the currents first become languid in the plains, keeping mostly in the middle of the stream, where it takes a red hackle very freely, as well as worms and other bait. It is very powerful, often attaining two feet and upwards in length, and usually weighing from eight to twelve pounds.'

Wood (**13**, pp. 71, 72) in his notes on *Fishing in India and Europe* recorded the following observations regarding *Booka* or the snub-nosed Mahseer:—

'The *Booka* or snub-nosed Mahseer. This is a true Carp and the colour is duller than in the last; the fins are bluish-red and the pharyngeal teeth are broader and flatter. As the *Booka* is not such a cannibal as the true Mahseer, feeding more on falling fruits, weeds, grasses, etc., it does not attain to a very great size, 12¾ lbs. being the heaviest I ever got. A curious thing about him is that his fins are never entire, pieces especially in the caudal fin being bitten out. The Khasias have told me that this is done by a little fish with a beak like a parrot and which can blow itself out. They call it the *Poothla Mas*. I have seen little boys blowing these fish up as one does a toy balloon. Sometimes when bathing these fish will nip your legs. The Khasias hate the *Booka* and many will not eat them, as they say they devour the excrement of monkeys. I fancy there is something in this. A fruit which they are fond of, a species of small fig is often found on

trees overhanging the water. I have seen hosts of monkeys feeding on the berries and when the fruit[1] fell into the pool below it was eaten by the *Booka* and other fish; the excrement also dropped into the water and I do not think the *Booka* would object to eating this. The *Booka* does not make the terrific rush like the Mahseer, he rather bores down into the depths of the water and shakes the line like a bull dog. By this feeling you can always tell you have a *Booka* on. They take a G and S spoon well but one has to spin deep for them and in a pool they soon get scared of a spoon. During a sudden heavy spate, when the river gets muddy like pea soup, I have seen *Booka* spring into the air to get more oxygen. The teeth of the true Mahseer are much longer and pointed than those of the *Booka*, some having a distinct notch. They play on a hinge system and the teeth point downwards into the pharynx. They are admirably adapted for cutting purposes and their strength can be gauged by putting one's fingers down the throat of a small Mahseer.'

Shaw and Shebbeare (**11**, p. 38) noted that the habits of *Katli* are 'Very similar to those of the Mahseer. As a sporting fish there is nothing to choose between them, weight for weight. It is unfortunate that, as both take the same lures, and are found in the same water, the smaller species is often taken on much too heavy tackle which does not give him a chance to show his power.'

ACKNOWLEDGMENTS.

I am indebted to the authorities of the Bombay Natural History Society for bearing the cost of the illustrations for this article. Mr. K. S. Misra very kindly prepared the table of measurements and for this my thanks are due to him. The colour sketch was made from a specimen caught by Mr. W. K. Langdale Smith of the Rungli Rungliot Tea Estate, Darjeeling District, from the Tista River and later kept by him in a Katchha tank. I am indebted to Mr. Langdale Smith for affording facilities to my artist to make the colour sketch. The illustrations were prepared by Babu B. Bagchi with his usual skill and care under my supervision.

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[1] In this connection reference may be made to Hopwood's (**5**) observations on 'Effect on Mahseer of eating the fruit of the Kalaw tree (*Taraktogenos Kurzii*)'. The flesh of the fish which eat the fruits of this tree becomes poisonous.

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Explanation of Plate.

Colour sketch of a tame Katli, *Barbus (Lissochilus) hexagonolepis* McClelland of the Tista River.

The specimen, 268 mm. in total length, was collected by Mr. W. K. Langdale Smith, and kept in a katchha tank at the Rungli Rungliot Tea Estate, Darjeeling District. The colours shown in the drawing probably differ from those of specimens living under natural conditions.

A CONTRIBUTION TO THE LIFE HISTORY OF *TRIDAX PROCUMBENS* LINN.

BY

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(*With two plates and 25 text-figures*).

The family Compositae includes over 23,000 species and contains about one-tenth of the total number of flowering plants. It is distributed throughout the world, and the plants show remarkable diversity in habit.

Although a considerable amount of work has been done on the embryology and cytology of the plants belonging to the family Compositae our knowledge is far from complete. Schnarf (16) and Bhargava (3) have reviewed the vast literature on the subject. It is interesting to note that various types of embryo-sac development, as also variation in the number and structure of antipodal cells have been recorded in different species. The literature on the cytology of the family is also very extensive. Of the interesting observations made in recent years, mention may be made of the occurrence of secondary association of chromosomes and polyploidy in several genera. Meiotic irregularities leading to the formation of sterile or multinucleated pollen grains, as also the parthenogenetic development of the egg have been recorded by several investigatiors.

Tridax procumbens is a common weed found in all waste places in Bengal. The plant flowers during the greater part of the year and is easily recognised in its natural environment by its straggling habit, opposite pinnatifid leaves and long pedunculated flower-heads containing pale yellow coloured ray florets.

MATERIAL AND METHODS.

The material used in this investigation was obtained from plants growing as weeds in the college compound. Fixation was usually made between 12 noon and 4 p.m. Various fixing fluids were tried of which Allen's modified Bouin's fluid, and Flemming's weak solution gave the best results. The involucral bracts were removed before fixation and the flower-heads were cut into small pieces to facilitate penetration of the fixing fluid. An exhaust pump was always used for the same purpose. The material was dehydrated and cleared in the usual way. Sections were cut 8 to 14 microns thick, depending on the stage required for study. Heidenhain's iron-alum haematoxylin and Newton's iodine gentian violet were the stains commonly used.

OBSERVATIONS.

1. *Flower development.* The flowers are arranged in long pedunculated heads which are about 1/3 to 1/2 inch in diameter. The ray florets are carpellate and the disc florets hermaphrodite. The opening of the florets is

centripetal, and the disc florets become differentiated first. The individual florets appear on the convex floral axis as minute papillate processes, each subtended by a bract (Fig. 1). The apex of the flower primordium very soon curves inwards and develops into the corolla. (Fig. 2). The primordia of the stamens, five in number, are seen to arise on the inner side of the petals (Figs. 3 and 4), and rapidly grow upwards and become differentiated into

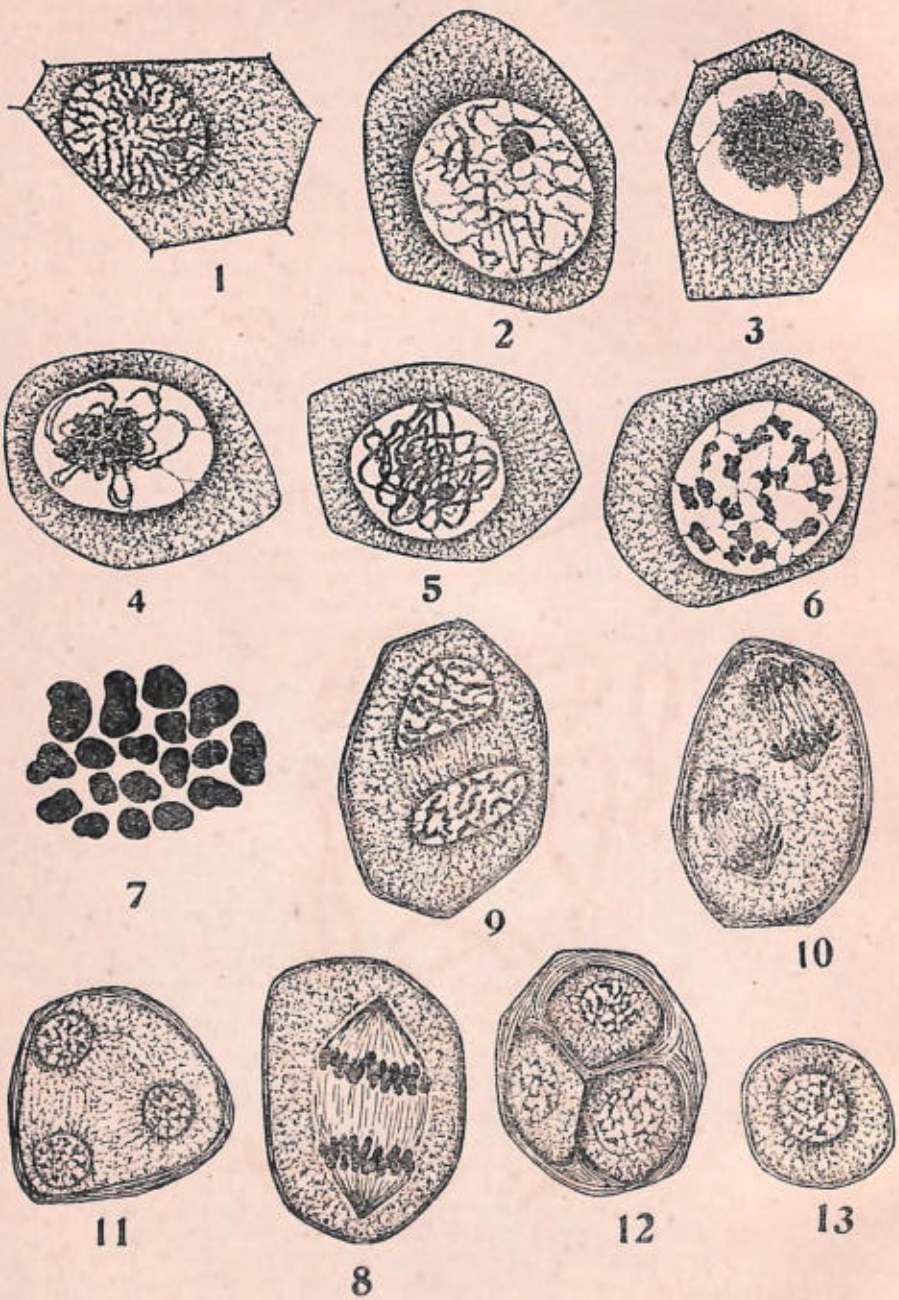
Figs. 1-6.—*Tridax procumbens*. Figs. 1-5, Stages in the development of the disc florets. Explanation in text. Fig. 6, Part of pappus showing arrangement of cells. Figs. 1-5, ×940; Fig. 6, ×430.

comparatively large anthers and small filaments. Immediately after the appearance of the staminal primordia, the origin of the sepals is noted. In longitudinal sections of the flower these appear as two scale-like projections on the outer side of the petals (Fig. 5). In the initial stages of their development they are composed of a few cells, but later develop into hairy structures known as 'pappus'. Figure 6 represents the arrangement of the cells composing the pappus. A spindle shaped nucleus is seen in each cell. The last floral whorl to appear is the gynaecium composed of two carpels which arise on the inner side of the stamens and close to the centre of the floral axis. In the early stages of their development they remain side by side, but with increased growth their distal ends come together to form the solid style, while their proximal ends separate out to form the ovarian chamber. The carpels open out again at the apex to form the bifid stigma. The stigma is clothed by unicellular subulate hairs. From the base of the ovary a papillate protuberance develops which at first grows obliquely upwards, but very soon curves to form the single anatropous ovule.

The development of the ray florets is similar to the above, except that the corolla becomes ligulate and the stamens are absent. The style in both types of flowers is surrounded at the base by a ring of glandular tissue. Figures 1 to 5 represent stages in the development of the disc florets.

The sequence of development of the floral parts appears to be similar to that observed by Martin (10), Merrell (11), and others.

2. *Microsporogenesis*. The origin of the archesporial cells, or the early differentiation of the sporogenous cells could not be made out. When first noted the sporogenous cells appear to be separated from the epidermis by



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For explanation see end of article.

four or five layers of cells. In the resting stage the sporogenous cells are packed close together in the anther loculus and they are mostly polygonal in outline. The nucleus is generally situated centrally inside the cell and contains a single nucleolus surrounded by a hyaline zone. At the periphery of the nucleus a granular reticulum is noted. With the onset of prophase a number of elongated and beaded threads are seen to lie scattered irregularly inside the nuclear cavity. (Plate I, fig. 1). The double nature of the threads could not be very clearly made out, but from their beaded appearance it is inferred that they are composed of two filaments which are spirally intertwined. Close approximation of the leptotene threads next takes place. Figure 2 in plate I represents a typical zygonema stage. The threads next contract away from the periphery of the nucleus and ball up into a tight knot. (Plate I, fig. 3), the nucleolus being enclosed in the meshes of the thread. Synizesis lasts for a long time as is evidenced from a large number of preparations showing this stage. The spireme next opens out and gradually fills up the nuclear cavity. Careful examination at this stage reveals the double nature of the spireme (Plate I, fig. 4). At the pachynema stage the spireme appears as a uniform thread which lies loosely convoluted inside the nuclear cavity. (Plate I, fig. 5). At this stage the nucleolus decreases in size and its chromaticity also becomes reduced. The pachytene thread next segments into a number of unequal bits. These synapsed portions separate out markedly except at the portions where chiasmata are established. The four-partite nature of the diplotene threads is evident at certain regions only. The number of chiasmata depends on the length of the threads. As a rule the number varies from five to two (Text fig. 7). Some of the longer pairs have three interstital and two terminal chiasmata, while others have one interstital and two terminal chiasmata. In some others, especially in the shorter ones, two terminal chiasmata are seen. In later diplotene stages there is a reduction in the number of chiasmata and

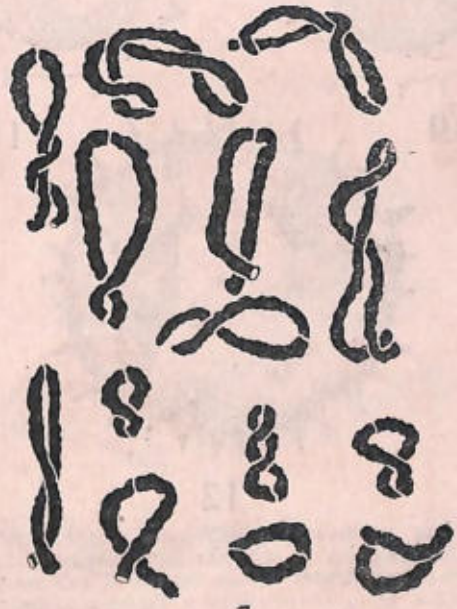

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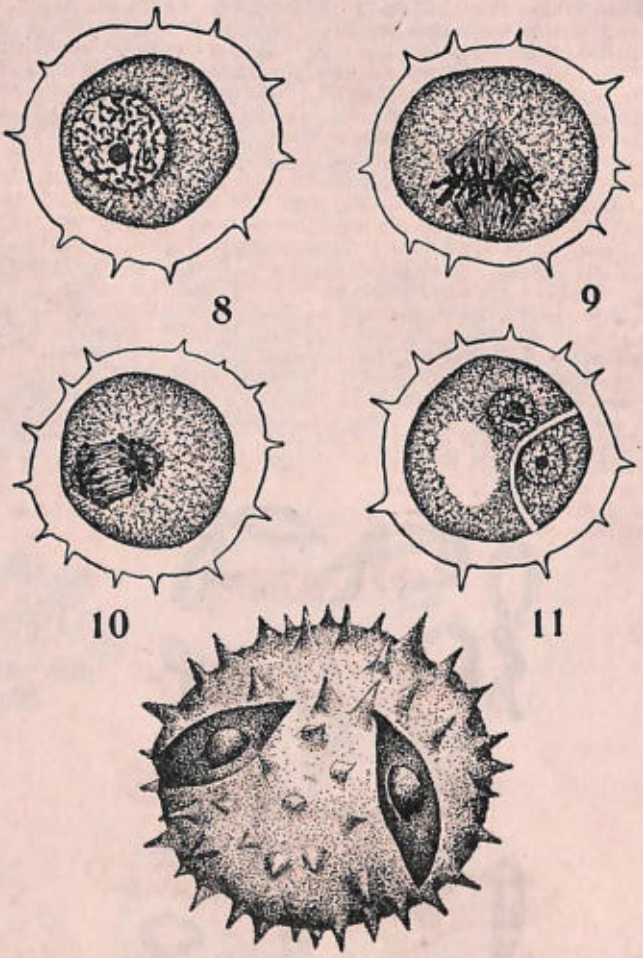
Fig. 7.—*Tridax procumbens.* Some of the diplotene bivalents showing the number of chiasmata and the spiral nature of the strands × 3650.

a shifting of their positions towards the ends. Terminalisation of the chiasmata appears to be complete in every instance and at diakinesis the bivalents are seen to lie side by side. (Plate I, fig. 6). The nucleolus becomes still smaller and paler and finally disappears at this stage. The heterotypic spindle is next

noted. The spindle is well defined with sharp ends, and the bivalent chromosomes are aligned on the equatorial region. A polar view of an equatorial plate shows clearly eighteen bivalent chromosomes. (Plate I, fig. 7). The anaphasic movement of the chromosomes appears to be regular (Plate I, fig. 8). Non-disjunction or other meiotic irregularity has not been noted at this stage.

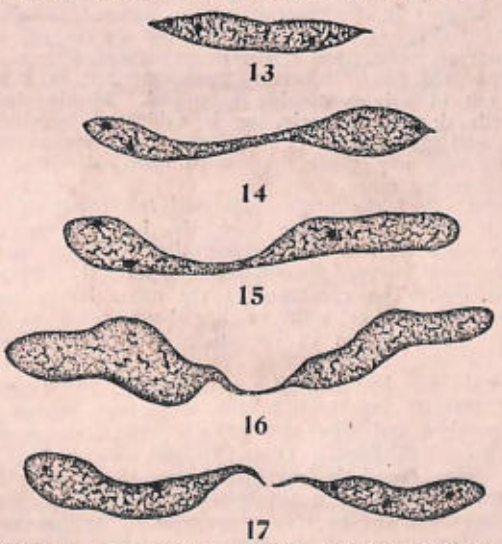


Figs. 8-12.—*Tridax procumbens*. Fig. 8, Microspore nucleus in prophase. Figs. 9 and 10, Division of the microspore nucleus. Fig. 11, Tube and generative nucleus separated by an ephimeral cell membrane. Fig. 12, A mature pollen grain (mounted in a liquid medium); note germ-pores and sculpturing on the exine. Figs. 8-11, ×1555; Fig. 12, ×3650.

On reaching the poles the chromosomes at first clump together, but very soon they open out and their spiral nature is once more apparent. A nuclear membrane is secreted and the two daughter nuclei are connected by cytoplasmic strands (Plate I, fig. 9). The spindles are oriented either at right angles, or parallel to each other. The chromosomes while oriented on the spindle appear to be somewhat elongated (Plate I, fig. 10). On the completion of the second

division four daughter nuclei are organised, inside which irregularly coiled threads are noted (Plate I, fig. 11). The microspore tetrads are either isobilateral or tetrahedral in arrangement and are encased by a mucilaginous pellicle (Plate I, fig. 12). Cytokinesis takes place by the advancement of peripheral furrows which meet at the centre of the protoplast. Quadripartition by furrowing is now believed to be the general method of cytokinesis in dicotyledonous plants. The young microspores are at first enclosed in the mucilaginous pellicle, but as the latter gradually undergoes dissolution they are liberated and lie free inside the microsporangium. At this stage they have a wavy outline but very soon they round up and the exine becomes differentiated. The nucleus of the microspore increases in size and prepares for division. The various stages of the division are shown in text figures 8 to 10. The nucleus migrates towards the periphery before the commencement of division and the metaphase spindle lies at one side (Fig. 9), and occupies more than half the diameter of the microspore. According to Wulff and Maheshwari (19) this is the general condition in angiosperms though exceptions have also been recorded. On the completion of division two cells are formed which are unequal in size and are separated by a cytoplasmic membrane. The generative cell, as in most plants, is lens-shaped and lies close towards the periphery. Its nucleus is slightly smaller than that of the vegetative cell (Fig. 11). Geitler (6) believes that this might be due to the small amount of karyolymph present in the generative nucleus. The mature pollen grains are two celled, and ellipsoidal, but become spheroidal when mounted in a liquid medium. Their diameter varies from 32·5 to 36·8 microns. They are echinate, the spines having a broad base. Four broad and short furrows with tapering ends are present, each having a single germ pore, from the centre of which the intine protrudes as a tiny papilla (Fig. 12). The intra-colpar regions show the presence of vestigial spines.

3. *Periplasmodium.*—In the early stages of meiosis the tapetal cells are uninucleate and somewhat elongated. Before the pollen-mother cells have completed the I division, the nuclei of the tapetal cells divide mitotically and the cells become binucleate due to the non-formation of a cell wall. The two



Figs. 13-17.—*Tridax procumbens.* Stages in the amitotic division of the tapetal nuclei, ×1555.

nuclei mostly lie side by side. During the tetrad stage of the pollen mother cells, the first indication of plasmodium formation is observed. The walls delimiting the individual cells disappear and their cytoplasm coalesce and protrude inside the anther cavity. As this process takes place from all sides, the microsporangium is soon filled by the tapetal plasmodium which closely surrounds

the young microspores. The tapetal nuclei before migration into the anther cavity become very much elongated. They show the presence of fine chromatin granules and a few small nucleoli. At a later stage they are seen to divide amitotically. Text figures 13 to 17 represent the various stages of division. The daughter nuclei formed as a result of the disorganisation of the constricted area, withdraw the attenuated portion very soon and become elongated in form. They remain in this condition till the disappearance of the plasmodium when they degenerate.

The formation of a tapetal plasmodium has been recorded in many plants of the family Compositae. Merrell (11) working on *Silphium* observed the collection of plasma around the microspores which later became encrusted by it in the form of a sheath. Gates and Rees (5) state 'the plasmodium flows in among the pollen grains and may contribute directly to the sculpturing of the wall'. Similar observations have been made by the present writer (1) working on *Carthamus tinctorius*. In *Tridax procumbens* though the plasmodium was seen to be in intimate contact with the spinous projections of the exine, yet in the absence of further evidence it would be unsafe to suggest that the plasmodial substance is incorporated on the exine. The plasmodial substance is finally resorbed so that hardly any trace of it is left in the anther.

4. *Multi-nucleated pollen mother cells.* During the later stages of meiosis when the pollen mother cells have rounded up, in some anthers a few large cells have been noted. As a rule not more than one such cell is present in the anther and it lies close towards the periphery. These cells contain two, three or four nuclei. (Plate II, fig. 14). The nuclei in most cases show the early prophasic changes, while the surrounding pollen mother cells show all stages from diakinesis to pollen tetrads. Figure 15, in plate II, represents a stage in which the presence of eight nuclei is seen in the protoplast. From the form and arrangement of the nuclei it appears that they are the product of division of pre-existing nuclei. The nuclei being probably in the interkinetic stage. Figure 16 in the same plate illustrates another stage where the nuclei are in a state of division. Seven telophasic spindles with polar grouping of chromosomes are clearly seen. From the occurrence of a chromosome group at the position marked x in the diagram one is inclined to believe that another spindle is present at that region, probably masked by the adjacent chromosome groups. This condition would then represent an advanced stage to that observed in figure 15. (Plate II). But it is very rare, and has been observed in only one preparation out of a large number examined. Mostly the multi-nucleated pollen mother cells degenerate early, as is evidenced by their collapsed and irregular outlines and the presence of large dark shapeless masses in the anther. In no preparation was any giant microspore observed nor a polycaric condition of the pollen grains noted.

5. *The development of the megaspores and the female gametophyte.* The ovule arises as a tiny protuberance from the base of the ovary when the sporogenous cells have just become differentiated in the anther. It grows obliquely upwards and curves inwards even before the differentiation of the megaspore mother cell. The curvature of the ovule is not brought about by its contact with the ovarian wall as has been noted by Reeves (15) in *Medicago sativa*. The direction of curvature of the ovules is not the same in all florets.

The archesporial cell becomes differentiated in the hypodermal layer of the nucellus and directly functions as the megaspore mother cell. (Fig. 18). The megaspore mother cell increases in size and then passes through the usual stages of reduction division (Figs. 19 and 20), and a linear tetrad of four megaspores is produced in every instance (Fig. 21). The nucellus is greatly reduced and consists of a single layer of cells lining the megaspores, which are completely encased by the integument. The lowest or the chalazal megaspore always functions, while the rest degenerate and could be made out by their dark shapeless masses capping the functional megaspore. The functional megaspore increases in size before division. The two nuclei produced as the result of division show distinct polarity, and at this stage degeneration of the surrounding cells of the nucellus is first noted. The quadri nucleate stage is next reached and the embryo-sac becomes encased by the radially elongated cells of the integument. This condition appears to be a characteristic feature in the family Compositae, and the inner cells of the

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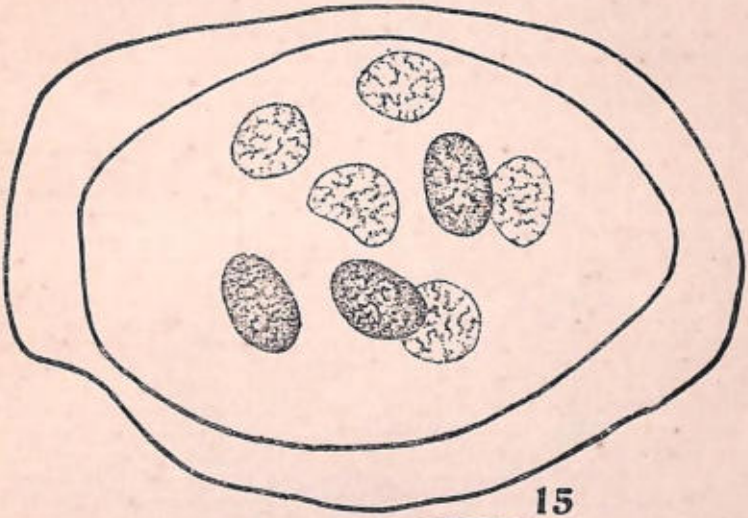

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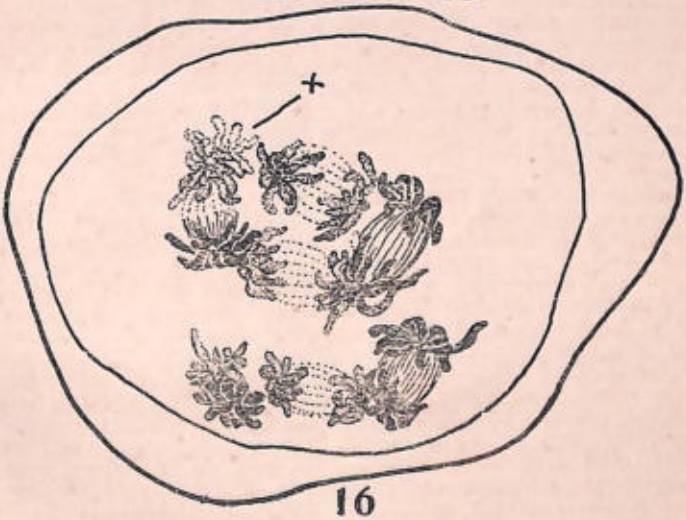

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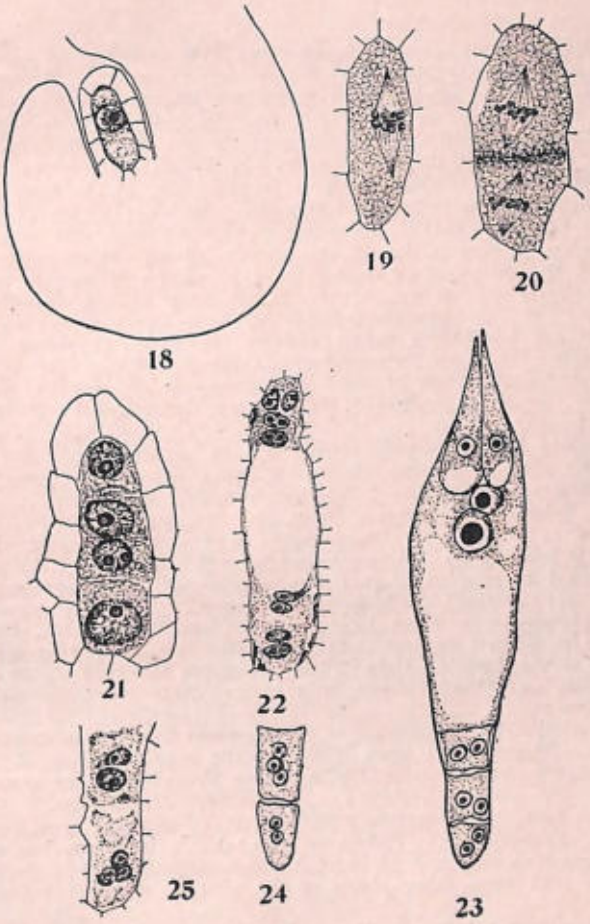
integument have often been referred to as the 'integumental jacket'. The eight nucleate stage is next reached and the embryo-sac shows considerable increase in size.

The mature embryo-sac is of the normal angiospermous type (Fig. 23). The synergids are pear shaped and have prominent beak like processes which extend inside the micropyle. A big vacuole occurs at the base of each synergid at the top of which the nucleus is placed. The egg is very much elongated,



Figs. 18-25.—*Tridax procumbens*. Fig. 18, Longitudinal section of the ovule showing the hypodermal origin of the megaspore mother cell and the single integument. Fig. 19, Heterotypic division of the M.M.C. Fig. 20, Homotypic division of the M.M.C. Fig. 21, Tetrad of megaspores. Fig. 22, Eight-nucleate embryo-sac. Fig. 23, Mature embryo-sac, the antipodal cells bi-nucleate. Fig. 24, Antipodal region of an embryo-sac, showing two antipodal cells, of which the upper one is three-nucleate and the lower binucleate. Fig. 25, Same, showing two anti-podal cells, the lower cell has three nuclei and the upper two. Fig. 18, ×430; Figs. 19-21, ×1050; Figs. 22-25, ×940.

it lies below the synergids and shows the usual form. The secondary nucleus lies very close to the egg. It is bigger than the egg nucleus and is surrounded by a dense mass of cytoplasm. The three antipodal cells which are separated

from one another by cytoplasmic membranes lie at the chalazal end of the embryo-sac. At first they are uni-nucleate, but very soon become binucleate. In a few instances only two antipodal cells have been noted in the mature embryo-sac. Of these cells sometimes the upper one was seen to be trinucleate and the lower binucleate (Fig. 24), or the reverse condition prevailed (Fig. 25).

Discussion.

1. *Meiosis.*

The spiral structure of the chromosomes first observed by Baranetsky (4) has now been definitely established. There are, however, different views regarding the number of spirals that compose the prophase chromosomes. Among the recent investigators on the subject Nathany (12), Huskins and Smith (8) and others are of opinion that the leptotene threads are single, while Koshy (9) and others believe that they are double. In *Tridax procumbens* the leptotene threads appear to be beaded, which is probably due to the close intertwining of two threads forming nodes and internodes. Such appearance of the leptotene threads has been observed by Koshy (9) in *Aloe littoralis*, and he is of opinion that the beaded nature is due to two closely intertwined chromonemata. The structure of the chromosomes during the later stages of meiosis could not be made out clearly on account of the unsuitability of the material for such investigation. The chromonematic structure of the chromosomes again becomes apparent in the interkinetic nuclei and in the nuclei of young microspores. It thus appears that each chromosome is composed of two spirally intertwined threads. Further indication of the spiral nature is obtained in the diplonema stage where the wavy outline of chromosomes is suggestive of the existence of coiled strands.

The method of chromosome conjugation is parasynaptic. The pairing of the leptotene threads is apparent in the early prophasic stages and as the spireme recovers from synizesis, its double nature is evident at places. The absence of a 'second contraction' stage and the segmentation of the spireme to give rise to the bivalent chromosomes lend support to this view. Gates and Rees (5) working on *Lactuca* have observed a looping of the spireme during the second contraction stage. The number of loops corresponded to the number of chromosomes, and it was concluded that each loop represented a pair of chromosomes which later separated out. The above observation led the authors to believe that synizesis in *Lactuca* has no part in bringing about the pairing of the threads. It is difficult to accept this view as the observations on *Tridax* indicate that synizesis is a critical stage when the pairing of the threads takes place.

Great variation in the number of chromosomes has been noted in the family Compositae. Tischler (17) gives a list of the numbers recorded till recently. Of the plants under the tribe Helianthoidae the chromosome numbers of the following have been recorded: *Xanthium Strumarium*, *X. italicum*, *X. inflexum* and *X. pensylvanicum* (n=18); *Galinsoga parviflora* (n=18); *Helianthus annuus* (n=17); *Bidens sp.* (n=24). It is interesting to note that *Tridax procumbens* possesses 18 haploid chromosomes and thus shows chromosomal affinity with some other plants of the tribe to which it belongs.

2. *Multi-nucleated pollen mother cells.*

The presence of large multi-nucleated pollen mother cells in the microsporangium during the later stages of meiosis is an interesting feature in *Tridax*. Careful examination of the synizetic and presynizetic stages failed to show the presence of such cells, and it can therefore be concluded that these cells are not differentiated as such during sporogenesis. The origin of these cells might be due to the union of the cytoplasm of two or more pollen mother cells or to a process of nuclear migration or cytomyxis. As the latter conditions have not been observed in any preparation, it is likely due to the former. Besides, measurements show that the size of the nuclei in the large pollen mother cells is nearly the same as those of the ordinary meiocytes in the same stage of meiosis. The number of separate nuclei in the protoplast indicates the number of pollen mother cells involved in the process. Gates and Rees (5) have observed similar bi-nucleate pollen

mother cells in *Lactuca*. These were noted in the presynizetic and synizetic stages of the pollen mother cells and not later. It has been suggested that these cells owe their origin through a breakdown or due to the incomplete formation of a cell membrane between the two cells. The absence of any evidence in that direction and the presence of multi-nucleated cells in *Tridax procumbens* makes this interpretation difficult to accept. Holmgreen (7) has observed quadrinucleated pollen grains in *Erigeron eriocephalus* and *E. malaschkensis*. According to him these resulted from the failure of wall formation after reduction division. Non-formation of walls after reduction division appears to be the condition in *Tridax* also, and it results in an increase in the number of nuclei. Such a condition is illustrated in figures 15 and 16, plate II. In the first figure, the arrangement of the nuclei indicates that they have just completed the division and are in the interkinetic stage, while in the second figure, all these eight nuclei are in a state of division. The large eight-nucleated cell (Fig. 15, Plate II), therefore must have resulted from the coalescence of the cytoplasm of four pollen mother cells, and not as a result of non-formation of wall after reduction division. Besides, as in most other cases the nuclei of the aberrant pollen mother cells are seen in early prophase, they could not have possibly resulted from a process of division as suggested by Holmgreen (7).

3. *Tapetal plasmodium.*

The tapetal cells become bi-nucleate in the early stages of meiosis. Quadri-nucleate tapetal cells as reported by many workers on Compositae have not been observed. A true plasmodium was formed during the later stages of meiosis and as the tapetal nuclei migrated inside the microsporangium, they became very much elongated and divided amitotically. Similar amitotic division of the tapetal nuclei has been noted by the present writer (2) in *Colocasia antiquorum*. Bhargava (3) has noted the occurrence of a tapetal plasmodium in *Eclipta erecta*—a member of the tribe Helianthoideae—but he does not mention the amitotic division of the tapetal nuclei.

4. *Pollen grains.*

In recent years the study of pollen morphology has received considerable attention. Wodehouse (18) states—'pollen grains of the same species and of closely related species tend to be alike, and if the environmental factors are alike, the degree of their similarity is a measure of their closeness of relationship'. The pollen morphology of a few plants belonging to the tribe Helianthoideae has so far been studied. *Helianthus annuus, Xanthium catharticum, Chrysanthemum coccineum, C. morifolium, C. carinatum* and *Eclipta erecta* could be mentioned in this connection. The size of the pollen grains in this tribe does not show great variation. The pollen grains of the different species of *Chrysanthemum* studied, range between 26·6—36·5 microns in diameter, while those of *Xanthium, Helianthus* and *Eclipta* are 20·9, 27·7 and 18·0 respectively. The diameter of the pollen grains of *Tridax procumbens* has been found to vary from 32·5 to 36·8 microns (with spines).

Wodehouse (18) has observed the pollen grains of the different species of *Chrysanthemum* studied by him to be tetra- or hexa-colpate. It is interesting to note that the pollen grain of *Tridax* are also tetracolpate. In general, the pollen grains are similar to those of *Helianthus*.

The shape of mature pollen (mounted dry) of *Tridax procumbens* is ellipsoidal. This agrees with the observation of Wodehouse (18) on other members of the tribe Helianthoideae. Bhargava (3) however, states that the pollen grains of *Eclipta erecta* to be spherical and questions Pope's (14) observation on other Compositae. In *Tridax* the ellipsoidal condition is due to harmomegathy of the germinal furrows and the pollen grains assume a spheroidal form when mounted in a liquid medium. In the light of our present knowledge, a careful re-examination of the pollen grains of *Eclipta erecta* seems to be necessary.

5. *Development of the female gametophyte.*

The development of the megaspores and the female gametophyte is of the normal type. It is interesting to note that in the few plants of the tribe Helianthoideae so far investigated, the same type of embryo-sac development prevails. The variability in the number of antipodal cells and their nuclei, as

observed in the material investigated, appears to be a characteristic feature of this tribe. Fusion of the nuclei of the antipodal cells as observed by Palm (13) in *Zinnia* was not seen in any preparation.

Summary.

The paper gives an account of the development of the flower, pollen grains and the female gametophyte of *Tridax procumbens*.

1. The ray florets of the capitulum are carpellate and the disc florets hermaphrodite. The development of the latter takes place in the following sequence :—petals, stamens, sepals and carpels.

2. The chromonematic structure of the chromosomes is seen in the nuclei of the microspore mother cells in early prophase and also during interkinesis.

3. Chromosome conjugation is of the parasynaptic type. No irregularity was noted in the meiotic process.

4. The haploid number of chromosomes is eighteen.

5. Cytokinesis takes place by a process of furrowing.

6. A true periplasmodium is formed, the nuclei of which divide amitotically when inside the microsporangium.

7. Large multinucleated cells have been observed to be present inside the microsporangium in some anthers. Generally the nuclei of these aberrant cells show early prophasic changes while the surrounding pollen mother cells show all stages from diakinesis upwards. In a few anthers the nuclei of these large cells have been observed to divide.

8. The pollen grains are bi-nucleate. They are ellipsoidal, echinate and tetracolpate. Germ-pores are four in number and are situated in the centre of short furrows.

9. The development of the embryo-sac is of the normal type. A linear tetrad of megaspores is produced of which the chalazal one always functions. The organisation of the mature embryo-sac is of the normal eight nucleate type.

10. The number of antipodal cells varies from two to three. Normally the antipodal cells are bi-nucleate, but sometimes tri-nucleate cells also occur.

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Explanation of Plates.

All figures were drawn at table level with the help of a Zeiss camera lucida. With the exception of figure 7, the rest of the figures in plate I have been drawn at a magnification of 1,400 diameters. Figure 7 has been drawn at a magnification of 3,650. Magnification of the figures in Plate II, is given below.

Plate I.

Fig. 1.—Nucleus of microspore mother cell in early prophase. Note the beaded nature of the leptotene threads.
Fig. 2.—Zygonema stage.
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Fig. 10.—Homotypic anaphase.
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Fig. 13.—A young microspore liberated from the tetrad.

Plate II.

Fig. 14.—A longitudinal section of an anther showing a multinucleated pollen mother cell and pollen tetrads surrounded by tapetal cells, ×430.
Fig. 15.—A large pollen mother cell showing the presence of eight nuclei, ×2140.
Fig. 16.—Another large cell in which the nuclei are in a state of division. Seven polar groups of chromosomes are clearly seen, another group probably occurs at the position marked x; 2,140.

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SOMETHING ABOUT SWORDFISH.

BY

LIEUT.-COL. R. W. BURTON, I.A. (*Retd.*)

(*With a plate*).

There is something about the taking of swordfish, and other monster fish of the sunlit tropic seas with rod and line, which has captured the fancy of the public and the big-game sea fishing fraternity; so each season many sportsmen, and sportswomen too, have been attracted to Australian and New Zealand waters.

It is an exciting sport packed with thrills, for there is always the hope that each day, each hour, each minute may bring a yet larger and more furiously fighting leviathan to test the tackle and endurance of the fisherman.

Swordfishing was begun in New Zealand waters some thirty years ago, the first of the species being captured off Cape Brett by Mr. A. D. Campbell in 1910 or 1911. In 1926 Mr. C. Alma Baker, a Vice-President and veteran Member of the Bay of Islands Swordfish and Mako Shark Club, induced Mr. Zane Grey to visit the Bay of Islands where he pitched camp at Otehei Bay on the island named Urapukapuka (meaning? Diary should say, but doesn't). On the shores of that lovely cove is now the Otehei Bay Hotel, where the visiting angler finds everything he needs for his comfort and his sport. Those wishing to be nearer the fishing grounds can obtain accommodation at Deep Water Cove which is ten minutes run, instead of an hour's, from Bird Rock: there are other places also.

Mr. White Wickham's broadbill of 675 lbs. was the record for that species up to 1928, and may be so to the present time. Names of a number of noted sportsmen are in the Club records.

New Zealand swordfish waters are off Whangaroa Heads, Cavalli Islands, Cape Brett, Mayor Island in the Bay of Plenty, and some in-between places of less note. From the available records the best period off Cape Brett is the last week of February and the first three weeks of March; this would also apply to the first two named localities. On a future visit the inclination would be to find two companions to share a launch suitable to live on a few days at a time, and so work the Cavalli area as well as Cape Brett. The cost would be less, and the sport might be more. Ordinarily the cost of this fishing is N.Z. £5 to £6 a day. (Rs. 52 to Rs. 65).

During the season 1936/37 (1st Dec. to 31st May) 28 black marlin averaged 452 lbs.; 321 striped marlin 283 lbs.; 97 mako shark 175 lbs.: the largest of the three species being 850, 404, and 612 lbs. respectively. The largest thresher shark, hammer-head shark, and king fish were 922,394, and 75 lbs.; the first named a record. Record for king fish—a redoubtable fighter, is 111 lbs.

(Zane Grey). When in Fiji the writer saw a photograph of a 112 lb. king fish, but caught nothing approaching that size in those seas during a three months stay.

Seasons vary considerably. 1937 was exceptionally good. In the following year the figures for the first three species were 9,130, and 58 only, there being much stormy weather during February and early March. Up to 9th March 1937 172 swordfish were caught off Mayor Island. Thresher and hammer-head are much less common than mako, which is a magnificent fighter.

One never knows what may come along. The late Captain Mitchell of America killed a black marlin of 985 lbs. (length 13 ft. 5 in.) off Whangaroa on the 25th February 1926. It was then a world's record. Mr. H. J. Court killed one of 957 lbs. in 1936; and in 1932 one of 823 lbs. was captured by Mrs. Eastham Guild of Tahiti. Monster fish of this species are always hoped for!

On the 8th February 1938 G.H.D. and the writer were trolling around Piercey Rock in one direction while E. E. G. and C, in Alma GII, circled the opposite way. The launches were on opposite sides when a huge black marlin, biggest launchman Arliss had ever seen, and he had been at the killing of fish of over 1000 lbs. with Zane Grey in American waters, rushed the bait from below, shot out of the water in a great curve, and went off at tremendous speed. After a hundred yards the reel overran, the line broke. Then the fish broached again—ten feet and more of him in the air—and threw the bait. Again he came up and repeated the spectacular performance in vain endeavour to get rid of the hook—then he was seen no more.

What a misfortune for G! And had the monster taken C's bait would his reel have jammed? Or D's, or mine? Who knows, Kismet. But was it just bad luck? One has to be most careful to wind the line, after wetting it, tightly on to the drum; and to brake the reel just right, neither too tight nor too loose.

That matter of luck. C. had bad luck all along, while G's was consistently good. One marlin took the bait off C's hook, then seized G's and was killed. That day 'Minerva' saw no sign of fish: while 'Valhalla', 'Alma G.II', and 'Lorna Doone' killed two each. Some sportsmen, frequently novices, do extraordinarily well; others, of much experience, will go a whole month with but one fish! Luck has it all the time: but care counts.

Broadbill are not often caught in New Zealand waters. A fine specimen taken in 1937 is mounted in the Auckland Museum; where also are exhibited specimens of marlin, mako, and other big-game fish, which should be seen.

The sword of the broadbill is as much as four feet in length, that of the striped marlin being thirty to thirty-four inches; the bill of the black marlin is shorter in proportion though the fish attains far greater size than his striped relative.

Talking of 'swords'. Before me is a photograph of the launch 'Little Jim' which was rammed off Leigh (opposite Little Barrier Island) by a striped marlin on the 29th January 1932. At the time of the attack the launch was not fishing. The sword was broken off by the frantic struggles of the great fish and is seen

to pierce the planks above the water line and protrude six inches above the deck! At Otehei Bay can be garnered authentic stories of swords broken off in bodies and heads of mako shark. The 'Minerva', seen in the photograph, bears a scar from sword of a marlin which struck a glancing blow. There must be many terrible fights when the monsters of the deep seas meet at feeding time on the immense shoals of *trevalli* and other fish which swarm in those prolific waters. Swordfish opened up have been found to contain fish of several species with spear holes in them. The prey is swallowed whole. A swordfish taking a trolled bait has been charged and transfixed by a companion fish; they often swim in pairs. One is known to have shattered his spear against Piercey Rock in his wild rush to escape. In 1937 there was a newspaper report of a terrific swordfish battle seen off Hokitika on West Coast of South Island.

No doubt the fish often die when swords are broken off, but there is a record of a piece a foot long having been left inside a rammed launch. A month later that same fish was caught (267 lbs.) his broken rostrum exactly fitting the piece in the launch. (T. E. Donne, *Rod Fishing in New Zealand Waters*, 1927). Swordfish are said to attain a speed of fifty miles an hour. That can well be believed. The caudal fins of spearfish have a greater spread than those of the true swordfish, and as the former are even more streamlined, and have two strengthening keels as supports to the waist of the tail as compared with the single keel of *Ziphias gladius*, it is likely they are the more speedy. The speed and weight of all 'swordfishes' is ample to drive their weapons through planking of any thickness found in ships and boats.

The sailfish attains a weight of nearly two hundred pounds. Not long ago a lady angler caught one of 170 lbs. off the Seychelles.

Off the coast of Chile broadbill are found in great number and are fished for commercially. One of over 800 lbs. has been taken in those waters on rod and line. (*The Field*, 21st Sept. 1935).

Fishermen, and anglers too, are sometimes injured by attacks on boats. Some have occurred on the Travancore coast. One instance was that of a fisherman wantonly attacked while sitting on his catamaran and speared through the shoulder. (*Journal* vol. xxxiii, p. 373).

When cruising at the surface striped and black marlin are distinguished by the tail fluke ripping scimitar-like through the water; broadbill show both dorsal fin and tail fluke; mako the dorsal only. Sunfish (*Orthagoriscus mola*) are sometimes seen, being known by the peculiar side movement of the big fin. Field glasses should be used. Basking Sharks (*Rhinodon typicus*), sometimes, though erroneously, called sun-fish, are of great size. One seen at Auckland in 1885 was 34 feet long with a dorsal fin of five feet in height; and one of this species stranded at Trivandrum, Travancore, in 1900 measured 29 feet with a circumference of 11 feet 3 inches.

Now let us have something from the scientists. The name 'swordfish' should, strictly speaking, be applied to the Broadbill only. Scientists divide 'swordfishes' into two families. Xiphiidae comprise one genus and species only. *Ziphias gladius*, the true

swordfish, known to sportsmen as the Broadbill. It has a flat, smooth, sword and erect backward-curved non-depressable dorsal fin. The family Istiophoridae comprises the spearfishes and sailfishes which have round, rough, bills shorter than that of the Broadbill and dorsal and ventral fins folding into recesses, thus rendering them even more stream-lined than *Z. gladius*. They also differ from *Z. gladius* in having paired pelvic fins placed beneath the body in line with the pectoral fins and also folding neatly back into a longitudinal groove. These fins are apparently in course of atrophy—a condition found in other vertebrata as instanced by the floating collar-bone of felines. It may be conjectured that by means of these the fish may know when they are touching the floor of the sea. In all species the pectoral fins fold backwards, but not into grooves.

The swords in all these 'swordfishes' are formed by the coalescence of the praemaxillae, vomer, and ethmoid bones. The roughness on the sides and under surfaces of the spearfish and sailfish bills is due to the presence of very short mediatory teeth pointing backwards.

The 'swordfish' taken off the coasts of New Zealand are mostly true spearfish, or marlinspike fishes, of two species. The Black Marlin is *Makaira mazara;* the Striped Marlin, *Makaira mitsukurii*. The Broadbill is not often taken both because of its scarcity in those waters, and because of it not readily taking a bait. The Salifish, *Istiophorus* is not apparently found in New Zealand seas. It is common in the Indian Ocean where one species of marlin is *Makaira indica* : there may be others.

Mr. V. W. Lindauer of Russell, a Life Member of the Bay of Islands Club, informed the writer that there is very little difference to mark the sexes of the marlins killed off the New Zealand coast. The more mature fish are probably females who take the bait more readily owing to developing ova; while the smaller fish may be immature males: but it may reasonably be asked whether there are any males among those caught by rod and line sportsmen. There is yet something, a good deal indeed, to be learnt about these fish.

The principal fishing ground from Bay of Islands is off Cape Brett around Piercey Island and near Bird Rock about 2 miles to the north. The first two were named by Captain Cook in November 1779 after Sir Piercey Brett, a Lord of the Admiralty. Piercey Island has a large archway through the shoreward end of it so no doubt the famous navigator had a good chuckle when he gave that name; the arch is now known as 'The Hole-in-the-Wall'.

Around these two rocks can be seen positively acres of *trevalli*, also called *cavalli* (*Caranx georgianus*) averaging four or five lbs.; seen with them is a violet-coloured fish (the *maomao, Ditrema violacea*) eight to ten inches in length. All the time there are violent upheaving splashes as the much harried fish scatter to escape the hungry under-water onslaughts of king-fish and schnappers; but not infrequently there is a rapid-running splash of a hundred yards or more, clearly indicating the furious charge of a swordfish through the lower stratum of the shoal. Somehow

one does not have much swordfish success close to these shoals, perhaps because the bait is quickly torn to pieces by smaller predatory fish.

Trevalli have small mouths and are not to be caught by any ordinary method. They are best snatched by a large treble hook thrown well into the shoal by a bait-casting rod, and afford quite good play, but time is too important to admit of any nicety in the matter. Being flat-sided fish they are excellent for trolling. The other bait used is the *kahawai* (*Arripis salar*) a salmon-shaped fish averaging five to seven lbs. and taken by any small spinner trolled with a hand-line behind the running launch. These also afford excellent sport with suitably light rod and tackle.

In my diary I find—'much time is wasted in procuring bait. The launches should be fitted with live-bait tanks under the counter: it seems foolish to waste hours of expensive launch hire, and some of the best fishing hours in the early part of the day—in searching for bait: and surely it is better to use live bait for drifting?'

The proper way to seek swordfish is no doubt by trolling, and all would fish that way during the greater part of the time were it not for the increased consumption of petrol. The smaller launches, such as 'Minerva', consume a gallon an hour—about eight miles to the gallon; larger ones considerably more. All hands need a rest occasionally and then drifting with the tide is done. That way anything—any of the four species of shark—Blue, Raremai, Tiger, Grey Nurse, may be hooked; as also Mako, Hammer-head, and Swordfish. It savours of bottom fishing for mahsir with a lump of paste! One feels with this swordfishing from a power launch that the launch kills the fish; and I agreed with D, my companion for a week, that a king fish on suitably lighter tackle affords better actual *sport*. It would be a different contest were one to fish from a row-boat, or dug-out, as is usual in some seas but could only be done on carefully chosen days in New Zealand waters; not practical politics in fact.

The question of hooks. The Bay of Islands Club did not, up to 1938, bar the use of two hooks, the practice being with some launch-men, not all, to use a treble hook as a 'dangler'. This can only be for the purpose of foul-hooking, and should not be allowed. There should be only one hook, except for sharks when two are permissible; but it is seen in the Proposed Rules for a World Big-Game Fishing Association the Rule would be:—'No multiple or 'gang' hooks may be used. Not more than two single hooks are allowed, which must be placed at least a shank's length apart'. That would seem to permit a flying hook which might foul-hook a fish. Not good! The Rule should provide for both hooks to be attached to the bait.

Now let us set out in search of the 'striped tiger of the sea', or his larger relatives. Harness is adjusted; rod placed in the socket of revolving chair; doubled portion of line fastened to wire trace by a buffer knot; No 14 hook passed firmly from below behind the lips of the bait; baited trace let out some thirty feet, the idea being to have the bait dancing on the surface, for which purpose the *trevalli* is so good; reel-brake properly adjusted; in fact every-

Photo by *Author.*

A Striped Marlin—313 lbs.

thing 'just right'. Then the 'teasers' are let out on either side, and we cruise around at five to six miles the hour all eyes on the watch for a showing fin.

This is the time for real enjoyment. The bold outlines of Cape Brett please the eye; there is the charm of watching the cloud shadows sweeping across the grassy and wooded slopes of the steep hills; of seeing the on-rushing waves ceaselessly thundering in vain fury against the perpendicular battlements of Piercey Island. The gulls scream and wheel; the great gannets steeply plunge; petrels, Mother Carey's Chickens, and other birds are seen; and there is the never-ceasing interest of the great *trevalli* shoals. The hours of waiting and expectancy may be long; the rays of the sun may be most unpleasantly hot, or the motion of the launch such as to defeat even the hardiest of sailors; but there is so much life to observe, so much movement, that there are no dull moments: while all the time there is that hopeful feeling, and not for an instant can the state of readiness be relaxed.

Marlin seem to take under most conditions, provided the water is not discoloured by storms, and will strike in calm or rough seas, on dull days and on bright days. The best hours seem to be from sunrise to mid-day and from four to six in the evening.

The 13th February was fine, the sea calm. We secured only two baits and each got a fish! Mine ran about three hundred yards before broaching in a smother of foam to stand on his tail. Failing to throw the hook he came up again several times—fighting furiously—and then bored deep, so heavy 'pumping' was necessary to prevent sounding as these fish sometimes die far below and are then very difficult to recover. Special equipment is necessary for the purpose but is not carried by all launches. After fifty minutes the fish was moving slowly to and fro some fifty yards away and in another five minutes was gaffed and quickly secured on the counter—a striped marlin of 313 lbs.

Within a few minutes we got going again and almost immediately a marlin, perhaps attracted by all the disturbance, took D's trolled bait. It was not a good fighter so was killed in 35 minutes—226 lbs. Next day D's *trevalli* was taken by a big marlin which emerged a long way off and threw the bait. Our lines were not marked at each hundred yards. It is difficult to know how much line is out and fish are missed by not striking at the right time. That has to be learned by experience and I missed two fish for that reason. As the bait was being reeled in for examination another fish seized it and gave a great display of leaping, standing on tail, skittering along the waves, a most spectacular performance. It fought all the time close to the surface. 45 minutes, 197 lbs, a striped marlin. Marlin appear to vary a good deal in fighting qualities. These two fish of the 13th are seen in the photograph of the 'Minerva'.

We hooked several sharks of the unwanted unsporting kind and cut them loose.

It was learnt in Australia that big-game fishing off the coast of New South Wales is making great progress. There are several Clubs: The Sword-fish and Tunny Club of Australia (Vic.); The

Bermagui Big-Game Angler's Club; The Illawarra Game Fish Club (N.S.W.); and further north other Clubs, including the Queensland Game Fishing Association and the Great Barrier Reef Angling Club. So the visiting sportsman has much choice of locality and can follow the coast line with the season from south to north. Off the Queensland coast boarding house accommodation can be had on several islands.

The name of Barrier Reef has a special attraction and the wonder of those prolific waters has to be seen to be realized, while the large variety of sporting fish afford never ceasing enjoyment. Perhaps the best of all is the Barred Spanish Mackerel, a leaping fighting fury running 40 to 100 lbs; it is a near relative of the well-known Seir fish of Indian seas: and there is the Queen Fish which fights almost more out of the water than in it! Others of note are bonito, albacore, kingfish, swordfish and sailfish; and one may strike a great ugly stubborn 'groper' running to seven or eight hundred pounds. The season is June to September.

As in Auckland, so in Sydney and other places all and every kind of rod, reel, line, and gear can be purchased. The *N.S.W. Official Fishing Guide and Holiday Sporting Handbook* is indispensable: in it will be found much of interest, besides many useful hints for angler and camper.

The serious Big-Game angler will know all about the Proposed World Big-Game Fishing Association, the Rules of which are to be found in the *Fishing Gazette* for the 21st and 28th January and 4th March 1939, together with interesting comments by Mr. Mitchell Henry.

'But', readers of the *Journal* may ask, 'are there no swordfish to be had nearer than the other side of the world?' Yes! Throughout the tropic seas swordfish, sawfish, spearfish, and those beautiful creatures with the lovely prussian blue dorsal fin known also as sailfish, are to be found. Wherever there are coral islands, reefs, and underwater banks all kinds of sea fish congregate, so there also are the larger fish of the deep seas which prey upon them.

Off the Seychelles, Ceylon (where is an established Sea Angler's Club providing all that is necessary for the taking of all kinds of fish), and the Andaman Islands there are swordfish and their brethren. Spearfish and Sailfish, doubtless Swordfish also, are to be found off the coast of Bombay over the Angria Bank west of Ratnagiri; the Cora Divi Bank west of Kundapoor; and the Sesostris and Bassas de Pedro Banks west of Mangalore. All these Banks being beyond the one hundred fathom line, and surrounded by deep ocean, swarm with sea fish of every description.

Adventurous Ratnagiri fishermen no doubt spread their nets and set their 'trot' lines over the Angria Bank, and it is known to the writer that the people of Chetlat and Kiltan of the Laccadives fish over the Bassas de Pedro—called by them the Munyal Par—with great success at seasons of the year when favourable weather is assured to them.

Off certain of the banks and reefs nearer to the Laccadives there are seerfish, sawfish, and every other kind of sea fish. Much

can be done by hiring a Laccadive boat of about 18 tons burthen during the months of December and January. The conditions are of course rather hard and primitive; but the sport is good and the expense not great. The fishing is out of the sailing dug-out taken along as a towed dinghy. These are the conditions for real sport as the great pelagic fish are fought on equal terms with a big-game reel of five to seven hundred yards capacity of 36 thread line. There is no room for a swivel chair. You sit on the floor of the boat with the rod butt in a stout block of wood and swivel around on the 'ischial callosities' which you soon acquire.

Indian boatmen are exceedingly happy-go-lucky so it is essential to make sure that the boats are properly fitted and found in every respect. On one occasion I had the mast come down in half a gale of wind because the stepping block was secured (!) by wire nails of insufficient length and strength. That was off Quilon, and entailed a seven mile row against wind and tide for return to the coast. One does not want such happenings in mid-ocean! And the cordage: as well to make sure it is sound, as also the sails which the west coast fishermen use to the last rotten rag. The deep sea islanders are more careful: but 'safety first' is a good slogan.

There are 'swordfish' off Cape Comorin but conditions there need a power boat. The owner of a seagoing 12 H.P. Diesel Engine Launch would have all the places mentioned at his disposal and, after the necessary exploration and experience, as good fishing as is obtainable anywhere.

Now we know something about 'swordfish'; where to seek them and how to get hitched on to these leviathans of the deep seas, as also many other worthwhile sporting fish of various kinds. All that remains is to do our individual best to aid the world to a sane existence and hope there may be tight lines for some when all the turmoil is over.

Supplementary Note.—All sportsmen interested in 'Sea Fishing in Indian Waters' should read the contributions under that title by Engineer Commander F. O. Gadsden of the R.I.M. (now the Royal Indian Navy) in volumes xii and xiii of our *Journal*. He wrote in an interesting and informative way of Bamin, Mullet and Garfish, The Andaman Seas, Karachi, and Aden.

Extremely informative articles by Major W. H. Lane as to 'Game Fish of the Persian Gulf' are contained in vols. xxiv and xxv.

A list of seafish found off the coast of Travancore is in vol. xxxiv.

The Fish Supply of Our Western Coast is exhaustively dealt with by the Editors of our *Journal* in vol. xxix, part 2, and vol. xxxiv part 4. There are many illustrations. The Authors rightly remark as to sustained supply of fish by commercial methods that 'a wide local knowledge of the life history and habits of our food fishes is essential to success': so also sea anglers should, as said by Major Lane, get a firm grasp of the habits and nature of the particular fish in quest; determine the method which will present the lure in the most natural way; ascertain what pattern

of lure is most deadly; select the most suitable locality': to which sound advice may be added the necessity of knowledge of the season—the precise month—during which the various species sought are to be found in suitable localities.

Only by reading and studying all the above-cited articles will the sea angler arrive at that success which he would otherwise only attain at long last through expensive and vexatious experience.

All Fresh Water Anglers in India will be interested and widely informed by the illustrated article 'Game Fishes of Bombay, the Deccan, and the Neighbouring Districts of the Bombay Presidency' contributed by Sir Reginald Spence and Mr. S. H. Prater and published in part I of vol. xxxvi. The article by Mr. A. Macdonald in vol. xxxiii part 2 on the Mahsir of the Irrawaddy Confluence above Myitkyina should not be overlooked.

If any Member wishes to try 'Fishing without a Fish Hook' and so catch fish in running streams in the most sporting manner imaginable, he should read Miscellaneous Note xix at page 789 of vol. xxii and marvel at the ingenuity of the untutored human of the wilds.

R. W. B.

Editors' Note.—Back numbers of the *Journal* referred to above are available at a cost varying from Rs. 3 to Rs. 5 per copy.

In connection with the study of fishes the Editors invite attention to the illustrated series, *The Game Fishes of India,* now appearing in the *Journal* with the permission of the Director, Zoological Survey of India. The author of this series is Dr. Sunder Lal Hora to whom has been entrusted the preparation of the second edition of Dr. Day's *Fishes in the Fauna of India* Series. It is anticipated that this second edition will extend to at least five volumes. The first edition was of two volumes and published in 1889.

By a curious coincidence we received Colonel Burton's article on the same day that a copy of Memoirs of the Royal Asiatic Society of Bengal, vol. xii No. 2, pp. 215 to 315 came to us from Calcutta. In that issue of the Memoirs is an article by Mr. E. W. Gudger, Honorary Associate in Ichthyology, American Museum of Natural History, New York, entitled 'The Alleged Pugnacity of the Swordfish and the Spearfishes as shown by their Attacks on Vessels'. All specially interested in this subject would be very fully informed by perusal of this comprehensive and well illustrated contribution to science. The cost of it is Rs. 7/14.

NOTES ON SOME NEW AND INTERESTING BUTTERFLIES CHIEFLY FROM BURMA.

BY

MAJOR-GENERAL SIR HARRY TYTLER, K.C.B., C.M.G., C.I.E., D.S.O.

PART II.

[Owing to the death of the author, the manuscript of this part has been edited by Mr. G. Talbot, F.R.E.S., who has also corrected the proofs of both parts.—*Ed.*].

NYMPHALIDÆ.

Charaxes fabius nagaensis, s.sp. nov.

Male: differs from the typical form before me from Chota Nagpore, and the United Provinces, in being larger, and in having the yellow macular band narrower and spots smaller; it is as large as the Ceylon form *Ch. fabius cerynthus*, Fruh. but the yellow macular band is paler; it differs from *Ch. fabius sulphureus*, Rothsch. in being larger, with the macular band darker.

A large series of males was taken at Nichuguard at the foot of the Naga Hills; a female was taken in the Lushai Hills.

Further south-west, in the Chin Hills, a male of *Ch. fabius sulphureus*, Rothsch. was taken. I have not taken the latter farther north than Bhamo; it occurs more commonly further south in S. Shan States and in the Karen Hills.

♂ and ♀ paratypes are deposited in the British Museum.

Eriboea narcaea thawgawa, s.sp. nov.

This form is very close to *E. lissainei*, Tytl. from the Naga Hills, and to *E. aborica*, Evans. In size it is equal to the latter. On the *upperside* it agrees with *aborica*, Evans in having on the forewing the dark submarginal band as broad, but the pale spots are much larger. On the hindwing it differs in lacking the pale line in the middle of the post-discal black band from the tornus to v. 4. On the forewing the submarginal spots have rounded apices, in interspaces 1, 2 and 3, instead of being pointed.

From *E. lissainei*, Tytl., it differs on the *upperside* in the black border to the forewing being broader, and the pale spots rather larger. On the hindwing there is no trace of the pale brown edging to the discal band which shows through from the underside. It is not rare, and a large series of males was taken at Htawgaw at the end of June.

A ♂ paratype is deposited in the British Museum.

Eriboea eudamippus nigrobasalis, Lathy.

Brig. Evans, in his 'List of Indian Butterflies,' gives the range of *E. e. eudamippus*, Doubl. as Kumaon-Assam; of *E. e. nigrobasalis*, Lathy as N. Burma; and of *E. e. jamblichus*, Fruhst. as Karens—S. Burma.

The type of *E. e. nigrobasalis*, Lathy came from Pak-a-jong, Siam. I have not seen the original description nor have I seen the type, but according to Lord Rothschild and Dr. K. Jordan, (*Novitates Zoologicae*, vol. vi, 1899, pp. 266-267), the type has the cell of forewing all black and the abdomen above *pale yellow*.

Lord Rothschild and Dr. Jordan include specimens from the Shan States in this subspecies, but at the same time note that these specimens have *black* bodies and state 'It appears singular that in the specimens from Pak-a-jong *the abdomen is pale yellow* as in *E. eudamippus*'.

I have a fairly large series of *E. eudamippus* before me and note the following differences amongst the geographical forms:—

Specimens as far east as Assam, Naga Hills and Manipur, and at Sadon, extreme N.-E. Burma, are the same as those from Sikkim, i.e. typical *E. e. eudamippus*, Doubl.

At Htawgaw, which is considerably to the south of Sadon, a *large* form occurs with cell and base of forewing entirely black, and base of hindwing yellow; the marginal area of hindwing is not clear yellow but dusted with dusky bluish. Two males were taken in June (wet season). I propose calling this form **splendens**, s.sp. nov.

Further south, at Maymyo, N. Shan States, a slightly different form occurs; two specimens taken in June and September (wet season) are very much smaller, and in addition to having the cell and base of forewing black, the base of the hindwing is also black. Two specimens taken at the same place, one in February (dry season) and the other undated, but probably a dry season form, are slightly larger; the body and cell of forewing are black, but the cell has a small pale diffuse spot in it, and the base of both wings is only slightly dusted with black. The marginal area of hindwing is clearer yellow than the above form *splendens*, Tyt.

From further south and east I have received two specimens from Loimwe close to the Siam border, taken in July (wet season), which are very similar to the form from Maymyo with cell and base of forewing entirely black, and with a slight dusting of black on base of hindwing. Still further south, of ten males and one female from the Karen Hills, two have the cell and base of forewing entirely black, and the remainder have the cell black with a large whitish suffused patch against the lower edge of the cell; these have the base of the forewing only slightly dusted with black, and one male and the female have no dusting of black at all. The abdomen of all these is *greyish yellow*, in only one is it *pure yellow*. The late Mr. G. E. R. Cooper informed me that still further south, in the Dawna Range, in the dry season, he has taken both *black-bodied* forms and *greyish yellow-bodied* forms but at different elevations.

It would appear that the Karen Hills form is very close to *Eriboea e. nigrobasalis*, Lathy, but without seeing the type I am unable to say whether they are identical or not; but the black-bodied forms from Maymyo and Loimwe are certainly not *nigrobasalis*, Lathy and will require a new name. I propose the name **chota**, s.sp. nov. for this form. Type ♂, Maymyo.

Eriboea eudamippus jamblichus, Fruhst.

The type is given as from Tenasserim, but without further precise locality; Fruhstorfer, in his description, states:—

'Males from Tenasserim in my collection are smaller than males of the dry season period from Sikkim, and do not show any blue bordering at all on the proximal part of the submarginal catenary band of the hindwings which is copiously provided with very large pupils.'

I have seen no Karen Hills nor Dawna Range specimens which agree with this description, but I have seen specimens from Tavoy and Mergui, in the late Mr. G. E. R. Cooper's collection, which do agree, and it seems probable that *E. e. jamblichus* only occurs in the extreme south of Burma.

Apatura cooperi, Tytler.

There are two broods of this insect; the spring brood, flying in May and June, and the autumn brood, in October and November. The latter seasonal form is the more plentiful.

The two forms do not differ.

Apatura ulupi kalawrica, Tytler.

There are two broods of this form; the spring form, flying in May and June, and the autumn form, in September and October.

A male taken at Maymyo is a melanic aberration with the yellow markings dusted with black.

Apatura ulupi mai, s.sp. nov.

A single male taken at Loimwe, S. Shan States, differs from *Ap. ulupi florenciae,* Tytl. as follows:—

Upperside: darker brown and not so tawny. Forewing with all the yellow markings smaller and more round. Hindwing with all the yellow markings very small and indistinct; a well defined row of macular terminal yellow spots as in *Ap. u. florenciae,* Tytl. but darker; the subterminal row of blackish spots obsolescent and very indistinct. Apex of forewing and tornus of hindwing much blunter and not nearly so much produced. The differences are well marked and although only a single male was taken, I consider it is a good local race. Its occurrence at Loimwe extends the range of the collective species a considerable way to the east. It appears to be very rare.

Apatura parvata burmana, s.sp. nov.

Male: Larger than *Ap. parvata,* M., from Bhutan and the Naga Hills, of which I have a large series before me.

Upperside: darker, with yellow markings more distinct; the band on the hindwing much broader and better defined.

Underside: darker, all black markings more defined; discal band broader as on upperside.

Hindwing: tornus more produced.

Six males were taken at Htawgaw and Sadon, N.-E. Burma, from June to September.

A ♂ paratype is deposited in the British Museum.

Euripus halitherses, Doubl.

Brig. Evans gives four forms of females, namely:—

♀ *v. isa,* M. as typical form; outer half upper hindwing brown.

♀ *v. nyctitius,* Db. Upper forewing dark brown with apex broadly suffused bluish. Upper hindwing all dark brown.

♀ *v. cinnamoneus,* W.-M. As last, but upper hindwing outwardly with white streaks.

♀ *v. alcathaeoides,* de N. As *nyctitius* but upper forewing all dark brown.

In the large series of females before me I notice the following subdivisions:—

♀ *f. isa,* M. *1st form*: typical. *2nd form*: hindwing very white, almost extending over the whole wing. *3rd form*: as 2nd form, but darker and white area, which extends to termen, well-defined with brown streaks along the veins.

♀ *f. cinnamoneus,* W.-M. *1st form*: white streaks on hindwing restricted to the terminal area. *2nd form*: white streaks more extensive, and produced inwardly to the discal area. *3rd form*: as in 2nd form but apex of forewing suffused with violet.

Penthema lisarda, Doubleday.

Fruhstorfer gives the range of this species as Sikkim to Assam, and that of the form *T. mihintala,* Fruhst. as the Chin Hills.

Brig. Evans extends the range of the species to Manipur, probably based on specimens taken by myself, 1911-1914.

Fruhstorfer separated the form from the Chin Hills as being larger than Sikkim forms, the colour of the underside being dull brown and not red brown, and the spots in the cell being rounder and the internervular strigae broader.

I have a large series of forms taken in the Abor Hills, foot of the Lushai Hills bordering on Cachar, Manipur and N.-E. Burma; also one male from the Arrakan Hills which agrees with Fruhstorfer's description of his *mihintala.*

All the other forms are intermediate in varying degrees between typical *lisarda,* Db. and *mihintala,* Fruh., those from the foot of the Lushai Hills being closer to *lisarda,* and those from Manipur and N.-E. Burma being closer to *mihintala.*

I have only one specimen before me from the Arrakan Hill tracts but have seen several in Mr. Cooper's collection; he kindly gave me the specimen referred to; this form is constant in the shade of colouring on the underside.

The occurrence of the collective species to N.-E. Burma extends its range considerably to the east.

Penthema darlisa, Moore.

The type came from the Thounguen forests in Upper Tenasserim.

Further North, in the Karen Hills and at Maymyo, Northern Shan States, a modified form occurs which appears to be constant. It differs in the following respects :—

Male and female. *Upperside.* Forewing with a long bluish-white streak in interspace 1, not broken into two spots as is generally the case in the typical form. *Hindwing* with discal row of spots not touching the internal streaks except in interspace 2; a round detached spot placed inwards to the discal spot in interspace 6, in the typical form replaced by a discal streak touching the outer spot.

Underside. As on upperside but discal spots on hindwing very small.

I propose the name **shania,** s.sp. nov. for this form.

To the south, in Tavoy, a very large and distinct form occurs.

Male and female. *Upperside* with all white markings large. Forewing with a long streak in interspace 1. *Hindwing* with discal streaks broad, and coalescing with the discal spots, forming one uninterrupted streak. *Underside,* as upperside except that some of the discal spots in 4, 5, 6 and 7 are sometimes clear of the discal streaks.

I propose the name of **cooperi,** s.sp. nov. for this race.

The late Mr. G. E. R. Cooper found this form as Kanbank, Tavoy, and kindly gave me a pair.

Penthema binghami, W.-M.

The late Mr. G. E. R. Cooper, in his large series, had several interesting forms of *binghami,* some of which were intermediate between the various named forms :—

(*a*) *The typical* form from Dawnas with small spots on fore and hindwings.

(*b*) *P. binghami merguia,* Evans, from Ataran Valley, with spots on forewing small and discal streaks on hindwing joined to terminal spots.

(*c*) An intermediate form, from Hangatharaw, in which the spots on forewing are the same as (*b*) but much larger than in (*a*); the two discal streaks near the tornus are joined to the submarginal spots.

Euthalia flora cooperi, s.sp. nov.

Specimens of *E. flora,* Butl., taken by the late Mr. Cooper in the Ataran Valley, have the borders on the upperside pinkish-violet and not blue, and are very close to the form of *salangana,* Fruh. which occurs on the Western Coast of Siam opposite the Nicobars, the only difference being that the border is not so broad. Typical *E. flora andersoni,* M. has a blue border, and occurs further south.

It is better to consider *E. andersoni* as a race of *E. flora,* Butl. than of *E. lepidea,* M.

Euthalia julii anisakani, s.sp. nov.

Male : Wet season form very like *Eu. julii xiphiones,* Butl. on the upperside, but on the underside the two discal rows on forewing are rather farther apart, and the inner spot in 4 is not so bent outwards and out of line.

The dry season form is much smaller and paler. Female. *Upperside* rather similar to *E. julii adima,* M. female. *Underside* very similar to the female of *E. julii xiphiones,* but as in the male the two brown discal lines are rather further apart, and the inner spot in 4 not so outwardly thrown out of line and so placed further from the outer spot.

A male and female of the autumn form, taken in December, is as large and dark as the w.s.f., but all the markings on the underside are obliterated.

Types : male and female, Anisakan, N. Shan States. Several specimens were also taken in Maymyo.

Euthalia kesava maymyoensis, s.sp. nov.

Types : Male and female. Maymyo, N. Shan States.

Brig. Evans gives the habitat of *E. kesava kesava,* M. as Assam—N. Burma and of *E. kesava discispilota,* M. as Bhamo—S. Burma. Besides males before

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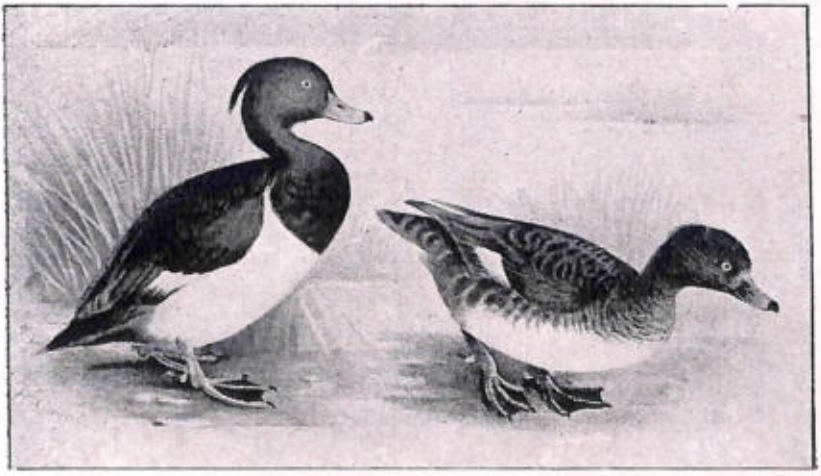

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me I have a female from Bhamo and one from the Upper Chindwin which are certainly not *discispilota*, M.; the female is quite different.

The male is similar to *E. kesava kesava*, M. and to *E. kesava discispilota*, M.

Female. Much smaller than the former and slightly so than the latter. It is nearer to *E. kesava kesava*, M. than to *E. kesava discispilota*, M., but differs from the former as follows:—

On the *upperside* both wings with discal grey area extending well over the submarginal line; submarginal line not so crenulate.

Underside: submarginal line as on upperside. The specimen taken on the Upper Chindwin is not typical but nearer to this form than to *E. kesava kesava*, M. Specimens of the ♀ taken at Sadon, N.-E. Burma, are typical *E. kesava kesava*, M.

Euthalia eriphylae, de Nicév.

There has been a good deal of confusion regarding de Nicéville's insect.

Bingham placed it under *Euthalia apicalis*, Voll., and Brig. Evans considered it to be a race of *Eu. merta* M.

E. eriphylæ de N., according to Fruhstorfer, was based by de Nicéville on males of two different species, namely true *Eu. eriphylæ* de N., figured by de Nicéville himself, and *on E. apicalis*, Voll., or rather on *Eu. merta*, M., the Tenasserim form of *apicalis*, Voll.

According to Bingham de Nicéville described and figured the female of *Eu. eriphylæ*, erroneously as *Eu. binghami*, de N. This statement I do not consider to be correct as de Nicéville's fig. of *Eu. binghami* does not agree with a large series of females of *Eu. delmana*, Swinh., the Assam form of *Eu. eriphylae*, de N. (the Burma form) and which are undoubtedly the females of that species.

The females of *Eu. eriphylæ delmana*, Swinh. can easily be recognised by the shape of the submarginal dark band on the upperside of the forewing; this band is *not* parallel to the termen but inwardly bent in the middle in the same way as it is in the male. de Nicéville's fig. of the male clearly shows the shape of this band.

So de Nicéville's figure and determination of the female of his *binghami* must be assumed to be correct until proved to the contrary.

Eu. merta, M. is a distinct species and has nothing to do with *Eu. eriphylæ*, de N.

The males of *Eu. eriphylæ*, de N., dry season form, differ from the dry season form of *Eu. delmana*, Swinh. in having the apex of the forewing and tornus of the hindwing more pointed. The *upperside* is not so dark and all the pale markings are still paler, especially along the termen of both wings. The pale terminal area of the hindwing has a series of detached dark spots, whereas in *delmana* these spots coalesce and form a continuous dark brown band. *Underside* darker, otherwise the same.

Female. The single d.s.f. ♀ of *Eu. eriphylæ*, de N. in the British Museum, taken at Pattechaung in the Karen Hills in March 1926, and kindly sent to me on loan for examination, differs considerably from the d.s. forms of *delmana* now before me from the Naga Hills.

Upperside. Much paler; the white sub-apical markings of forewing nearly pure white instead of being sullied or pale brown; submarginal band on hindwing slightly paler on its inner edge, and inwardly the crescents are more pointed.

Underside very pale; the bluish suffusion which almost covers the hindwing is carried into the base of the forewing and into the cell. In *delmana* this bluish suffusion is confined to the lower half of the hindwing and does not extend to the forewing except slightly into the cell.

The wet season males of *delmana* are darker above than the dry season forms, and all the dark markings below are more prominent.

The wet season females are much darker above; the underside is also darker and the bluish suffusion is more vivid.

In the British Museum there is a fair series of dry season males and one female of true *E. eriphylæ*, de N., from Lower Burma, and two males and one female of *Eu. delmana*, Swinh., including ♂ and ♀ types from the Khasi Hills.

Of *Eu. delmana*, Swinh., there are before me, in my collection, four males and five females of the wet season form and thirteen males and six females of the dry season form. It is very rare in the Naga Hills and apparently also rare in the Khasi Hills.

Eu. eriphylæ, de N., also appears to be very rare in Lower Burma.

Two males and a female from the Naga Hills have been deposited in the British Museum.

Euthalia duda amplifascia, s.sp. nov.

Male: *Upperside* with white discal band on both wings very much broader than in the typical form, as broad as in *D. durga*. Forewing with discal band continuous and not macular as in *D. duda*, Stgr. *Underside* with ground-colour and all markings darker.

The type was taken at Sadon, N.-E. Burma, at about 6,000 ft., in July.

Euthalia durga splendens, Tytler.

Two specimens of this very rare form were taken at Sadon, N.-E. Burma, in July, at about 6,000 ft.

Euthalia nara, Moore.

Moore's type was described from Sikkim; the collective species extends over a large area and is represented by local forms as far East and South as the Shan States, Burma.

Evans, in his *Ident. Ind. Butt.*, has separated the form from Loimwe, S. Shan States, under the name *shania*, based on the colour of the male which he describes as bright dark green instead of bronze olive-green as in Sikkim males. He does not mention the female.

The males of the various local races are hard to describe in writing but can readily be seen when series of each form are placed side by side. The females, however, are different, and easily distinguishable.

I propose separating the form from the Naga Hills and Manipur and also the form from Kalaw in the northern portion of the S. Shan States. A single male from N.-E. Burma is again different, but until the female is found and a larger series of males obtained, it had better be placed with the Naga Hill form.

Euthalia nara nagaensis, s.sp. nov.

Male: *Upperside* darker bronzy green than Sikkim males, with all dark markings more conspicuous. Female: *Upperside* very bronzy, much more so than in Sikkim females. Forewing with discal white band narrower, especially in interspace 2, where it is very small. Hindwing with the two costal white spots obsolescent and blurred, not white and clear as in the typical form. *Habitat*:—Naga Hills and Manipur.

Euthalia nara kalawrica, s.sp. nov.

Male: *Upperside* with all dark markings more conspicuous than in the Sikkim form. Hindwing with the apical yellow patch smaller, with the discal green area dividing it in two and reaching the costa. Female: *Upperside* brighter green and dark markings more distinct, as in male. Forewing with the discal transverse white band much broader, except in interspace 2, where it is much smaller. *Habitat*:—Kalaw, northern portion of the S. Shan States.

Euthalia nara shania, Evans.

Type, Loimwe, S. Shan States.

As Evans' description, in his *Ident. Ind. Butt.*, is rather scanty, and only refers to the male, I am giving a fuller description based on a large series of both sexes.

Male. *Upperside*, as stated by Evans, brighter green. All dark markings more conspicuous than in the typical form. Hindwing with discal yellow area larger, the green discal colour just entering interspace 6.

Female. *Upperside* rather darker than the Sikkim form, with all dark markings more conspicuous. Forewing with the white discal band similar, but the spot in 2 much smaller. Hindwing with the two costal white spots, in 6 and 7, completely absent or only one minute spot in interspace 6 sometimes present.

Males are common; the females very rare.

Euthalia narayana, Gr.-Sm.

The type, a ♀, was taken in the Ruby Mines, in the Bhamo Hills.

It also occurs commonly in the Naga Hills, rarely in Manipur, rarely in the extreme N.-E. of Burma; side by side with races of *E. sahadeva*, M. it also occurs throughout the S. Shan States.

At Loimwe, in the extreme S.-E. of the S. Shan States, it occurs commonly with *E. sahadeva* which, however, is very rare.

There has been some confusion about this form, and it has been considered by some authors to be a race of *E. sahadeva*, M. As the two forms occur together over a great part of their range I think it better to give *E. narayana*, Gr-Sm. specific rank.

This form is represented in my collection by 13 ♂♂ and 14 ♀♀ from the Naga Hills; 1 ♂ and 2 ♀♀ from Manipur; a pair from extreme N.-E. Burma; 5 ♂♂ and 4 ♀♀ from Maymyo, N. Shan States; 6 ♂♂ and 3 ♀♀ from the Kengtung State, extreme east of the S. Shan States. It is curious that both *sahadeva nadaka* and *narayana*, which occur commonly side by side in the Naga Hills, are rare in the adjoining Hills of Manipur.

Euthalia sahadeva, Moore.

The following notes are tentative and are based on 30 ♂♂ and 35 ♀♀ in my collection and now before me.

The collective species has been divided up into three subspecies:—

E. sahadeva sahadeva, M.	type, ? Bhutan; Sikkim.
E. ,, *nadaka*, Fruh.,	type, Khasi Hills.
E. ,, *narayana* Gr.-Sm.,	type ♀, Ruby Mines, N. Burma.

There is no difficulty in recognising the Sikkim-Bhutan form, *E. sahadeva sahadeva*, M., in which the males have all the markings large and yellowish-white, and on the hindwing the post-discal series of six spots extending to interspace 2. The female is much larger than the male; upperside dark bronzy-green; discal band on forewing white, and hindwing with one subcostal white spot in 6.

There should also be no difficulty in recognising *E. sahadeva nadaka*, Fruh., from the Khasi Hills, which Fruhstorfer describes as ♂, on both sides darker leaf-green than specimens from further west; hindwing with *three*, instead of *six*, white discal spots.

Female, as figured by Moore, with no white spots on hindwing.

I have no males before me from the Khasi Hills, and only two females: these differ from Moore's fig. in one having one small white subcostal spot in 6 on upper hindwing and the other having three spots in 5, 6 and 7; otherwise similar to the female from Sikkim.

This form extends into the Naga Hills and Manipur where it differs slightly in the male having very occasionally one or two additional discal spots below the upper three; in the female the number of spots on the hindwing may be one or two, or they are entirely obsolescent.

Of this form there are before me 27 ♂♂ and 9 ♀♀ from the Naga Hills, and one male from Manipur.

Euthalia sahadeva thawgawa, s.sp. nov.

A third form of *sahadeva*, which I propose calling as above, occurs at Hthawgaw, N.-E. Burma. Both sexes are darker than the Naga Hills specimens, and the female is brighter green; the male has five discal spots on hindwing instead of three; the female has none.

There are also before me two females from the extreme S.-E. end of the S. Shan States; these agree with the females from Hthawgaw, but without seeing a male it is not certain whether they are the same or not. It is curious that I have received no specimens from intermediate areas, but they probably occur.

Euthalia lengba, s.sp. nov.

In the *J. B. Nat. Hist. Soc.*, Feb. 2nd, 1915, I recorded the capture of this species, in Manipur, erroneously under the name of *E. taooana*, M., which is, however, quite different.

Male. Smaller than *E. taooana*, M.

Upperside rather more yellowish, markings very similar, but discal band on forewing not so broad and spots narrower; spot in 3 not touching spot in 4. Hindwing with three post-discal spots, and one or two black white-centred spots in 3 and 4; the outer edge of these spots *convex*. *Underside* more greenish-yellow than *E. taooana;* marking very similar. In appearance it is between *E. taooana*, M., and the form of *confucius* described below.

Euthalia confucius sadona, s.sp. nov.

Male: very like *E. lengba*, Tytl., but upperside much darker green. *Upperside*. Forewing with post-discal band darker yellow; spot in 4 projecting outwards beyond spots on either side. Hindwing with three discal spots in 5, 6 and 7; no traces of spots below; spots in 5 and 6 excavated on the inner edges.

Underside. Forewing with conspicuous black subterminal band bordering the subcostal spots and reaching spot 2; inner edge of all the spots in the post-discal band edged with black; a large black area below the white spot in 2, with two small white dots in the middle. It differs from *E. confucius*, Leech, in being much smaller, with more pointed wings; the colour is much darker green on the upperside; the post-discal band on forewing is much narrower; no spot in 1. Hindwing with three post-discal apical spots.

Type ♂ from Sadon, N.-E. Burma, 16-7-1929, deposited in the British Museum. Also a male from Hthawgaw, N. Burma, 27-7-1927, in my collection.

Limenitis austenia purpurascens, Tytl.

This form occurs in N.-E. Burma as a variety of *L. austenia austenia*, M.; of four males secured, three are very close to typical *austenia*, M., and one is identical with typical *purpurascens*, Tyt., with the rosy purple colour very conspicuous.

Limenitis brunnea, s.sp. nov.

Male. *Upperside* dark brown, with paler brown discal and subterminal bands *parallel* to the outer margin; edges of the bands even. Forewing with a white apical spot as in *L. danava*, M. *Underside* very similar to *L. danava*, M., but darker; the outer edge of the subterminal band on hindwing even and not crenulate. Two males were taken at Konglu and Hthawgaw, N.-E. Burma. It appears to be very rare. A paratype has been deposited in the British Museum. There also are four males from Lingtsi, Bhutan, 6,500-7,500 feet, and one from the Mishmi Hills, 4,000 feet.

Limenitis zayla, Doubl.

A single male was taken at Hthawgaw N.-E. Burma. I believe this species has not been recorded from Burma.

Limenitis oberthüri rileyi, s.sp. nov.

Male. *Upperside* very similar to *Hestina oberthüri*, Leech, from W. China but all the pale grey streaks between the veins broader. *Underside* ground colour reddish-brown and not grey-brown as in *oberthüri*, Leech. Forewing

with grey markings broader as on upperside and dusted over with darker grey. Hindwing with grey markings dusted with reddish-brown, broader in the cell and in 5, 6 and 7, getting very indistinct towards the tornus where the reddish-brown colour is superimposed.

I have much pleasure in naming this species after Capt. Riley who has afforded me the greatest assistance in working out my new form from Burma. Four males were taken at Hthawgaw, N.-E. Burma, in June. A male paratype is deposited in the British Museum.

Pantoporia sulpitia adamsoni, Moore.

This butterfly has, I believe, only been recorded from N. Burma, and I have taken it from Putao N.-E. Burma to Maymyo N. Shan States. I have also taken one ♂ at Pattechaung, Karen Hills. This extends its range a good deal further south. It must be very rare in the Karen Hills as Pattechaung has been systematically worked by numerous collectors.

Pantoporia zeroca whitei, s.sp. nov.

A single male taken at Fort White, Chin Hills, differs considerably from typical specimens from the Naga Hills and Manipur.

Upperside. Both wings with pale bands broader and broadly edged with greyish-blue. *Underside.* Forewing: the two apical spots are very narrow; the pale band in the cell has below it three dark vertical lines connecting this area with the lower edge of the cell. Hindwing post-discal band very narrow.

It is a very beautiful and distinct looking insect.

Pantoporia opalina shan, s.sp. nov.

Male and female differ from *P. opalina orientalis,* El., from the Khasi and Naga Hills, in being smaller; the markings on the upperside are pure white and not sullied; the white spot beyond the apex of cell of forewing, blunt and short, not long and narrow and pointed. On the underside the terminal and dorsal area of the hindwing not washed with violet as in *P. orientalis* and *P. opalina opalina,* Koll., from the N.-W. Himalayas.

It occurs commonly in the Northern and Southern Shan States.

Types, male and female from Maymyo. From the extreme N.-E. Burma there is before me a male which agrees with true *P. orientalis,* El., from the Naga Hills and Assam. ♂ ♀ paratypes are deposited in the British Museum.

Pantoporia punctata, Leech.

Four males of this species were taken in Hthawgaw, N.-E. Burma, in June. They only differ from Leech's figure in having the discal patch on the hindwing much larger.

This is an interesting capture as it has not been recorded within Burmese limits before.

Pantoporia jina jinoides, Moore.

A large series was obtained at Sadon N.-E. Burma. Some of the specimens were hardly separable from *P. jina,* M.

Neptis sankara guiltoides, s.sp. nov.

Male and female differ from *N. guilta,* Swinh., in having all the bands on the upperside purer white and not sullied with brown; the markings on the underside are broader, especially the submarginal pale band of the hindwing.

Numerous specimens of both seasonal forms were taken at Maymyo, N. Shan States; and also in the Karen Hills. Two females taken in August and October differ from others taken in October in the pale markings on the upperside being tinged with yellow, as is sometimes the case with *N. sankara guilta,* Swinh.

A curious aberration taken by Dr. Haynes, and kindly presented to me, is *very pale* sepia-brown on both upper and lower surfaces.

Specimens taken at Sadon, in the extreme N.-E. of Burma, are not typical but intermediate between this form and *guilta*, Swinh.

Paratypes ♂ and ♀, and the aberration noted above, have been deposited in the British Museum.

Neptis cartica cartica, Moore.

The range given for this insect by Brig. Evans in his *Ident. Ind. Butterflies* (2nd Ed.) is 'Sikkim-Assam' and of *N. cartica burmana*, de N., 'Assam-Burma'. I have a large series of both forms before me and find that no specimen of *burmana* has been taken further north than the Karen Hills; whereas the form occurring commonly from Manipur, through the Naga Hills, and N.-E. Burma to the S. Shan States is *N. cartica cartica*, M. *N. cartica burmana*, de N. does not appear to be so common as *N. cartica cartica*, M.

Neptis ananta learmondi, s.sp. nov.

Male. *Upperside* differs from *N. ananta ochracea*, Ev., in having all the yellow markings larger and of a brighter and lighter colour.

Underside. Forewing somewhat similar. *Hindwing* with discal band broader, and on its inner edge margined with blue from the dorsal margin to v. 5; the violet post-discal band is narrower, and the subterminal violet band is much broader.

Female. *Upperside* rich clear yellow; darker than the female of *ochracea*, Ev.; subterminal band very broad; somewhat similar in colour to the female of *N. ananta namba*, Tytl., but the subterminal yellow band broader.

Underside very similar to *N. ananta namba*, Tytl., but the subterminal band on hindwing much broader.

Fifteen males and a female were obtained at Loimwe, S. Shan States, by Capt. Learmond after whom I have much pleasure in naming this form.

Neptis ananta namba, Tytl.

A large series was obtained on the Putao Road, N.-E. Burma, in March.

Neptis melba gafuri, s.sp. nov.

In the *Journ. Bomb. Nat. Hist. Soc.*, 1915, p. 508, I erroneously recorded this form from the Naga Hills as *N. antilope*, Leech. I recorded how it differed from Leech's insect, and stated that in view of those differences it might prove to be a race of that species. It is very close to *N. melba*, Evans, and is undoubtedly a race of that form, from which it only differs in the *upperside* being yellow instead of white. The *underside* also differs in being yellow instead of whitish. The female is very similar to the male.

Neptis melba pila, s.sp. nov.

This form is very like *N. melba melba*, Ev., but the colour on the *upperside* is pale yellow and not white. It differs on the *upperside* from *N. melba gafuri*, Tytl., in the yellow colour being much paler; on the hindwing the post-discal yellow band broader. The *underside* is very similar to *N. melba melba*, Ev., but the colour is very pale yellowish.

Five males and two females were obtained at Loimwe, S. Shan States, in April, September, and December. A female was also taken in Bhamo in May. I think it better to consider *N. melba*, Ev., as a distinct species and not as a sub-species of *N. antilope*, Leech, to which insect it is very different in appearance.

♂ ♀ paratypes are deposited in the B. M.

Neptis aspasia, Leech.

A single ♂ was taken at Hthawgaw, N.-E. Burma, in July.

Neptis radha asterastilis, Oberthür.

The type in the Oberthür Collection came from Momeit, N. Shan States. It may be a dry season form. All the specimens I have seen from Burma, except two in the British Museum which agree with the type, are typical *radha*, M. Oberthür's fig. unfortunately accentuates the paleness and makes the ground-colour pale yellow, almost white in places, which is not the case in the type.

I have before me three ♂♂ from N.-E. Burma which are typical *N. radha*, M., and one ♂ from Bhamo, N. Shan States, and close to where the type came from; this is slightly paler on the upperside and may be considered to be *asterastilis*, Obrth.

Neptis zaida thawgawa, s.sp. nov.

Male. *Upperside* somewhat similar to *N. zaida drummondi*, Tyt., but the apical and submarginal spots on forewing are larger. Hindwing with discal band broader, and the submarginal band narrower. *Underside* markings somewhat similar to *N. zaida manipurensis*, Tytl., but the ground-colour is greenish-yellowish tinged with rufous. A single male was taken at Hthawgaw, N.-E. Burma, between 5,000 feet and 8,000 feet, in June.

Neptis beroë, Leech.

A single male was taken ot Loimwe, S. Shan States, in April 1928.

This is an interesting capture as this Chinese insect has not previously been recorded from Burma.

Doleschallia bisaltide kara, s.sp. nov.

Male. Rainy season form differs from *D. andamanensis*, Fruh., on the *upperside* in being rather darker; interspaces 2 and 3 in the forewing are concolorous with the rest of the wing and not paler as in that form; the black terminal area darker, extending as far as the tornus; the fulvous bar across the apex narrower and more diffuse, especially the portion in 4 and 5; four subapical white spots instead of three. Hindwing terminal area with two very distinct marginal lines, and two discal black spots large and more distinct.

Underside very dark, and all markings very prominent.

Dry season male above as in the wet season form; below very dark but markings not very prominent.

Female. The dry season form does not differ very much from the Andaman form, types form Car Nicobar, except that the underside is uniform light fulvous.

Vanessa cardui aureum, Linn.

A female was obtained on 16th December, 1924, at Loimwe, close to the Yunnan and Siam borders. It agrees entirely with specimens in the British Museum. It has not previously been recorded from Burma. Brig. Evans probably referred to this specimen in his '*Identification of Indian Butterflies.*'

Vanessa urticae chinensis, Leech.

Three males were taken at Hthawgaw in July. This is an interesting capture as it has not been previously recorded from Burma.

Araschnia prorsoides dohertyi, Moore.

A large series was obtained at Hthawgaw, N.-E. Burma, during July-October.

Symbrenthia brabira doni, s.sp. nov.

Male and female. *Upperside* with fulvous markings slightly broader. Specimens taken in May and June (dry season) are very like *S. brabira*, M., taken in June and August. *Underside* very similar, but the ground-colour

is not uniformly yellow and has some paler patches; the black markings are slightly heavier; the post-discal band has no blue centres on the yellow ground.

The wet season form, taken in August, is larger and darker, with narrower fulvous markings, otherwise similar. Types from the Naga Hills. It also occurs at Hthawgaw, N.-E. Burma.

Argynnis laodice indroides, s.sp. nov.

The form occurring in N.-E. Burma differs from the Khasi Hills form, *A. laodice rudra,* M., in the following respects:—

Upperside paler and spots smaller.

Underside of hindwing with subterminal pale pinkish band much broader.

Six males and one female were taken at Hthawgaw, N.E. Burma, in June, 1927.

Argynnis adippe astorica, s.sp. nov.

Male and female smaller and paler than *jainadeva,* M., above and below, but darker and larger than *pallida,* Ev. A large series was taken at Rama, Astor, in August.

Argynnis adippe gyala, s.sp. nov.

Male. *Upperside* rather similar to *jainadeva,* M. Female. Very like the male, but paler. *Underside* of hindwing with all silver spots large; in interspace 7 the third silver spot from base large and well separated from the fourth; an inner discal row of small silver spots above and close to the discal row.

Three males and a female were kindly given me by Col. Bailey, and were taken at Gyala, S.-E. Tibet, in July.

Argynnis pales hunzaica, s.sp. nov.

Male. *Upperside* with all markings on both wings much smaller and less pronounced than in *A. pales sipora,* M. *Underside* of forewing with no spots on disc of wing; a subapical brown streak pointing to the dorsum; below this there is a submarginal row of five small black spots in 6-2, the spots in 2 and 3 being more inwardly placed. Hindwing ground-colour more extensive and yellowish than in *A. pales sipora,* M.; submarginal spots blackish-red and conspicuous.

The hindwing is of a different shape to *sipora,* M., in *hunzaica* the termen is round; in *sipora,* M., it is rather straight from the apex to vein 4, and then sharply bent inwards to the tornus, giving the wing rather a square look.

Eight males and a female were taken by my native collectors at Mizgah, Hunza, in August.

ERYCINIDAE.

Dodona dipoea dipoea, Hew.

Two males were obtained at Hthawgaw, N.E. Burma. I believe this form has not previously been recorded from Burma.

Dodona dracon, de Nicév.

There are two forms of ♀ differing considerably from one another:—

1st form. A single female taken at Hthawgaw, N.-E. Burma, in September, only differs from the male from the same locality in being larger and all markings on uppersides and undersides being larger and paler.

2nd form. A single female taken at Bhamo, N. Shan States, in July, and a single female taken at Loimwe, in December, differ from the 1st form in being more ochreous-brown with all the pale markings being tinged with ochreous on the forewing, and very ochreous on the hindwing.

The males vary a good deal according to locality:—

Four males taken near Putao, extreme north of N.-E. Burma, are much smaller and form a separate subspecies.

Eighteen males, taken at Hthawgaw, N.-E. Burma; two males at Bhamo, N. Burma; and ten males taken at Loimwe, S. Shan States, agree with each other fairly closely; the form from Loimwe and Bhamo on the whole has the markings on the underside rather narrower than the form from Hthawgaw; the female from Hthawgaw however, as previously stated, differs from the female from Bhamo and Loimwe, and if this difference is constant the form from Hthawgaw will require a new name.

The type of *D. dracon*, de N., is stated by Fruhstorfer as coming from the Ruby Mines, N. Burma, which is a good deal south of Hthawgaw but much further north than Loimwe.

Dodona dracon putaoa, s.sp. nov.

Male. Much smaller than *D. dracon*, de N. Upperside markings very similar, except on the forewing the spots are fulvous and not white. *Underside* much warmer and darker reddish-ochraceous; markings rather broader.

As previously stated, four males were taken at Putao on the extreme north of N.-E. Burma. The female was not obtained.

Dodona adonira, Hew.

The collective species has been divided into two races, *D. adonira adonira*, Hew., from Sikkim-Bhutan, and *D. adonira argentea*, Fruh., from the Ruby Mines, N. Burma.

Fruhstorfer states that *argentea* differs from the Sikkim form in having a black base to forewing instead of a brown one, a much broader black distal border, and more extensive submarginal band. On underside, the long longitudinal bands are not black but brown; the space between the two submarginal bands and the two basal bands, as well as the subanal region, are covered with broad silvery stripes; also at the costal margin there is a square silvery spot.

I have not seen any specimens from the Ruby Mines where the type came from, and I have no forms which agree *altogether* with Fruhstorfer's description. The nearest locality to the Ruby Mines from which I have received a male is Bhamo, 120 miles away. This might be considered to be typical, except that it has not a black base to the fore and hindwings, but agrees with Sikkim specimens in this respect.

On the other hand I have before me numerous specimens from the Naga and Manipur Hills; from Hthawgaw, 150 miles North of Bhamo; and from the extreme S.-E. of the Shan States, about 300 miles S.-E. of the Ruby Mines, which vary a good deal and may form new subspecies.

Fruhstorfer considered specimens from the Naga Hills and Bernardmyo might be referable to his *argentea*. The Naga Hills are a very long distance from the Ruby Mines, whereas Bernardmyo is so close to the Ruby Mines that there can be no doubt specimens taken there by Doherty are typical; on the other hand specimens from the Naga Hills, as before stated, may form a new sub-species.

The following key will assist in separating the *adonira* from Assam, and the Burma forms of Fruh.

(*A*) *Upperside*: base of both wings brown and not as dark as the black margin of the forewing.

(*ai*) *Upperside*: very similar to *D. adonira* from Sikkim, but on the *underside* the markings are not quite so black, and the hindwing has the silvery markings of *argentea* but not quite so conspicuous.

Dodona adonira naga, s.sp. nov. Naga Hills, Manipur.

(*aii*) *Upperside*: fulvous markings broader and paler than the Sikkim form. *Underside*: all markings very narrow and fulvous.

D. adonira argentea, Fruh. Ruby Mines, Upper Burma.

(*B*) *Upperside*: base of both wings very dark, almost the same colour as the marginal border of forewing.

(*bi*) large; markings on underside narrow, and only slightly fulvous; silvery markings well developed.

D. adonira kala, s.sp. nov. Hthawgaw, N.-E. Burma.

(*bii*) smaller; markings of *upperside* similar. *Underside*: dark bands on both wings broader and markedly fulvous; silver spaces still more developed.

D. adonira learmondi, s.sp. nov. Loimwe, S. Shan States.

Abisara chela amplifascia, s.sp. nov.

The male differs from the typical form from Sikkim in having the white band on both sides of the forewing much wider.

Two males were obtained on the Irang River, Manipur, in March and April; fourteen males at Sadon, N.-E. Burma, in October—December; a male taken in the Abor Hills in July belongs to this form; it is a wet season form and the white band is slightly narrower but still very much broader than the Sikkim form.

LYCAENIDAE.

Allotinus drumila grisea, Riley and Godfrey.

The type was described from a single extreme dry season female from Siam, taken in April. A large series was obtained at Kalaw, S. Shan States, and at Loimwe on the extreme east of the S. Shan States, close to the Siam border.

The male is very close to the typical form, and only differs in the apical pale band not being so pure white. The females, taken at Kalaw in October, belong to the wet season, the ground-colour is brown and not whitish; those caught in November are transitional forms to the dry season form, and one specimen agrees entirely with the type.

Lycaena tseng mandersi, Elwes.

This form only differs from the typical form from China in the colour of the upperside which is much brighter.

Six males were obtained at Hthawgaw, N.-E. Burma, and a female in the Bhamo Hills. A male was also obtained in Kalaw, S. Shan States.

The type, a male, was taken at Bansan, Shan States.

Surendra learmondi, sp. nov.

Female. *Upperside* dark blackish-brown, with a large bright purple patch filling the cell and inner half of forewing and cell of hindwing; in one specimen the cell of hindwing has only a little blue towards its apex. *Underside* vinous-brown with purplish-black spots, mostly rectangular. Forewing with two spots in cell, with a costal spot over the outer one; a large spot closing the cell, with a spot above and below it; a post-discal row of six spots in echelon, those in 2, 4 and 6 being placed more outwardly than those in 3, 5 and 7. Hindwing with four basal round spots, followed by a discal and post-discal band composed of peculiarly shaped markings, hard to describe; a well defined lobe at tornus, and a fairly long and stout tail.

Expanse: ♀, 42 m.m.

Two females were obtained at Loimwe, S. Shan States, in June. It is a very distinct species and unlike anything I know.

Spindasis learmondi, sp. nov.

Male. *Upperside* very like *S. nipalicus evansi*, Tytl., but smaller tornal area of hindwing in two specimens, not marked with black spots, one specimen with a maroon spot; inner tail rudimentary, outer tail thicker and mostly maroon with a white tip. *Underside* plumbeous wine-colour; markings on outer margin inclined to be obsolescent, a maroon spot at tornus. This is a very distinct species and unlike anything I know; the underside is very distinctive. It agrees with *S. mascinus*, Elw. in having only the outer tail fully developed, the inner one being rudimentary.

Pratapa vidura vidura, Horsfield.

Mr. G. Cooper has taken in Mergui several specimens of a form which agrees with the type from Java. There is a specimen from Lower Burma in the B. M. over the label *P. burmana,* M., and there is also a specimen from Perak over the label *D. v. vidura,* Horsf.

It can easily be distinguished from *D. v. burmana* by the greater development of the orange spot above the inner tail of the hindwing.

It would appear that typical *vidura* extends to the extreme end of S. Burma, and *burmana* is from further north. The type of *burmana* was taken at Moulmein.

Tajuria luculentus luculentus, Leech.

Two males, which appear to be nearer the typical form than to *T. l. nela,* Swinh., were taken at Loimwe.

Tujuria mantra, Feld.

Two females of this rare form were taken at Maymyo in July.

Tujuria yajna ellisi, Evans, ♀.

The female, which I believe is undescribed, is very similar to the ♂, but on the upperside the blue is rather duller, and on the forewing is more extended; underside ground colour much paler.

Biduanda melisa cooperi, s.sp. nov.

Mr. G. Cooper took several specimens of a *melisa* which differ from typical specimens from further south in having the blue area on the hindwing dark purplish-blue as in *B. m. cyara,* Hew., and not bright shining blue. It appears to be a good race. Type ♂ from Maymyo, Anisakan.

There is a specimen in the B.M. taken by Mr. Godfrey in S.-E. Siam, in April, 1914.

N.B.—The location of the types of *Spindasis learmondi* and *Tajuria yajna ellisi* ♀, omitted by the author, cannot be given as the specimens are not available. The former probably came from Loimwe (G. T.).

A CONTRIBUTION TO THE FLORA OF THE PUNJAB PLAINS AND THE ASSOCIATED HILL REGIONS

BY

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The flora of the Punjab plains is closely related to the floras of the Indian desert and Sind and shows considerable similarity to the plant population of the latter.

The area dealt with is approximately enclosed by the lines joining the South-West end of the Punjab to Mianwali, from Mianwali to Gujrat, south of the Salt Range, and from Gujrat through Amritsar, Ludhiana and Saharanpur to the South end of the Punjab. It includes the following districts:—

Bahawalpur, Muzaffargarh, Multan, Mianwali up to Salt Range, Montgomery, Lyallpur, Jhang, Shahpur, Gujrat south of Salt Range, Gujranwala, Lahore, Amritsar, Ferozepore, Ludhiana, Patiala, Hissar, Jind, Nabha, Karnal up to railway-line, Ambala, Saharanpur, Rohtak, Gurgaon, (the Jumna to form the E. boundary of the regions).

The plants from the associated hill regions are also included to determine to what altitude the same species can grow.

The present contribution is compiled from the data obtained from the plant collections in the Herbarium of the Forest Research Institute, Dehra Dun. Original notes made by the several plant collectors are also incorporated. Localities mentioned under distribution are largely drawn from the Flora of the British India by Hooker. The Flora represents 118 families which include 530 genera and 949 species.

I wish to take this opportunity to thank Mr. C. E. Parkinson for facilities for studying the collections in the Herbarium of the Forest Research Institute, Dehra Dun.

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I. RANUNCULACEAE.

1. CLEMATIS *L.*

1. **Clematis Gouriana** Roxb. Hort. Beng. (1814), 43.

Locality.—Dalhousie (Drum. 66a !); Sindhiara in Chamba (66a !); Jhelum and Hoshiarpur (Ait. 436 !).
Flowers.—August-September.
Distribution.—Java, Philippines. India—hilly districts from the Western Himalaya, alt. 1-3,000 ft., to Ceylon and the Eastern Peninsula.

2. **Clematis grata** Wall. Cat. (1828), 4,668.

Locality.—Dalhousie (Drum. 4,586 !, 68 !, 67 !, 70 !).
Flowers.—May-September.
Distribution.—Afghanistan, China, Tropical Africa. India—subtropical and temperate Himalaya, from Kumaon westwards, alt. 2-8,000 ft.

3. **Clematis graveolens** Lindl. in Journ. Hort. Soc. I (1846) 307.

Locality.—Kunawar (Nanak 1138 !).
Flowers.—July-September.
Distribution.—India—W. temperate Himalaya, from Murree to Kulu and Kumaon, alt. 6-11,000 ft.

4. **Clematis Buchananiana** DC. Syst I (1818), 140.

Locality.—Dalhousie (Drum. 71 !).
Flowers.—August-November.
Distribution.—India—throughout temperate Himalaya, alt. 5-10,000 ft.

5. **Clematis flammula** L. Sp. Pl. 544.

Locality.—Lahore, gardens (Parker 13622 !, 13769 !).
Flowers.—June-September.
Distribution.—Mediterranean region,

2. THALICTRUM *L.*

6. **Thalictrum foliolosum** DC. Syst. I, 175.

Locality.—Dalhousie (Drum. 79).
Flowers.—August.
Distribution.—India—temperate Himalaya, alt. 5-8,000 ft.; Khasia Hills, alt. 4-6,000 ft.

3. RANUNCULUS *L.*

7. **Ranunculus aquatilis** L. Sp. Pl. 556.

Locality.—Rawalpindi (Ait. 333 !).
Flowers.—March.
Distribution.—Temperate N. and S. hemispheres. India—W. Himalaya, from Kumaon to Indus; plains of the Punjab, as far south as Delhi and Saharanpur. East and West Tibet.

8. **Ranunculus sceleratus** L. Sp. Pl. (1753) 551.

Locality.—Ludhiana (Drum. 1172 !); Karnal (Drum. 3020 !); Lahore (Stewart 2821 !); Rawalpindi.
Flowers.—January-April.
Distribution. Throughout the N. Temperate Zone. India—river banks in Bengal and Northern India; marshes of Peshawar, warm valleys of the Himalaya; (unknown south of the Nerbudda).

9. **Ranunculus pensylvanicus** Linn.

Locality.—Karnal (Drum. 4336 !, 6278 !).
Flowers.—August.
Distribution.—North China; Amurland; N. America. India.

10 **Ranunculus muricatus** L.

Locality.—Gurdaspur (Drum. 81 !); Lahore (Parker !); Rawalpindi (Ait. 306 !); Near Peshawar (Collett !).
Flowers.—February-April.
Weed in wet places.
Distribution.—Europe, W. Asia, temp. N. America.
India—swampy places, at low elevations, in the Punjab-Himalaya, and in the plains at Peshawar and Ambala.

11. **Ranunculus arvensis** L.

Locality.—Rawalpindi (Ait. 305 !); near Peshawar (Collett !).
Flowers.—February-April.
In wet places.
Distribution.—Europe, Asia Minor, Afghanistan, Western Siberia. India—Western Himalaya, from Kashmir to Kumaon.

4. DELPHINIUM *L.*

12. **Delphinium saniculaefolium.** Boiss. Fl. Orient I, 91.

Locality.—Rawalpindi (Ait. 307 !).
Flowers.—March.
Distribution.—Afghanistan. India—W. Punjab, on the dry hills from the Indus to the Jhelum.

13. **Delphinium denudatum** Wall. Cat. No. 4719.

Locality.—Dalhousie (Drum. 87 !).
Flowers.—July.
Distribution.—India—W. temperate Himalaya, from Kashmir to Kumaon in grassy places.

II. MAGNOLIACEAE.

5. MICHELIA *L.*

14. **Michelia Champaca** *L.*

Locality.—Hoshiarpur (Ait. 555 !).
Distribution.—Java. India—commonly cultivated; but wild in the forests of the temperate Himalaya, from Nepal eastwards, and in Pegu, Tenasserim and Travancore.

III. ANONACEAE.

6. UNONA *L.*

15. **Unona discolor** Vahl. Symb. II 63, t. 36.

Locality.—Lahore-Govt. Gdns. (Parker 13621 !).
Flowers.—June.
Distribution.—Malayan Archipelago (all the forms). India-Tropical forests from Sikkim, Assam and Silhet, to Arakan and Malacca, Orissa and Konkan.

7. Polyalthea *Bl.*

16. **Polyalthea longifolia** Benth & H. f. Gen. Pl. I, 25.

Locality.—Hoshiarpur (Ait. 552 !); Parker 14383.
Flowers.—May.
Distribution.—Drier parts of Ceylon. Cultivated throughout the hotter parts of India.

IV. MENISPERMACEAE.

8. Tinospora *MIERS.*

17. **Tinospora cordifolia** Miers. Contrib. iii, 31.

Locality.—Karnal (Drum. Herb. 6291 !).
Flowers.—April.
Distribution.—Throughout India from Kumaon to Assam and Burma, and from Bihar and Konkan to Ceylon and the Carnatic.

9. Cocculus *DC.*

18. **Cocculus Leaeba** DC. Prodr. I, 99.

Locality.—Rawalpindi (Ait. 175 !); Montgomery (Parker 6263 !); Changa Manga (Kanjilal !).
Flowers.—September; *Fr.*—November.
Distribution.—Afghanistan, Arabia, tropical and subtropical Africa. India—drier parts of Western India, the Punjab, Sind and the Carnatic.

19. **Cocculus villosus** DC. Prodr. I, 98.

Locality.—Karnal (Drum. 1647 !).
Flowers.—May.
Distribution.—Tropical Africa. Throughout tropical and subtropical India—from the base of the Himalaya to Malabar and Pegu (absent in the Eastern Peninsula and Ceylon).

10. Cissampelos *L.*

20. **Cissampelos Pareira** *L.*

Locality.—Karnal (Parker 1220 !, 1221 !); Rawalpindi (Ait. 717 !); Alt. 4,000-5,000 (Jerram !); Dalhousie (Drum. 90 !, 91 !).
Flowers.—August.
Distribution.—Cosmopolitan in warm regions. India—tropical and subtropical, from Sind and the Punjab to Ceylon and Singapore.

V. BERBERIDACEAE.

11. Berberis *L.*

21. **Berberis Lycium** Royle Ill. 64.

Locality.—Rawalpindi (Jerram !).
Flowers.—April.
Distribution.—India—Western Himalaya, in dry places, alt. 3-9,000 ft. from Gharwal to Hazara.

VI. NYMPHAEACEAE.

12. Nymphaea *L.*

22. **Nymphaea Lotus** L.

var. *pubescens* H. f. & T. Fl. Ind. 241.
Locality.—Rawalpindi (308 !).
Flowers.—August.

Distribution.—Africa, Hungary, Java, Philippine Islands. India—common throughout the warmer parts.

23. **Nymphaea stellata** Willd.

Locality.—Hoshiarpur (Ait. 289!).
Distribution.—Africa. India—common throughout the warmer parts.

13. NELUMBIUM *Juss.*

24. **Nelumbium speciosum** Willd.

Locality.—Rawalpindi (Ait. 421!).
Distribution.—Persia, Malay Islands, China, Japan, tropical Australia, India—throughout, extending as far to the N.-W. as Kashmir.

VII. PAPAVERACEAE.

14. PAPAVER *L.*

25 **Papaver Hookeri** Baker ex. Hook. f. Bot. Mag. t. 6729.

Locality.—Lahore (Stewart 2580!); Karnal (Drum. 6293!).
Flowers.—March.
Distribution.—India—Punjab.

15. ESCHSCHOLTZIA *CHAM.*

26. **Eschscholtzia californica** Cham. in Nees. Hor. Phys. Berol. 74.

Locality.—Islamia College Peshawar (Quizilbush 56!).
Distribution.—California.

VIII. FUMARIACEAE.

16. CORYDALIS *DC.*

27. **Corydalis cornuta** Royle Ill. 69.

Locality.—Dalhousie (Drum. 67, 69).
Distribution.—India—temperate Himalaya, alt. 8-10,000 ft.

17. FUMARIA *LAMK.*

28. **Fumaria parviflora** Lamk.

Locality.—Islamia College, Peshawar (Quizilbush 8!); Lahore (Parker 10!; Brandis 2954; Stewart 2832!).
Distribution.—India—Indo-Gangetic plain, lower Himalaya and Nilgiri Hills; a weed of cultivation.

IX. CRUCIFERAE.

18. NASTURTIUM *Br.*

29. **Nasturtium officinale** Br. in Hort. Kew. ed. 2 IV, 110.

Locality.—Rawalpindi (Ait. 176!, 312!).
Flowers.—September.
Has been introduced in Salt Range.
Distribution.—Afghanistan, temperate Europe and Asia. India—Rohilkhand, Punjab, also found near all the hill stations, but probably introduced.

30. **Nasturtium palustre** DC. Syst. Veg. II, 191.

Locality.—Rawalpindi (Ait. 1007!).
Flowers.—March. The fruit peculiarly large and bloated.

Distribution.—Many temperate regions. India—abundant in temperate Himalaya, ascending to 10,000 ft., and in N.-W. India, rare in Assam and Bengal.

19. Arabis *L.*

31. **Arabis taraxacifolia** Anders.

Locality.—Rawalpindi (Ait. 319!).
Flowers.—March.
Distribution.—India—Punjab.

20. Farsetia *DESV.*

32. **Farsetia Jacquemontii** H. f. & T. Journ. Linn. Soc. V, 148.

Locality.—Hissar (Duthie 38331); Multan (1886, Munro 29!, 61!, 185! 348!, Duthie 10784!), Punjab (Ait. 424!), Lahore (Stewart 2834!, 2610!. 2574!).
Flowers.—April-December.
Eaten as a tonic, small branches eaten raw. Chutney prepared from it.
Distribution.—Afghanistan, Baluchistan. India—sandy places in the Punjab and Sind.

21. Malcomia *Br.*

33. **Malcomia africana** Br. Hort. Kew. ed. 2 IV, 121.

Locality.—Rawalpindi (Ait. 315!); Lahore (Parker!; Stewart 2514!).
Weed in wheat crop.
Distribution.—W. Asia; Mediterranean region. India—fields and waste places in the Punjab, Kashmir and Western Tibet, ascending to 13,000 ft.

34. **Malcomia africana** Br.

var. *gracilis* O. E. Schulz.
Locality.—Muzaffargarh (Monro 161!).
Flowers.—March.
Eaten by cattle.
Distribution.—S. Europe; Orient.

35. **Malcomia strigosa** Boiss. Fl. Orient. I, 224.

Locality.—Rawalpindi (Ait. 316!, 160!).
Flowers.—Mach-July.
Distribution.—Afghanistan, Baluchistan, Persia. India—in the Salt Range, Punjab.

22. Sisymbrium *L.*

36. **Sisymbrium Thalianum** Gay & Monn. in Gaud. Fl. Helv. IV, 348.

Locality.—Dalhousie (Drum. 105!); Barrakow near Rawalpindi (Ait. 1142!).
Flowers.—March.
Distribution.—Temperate Europe, Asia, Abyssinia. India—temperate Himalaya from Bhotan to Kashmir, and in Western Tibet, alt. 5-10,000 ft.

37. **Sisymbrium rupestre** Edgew. in Trans. Linn. Soc. XX, 33.

Locality.—Peshawar (Quizilbush 391!).
Distribution.—India—in the dry regions of the Western Himalaya, from Kumaon to Kashmir, alt. 8-14,000 ft.

38. **Sisymbrium strictum** H. f. & T. Jour. Linn. Soc. V, 161.

Locality.—Dalhousie (Drum. 107!, 111!, 112!).
Distribution.—India—Western Himalaya from Kumaon to Kashmir, alt. 5-10,000 ft.

Distribution.—Africa, Hungary, Java, Philippine Islands. India—common throughout the warmer parts.

23. **Nymphaea stellata** Willd.

Locality.—Hoshiarpur (Ait. 289 !).
Distribution.—Africa. India—common throughout the warmer parts.

13. NELUMBIUM *Juss.*

24. **Nelumbium speciosum** Willd.

Locality.—Rawalpindi (Ait. 421 !).
Distribution.—Persia, Malay Islands, China, Japan, tropical Australia, India—throughout, extending as far to the N.-W. as Kashmir.

VII. PAPAVERACEAE.

14. PAPAVER *L.*

25 **Papaver Hookeri** Baker ex. Hook. f. Bot. Mag. t. 6729.

Locality.—Lahore (Stewart 2580 !); Karnal (Drum. 6293 !).
Flowers.—March.
Distribution.—India—Punjab.

15. ESCHSCHOLTZIA *CHAM.*

26. **Eschscholtzia californica** Cham. in Nees. Hor. Phys. Berol. 74.

Locality.—Islamia College Peshawar (Quizilbush 56 !).
Distribution.—California.

VIII. FUMARIACEAE.

16. CORYDALIS *DC.*

27. **Corydalis cornuta** Royle Ill. 69.

Locality.—Dalhousie (Drum. 97, 99).
Distribution.—India—temperate Himalaya, alt. 8-10,000 ft.

17. FUMARIA *LAMK.*

28. **Fumaria parviflora** Lamk.

Locality.—Islamia College, Peshawar (Quizilbush 8 !); Lahore (Parker 10 !; Brandis 2954; Stewart 2832 !).
Distribution.—India—Indo-Gangetic plain, lower Himalaya and Nilgiri Hills; a weed of cultivation.

IX. CRUCIFERAE.

18. NASTURTIUM *Br.*

29. **Nasturtium officinale** Br. in Hort. Kew. ed. 2 IV, 110.

Locality.—Rawalpindi (Ait. 176 !, 312 !).
Flowers.—September.
Has been introduced in Salt Range.
Distribution.—Afghanistan, temperate Europe and Asia. India—Rohilkhand, Punjab, also found near all the hill stations, but probably introduced.

30. **Nasturtium palustre** DC. Syst. Veg. II, 191.

Locality.—Rawalpindi (Ait. 1007 !).
Flowers.—March. The fruit peculiarly large and bloated.

Distribution.—Many temperate regions. India—abundant in temperate Himalaya, ascending to 10,000 ft., and in N.-W. India, rare in Assam and Bengal.

19. ARABIS *L.*

31. **Arabis taraxacifolia** Anders.

Locality.—Rawalpindi (Ait. 319 !).
Flowers.—March.
Distribution.—India—Punjab.

20. FARSETIA *DESV.*

32. **Farsetia Jacquemontii** H. f. & T. Journ. Linn. Soc. V, 148.

Locality.—Hissar (Duthie 38331); Multan (1886, Munro 29 !, 61 !, 185 ! 348 !, Duthie 10784 !), Punjab (Ait. 424 !), Lahore (Stewart 2834 !, 2610 !, 2574 !).
Flowers.—April-December.
Eaten as a tonic, small branches eaten raw. Chutney prepared from it.
Distribution.—Afghanistan, Baluchistan. India—sandy places in the Punjab and Sind.

21. MALCOMIA *Br.*

33. **Malcomia africana** Br. Hort. Kew. ed. 2 IV, 121.

Locality.—Rawalpindi (Ait. 315 !); Lahore (Parker !; Stewart 2514 !).
Weed in wheat crop.
Distribution.—W. Asia; Mediterranean region. India—fields and waste places in the Punjab, Kashmir and Western Tibet, ascending to 13,000 ft.

34. **Malcomia africana** Br.

var. *gracilis* O. E. Schulz.
Locality.—Muzaffargarh (Monro 161 !).
Flowers.—March.
Eaten by cattle.
Distribution.—S. Europe; Orient.

35. **Malcomia strigosa** Boiss. Fl. Orient. I, 224.

Locality.—Rawalpindi (Ait. 316 !, 160 !).
Flowers.—Mach-July.
Distribution.—Afghanistan, Baluchistan, Persia. India—in the Salt Range, Punjab.

22. SISYMBRIUM *L.*

36. **Sisymbrium Thalianum** Gay & Monn. in Gaud. Fl. Helv. IV, 348.

Locality.—Dalhousie (Drum. 105 !); Barrakow near Rawalpindi (Ait. 1142 !).
Flowers.—March.
Distribution.—Temperate Europe, Asia, Abyssinia. India—temperate Himalaya from Bhotan to Kashmir, and in Western Tibet, alt. 5-10,000 ft.

37. **Sisymbrium rupestre** Edgew. in Trans. Linn. Soc. XX, 33.

Locality.—Peshawar (Quizilbush 391 !).
Distribution.—India—in the dry regions of the Western Himalaya, from Kumaon to Kashmir, alt. 8-14,000 ft.

38. **Sisymbrium strictum** H. f. & T. Jour. Linn. Soc. V, 161.

Locality.—Dalhousie (Drum. 107 !, 111 !, 112 !).
Distribution.—India—Western Himalaya from Kumaon to Kashmir, alt. 5-10,000 ft.

39. **Sisymbrium Columnæ** Jacq. Fl. Austr. t. 323.

Locality.—Rawalpindi (Ait. 318!).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Western Himalaya from Kumaon to Kashmir, ascending to 10,000 ft.

40. **Sisymbrium Irio** L.

Locality.—Rawalpindi (Ait. 313!, 317!).
Flowers.—April.
Distribution.—Afghanistan and westwards to the Canary Islands. India—Northern India from Rajputana to the Punjab.

41. **Sisymbrium Irio** L.

var. *dissectum* O. E. Schulz.
Locality.—Lahore (Stewart 2575!, 2576!).

23. Brassica L.

42. **Brassica campestris** L.

Locality.—Rawalpindi (Ait. 320!).
Flowers.—February.
Distribution.—Cultivated for its seed for oil throughout India.

43. **Brassica alba** H. f. & T.

Locality.—Rawalpindi (Ait. 321!).
Flowers.—April.
Distribution.—From Syria eastwards throughout S. Europe. India—cultivated fields at Ferozepore in the Punjab.

24. Capsella *MOENCH.*

44. **Capsella Bursa-pastoris** Moench.

Locality.—Peshawar (Quizilbush 26!).
A weed of cultivation.
Distribution.—Cultivated places throughout temperate India.

25. Lepidium L.

45. **Lepidium sativum** L.

Locality.—Lahore (Parker 21038!; Stewart 2515!); Rawalpindi (Ait. 324!).
Flowers.—March.
Weed in wheat crop (Aitchison); but cultivated and spread, not indigenous.
Distribution.—Cultivated throughout India and Western Tibet.

46. **Lepidium Draba** L.

Locality.—Rawalpindi (Ait. 1012).
Distribution.—Westwards to Europe. India—a weed of cultivation in the Punjab.

26. Thlaspi L.

47. **Thlaspi arvense** L.

Locality.—Rawalpindi (Ait. 1015!).
Flowers.—March.
Distribution.—Europe, Asia, always in cultivated places. India—a weed of cultivation throughout the temperate and subalpine Himalaya, ascending to 14,000 ft.

27. NESLIA *DESV.*

48. Neslia paniculata Desv. Jour. III, 162.

Locality.—Rawalpindi (Ait. 323 !).
Flowers.—March.
Distribution.—Persia, Western Asia, temperate Europe. India—in the Punjab-Himalaya, from Hazara to the Beas; Kashmir, alt. 5-6,000 ft.

28. EUCLIDIUM *Br.*

49. Euclidium syriacum R. Br. in Hort. Kew. ed. 2, IV, 74.

Locality.—Rawalpindi (Ait. 1015 !).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Kashmir, alt. 5-6,000 ft., Punjab at Peshawar.

29. GOLDBACHIA *DC.*

50. Goldbachia laevigata DC. Syst. II 577.

Locality.—Rawalpindi (Ait. 325 !).
Flowers.—March.
Distribution.—Westwards to S. Russia. India—Kashmir, alt. 5,000 ft., common in the Punjab.

X. CAPPARIDACEAE.

30. CLEOME *L.*

51. Cleome papillosa Steud. Nomencl. ed. 2., I. 382.

Locality.—Rawalpindi (Ait. 573 !, 139 !).
Flowers.—August-October.
Distribution.—Abyssinia; Kordofan; Arabia. India—Rajputana and arid districts of Sind and Western Punjab.

52. Cleome brachycarpa Varl ex DC. Prodr. I, 240.

Locality.—Lahore (Stewart 2508 !); Hissar (Duthie 3837 !); Punjab (Ait. 196 !).
Flowers.—August.
Distribution.—Arabia, Abyssinia. India—N.-W. India from Agra to Peshawar.

53. Cleome viscosa L.

Locality.—Rawalpindi (Ait. 326 !); Lahore (Stewart 2507 !).
Flowers.—August.
Distribution.—Abundant throughout tropical and warm India and the rest of the world.

31. GYNANDROPSIS *DC.*

54. Gynandropsis pentaphylla DC. Prodr. I, 238.

Locality.—Rawalpindi (327); Multan (* Monro 65 !); Hissar (Duthie 3839 !).
Flowers.—June-August.
* Leaves collected and made into plaster for sores. Leaves and flowers eaten cooked.
Distribution.—Abundant throughout the warm parts of India and all tropical countries.

39. **Sisymbrium Columnæ** Jacq. Fl. Austr. t. 323.

Locality.—Rawalpindi (Ait. 318 !).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Western Himalaya from Kumaon to Kashmir, ascending to 10,000 ft.

40. **Sisymbrium Irio** L.

Locality.—Rawalpindi (Ait. 313 !, 317 !).
Flowers.—April.
Distribution.—Afghanistan and westwards to the Canary Islands. India—Northern India from Rajputana to the Punjab.

41. **Sisymbrium Irio** L.

var. *dissectum* O. E. Schulz.
Locality.—Lahore (Stewart 2575 !, 2576 !).

23. Brassica *L.*

42. **Brassica campestris** L.

Locality.—Rawalpindi (Ait. 320 !).
Flowers.—February.
Distribution.—Cultivated for its seed for oil throughout India.

43. **Brassica alba** H. f. & T.

Locality.—Rawalpindi (Ait. 321 !).
Flowers.—April.
Distribution.—From Syria eastwards throughout S. Europe. India—cultivated fields at Ferozepore in the Punjab.

24. Capsella *MOENCH.*

44. **Capsella Bursa-pastoris** Moench.

Locality.—Peshawar (Quizilbush 26 !).
A weed of cultivation.
Distribution.—Cultivated places throughout temperate India.

25. Lepidium *L.*

45. **Lepidium sativum** L.

Locality.—Lahore (Parker 21038 !; Stewart 2515 !); Rawalpindi (Ait. 324 !).
Flowers.—March.
Weed in wheat crop (Aitchison); but cultivated and spread, not indigenous.
Distribution.—Cultivated throughout India and Western Tibet.

46. **Lepidium Draba** L.

Locality.—Rawalpindi (Ait. 1012).
Distribution.—Westwards to Europe. India—a weed of cultivation in the Punjab.

26. Thlaspi *L.*

47. **Thlaspi arvense** L.

Locality.—Rawalpindi (Ait. 1015 !).
Flowers.—March.
Distribution.—Europe, Asia, always in cultivated places. India—a weed of cultivation throughout the temperate and subalpine Himalaya, ascending to 14,000 ft.

27. NESLIA *DESV.*

48. **Neslia paniculata** Desv. Jour. III, 162.

Locality.—Rawalpindi (Ait. 323 !).
Flowers.—March.
Distribution.—Persia, Western Asia, temperate Europe. India—in the Punjab-Himalaya, from Hazara to the Beas; Kashmir, alt. 5-6,000 ft.

28. EUCLIDIUM *Br.*

49. **Euclidium syriacum** R. Br. in Hort. Kew. ed. 2, IV, 74.

Locality.—Rawalpindi (Ait. 1015 !).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Kashmir, alt. 5-6,000 ft., Punjab at Peshawar.

29. GOLDBACHIA *DC.*

50. **Goldbachia laevigata** DC. Syst. II 577.

Locality.—Rawalpindi (Ait. 325 !).
Flowers.—March.
Distribution.—Westwards to S. Russia. India—Kashmir, alt. 5,000 ft., common in the Punjab.

X. CAPPARIDACEAE.

30. CLEOME *L.*

51. **Cleome papillosa** Steud. Nomencl. ed. 2., I. 382.

Locality.—Rawalpindi (Ait. 573 !, 139 !).
Flowers.—August-October.
Distribution.—Abyssinia; Kordofan; Arabia. India—Rajputana and arid districts of Sind and Western Punjab.

52. **Cleome brachycarpa** Varl ex DC. Prodr. I, 240.

Locality.—Lahore (Stewart 2508 !); Hissar (Duthie 3837 !); Punjab (Ait. 196 !).
Flowers.—August.
Distribution.—Arabia, Abyssinia. India—N.-W. India from Agra to Peshawar.

53. **Cleome viscosa** L.

Locality.—Rawalpindi (Ait. 326 !); Lahore (Stewart 2507 !).
Flowers.—August.
Distribution.—Abundant throughout tropical and warm India and the rest of the world.

31. GYNANDROPSIS *DC.*

54. **Gynandropsis pentaphylla** DC. Prodr. I, 238.

Locality.—Rawalpindi (327); Multan (* Monro 65 !); Hissar (Duthie 3839 !).
Flowers.—June-August.
* Leaves collected and made into plaster for sores. Leaves and flowers eaten cooked.
Distribution.—Abundant throughout the warm parts of India and all tropical countries.

32. Maerua *FORSK.*

55. **Maerua arenaria** H. f. & T.

Locality.—Hissar (Duthie 3840 !).
Flowers.—August.
Distribution.—India—Western Himalaya and Central India abundant.

33. Cadaba *FORSK.*

56. **Cadaba indica** Lamk.

Locality.—Lahore—Changa Manga. (* Parker 14877); Kanjilal !; Chatterji 129 !; Montgomery, Okara (Parker 4563 !).
Flowers.—November-January; Fr. January.
Distribution.—India—Western Peninsula, from Gujrat and the Konkan southwards, on old walls and in waste dry plains. * On unirrigated canal belt.

34. Capparis *L.*

57. **Capparis spinosa** L.

Locality.—Bashahr (18256 !, 18128 !, 17131 !, 18125 !); Jhelum (J. Prasad 32 ! alt. 2000); Rawalpindi (Ait. 177 !).
Flowers.—August-November.
Distribution.—Afghanistan, West Asia, Europe, N. Africa, Australia, Sandwich Islands. India—hot western Himalayan valleys eastwards to Nepal; West Tibet, ascending to 13,000 ft.

58. **Capparis aphylla** Roth.

Locality.—Multan (Ram Nath 47327 !); Fatehganj in Rawalpindi (Ait 328 !); Hissar (Duthie 3842 ! 4512 !); Lahore (Ram Nath 17952 !).
Flowers.—April-August; Fr. October to December.
Distribution.—Arabia, Egypt, N. tropical Africa. India—driest places in the Punjab, Sind, Gujrat, Rajputana, the Deccan and South Carnatic.

59. **Capparis sepiaria** L.

Locality.—Hissar (Duthie 3841 !, 3843 !); Karnal (Parker 1254 !).
Flowers.—August.
Distribution.—Philippines, Ceylon. Dry places throughout India, from the Punjab and Sind to Burma, the Carnatic and Pegu.

60. **Capparis horrida** L.

Locality.—Hoshiarpur (Ait. 565 !).
Distribution.—Java, Philippines, Ceylon. India—Gangetic plain, Western Peninsula, Chittagong to Pegu.

35. Crataeva *L.*

61. **Crataeva religiosa** Forst.

Locality.—*Jhelum* (Ait.).
Distribution.—Tropical Africa. India—near streams in Malabar and Canara; cultivated elsewhere in India.

XI. RESEDACEAE.

36. Oligomeris *CAMB.*

62. **Oligomeris glaucescens** Cambess.—in Jacq. Voy. Bot. 23, t. 25.

Locality.—Multan (Monro 247 !); Lahore (Stewart 2519 !); Hoshiarpur (Ait. 70 !); Rawalpindi (Ait. 697 !).

Flowers.—March-April.
Distribution.—Westwards to Spain and the Canaries. India—Sind, and the Punjab, from the Jumna eastwards, common; rare in the Konkan hills.

XII. VIOLACEAE.

37. VIOLA *L.*

63. **Viola Patrinii** DC. Prodr. I, 293.

Locality.—Peshawar, College (Quizilbash 34 !).
Distribution.—Afghanistan, N. Asia, Japan, Middle Russia. India—temperate Himalaya, alt. 4-8,000 ft. from Kashmir to Bhotan, Western Tibet, Khasia Hills, hills of the Western Peninsular, Ceylon.

64. **Viola serpens** Wall. in Roxb. Fl. Ind. ed. Wall. II 449 (not of Cat.) and in DC. Prodr. I, 296

Locality.—Hoshiarpur (Ait. 541 !).
Distribution.—Java, China. India—moist woods, etc., throughout temperate Himalaya, Khasia Hills, Pulney and Nilgiri Hills and Ceylon, alt. 5-7,000 ft.

65. **Viola cinerea** Boiss, Fl. Orient I, 454.

Locality.—Rawalpindi (Ait. 30 !).
Distribution.—Afghanistan, Persia, Arabia. India—dry hilly regions of the Punjab and Sind, common.

66. **Viola tricolor** L.

Locality.—Rawalpindi (Ait. 331 !); Lahore (Stewart 2822 !).
Flowers.—April. Cultivated. A garden escape.
Distribution.—Europe, Asia and N. America.

XIV. BIXACEAE.

38. FLACOURTIA *Comm.*

67. **Flacourtia Ramontchi** L' Hérit Stirp. 59, t. 30, 31.

Locality.—Kalesar, alt. 1,200 ft. (Lace 11 !).
Flowers.—March.
Distribution.—Madagascar, the Eastern Archipelago. India—Common throughout, wild or cultivated.

68. **Flacourtia Ramontchi** L' Hérit Stirp. 59, t. 30, 31.

var. *sapinda* H. f. & T.
Locality.—Hoshiarpur (Ait. 504 !); Gurdaspur (Bisram 850 !).
Flowers.—May.
Distribution.—India—common in the western Ghats and elsewhere in the Peninsula.

69. **Flacourtia sepiaria** Roxb. Cor. Pl. I, 48, t. 68.

Locality.—Lahore—Gardens (Parker 6252 !).
Flowers.—April.
Distribution.—Java. India—dry jungles throughout Bengal, the Western Peninsula; Ceylon.

39. XYLOSMA *FORST.*

70. **Xylosma longifolium** Clos. in Ann. Sc. Nat. Ser. 4, VIII, 231.

Locality.—Hoshiarpur (Ait. 597 !).
Distribution.—India—Western Himalaya on the outer ranges, ascending to 5,000 ft., from Kumaon to Murree; Assam: at Nowgang and Gowhatty.

40. ABERIA *HOCHST.*

71. **Aberia caffra** Harv & Sond. Fl. Cat. II, 584.

Locality.—Madhopur in Gurdaspur district (* Parker 14862 !, 14863 !).
Flowers.—March.
* A shrub 12 ft. high; dioecious.
Distribution.—South Africa.

XV. PITTOSPORACEAE.

41. PITTOSPORUM *BANKS.*

72. **Pittosporum floribundum** W. & A. Prodr. 154.

Locality.—Rawalpindi (6256 !, 6258 !); Bindaraban, Nurpur, Kangra District (6257 !); Kangra (21 !).
Flowers.—June-December.
Distribution.—Tolerably common along the range of the ghats in the Bombay Presidency; subtropical Himalayas.

73. **Pittosporum phillyraeoides** DC. Prodr. I, 347.

Locality.—Lahore—Gardens (Parker 11415 !).
Flowers.—February.
Distribution.—Australia.

74. **Pittosporum Tobira** Ait. Hort. Kew. ed. II, ii, 27.

Locality.—Lahore—Gardens (Parker 12966 !).
Flowers.—April.
Distribution.—Japan; China.

42. CITRIOBATUS *A. CUNN.*

75. **Citriobatus pauciflora** A. Cunn. in Lond. Hort. Brit. Suppl. I, 585.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38695 !).
Flowers.—April.
Distribution.—Australia.

XVI. POLYGALACEAE.

43. POLYGALA *L.*

76. **Polygala abyssinica** Fresen. in Mus. Senk. II 273.

Locality.—Rawalpindi, Barrakow to Tiete (Ait. 334 !).
Flowers.—September
Distribution.—Afghanistan; Abyssinia to Natal. India—subtropical and temperate Himalayas, alt. 3-8,000 ft., from Murree to Kumaon, Punjab at Multan.

77. **Polygala Hohenackeriana** Fisch. & Mey. Ind. Sem. Hort. Petrop. IV 42.

Locality.—Rawalpindi (Ait. 991 !).
Flowers.—July.
Distribution.—Afghanistan; Baluchistan; Persia; Caucasus. India—Western Punjab; Attock; Waziristan, ascending to 3,500 ft.

78. **Polygala erioptera** DC. Prodr. I 326.

Locality.—Maniniajra (Nanak 1275 !); Hissar (1288 !, 1287 !); Ludhiana (1276 !); Lahore (Stewart 2619 !).
Flowers.—March-April.
Distribution.—Kordofan; Baluchistan; Arabia; Tropical Asia and Africa. India—the Punjab; Sind; Rajputana; Bihar; the Western Peninsula; Ava; Burma.

79. **Polygala chinensis** L.

Locality.—Rawalpindi—Barrakow to Tiete (Ait. 333 !).
Flowers.—September.
Distribution.—Tropical Asia, Australia and Ceylon. India—throughout, from the Punjab to Pegu, and in the Western Peninsula.

XVII. CARYOPHYLLACEAE.

44. Gypsophila *L.*

80. **Gypsophila cerastioides** Don Prodr. 213.

Locality.—Dalhousie (Drum. 138 !); Lahore (Stewart 2907 !).
Flowers.—April.
Distribution.—India—temperate Himalaya from Kashmir and Kunwar to Sikkim, Alt. 6-12,000 ft.

45. Saponaria *L.*

81. **Saponaria Vaccaria** L.

Locality.—Lahore—Gardens (Parker 21032 !; Stewart 2542 !); Rawalpindi (Ait. 335 !).
Flowers.—March.
A weed of cultivation.
Distribution.—In wheat fields throughout India.

46. Silene *L.*

82. **Silene conoidea** L.

Locality.—Peshawar—Gardens (* Quizilbash 53 !); Lahore—(Stewart, 2918 !; Gdns-Parker 21029 !, 21030 !); Hoshiarpur (* Ait. 57 !); Rawalpindi (Ait. 336 a !); Barrakow in Rawalpindi (336 b !); Peshawar (22 !).
Flowers.—March-April.
* On this specimen may be seen both forms *conica* L. & *conoidea* L.
Distribution.—Westwards to the Atlantic Ocean. India—Western Himalaya; from Kumaon to the Indus, alt. 1-8,000 ft., and from Oudh to the Punjab in the Plains.

83. **Silene arenosa** C. Koch in Linnaea XV, 711.

Locality.—Peshawar—(Quizilbash 30 !); Rawalpindi—Hurror (Ait. 1021 !).
Flowers.—March.
Distribution.—Afghanistan; Persia; Armenia. India—Western Punjab, common at Peshawar, Attock.

84. **Silene Falconeriana** Benth. in Royle Ill. 79, t. 20.

Locality.—Dalhousie (Duthie 136 !).
Distribution.—India—Western Himalaya, from Kumaon to Kunwar, alt. 3-9,000 ft.

47. Stellaria *L.*

85. **Stellaria media** L.

Locality.—Lahore (Stewart 2544 !); Changa Manga (* Parker 21714); Lahore-Nowoagarh (Stewart 2993 !); Cachrah (Stewart 2914 !); Rawalpindi (Ait. 337).
* In most shady places. Completely covers the ground after good winter rain or cold weather irrigation.
Distribution.—Throughout the Punjab and temperate regions of India, ascending in the Himalaya to 12,000 ft. Ceylon, all Arctic and N. temperate regions; a doubtful native elsewhere.

48. ARENARIA *L.*

86. **Arenaria serpyllifolia** L.

Locality.—Hoshiarpur (Ait. 334!).

49. SPERGULA *L.*

87. **Spergula arvensis** L.

Locality.—Lahore—Gardens (Parker 21704!); Rawalpindi—Futtehganj (Ait. 1022!).
Flowers.—March-April.
Distribution.—Cultivated fields in various cool parts of India; and throughout the Northern hemisphere.

88. **Spergula pentandra** L.

Locality.—Lahore (Stewart 2586! 2587!); Lyallpur (Inayat 27!); Hoshiarpur (Ait. 577!).
Flowers.—March.
Distribution.—Cultivated fields in various cool parts of India; and throughout the Northern hemisphere.

89. **Spergula rubra** L.

Locality.—Lahore (* Stewart 2911!, 2588).
Flowers.—March.
* Named *S. pentandra* L. in the Brandis collection.
Distribution.—Europe.

XVIII. PORTULACACEAE.

50. PORTULACA *L.*

90. **Portulaca oleracea**

Locality.—Rawalpindi (Ait. 339!).
Flowers.—July.
Distribution.—Throughout India ascending to 5,000 ft. in the Himalayas; all warm climates.

XIX. TAMARICACEAE.

51. TAMARIX *L.*

91. **Tamarix Troupii** Hole in Indian Forester, 1919 XIV 248.

Locality.—Montgomery—Chichwatni (Parker 20781!, 20778!, 20782!, 20783!, 20779!, 20787!); Hoshiarpur (Ait. 625!); Ludhiana (Duthie 10791!).
Flowers.—September-December.
Distribution.—Orient. India.

92. **Tamarix dioica** Roxb. Hort. Beng. 22.

Locality.—Montgomery—Chichwatni (Parker 20513!, 20515!, 20518!, 20517!); Multan (Monro 36!; Duthie 10792!); Rawalpindi (Ait. 346!).
Flowers.—September-December.
Distribution.—India—from Rajputana, Sind and the Punjab to Assam, the W. Peninsula and Burma, near rivers and on the Sea Coast.

93. **Tamarix articulata** Vahl, Symb. II 48, t 32.

Locality.—Changa Manga (* Parker 21223!); Lahore (Parker 6048!; 38776!); Rawalpindi (Ait. 341!); Montgomery—Chichwatni (Parker 20522!; 20521!).
Flowers.—August-October.
* Small tree with nearly smooth bark.

Distribution.—Baluchistan; Algeria; S. Africa; Egypt; Arabia. India—very common, especially on Kalar soil throughout Sind, abundant in the Punjab.

94. **Tamarix Parkeriana** Hole. Vern. N. *Phitlai.*

Locality.—Montgomery—Chichwatni (Parker 20734 !, 20777 !, 20733 !, 20774 !, 20731 !, 20735 !, 20736 !, 20737 !, 20776 !, 20739 !, 20740 !).
Flowers.—September.

XX. ELATINACEAE.

52. Bergia *L.*

95. **Bergia aestivosa** W. & A. Prodr. 41.

Locality.—Lahore (* Parker 12971 !); Multan (Monro 225 !).
Flowers.—April; pink.
* Branches lying flat on the ground.
Distribution.—India—Punjab.

XXI. HYPERICACEAE.

53. Hypericum *L.*

96. **Hypericum cernuum** Roxb. Hort. Beng. 59.

Locality.—Dalhousie (Drum. 4827 !).
Distribution.—India—W. temperate Himalaya.

97. **Hypericum patulum** Thunb. Fl. Jap. 295.

Locality.—Dalhousie (Drum. 4834 !).
Distribution.—Japan; Formosa. India—throughout temperate Himalaya; Khasia Hills.

XXII. DIPTEROCARPACEAE.

54. Shorea *ROXB.*

98. **Shorea robusta** Gaertn. f. Fruct. III, 48, t. 186.

Locality.—Hoshiarpur (* Ait. 539 !).
* Quite wild.
Distribution.—Tropical Himalaya, and along its base from Assam to the Sutlej; Eastern districts of Central India, W. Bengal hills.

XXIII. MALVACEAE.

55. Althaea *L.*

99. **Althaea rosea** L. Cav. Diss. II, 91, t. 29. f. 3.

Locality.—Lahore (Stewart 2573 !).
Distribution.—Orient.

56. Sida *L.*

100. **Sida humilis** Willd.

Locality.—Jullandur (9727 !); Gurdaspur (Drum. 4633 !).
Flowers.—December.
Distribution.—Tropical Africa and America. Generally distributed throughout the hotter parts of India.

101. **Sida spinosa** L.

Locality.—Changa Manga (* Parker 15042 !).
Flowers.—October.
* Common; 2-3 occasionally 5 ft. high.
Distribution.—Tropical and subtropical regions of both hemispheres. Hotter parts of India, from the N.-W. Provinces to Ceylon, Rajputana, Sind.

102. **Sida grewioides** Guill. & Perr. Fl. Seneg. I, 71.

Locality.—Hoshiarpur (20698 !); (Duthie 3876 !); Pabbi Hills (Parker 24328 !).
Flowers.—October-December.
Distribution.—Baluchistan; Arabia; Tropical Africa. India—N.-W. Provinces, Rajputana, Sind.

103. **Sida rhombifolia** L.

Locality.—Rawalpindi (Ait. 344 !).
Flowers.—September.
Distribution.—Tropics of both hemispheres. Widely distributed throughout India.

104. **Sida cordifolia** L.

Locality.—Gurdaspur-Madhopur (Parker 14350 !, 14351 !, 1,000 ft.); Jullandur (Parker 9726 !).
Flowers.—November-February.
Distribution.—Generally distributed throughout tropical and subtropical India and both hemispheres. A tropical weed.

57. ABUTILON *GAERTN.*

105. **Abutilon indicum** G. Don. Gen. Syst. I 504.

Locality.—Gurdaspur (Drum. 152 !); Lahore (Parker 7876 !; Stewart 2956 !, 2828 !).
Flowers.—December-March.
Distribution.—Baluchistan and Tropics. India—Rajputana, Sind; Ceylon.

106. **Abutilon bidentatum** Hochst. in A. Rich. Fl. Abyss. I, 68.

Locality.—Hissar (Duthie 3875 !); Lahore (* Parker 7883 !, 7875 !).
Flowers.—August.
* A weed in the Government gardens.
Distribution.—Arabia; Tropical Africa. India—N.-W. Provinces, Sind, Punjab, Rajputana.

107. **Abutilon fruticosum** Guill. & Perr. Seneg. I, 73.

Locality.—Changa Manga (Parker 7886 !); Gurdaspur (Drum. 4630 !); Rawalpindi—Futtehgunj (Ait. 345 !).
Flowers.—August-November.
Distribution.—Tropical Africa; Arabia; Baluchistan; Java. India—Sind, Rajputana.

108. **Abutilon molle** Sweet Hort. Brit. ed. II, 65.

Locality.—Lahore (* 31 !).
* Beginning to run wild.
Distribution.—Peru.

58. URENA *L.*

109. **Urena lobata** L.

Locality.—Hoshiarpur (Ait. 505 !).
Distribution.—Tropics of both hemispheres. Generally distributed over the hotter parts of India.

59. Pavonia *CAV.*

110. **Pavonia** near **P. hastata** Cav. of S. America & Australia.

Locality.—Lahore—Gardens (6770 !).
Flowers.—December. Flowers white with a crimson centre.

60. Hibiscus *MEDIK.*

111. **Hibiscus Solandra** L 'Hér. Stirp. I, 103, t. 49.

Locality.—Dalhousie (Drum. 154 !).
Distribution.—E. Tropical Africa. Hotter parts of India, from the N.-W. Provinces to Sikkim, and from Kumaon and Burma to Ceylon.

112. **Hibiscus vitifolius** L.

Locality.—Lahore—Changa Manga (Parker 40714 !, 40715 !); Lahore Gardens (Parker 14864 !).
Flowers.—October-November.
Distribution.—Tropical Africa; Australia. Hotter parts of India from the N.-W. Provinces to Ceylon.

113. **Hibiscus cannabinus** L.

Locality.—Lahore (Stewart 2847 !).
Distribution.—Cultivated in most tropical countries. India—generally cultivated, apparently wild east of the Northern Ghats.

114. **Hibiscus Gibsoni** Stocks. Mss.

Locality.—Rawalpindi—Barrakow to Triete (Ait. 346 !).
Flowers.—September.
Distribution.—Afghanistan; S. Tropical Africa; N. Australia. India—Punjab, Sind, Deccan, Konkan.

115. **Hibiscus ficulneus** L. Sp. Pl. 695.

Locality.—Rawalpindi (Ait. 178 !).
Distribution.—Asia; Tropical Australia.

116. **Hibiscus tiliaceus** L.

Locality.—Lahore—Gardens (Parker 12961 !).
Flowers.—April.
Distribution.—Tropics of both hemispheres, usually near the coasts. India—Coasts of both Peninsulas, Bengal and Ceylon.

117. **Hibiscus Rosa-sinensis** L.

Locality.—Peshawar College (Quizilbash 57 !).
Distribution.—Cultivated in gardens throughout India.

118. **Hibiscus argentinus** Speg. in Bot. Agric. Buenos Aires I, 304.

Locality.—Lahore—Gardens (Parker 17190 !).
Flowers.—June.
Distribution.—Argentine.

61. Thespesia *CORR.*

119. **Thespesia populnea** Corr. in Ann. IX, p. 290.

Locality.—Punjab (Ait. 633 !).
Distribution.—Tropical Asia, the Pacific Islands; Africa. Tropical shores of Bengal, Ceylon and both Peninsulas.

62. KYDIA *ROXB.*

120. **Kydia calycina** Roxb. Hort. Beng. 50.

Locality.—Rawalpindi—Triete (Ait. 348 !).
Flowers.—September.
Distribution.—India—Tropical regions of the Himalaya, from Kumaon eastwards, and throughout the Western Ghats.

63. CHORISIA *H. B. & K.*

121. **Chorisia insignis** H. B. & K. Nov. Gen. & Sp. V, t. 485, f. 1.

Locality.—Lahore—Gardens (Parker 38856 !, 37123 !).
Flowers.—January.
Distribution.—Peru.

XXIV. STERCULIACEAE.

64. STERCULIA *L.*

122. **Sterculia diversifolia** G. Don Gen. Syst. I, 516.

Locality.—Lahore—Gardens (Parker 13795 !, 12950 !, 12951 !).
Flowers.—April; *Fruits.*—May.
Distribution.—Australia.

65. HERITIERA *AITON.*

123. **Heritiera macrophylla** Wall. ex. Voigt. Hort. Suburb. Calc. 103, nomen and ex Kurz, in Journ. As. Soc. Beng. XLII (1873), II, 61.

Locality.—Lahore—Gardens (Parker 14390 !).
Flowers.—May.
Distribution.—India; Burma.

66. HELICTERES *L.*

124. **Helicteres Isora** L.

Locality.—Rawalpindi—Barrakow (Ait. 179 !).
Flowers and Fruits.—September.
Distribution.—Java; N. Australia. Dry forests throughout Central and Western India, from Bihar, as far west as Jammu, the Western Peninsula and Ceylon.

XXV. TILIACEAE.

67. GREWIA *L.*

125. **Grewia oppositifolia** Roxb. Fl. Ind. II, 583.

Locality.—Rawalpindi (Parker 22416 !); Hoshiarpur (Ait. 273 !); Kangra (alt. 3000).
Flowers and Fruits.—October-February.
Distribution.—India—Common and indigenous, wild in the N.-W. Himalaya, from Jammu to Nepal, ascending to 7,000 ft.; also frequently cultivated.

126. **Grewia populifolia** Vahl.

Locality.—Rawalpindi (Ait. 352 !, 198 !); Hissar (Duthie 3881 !).
Flowers.—August.
Distribution.—Afghanistan; Baluchistan; Arabia; Tropical Africa; Mauritius. India—Punjab, Rajputana, Sind, W. Peninsula, Nilgiris, Konkan.

127. **Grewia salvifolia** Heyne in Roth Nov. Sp. 239.

Locality.—Rawalpindi (Parker 22415!; Ait. 180!).
Fruits.—September-December.
Disrtibution.—Tropical Africa. India—N.-W. Provinces, Rajputana, Sind, W. Peninsula.

128. **Grewia sapida** Roxb. Fl. Ind. II 590.

Locality.—Rawalpindi—alt. 3500 (Jerrum 7328!).
Distribution.—India—tropical Himalaya, from Gharwal to Bhotan and Assam.

129. **Grewia flavescens** Juss. in Ann. Mus. Par. IV (1804) 91 = pilosa.

Locality.—Lahore—Gardens (* Parker 13793!).
Flowers.—September.
* Grown from seed collected in Jaipur State.
Distribution.—Tropical Africa.

68. Corchorus *L.*

130. **Corchorus trilocularis** L. Mant (1767) 529.

Locality.—Rawalpindi—Fattehganj (Ait. 350!, 351!); Hissar (Duthie 3885!); Lahore (Stewart 2830!, 2957!, 2986!).
Fruits.—August-September.
Distribution.—Tropical Africa; Afghanistan. India—N.-W. Provinces, from Ambala to the Punjab, Rajputana, Sind, Nilgiri Hills.

131. **Corchorus Antichorus** Raesch. Nomencl. Bot. ed. III, 158.

Vern. N. *Biphali.*
Locality.—Lahore—(Cleghorn 2643!; Changa Manga 42604); * Multan (27!, Ait!; Munro 234!); Hissar (Harsukh 20683!, 20685!); Lyallpur (Inayat!).
Fruits.—September-December.
* Used as medicine to produce cold in the body. Fodder for goats only but not very good.
Distribution.—Afghanistan; Aden; Tropical Africa; Cape de Verde Isles. India—N.-W. Provinces, Rajputana, Sind, Western Peninsula, in Kathiawar, Gujarat, the Deccan.

132. **Corchorus acutangulus** Lam. Encycl II (1786) 104.

Locality.—Rawalpindi (Ait 179!).
Flowers.—September.
Distribution.—Australia; Tropical Africa; West Indies. India—Rajputana, Sind and hotter parts; Ceylon.

69. Tilia *L.*

133. **Tilia vulgaris** Hayne Arzn. Gew. III, t. 47.

Locality.—Kangra (Trevar 14395!).
Distribution.—Europe.

134. **Tilia cordata** Mill. Gard. Dict. ed. VIII. n. 1.

Locality.—Between Kata top and Dalhousie alt. 7000 (Parker* 21653!).
Flowers.—June.
* Several specimens growing wild on the northern slope.
Distribution.—Europe.

62. Kydia *ROXB.*

120. **Kydia calycina** Roxb. Hort. Beng. 50.

Locality.—Rawalpindi—Triete (Ait. 348 !).
Flowers.—September.
Distribution.—India—Tropical regions of the Himalaya, from Kumaon eastwards, and throughout the Western Ghats.

63. Chorisia *H. B. & K.*

121. **Chorisia insignis** H. B. & K. Nov. Gen. & Sp. V, t. 485, f. 1.

Locality.—Lahore—Gardens (Parker 38856 !, 37123 !).
Flowers.—January.
Distribution.—Peru.

XXIV. STERCULIACEAE.

64. Sterculia *L.*

122. **Sterculia diversifolia** G. Don Gen. Syst. I, 516.

Locality.—Lahore—Gardens (Parker 13795 !, 12950 !, 12951 !).
Flowers.—April; *Fruits.*—May.
Distribution.—Australia.

65. Heritiera *AITON.*

123. **Heritiera macrophylla** Wall. ex. Voigt. Hort. Suburb. Calc. 103, nomen and ex Kurz, in Journ. As. Soc. Beng. XLII (1873), II, 61.

Locality.—Lahore—Gardens (Parker 14390 !).
Flowers.—May.
Distribution.—India; Burma.

66. Helicteres *L.*

124. **Helicteres Isora** L.

Locality.—Rawalpindi—Barrakow (Ait. 179 !).
Flowers and Fruits.—September.
Distribution.—Java; N. Australia. Dry forests throughout Central and Western India, from Bihar, as far west as Jammu, the Western Peninsula and Ceylon.

XXV. Tiliaceae.

67. Grewia *L.*

125. **Grewia oppositifolia** Roxb. Fl. Ind. II, 583.

Locality.—Rawalpindi (Parker 22416 !); Hoshiarpur (Ait. 273 !); Kangra (alt. 3000).
Flowers and Fruits.—October-February.
Distribution.—India—Common and indigenous, wild in the N.-W. Himalaya, from Jammu to Nepal, ascending to 7,000 ft.; also frequently cultivated.

126. **Grewia populifolia** Vahl.

Locality.—Rawalpindi (Ait. 352 !, 198 !); Hissar (Duthie 3881 !).
Flowers.—August.
Distribution.—Afghanistan; Baluchistan; Arabia; Tropical Africa; Mauritius. India—Punjab, Rajputana, Sind, W. Peninsula, Nilgiris, Konkan.

127. **Grewia salvifolia** Heyne in Roth Nov. Sp. 239.

Locality.—Rawalpindi (Parker 22415!; Ait. 180!).
Fruits.—September-December.
Distribution.—Tropical Africa. India—N.-W. Provinces, Rajputana, Sind, W. Peninsula.

128. **Grewia sapida** Roxb. Fl. Ind. II 590.

Locality.—Rawalpindi—alt. 3500 (Jerrum 7328!).
Distribution.—India—tropical Himalaya, from Gharwal to Bhotan and Assam.

129. **Grewia flavescens** Juss. in Ann. Mus. Par. IV (1804) 91 = pilosa.

Locality.—Lahore—Gardens (* Parker 13793!).
Flowers.—September.
* Grown from seed collected in Jaipur State.
Distribution.—Tropical Africa.

68. Corchorus *L.*

130. **Corchorus trilocularis** L. Mant (1767) 529.

Locality.—Rawalpindi—Fattehganj (Ait. 350!, 351!); Hissar (Duthie 3885!); Lahore (Stewart 2830!, 2957!, 2986!).
Fruits.—August-September.
Distribution.—Tropical Africa; Afghanistan. India—N.-W. Provinces, from Ambala to the Punjab, Rajputana, Sind, Nilgiri Hills.

131. **Corchorus Antichorus** Raesch. Nomencl. Bot. ed. III, 158.

Vern. N. *Biphali.*
Locality.—Lahore—(Cleghorn 2643!; Changa Manga 42604); * Multan (27!, Ait!; Munro 234!); Hissar (Harsukh 20683!, 20685!); Lyallpur (Inayat!).
Fruits.—September-December.
* Used as medicine to produce cold in the body. Fodder for goats only but not very good.
Distribution.—Afghanistan; Aden; Tropical Africa; Cape de Verde Isles. India—N.-W. Provinces, Rajputana, Sind, Western Peninsula, in Kathiawar, Gujarat, the Deccan.

132. **Corchorus acutangulus** Lam. Encycl II (1786) 104.

Locality.—Rawalpindi (Ait 179!).
Flowers.—September.
Distribution.—Australia; Tropical Africa; West Indies. India—Rajputana, Sind and hotter parts; Ceylon.

69. Tilia *L.*

133. **Tilia vulgaris** Hayne Arzn. Gew. III, t. 47.

Locality.—Kangra (Trevar 14395!).
Distribution.—Europe.

134. **Tilia cordata** Mill. Gard. Dict. ed. VIII. n. 1.

Locality.—Between Kata top and Dalhousie alt. 7000 (Parker* 21653!).
Flowers.—June.
* Several specimens growing wild on the northern slope.
Distribution.—Europe.

XXVI. LINACEAE.

70. Linum *L.*

135 **Linum strictum** L. Sp. Pl. 279.

Locality.—Rawalpindi (Ait. 353 !).
Flowers.—May.
Distribution.—Mediterranean region; Orient.

XXVII. MALPIGHIACEAE.

71. Galphimia *CAV.*

136. **Galphimia gracilis** Bartl. in Linnea, XIII (1839) 552.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38775 !, 38774 !).
Flowers.—August.
Distribution.—Mexico.

72. Stigmaphyllon *A. JUSS.*

137. **Stigmaphyllon periplocæfolium** A Juss. in Arch. Mus. Par. III (1843) 380.

Locality.—Lahore—Gardens (Parker 12976 !).
Flowers.—April.
Distribution.—Western India.

73. Hiptage *GAERNTN.*

138. **Hiptage Madablota** Gaertn. Fruct. II, 169, t. 116.

Locality.—Hoshiarpur (Ait. 600).
Distribution.—China; Java. Throughout the hotter parts of India, from Jammu and Sind to Burma, Malacca and Ceylon.

XXVIII ZYGOPHYLLACEAE.

74. Tribulus *L.*

139. **Tribulus terrestris** L. Sp. Pl. (1753) 387.

Locality.—Lahore (Stewart 2679 !); (Cleghorn 2653 !); Hissar (Duthie 3887 a !); Multan (Monro 32 !); Rawalpindi (Ait. 355 !).
Flowers.—April-October.
Distribution.—Throughout the warm regions of the globe. Throughout India.

140. **Tribulus alatus** Del. Fl. Aegypt. Arab. III (1812) 62.

Locality.—Multan (Monro 196 !).
Distribution.—Egypt; Arabia; Nubia. India—Rajputana, Sind, Punjab.

75. Fagonia *L.*

141. **Fagonia arabica** L.

Locality.—Jullandar-Phillur (Parker 8152 !); Peshawar College (Quizilbash !).
Flowers.—February.
Distribution.—Throughout N.-W. India, Sind, the Punjab and the southern provinces of the Western Peninsula. Westwards to Egypt.

XXIX GERANIACEAE.

76. Monsonia *L.*

142 **Monsonia heliotropioides** Cav.

Locality.—Multan (Duthie 10795 !; Monro !).

Flowers.—December.
Distribution.—India—the Punjab, Rajputana, Sind. Westwards to Egypt.

77. GERANIUM *L.*

143. Geranium rotundifolium L.

Locality.—Rawalpindi—Barrakow & Hissar (Ait. 357 !); Hoshiarpur (Ait. 250 !).
Distribution.—India—the Punjab and W. Temp. Himalaya. Siberia and eastwadrs to Europe and N. Africa.

78. OXALIS *L.*

144. Oxalis corniculata L. Sp. Pl.

Locality.—Rawalpindi—Barrakow (Ait 358 !); Lahore (Stewart 2835 !).
Flowers.—April.
Distribution.—Cosmopolitan. Throughout the warmer parts of India and Ceylon, ascending the Himalaya to 700 ft.

145. Oxalis corymbosa DC. Prod. I, 696.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 21215 !); Lahore (Parker 21216 !).
Flowers.—February. Pink.
* Naturalized in moist shady places. Completely naturalized.
Distribution.—Madagascar.

146. Oxalis latifolia H. B. K. Nov. Gen. et. Sp. V, 237. t, 467.

Locality.—Punjab plains in irrigated places (Parker 19504 !).
Flowers.—July.
Distribution.—Mexico.

147. Oxalis Pes-caprae L. Sp. Pl. 434.

Locality.—Lahore (* Parker 21217 !, 21218 !).
Flowers.—March; Yellow.
* Quite naturalized in moist places. Sometimes cultivated with double flowers.
Distribution.—S. Africa.

79. AVERRHOA *L.*

148. Averrhoa Carambola L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13613 !); Hoshiarpur (* Ait, !).
Flowers.—June.
* Cultivated tree.
Distribution.—In gardens throughout the hotter parts of India as far north as Lahore. Native country unknown.

XXX. RUTACEAE.

80. RUTA *L.*

149. Ruta graveolens L.

Locality.—Rawalpindi (Ait. 354 !).
Flowers.—April.
Distribution.—Cultivated in India. Westwards to the Canaries.

81. PEGANUM *L.*

150. Peganum Harmala L.

Locality.—Rawalpindi (Ait. 359 !); Lahore (Cleghorn !; Stewart 2540 !).
Flowers.—April.

XXVI. LINACEAE.

70. Linum *L.*

135 **Linum strictum** L. Sp. Pl. 279.

Locality.—Rawalpindi (Ait. 353 !).
Flowers.—May.
Distribution.—Mediterranean region; Orient.

XXVII. MALPIGHIACEAE.

71. Galphimia *CAV.*

136. **Galphimia gracilis** Bartl. in Linnea, XIII (1839) 552.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38775 !, 38774 !).
Flowers.—August.
Distribution.—Mexico.

72. Stigmaphyllon *A. JUSS.*

137. **Stigmaphyllon periplocæfolium** A Juss. in Arch. Mus. Par. III (1843) 380.

Locality.—Lahore—Gardens (Parker 12976 !).
Flowers.—April.
Distribution.—Western India.

73. Hiptage *GAERNTN.*

138. **Hiptage Madablota** Gaertn. Fruct. II, 169, t. 116.

Locality.—Hoshiarpur (Ait. 600).
Distribution.—China; Java. Throughout the hotter parts of India, from Jammu and Sind to Burma, Malacca and Ceylon.

XXVIII ZYGOPHYLLACEAE.

74. Tribulus *L.*

139. **Tribulus terrestris** L. Sp. Pl. (1753) 387.

Locality.—Lahore (Stewart 2679 !); (Cleghorn 2653 !); Hissar (Duthie 3887 a !); Multan (Monro 32 !); Rawalpindi (Ait. 355 !).
Flowers.—April-October.
Distribution.—Throughout the warm regions of the globe. Throughout India.

140. **Tribulus alatus** Del. Fl. Aegypt. Arab. III (1812) 62.

Locality.—Multan (Monro 196 !).
Distribution.—Egypt; Arabia; Nubia. India—Rajputana, Sind, Punjab.

75. Fagonia *L.*

141. **Fagonia arabica** L.

Locality.—Jullandar-Phillur (Parker 8152 !); Peshawar College (Quizilbash !).
Flowers.—February.
Distribution.—Throughout N.-W. India, Sind, the Punjab and the southern provinces of the Western Peninsula. Westwards to Egypt.

XXIX GERANIACEAE.

76. Monsonia *L.*

142 **Monsonia heliotropioides** Cav.

Locality.—Multan (Duthie 10795 !; Monro !).

Flowers.—December.
Distribution.—India—the Punjab, Rajputana, Sind. Westwards to Egypt.

77. GERANIUM *L.*

143. Geranium rotundifolium L.

Locality.—Rawalpindi—Barrakow & Hissar (Ait. 357 !); Hoshiarpur (Ait. 250 !).
Distribution.—India—the Punjab and W. Temp. Himalaya. Siberia and eastwadrs to Europe and N. Africa.

78. OXALIS *L.*

144. Oxalis corniculata L. Sp. Pl.

Locality.—Rawalpindi—Barrakow (Ait 358 !); Lahore (Stewart 2835 !).
Flowers.—April.
Distribution.—Cosmopolitan. Throughout the warmer parts of India and Ceylon, ascending the Himalaya to 700 ft.

145. Oxalis corymbosa DC. Prod. I, 696.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 21215 !); Lahore (Parker 21216 !).
Flowers.—February. Pink.
* Naturalized in moist shady places. Completely naturalized.
Distribution.—Madagascar.

146. Oxalis latifolia H. B. K. Nov. Gen. et. Sp. V, 237. t, 467.

Locality.—Punjab plains in irrigated places (Parker 19504 !).
Flowers.—July.
Distribution.—Mexico.

147. Oxalis Pes-caprae L. Sp. Pl. 434.

Locality.—Lahore (* Parker 21217 !, 21218 !).
Flowers.—March; Yellow.
* Quite naturalized in moist places. Sometimes cultivated with double flowers.
Distribution.—S. Africa.

79. AVERRHOA *L.*

148. Averrhoa Carambola L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13613 !); Hoshiarpur (* Ait, !).
Flowers.—June.
* Cultivated tree.
Distribution.—In gardens throughout the hotter parts of India as far north as Lahore. Native country unknown.

XXX. RUTACEAE.

80. RUTA *L.*

149. Ruta graveolens L.

Locality.—Rawalpindi (Ait. 354 !).
Flowers.—April.
Distribution.—Cultivated in India. Westwards to the Canaries.

81. PEGANUM *L.*

150. Peganum Harmala L.

Locality.—Rawalpindi (Ait. 359 !); Lahore (Cleghorn !; Stewart 2540 !).
Flowers.—April.

Distribution.—Soongaria; Arabia; N. Africa, and Westwards to Hungary and Spain. N.-W. India from Sind, the Punjab and the Kashmir plain to Delhi and Agra; Western Deccan.

82. Zanthoxylum L.

151. **Zanthoxylum a'atum** Roxb. Fl. Ind. III, 768.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 37193 !, ** 38635 !).
Flowers.—January—April.
** This is identical with a thornless form which is common in China (Duthie).
* Zanthoxlyum introduced from Argentina as *Fagara Coco* Engl. but apparently not that species.
Distribution.—Hot valleys of the subtropical Himalaya, ascending to 6,000 ft. from Jammu to Bhotan; Khasia Hills, 2-3,000 ft.

83. Murraya L.

152. **Murraya exotica** L.

Locality.—Hoshiarpur (Ait. 548 !); Hoshiarpur Siwaliks (Mardanali !).
Probably indigenous (Duthie).
Distribution.—Throughout the hotter parts of India from Gharwal to Assam and Burma, and southwards to Chittagong, Travancore and Ceylon. Eastwards to China, Australia, and the Pacific Islands.

153. **Murraya Koenigii** Spreng. Syst. Veg. II, 315.

Locality.—Peshawar (Quizilbash 4856 !).
Distribution.—Along the foot of the Himalaya, from Gharwal to Sikkim, ascending to 5,000 ft.; Bengal, Pegu and southwards to Travancore and Ceylon. Often cultivated.

84. Limonia L.

154. **Limonia acidissima** L.

Locality.—Kotla 37963 !; Hoshiarpur (Ait. 416 !).
Flowers.—April.
Distribution.—Yunnan.. Dry hills in various parts of India, N.-W. Himalaya in Simla and Kumaon, ascending to 4,000 ft.; Monghyr hills in Bihar; Assam; Western Peninsula, from the Bombay Ghats and Coromandel southwards.

85. Aegle *CORR.*

155. **Aegle Marmelos** Correa.

Locality.—Hoshiarpur (* Ait. 520 !).
* Quite wild.
Distribution.—Throughout India; wild or cultivated, ascending to 4,000 ft. in the W. Himalaya.

XXXI. OCHNACEAE.

86. Ochna L.

156. **Ochna squarrosa** Roxb.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13141 !, 13643 !).
Flowers.—May.
Distribution.—India—Silhet; Burma; E. and W. Peninsulas, and Ceylon.

XXXII. BURSERACEAE.

87. BURSERA *L.*

157. **Bursera serrata** Wall. Cat. 8492.

Locality.—Lahore—Gardens (*Parker 6115 !).
Flowers.—April.
* Cultivated.
Distribution.—India—E. Bengal; Garo Hills and Rajmahal Hills, Assam; and Chittagong.

XXXIII. MELIACEAE.

88. MELIA *L.*

158. **Melia Azedarach** L.

Locality.—Rawalpindi (Ait. 360 !).
Flowers.—April.
Distribution.—Persia; China. Commonly cultivated in India; wild in the sub-Himalayan tract, alt. 2-3,000 ft.

89. CHIKRASSIA *JUSS.*

159. **Chikrassia tabularis** A. Juss. in Mem. Mus. XIX 251, t. 22, f. 27.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14371 !, 14370 !, 14369 !).
Flowers.—April; Pale yellow.
Distribution.—India—W. Peninsula from the Konkan to Coorg. Malacca and Ceylon.

90. CEDRELA *L.*

160. **Cedrela Toona** Roxb. ex Rottl. & Willd. in Gesell. Nat. Freunde. N. Schr. IV, 198 (1803).

Locality.—Dalhousie (Drum. 206 !); Rawalpindi (* Ait.).
* Cultivated in Jhelum and Rawalpindi.
Distribution.—Java; Australia. India—tropical Himalaya; from the Indus eastwards ascending to 3,000 ft.; throughout the hilly districts of Central and S. India and Burma.

XXXIV. OLACACEAE.

91. OLAX *L.*

161. **Olax nana** Wall. Cat. 6783 A.B.

Locality.—Hoshiarpur (* Ait. 467 !).
* On the sand storm rocks in clefts.
Distribution.—India—Hot valleys of the W. Himalaya, ascending to 5,000 ft. from Nepal westwards and in the Punjab.

XXXV. ILICACEAE.

92. ILEX *L.*

162. **Ilex Cassine** Walt. Fl. Carol. 241.

Locality.—Lahore—Gardens (Parker 6260 !).
Flowers.—April.
Distribution.—N. America.

XXXVI. CELASTRACEAE.

93. Euonymus *L.*

163. **Euonymus pendulus** Wall. in Roxb. Fl. Ind. ed. Carey, II, 406; Cat. 4280.

var. *japonicus* L.
Locality.—Lahore—Ag. Hort. Gdns. (Parker 13652 !).
Flowers.—May.
Distribution.—India—temperate Himalaya.

164. **Euonymus Hamiltonianus** Wall. in Roxb. Fl. Ind. ed. Carey, II, 403; Cat. 4279.

Locality.—Rawalpindi alt. 6,000 ft. (Jerram 8063 !).
Distribution.—India—temperate Himalaya.

165. **Euonymus japonicus** L. f. Suppl. 154.

Locality.—Peshawar (*Quizilbash 61 !).
* Cultivated.
Distribution.—China; Japan.

94. Celastrus.

166. **Celastrus paniculata** Willd. Sp. Pl. I, 1125.

Locality.—Hoshiarpur (Ait. 564 !); Gurdaspur—Dhunera (Bisram 309 !).
Distribution.—Tropical and subtropical Himalaya alt. 1-4,000 ft.; Punjab and throughout the hilly districts of India ascending to 3,000 ft. **Ceylon;** Malay Archipelago and Philippine Islands.

167. **Celastrus Royleanus** Wall. = **Gymnosporia Royleana** Wall.

Locality.—Hoshiarpur (Ait. 40 !); Rawalpindi-Fattehgunj (Ait. 1030 !); Gurdaspur (Bisram 53264 !).
Flowers.—March.
Distribution.—Afghanistan. India—W. Himalaya, in Kumaon and Gharwal, alt. 1-4,500 ft.

95. Elaeodendron *JACQ. f.*

168. **Elaeodendron glaucum** Pers. Synops. I, 241.

Locality.—Rawalpindi (Parker 7102 !); Kangra (Parker 7096 !); Hoshiarpur (Ait. 545 !).
Fruits.—June.
Distribution.—Malay Archipelago. Throughout the hotter parts of India and Ceylon.

169. **Elaeodendron orientale** Jacq. IC. Rar. t. 48.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 38697 !).
Flowers.—May.
* A small tree 15 ft. high, but has been frozen many times. Has much the appearance of a *Podocarpus,* but is one of the Celastraceae. Ovary confluent with disk. One cell distinct with 2 erect collateral ovules, and possibly 1 or 2 empty cells as well, but this is obscure.
Distribution.—Mauritius; Madagascar.

XXXVII. RHAMNACEAE.

96. Zizyphus *JUSS.*

170. **Zizyphus Jujuba** Lamk. Dict. III 318.

Locality.—Hoshiarpur (Ait. 105 !); Rawalpindi (Ait. 110); Hissar (Duthie 3908 !); Gurdaspur—Dhunera (Bisram 310 !).

Flowers.—June-July-August.
Distribution.—Ceylon; Afghanistan; China; Australia; Africa. Throughout India.

171. **Zizyphus hysudricus** Hole, in Indian Forester, 1918, XLIV, 505: *Z. Jujuba*, var. *hysudricus* Edgew.
Locality.—Lahore (Gamble 23383!; Parker 21205!); Changa Manga (* Parker 21206!, 20991!, 21204!); Ag. Hort. Gdns. (* * Parker 20992!, 21207!).
Flowers.—August-September; *Fruits.*—March.
* Cultivated form, fruits ovoid. It is budded on to the globose fruited wild form of the same species.
** Petioles long, l. glabrous, or glabrescent below. Wild form reaches 10 ft. in girth.
Distribution.—India—Rawalpindi, Ajmer, D. Ismail Khan, Lahore.

172. **Zizyphus Spina-Christi** Willd. Sp. Pl. I, 1105.
Locality.—Lahore—Ag. Hort. Gdns. (* Parker 24053!, 24054!).
Fruits.—December.
* Cultivated in Government Ag. Hort. Gardens, Lahore, from seed obtained from the Ag. Hort. Depart. Cairo, Egypt.
Distribution.—N. Africa; Orient.

173. **Zizyphus vulgaris** Lamk. Dict. III, 316.
Locality.—Rawalpindi alt. 4,500 ft. (Jerram 8065!).
Flowers.—June.
Distribution.—Baluchistan; W. Asia; China; Japan; South Europe; India.

174. **Zizyphus oxyphylla** Edgew. in Trans. Linn. Soc. XX, 43.
Locality.—Rawalpindi (Ait. 144!).
Distribution.—India.

97. RHAMNUS *L.*

175. **Rhamnus persicus.** Boiss. Fl. Orient II, 17.
Locality.—Rawalpindi-Nandkot 4,000 ft. (Jaram 2266!, 7899!).
Flowers.—May.
Distribution.—Baluchistan; Persia, India.

176. **Rhamnus virgatus** Roxb. Hort. Beng. 17 (1814), nomen.
Locality.—Lahore—Gardens (Parker 8149!); Rawalpindi alt. 5,500-7,000 (Jerram 7900!).
Flowers.—April.
Distribution.—Nepal.

177. **Rhamnus triqueter** Wall. in Roxb. Fl. Ind. ed. Carey II, 376.
Locality.—Dalhousie (Drum. 4832!).
Distribution.—India—Punjab in the Salt Range; West Himalaya, from Jhelum to Kumaon.

178. **Rhamnus pentapomica** Parker in Kew Bull. 1921, 216.
Locality.—Rawalpindi—Futtehgunj (Ait. 1036!).
Flowers.—March.
Distribution.—N.-W. India.

98. SAGERETIA *BRONGN.*

179. **Sageretia Brandrethiana** Aitch. in Journ. Soc. VII, 62.
Locality.—Lahore—Ag. Hort. Gdns. (Parker 38781!); Rawalpindi—Futtehgunj (Ait. 361!); Rawalpindi—Hissand (Ait. 1035!).

Flowers.—February-August.
Distribution.—Westwards to Persia and Arabia. India—N.-W. Provinces.

99. HELINUS *E. MEYER.*

180. **Helinus lanceolatus** Brandis For. Fl. 574.

Locality.—Kangra—Dhamtal (7100 !).
Flowers.—July.
Distribution.—India—the Punjab, Oudh and the W. Himalaya from Kashmir to Kumaon, alt. 1-4,000 ft.

XXXVIII VITACEAE.

100. VITIS *L.*

181. **Vitis Jacquemontii** Parker, Forest Fl. Pb., ed. 2, 559 (1924).

Locality.—Rawalpindi 4300 (Jerram 8083 !); Dalhousie (Drum. 226 !).
Distribution.—E. India; China.

182. **Vitis trifolia** L. Sp. 203 = *V. carnosa* Wall. Cat. 6018. Vern. N. *Ratan bail.*

Locality.—Hoshiarpur (Ait. 211 !); Rawalpindi (Ait. 183 !); Hissar (* Cooper 3912 !; * * Duthie 3912 !).
Flowers.—September.
* Bulbous creeper. Largely applied to indolent swellings and promotes suppuration. Applied to anthrax with good results (from the letter of Dr. J. A. Cooper, Civil Surgeon).
* * Root said to be a remedy for carbuncles.
Distribution.—Tropical Himalaya, and throughout hotter parts of India from the Punjab and Burma to Ceylon and Malacca.

183. **Vitis arborea** L. Sp. Pl. 203.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38779 !).
Flowers.—August.
Distribution.—Orient; N. America.

XXXIX. SAPINDACEAE.

101. CARDIOSPERMUM *L.*

184. **Cardiospermum Halicacabum** L. Sp. Pl. ed. I, 366.

Locality.—Hissar (Duthie 3915 !).
Flowers.—August.
Distribution.—Most tropical and subtropical countries. Throughout India.

102. NEPHELIUM *L.*

185. **Nephelium tomentosum** G. Muell. in Trans. Vict. Inst. II (1858) 64.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37126 !, 37125 !, 37124 !).
Flowers, Fruits.—January.
Distribution.—Australia.

103. ACER *TOURNEF.*

186. **Acer pentamopicum** J. L. Stewart ex Brandis For. Fl. 111.

Locality.—Rawalpindi—Gainthal, alt. 2,500 ft. (12979 !; Jerram 8497 ! alt. 1800-3500 ft.).
Flowers.—April-July.
Distribution.—India—N.-W. temperate Himalaya.

104. DODONAEA *L.*

187. **Dodonaea viscosa** L. Mant. Pl. alt. 228.

Locality.—Rawalpindi (Ait. 1031 !); Hoshiarpur (51 !).
Flowers.—February-March.
Distribution.—Throughout India. Baluchistan; Ceylon and in all warm countries.

188. **Dodonaea triquetra** Andr.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11533 !, 13775 !, *12963 !).
Flowers.—February; bisexual.
* Grown from seed obtained in 1913 from Vilmorin under the above name. Resembles *D. viscosa* very closely but is monoecious. J. H. Maider, Sydney S. S. W. says 'appears to be referable to *D. viscosa* L.'

105. STAPHYLEA *L.*

189. **Staphylea Emodi** Wall. Cat. 4275.

Locality.—Rawalpindi (Jerram 8271 !; over 6,000 ft. 8270 !).
Flowers.—July.
Distribution.—Afghanistan. India.

BURMA'S DECREASING WILD LIFE.

BY

D'ARCY WEATHERBE.

(With two plates).

INTRODUCTION.

Were it possible to prepare a careful chronological record, covering the past 50 years, from all available reliable sources, including big-game hunting and shooting records, in countries of the Empire, indicating the quantity of game existing, the results would be of intense interest and value. They would disclose in all countries such an appalling decrease in the stocks of wild animals remaining, that the figures would be startling in the extreme.

Returning recently from eighteen months in the Far East, which included long tours in Burma proper, the Southern and Northern Shan States, the 'Tribal' and 'Backward' areas, Manipur and Assam, and a special inspection of the Kahilu Rhinoceros Sanctuary in Lower Burma, my attention was drawn to a letter from Mr. A. W. Moodie, Chief Conservator of Forests, Burma, in June in at least two magazines. The letter calls attention to certain articles in the Press during the past two years, which deplored the inadequacy of measures for Wild Life Preservation in Burma. Mr. Moodie commends to those interested in the subject the Annual Reports of the Game Warden, which reports, he infers, should dispel any doubt as to the efficacy of such measures.

In further support of his contentions that these measures are adequate, Mr. Moodie gives details of the sanctuaries set apart in Burma for the purpose, and emphasizes that 'a whole-time' Game Warden is in charge of this work. Incidentally he points out that the Reports may be obtained at the offices of the High Commissioner for India in Aldwych, or through any bookseller. Inquiry at the offices mentioned, elicited the information that no Reports of the Game Warden, Burma had been received since 1935-36. Of a number of booksellers visited, none knew anything of a later report and the office of the King's Printer in Kingsway was equally ignorant. I have, however, beside me, a copy of the 1935-36 Report and a condensed copy of the Report for 1938, published in the *Rangoon Times* on January 21, 1939. The quotations which I use below are from these two sources, and they do not support Mr. Moodie's views.

With some claim to a knowledge of the subject, it is, in my opinion, important at this time that the present position should not be glossed over; to pose that everything in the garden is lovely in Burma's measures for wild life preservation would be fatal. In reality, as I attempt to show below, the reverse is the case, the garden is choked with weeds, and until more drastic efforts

Photo : D'Arcy Weatherbe.

Thamin or Brow-antlered Deer (*Rucervus thamin* Thos.).

A fast disappearing species in Burma.

are made to save species, now in immediate danger of extinction, agitation for reforms must not be slackened, and the necessity for criticism of the apathy that pervades must not be forgotten.

As one who is keenly interested in the conservation of wild life, who has given the greater part of his time during the past ten years or more in visiting and living in the great game areas of the world, in studying the question from a practical angle, and who at intervals has travelled widely in Burma during the past eighteen years, I cannot share Mr. Moodie's complacency. I am, in fact, surprised that one who should be conversant with the real conditions has adopted a view which so many of the facts contradict.

If the Chief Conservator's letter is merely a defence of his Game Warden and his administration it is intelligible.

Personally I have not the slightest doubt that most of these men have their hearts in their work and have tried with inadequate facilities to carry out what, to some of them at least, must have been a heartbreaking task.

Burma's Wild Life Sanctuaries.

I would like to draw brief attention to some of the instances that Mr. Moodie cites, rather unfortunately I think, as evidence of the result of adequate measures.

I will not refer in any detail to the show-piece of the Department, the Pidaung Reserve, except to remark that it appears to fulfil its functions. But like all other sanctuaries in Burma it is not under a Trust, and like the other reserves is liable to molestation, or even cancellation, on commercial or political grounds, by the present or future administration. In the Game Preservation Report for 1936, the Game Warden writes:—

'. . . much depends, however, on the formation of a National Trust to take over the administration of sanctuaries . . . It is thought, therefore, that the formation of a National Trust for sanctuaries will be closely bound up with a Wild Life Protection Society, and the formation of a National Trust should be pressed forward with all speed.'

That was written some three years ago by the present Game Warden. Up to the present nothing whatever has been done to bring this about. The Game Warden's recommendation cannot be too strongly endorsed, as the danger of commercial or political exploitation hangs like the Sword of Damocles over these Sanctuaries.

A friend, a former high official and head of a department of the Government of India, in Burma, recently answering a protest of the writer, wrote as follows:—'If they cannot keep their National Parks inviolate in Malaya how can one expect any better behaviour in the case of a popular Government depending on the vote?' How indeed! Wild life have no votes.

He referred, of course, to the recent threat, by the present Administration in Malaya, to violate, for commercial purposes part of the King George V National Park. The attempt was, temporarily at least, frustrated by the matter being brought up strongly

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in the House of Commons—but that for the present is another story.

Mr. Moodie writes:—'THE SHWE-U-DAUNG SANCTUARY was constituted primarily for the protection of the Sumatran Rhinoceros, but it also contains a good stock of elephant, bison, saing, sambhur, serow, barking deer, tiger, leopard, bear, pig and birds.'

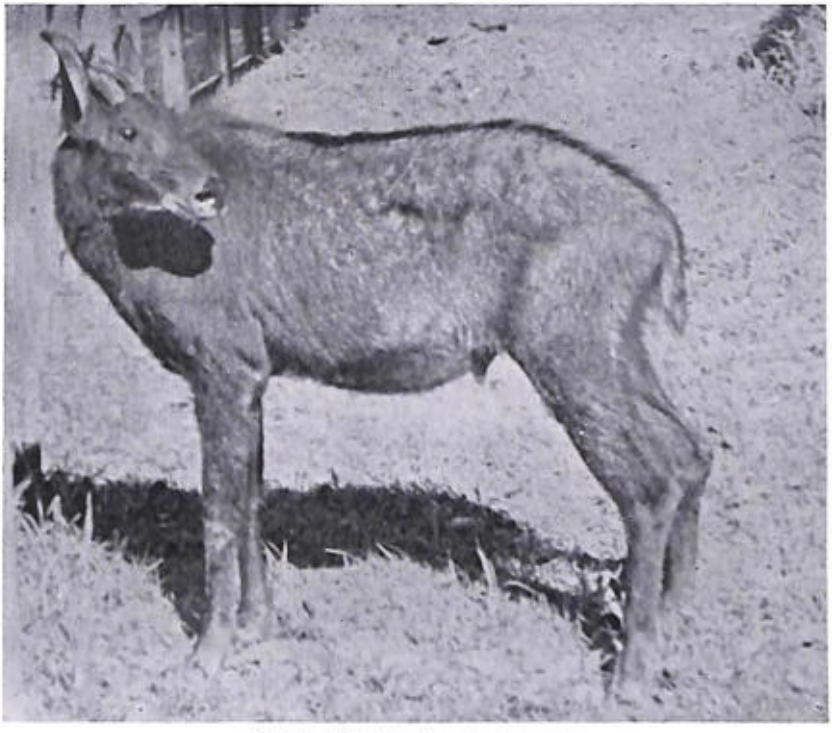
In the condensed Game Warden's Report for 1938, mentioned above, the Game Warden is quoted:—'The Principal Forest Officer estimates *at least five* rhino in the Sanctuary but *no young* . . it is a very dangerous probability that young rhino are being killed off by tigers.' No mention is made of any other animals in the Sanctuary except sambhur, tiger and pig. 'Sambhur were reported to be less numerous.' The Game Warden mentioned that steps were being taken to *reduce* the number of tigers. In the Divisional Forest Officer's Report for 1936, though he saw sambhur he writes that 'no other animals were seen', and in several visits by the Principal Forest Officer and at least two other Forest Officers no mention is recorded of bison, saing or serau. The Divisional Forest Officer reports that poaching undoubtedly takes place in the western side of this Sanctuary, which the Game Warden had apparently not visited in 1938. Not a very inspiring outlook?

Of the Kahilu Sanctuary, the Chief Conservator writes:—'Contains a few specimens of Rhinoceros which are, according to all *available evidence*, the Javan Rhinoceros. It also contains sambhur, barking deer, bison, pig and game birds.' The underlining is mine.

It is quite incorrect to say that *all* available evidence shows these rhino to be *Rhinoceros sondaicus*. The writer visited and carefully inspected this Sanctuary in 1938 with the special object of trying to gather evidence as to the identity of the rhinoceroses there. A detailed report of this visit was submitted to the Forest Department in the same year, and the opinion was expressed that the identity of species of the specimens there was not definitely proved. This opinion took into account all evidence both pro and con which had been gathered up to that date and has been concurred in by at least two well-known experts on the subject, one of whom goes so far as to say that he did not think the animals there were of the Javan species and that the photographs of the tracks were almost positively of *sumatranus*.

In the same report I expressed the opinion that measures for the proper conservation and propagation of the few rhinoceroses there, whichever of the two species they may be, are totally lacking.

Regarding bison. So far as I could gather, they do not inhabit the Sanctuary, seldom visit it, and are rare in these parts. I saw tracks in two places only, probably of the same animal. Sambhur are not plentiful and game birds scarce, and as all game may be legally killed by villagers, on the pretext of necessity for crop protection, and as villagers live in the Sanctuary and have dogs and guns, it is morally certain that birds and small game are regularly poached. At least one Forest Officer has advocated that the natives be allowed to kill pigs without licences, though the



Serow (*Capricornis sumatrensis*).

Another animal which should be carefully conserved.

two rangers in the Sanctuary would be available for such protection if it was really necessary. Also it is absurd that constant cultivation should be practised in a 'sanctuary'. As my report on this area has appeared elsewhere (*B.N.H.S's Journal*, 1939) it is unnecessary to enlarge further on its deficiencies as a sanctuary.

Of the other sanctuaries, most of which are quite unimportant from the point of view of saving the fauna of the country, I will only comment on Mr. Moodie's reference to the MULAYIT SANCTUARY. He writes in *The Field* as follows:—'It contains chiefly bison, serow and mouse deer.' In the case of all of these sanctuaries to mention species particularly, one would be led to believe that they contained at least a fair and not easily exhaustible breeding stock of the animals for which they were set aside? Of this Sanctuary, the MULAYIT, however, the Game Warden writes in his report for 1938:—'The report of a subordinate, *specially deputed* to compile an estimate of the stock of wild animals here, is most disappointing. *No traces of any big-game animals were seen.* Wild dogs were the only animals encountered.'

SHAN STATES.

Referring to these States the Game Warden's report for 1938 says:—'Legislation to provide protection would be almost valueless, considering the vast area of unclassed forest and the small number of Forest subordinates available.' And again:—'The Divisional Forest Officer, Northern Shan States, reports that jungle fowl appear to become scarcer every year,' and he adds 'it is not surprising in view of the energy with which local villagers hunt them down, wherever they are found, and so-called sportsmen cannot be said to be blameless in this matter. He might have truly said, further, that they are destroyed in and out of season equally relentlessly.

In another place, referring to proposals for improvement of protective measures the Game Warden's report says:—'The Principal Forest Officer (Shan States) writes . . . one great stumbling block will always exist, however, in the number of guns licensed as there seems to be no hope of their reduction to anything approaching reasonable numbers.'

Well might he complain for, incredible as it may seem, the official number of licences for guns issued in the Shan States alone, to say nothing of the rest of Burma, was over 27,000. Without the srongest protective measures, what chance has wild life of survival under such conditions?

In the 1936 report, the Game Warden wrote:—'Throughout the Shan States a large number of offences against the Game Rules must be committed annually, but, with the very limited forest staff available, it is impossible to detect the majority of these offences,' and, in another paragraph of the same report we find:—'The Divisional Forest Officer, MONGMIT DIVISION, reports that saing have been severely depleted by epidemic, especially in NAUHLIANG RESERVE. This is most unfortunate, as the NAUHLIANG RESERVE and the surrounding unclassed forests used to be well stocked with these animals.'

No mention of investigations as to cause or possible amelioration is made, but presumably that would be impossible without increased staff or the calling on Government veterinary officers or other skilled advice.

After a recent tour in the Northern and Southern Shan States, covering in all upwards of 800 miles, the writer's impression was that over a great portion of the whole area most of the larger fauna may be considered as practically extinct.

There may be, however, extensive tracts more sparsely settled, where strict protective measures might still produce favourable results. If such measures are not instituted promptly, the first-mentioned condition will maintain over the whole area.

A glance at the financial figures for the Shan States for 1934-5-6,—I have no figures for 1938—will make serious consideration of any protection in the region appear farcical. The revenue for 1934-5 from wild life was Rs. 832 and in 1935-6 was Rs. 710, while for the same respective periods the expenditure was Rs. 70 and Rs. 25, the equivalent of £5-3-0 and £2-0-0. It might be of interest to know on what these sums were expended.

Many more instances of the admittedly unsatisfactory state of Wild Life Protection in Burma generally might be quoted, were it necessary; but a summary of the specific causes of such unsatisfactory conditions with a few notes thereon will suffice.

Insufficient Provision of Funds.

This is the primary cause and the one that must be remedied before any further reforms need be considered.

Although destructive criticism may correctly analyse and call attention to ills it may not be very useful unless practical remedial suggestions are also given.

In Burma's case it may be thought that it is too late. That is a defeatist policy and not one to which I can subscribe. With regard to some of the fauna, determined and drastic measures may be necessary. Notably amongst species possibly doomed to early extinction in Burma is the Rhinoceros, followed by the Thamin deer. In the latter case the quick and efficient development and administration of the sanctuaries now proposed for its survival may save it as a species. Outside these areas it will not last long under present conditions. In some districts where they formerly existed large bovines, bison and saing, are already extinct; in other districts they are fast becoming so; while in the Pidaung Reserve it is refreshing to note that so long as it is maintained as at present, *including its necessary extensions*, these two species should flourish there.

It is curious to note that the one species naturally maintaining its existence in Burma is the very one that is now threatened by official slaughter at the hands of those selected to support its preservation. I refer of course to the Elephant and 'Elephant Control'. I hope to have more to say on this question elsewhere.

Now I think that I can indicate where funds should come from and logically show how and why certain revenues should be allocated for the work of conservation.

In the summarized extracts of the Game Warden's Reports for 1938, now before me, no figures of revenue and expenditure are available, but for comparison I have used the figures for 1935 and 1936. They are enlightening, though insufficient in detail.

Under Wild Life Protection the figures are as follows:—

	1935 Rs.	*1936* Rs.
Revenue	38,189	38,758
Expenditure	3,445	10,350

In the last figure for expenditure the 'Elephant Control' figures are not included, while the sum of Rs. 1,211 is not included in the revenue, the proceeds from fines.

But the most important omission is the revenue from licences and import duties on sporting arms and ammunition, which the Game Warden roughly estimates as another lakh of rupees. (Rs. 100,000).

It is not stated whether fees for export permits on trophies and wild life specimens are included but with a properly organized Game Department there is little doubt that on the present figures an approximate revenue from Wild Life Resources would amount to perhaps Rs. 150,000, which should be made available for conservation.

From what I have written above it must be obvious that without reforms and funds it is a matter of time only when no further expenditure on Wild Life Protection will be required—there will be nothing to protect.

Judging by the past, the period before we reach that condition will be short indeed, but before reaching it the revenue from wild life resources will also have disappeared. These implications are simple but will they be believed? The first question to be asked is:—Would a properly organized and independent department, with sufficient funds at its disposal, be able to save the majority of species holding their own and possibly resuscitate others now in danger? I think so, if present conditions are not allowed to drag on, and reforms *completed* within a couple of years at the most, though a few changes should be made immediately.

Outside the sanctuaries matters are in a critical state; inside them, bar the Pidaung Reserve, most unsatisfactory. If the Government of Burma are not satisfied that conditions are as represented above, then let them appoint an expert, but completely independent commission to inquire into the whole subject. Official findings, however disinterested, will never secure the complete confidence of the outside world. Let the work of inquiry be as competent and thorough as was that of the Wild Life Commission in Malaya, but for the sake of Wild Life Conservation, and for the reputation of the Burma Government, do not let the recommendations be ignored and wasted as were those in Malaya.

The above facts summarized are as follows:—

(*a*) There is an annual income from Wild Life Resources now being collected in Burma amounting to between Rs. 100,000 and 150,000.

(*b*) This income is derived solely through the existence of Wild Life.

(*c*) Wild Life is diminishing rapidly. Long before it is actually finished the greater part of the income from these resources will cease.

(*d*) The Wild Life, or a considerable portion of it, it is thought, if adequate measures are taken now, can be saved, and the income maintained. To do this the greater part of the income must be expended for the purpose to which it obviously belongs.

This principle is well recognized in countries that have looked the question in the face and successfully tackled it.

The reasons why the Burma Government has not done so must be put down to ignorance, disbelief or apathy, and the greatest of these is apathy.

An Unscientific and Compromising System forming the Present Machinery for the Administration of the Game Laws and other Measures for Wild Life Protection.

This heading refers to the fact that the administration at present is entirely under the Forest Department.

This antiquated system is a relic of the Government of India's jurisdiction over Burma during which the greater part of the wild life of both India and Burma has disappeared, and though this, perhaps, may be partly due to parsimony, until quite recently it was due to indifference to and lack of knowledge by the Forest Department of that branch of its work.

One of the chief reasons for the employment of the Forest Department for the protection of wild life was economy and, judging by results, a false economy; if we are to agree that the same serious considerations are to be given to this national possession as to others more definitely commercial.

The work of the Forest Department is essentially utilitarian and commercial. Where its immediate objects may conflict with the principles and practice of wild life protection, and they may so conflict in a number of cases, the interests of the former would prevail.

The use of the Forest Department is a makeshift, and its personnel, *per se*, is little if any better fitted for the duties of wild life protection than are members of a number of other departments. In practice a number of Forest Officers are shooting men, but that in itself is not necessarily a qualification. It may be, I regret to say, and in some instances I have known it was, a detriment. Many Forest Officers have not, as might well be expected, any interest either in destruction or preservation of wild life. Such men may be, and upon occasions are, in charge of critical areas, in which are situated sanctuaries requiring special attention. Their attitude would naturally be one of indifference. To such men a voluntary policy of vigorous apprehension or prosecution of offenders could hardly be expected, even if they were allowed to spend their time on such duties.

On principle I think that the term 'whole-time' Game Warden a misnomer, when applied to Forest Officers transferred temporarily to this position. I believe I am correct in saying that since the first Game Warden was seconded from that service some eleven years ago, there have been four incumbents, but for four years of that time there was no official Game Warden at all. One of these officers has acted in that position in an honorary capacity *in addition to his official duties.*

The position is not altogether independent, and is not looked upon either as a career or as a permanent occupation. When promotion comes, and perhaps before, for one reason or another, the Game Warden reverts to his position as Conservator or whatever it may be in the Forest Department. If on leave another Forest Officer is temporarily appointed as Game Warden, but whether in addition to his other duties or not, I do not know. During his tenure of office a Game Warden has not control of other officers of his department who are supposed to be assisting him in duties. They are under their own departmental chiefs and naturally their routine forest duties have first call on their time. The Game Warden cannot give them orders at all.

The Chief Conservator of Forests is Head of the Department administrating preservation of wild life; but he has not reached the position of Chief Conservator through any special qualifications for that branch of his department's work and might not, in fact, have the slightest interest in or knowledge of the subject. It is he, however, who is responsible, and who has to deal with the appropriate Ministry—a most important function.

The Art of Conservation of Wild Life cannot be picked up in one's spare time.

There can hardly be two opinions but that the Wild Life Protection Departments of countries of the Empire, like India, Burma and Malaya, should be entirely divorced and separated from any other department, and while in every way gratefully accepting cooperation and assistance, a completely independent department must be responsible for the work of Conservation.

The Director of such a department should be a man of suitable age and selected for his technical ability for, and experience in, practical wild life conservation, as well as his disinterested keenness in the work. In Burma, it is probable that such a man might be available from the Forest Department Service, could he be transferred from that department. But a separate department must be formed if success is to be obtained. We have sufficient proof of the failure of the present system.

Shortage in the number of Game Wardens, Game Rangers, Watchers, Guardians, etc.

At present there is only one Game Warden and whether he is 'whole-time' or not, it is physically impossible for him to properly visit or supervise his vast area in the six months season of the 'cold weather' during which time it is customary, and in some cases only possible, to travel in Burma.

It is a vast territory of forests, jungles, rivers, swamps and

mountains, sparsely traversed by roads or railways; and travelling off the beaten track is slow and arduous.

The area under the Game Warden, which contains some six sanctuaries, stretches north and south a thousand miles from above Myitkyina to Victoria Point, and from the China Border on the east to the Bay of Bengal and Assam on the west.

The Game Warden writes:—'In almost every Forest Division the Divisional Forest Officer admits that sufficient attention to wild life preservation cannot be given by the existing staff.' He further points out that during the year, while some 15,000 licences for sporting fire-arms were taken out, exclusive of the Shan States, only 721 of these licensees took out game licences. The inference is obvious. Further he writes:—'When it is realized that there are 31,300 square miles of Reserved Forests to which all of the Game Laws apply, and 92,000 square miles of Unclassed Forests to which many of the Game laws apply, the difficulty of controlling the activity of poachers with a limited staff can be appreciated.'

The Conservator of Forests in Sittang Circle who was the first Game Warden, and who afterwards acted in an honorary capacity, is quoted by the present Game Warden, in the 1938 report, as follows:—

Referring to South Toungoo and Pegu Divisions: 'In both these Divisions during the hot weather all the available staff is moved from the hill forests down to the plains in order to cope with the annually increasing amount of (forest) work . . . . the area in both these Divisions where game is most plentiful, or rather least scarce, are therefore left almost entirely unprotected during he period of the year in which protection is most needed.'

At the very minimum an additional two or three Game Wardens are urgently needed, whose duties should be in the field and not in an office, and who should be almost constantly touring the areas allotted to them. Although co-operation should maintain, as at present, with Forest Officers and subordinates in the field, a very much larger staff of permanently employed game rangers and other natives should be employed, and these should be under constant supervision of the Game Wardens. Watchers and others, who would be sources of information, in towns and villages, markets and fairs, should be regularly employed, and the police should be instructed to co-operate with them.

Honorary Game Wardens should be appointed wherever keen men could be induced to act, more especially in the game bird districts, where their assistance should prove invaluable.

There are, I feel sure from my own experience, many good sportsmen who would willingly act in this capacity. This branch of the conservation service is of great use in East Africa and it also was used in Malaya.

Lack of Comprehensive, Consistent and Practical Laws to Embrace the Conservation of Wild Life in all its Phases.

A law which would ensure facile provision for prompt legal apprehension, prosecution and punishment of all offenders against

its provisions giving, at the same time, wide powers to the Game Warden to enable him to carry out his work without irksome and time-wasting references, would go a long way to solve the problem which confronts wise conservation of wild life in Burma.

No such law is on the statute book in Burma today. Protection of Wild Life was embodied in the Forest Department Act, in the Burma Game Rules published under that Act, and in the Wild Birds and Animals Potection Act.

An attempt was made to better these provisions, and nearly three years ago a new act was drafted and called the 'Burma Wild Life Protection Bill, 1936.' At that time Burma was a Province of India, but before the draft with its rules was finally finished the inauguration of the new Burma Government became imminent. This draft was a move in the right direction and its promoters deserve considerable credit for what they achieved. It does not, however, fulfil the requirements of a complete law on the subject. Besides being inadequate it is in some respects inconsistent, and in one ludicrous. The provisions regarding rhinoceros prohibit the killing of the animal. In another clause, however, its blood may be legally sold by native medicine men and others though there is no special provision for killing it or importing it for this or any other purpose, except that there is one clause allowing the animal to be killed in protection of crops.

In fairness I should say that it was reliably stated to me that the reason it was submitted in this form was the urgency of getting it approved before the new and independent Legislature took office, as if not already approved the act might have been indefinitely delayed or not passed at all.

While I leave the reader to judge the value of this excuse, I would point out that the Rules for the Act had not been passed up to March 1938. So the Game Rules of 1927 are still being followed where they do not conflict with the provisions of the new Act.

The Inordinate Issue of Gun Licences for all Sorts of Unnecessary Reasons.

Although[1] the country is not at war there are over forty thousand licences issued for guns! For what purpose? These guns are not given to the police or to the armed forces, but to ordinary citizens. Such conditions are unknown elsewhere in the Empire. The populace should be disarmed and fire-arms only issued with the strictest supervision, and only for *bona fide* sporting purposes, and *in conjunction with game licences,* issued and renewable annually by the Game Warden alone.

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[1] Written before outbreak of war.

The Collection, Sale and Export of Wild Animals for Commercial Purposes.

This nefarious practice goes on, I believe, to a far greater extent than is perhaps supposed, and often upon the false plea that the animals are collected for scientific purposes. No animal should be captured or exported, except by special permit signed by the Game Warden himself, after the strictest inquiries as to the purpose. Co-operation of the police at all ports and elsewhere, to prevent the harbouring of wild animals or birds without permit, should be freely given, as also the good offices of the Customs Department to prevent illegal export. The lack of control is referred to in the Game Warden's Report for 1938.

His Majesty's Government has, I believe, on a number of occasions, through various Ministers, and through at least one Prime Minister, clearly enunciated that preservation of the wild fauna of the Empire was a policy that had its firmest support.

If, therefore, the suggestions I have made above fail with the Burma Government and with the Governor, then in that last resort persistent appeal must be carried to London. But through what organized channel is this appeal to be made? That is the difficulty.

In my view, though it is a depressing admission, until public opinion becomes sufficiently interested in the subject, none exists to-day that has practical influence.

Sayeedud-Din—*Allmania nodiflora* R.Br. (Nat. Size).

For explanation see end of article.

SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

M. SAYEEDUD-DIN,

Prof. of Botany, Osmania University, Hyderabad Deccan.

(With two plates).

(Continued from page 798 of volume xli, *No.* 4).

V.—ALLMANIA NODIFLORA R. Br.

(AMARANTACEAE).

SYNONYMY AND SYSTEMATIC DESCRIPTION.

Allmania nodiflora R. Br. (var. *aspera* Hook.) in Wall. Cat. 6890, excl. B; H. F. B. I., IV, 716; Gamble F. M. Pr., Pt. VII, 1167-1168; Syn:—*Chamissoa aspera*, Wt. Ic. t. 1772; *Celosia aspera* Roth Nov. Sp. 173.

An annual, diffusely dichotomously branched, sparsely hispidly hairy herb with stout root-stock. Leaves alternate, lanceolate. Flowers in large axillary and terminal globose brownish orange heads which consist of small dichasia, in each of which there are 3 flowers, the centre one sessile with 1 bracteole, the side ones pedicellate with 1 bract and 2 bracteoles; bracts and bracteoles narrow, scarious, hispid, with filiform tips. Perianth calycine, of 5 almost free lanceolate acuminate lobes. Stamens 5, filaments united in a membranous hypogynous cup, anthers 2-celled, opening by means of slits; pollen irregularly spherical and blackish when dry, round and brownish black when moistened. Ovary ovoid; ovule erect; style slender; stigma 2-lobed. Fruit an ovoid membranous utricle, circumscissly dehiscent. Seed erect, subglobose, in a cupular aril. (Plate I, & Pl. II, Fig. 4). Flowers practically throughout the year.

HABITAT.

Corn-fields, Coimbatore and Mysore (Hooker, 3); Deccan Districts, west to the E. slopes of the Ghats, less common in Circars or Carnatic, in fields (Gamble, 2); a common weed in Hyderabad Deccan, very variable (Sayeedud-Din, 7); Deccan: Purandhar Fort, Bhiva, (Cooke, 1). Distrib. China, Malay Islands.

Anatomical Notes.

Structure of the Leaf (Plate II, Fig. 3). Stomata are found on both sides of the leaf. They are surrounded by ordinary epidermal cells. The mesophyll is differentiated into palisade and spongy tissue. Epidermal cells are rather large.

Oxalate of lime is present in the form of large clustered crystals in the mesophyll, and in that of crystal-sand in the stem, as in *Pupalia lappacea* Moq. (Sabnis, 6). Mullan (5) has observed aggregate crystals and coarse granules in *Celosia argentea* L. The hairy covering (Plate II, Figs. 1-3) consists of ordinary clothing uniseriate trichomes both on the stem as well as on the leaves. Those on the stem are longer and in some cases provided with small protuberances in the upper portion. The hairs on the leaf form a fine tomentum. Capitate hairs with a unicellular or uniseriate stalk and unicellular spherical or ellipsoidal head, mentioned by Solereder (8) as having been observed by Nemnich in species of *Allmania* have not been seen.

Structure of the Stem. The herbaceous stem possesses stomata. They are not provided with any special subsidiary cells. No anomaly is found in the structure. The epidermis in the region of the ridges consists of small tabular cells with outer and inner walls slightly thickened and convexly arched outwards and inwards respectively. In the primary cortex chlorenchymatous cells occur with the collenchymatous groups at the angles. Stone-cells are found in the pericycle. There is an extensive pith composed of large thin-walled parenchymatous cells.

Conclusions.

The main anatomical characters revealed by the study of *Allmania nodiflora* R. Br. are: (1) stomata are surrounded by ordinary epidermal cells, and do not possess any special subsidiary cells; (2) oxalate of lime is present in the form of clustered crystals in the leaf, and in that of crystal-sand in the stem; (3) hairy covering consists of ordinary clothing uniseriate trichomes; (4) glandular hairs are absent.

Acknowledgments.

As before the photograph and the drawings were prepared by Mr. Sri Ramloo under my supervision, for which I am thankful to him. My thanks are also due to Mr. M. Moinuddin for the preparation of several slides.

Literature Consulted.

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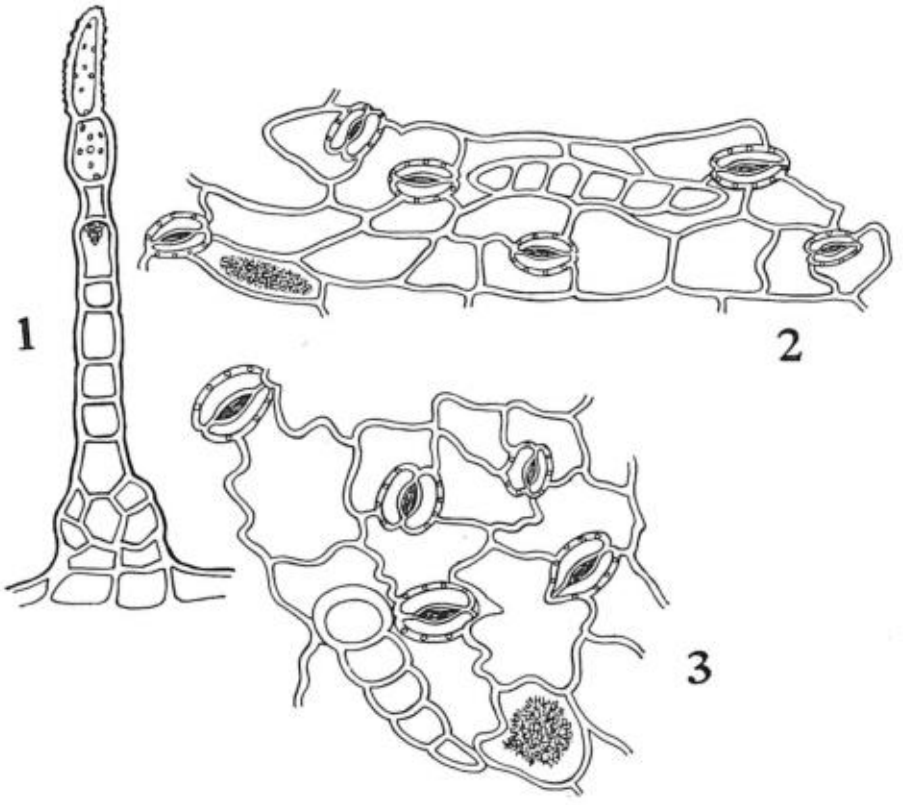

Sayeedud-Din—*Allmania nodiflora* R. Br.

For explanation see end of article.

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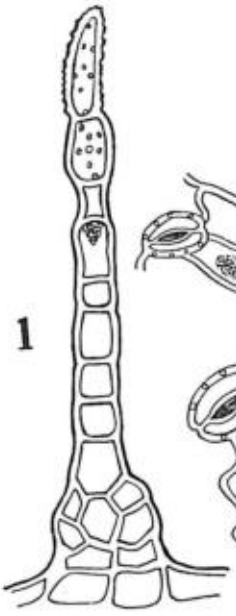

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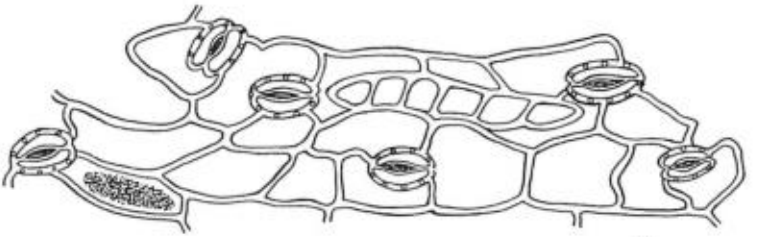

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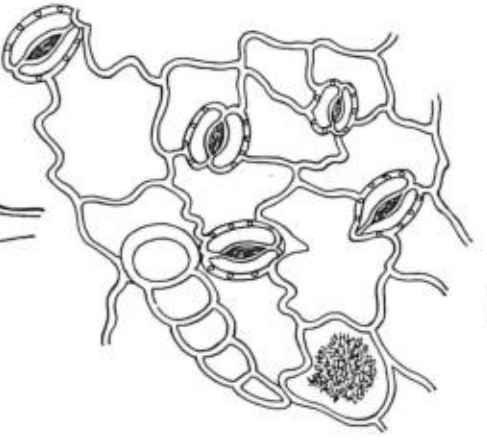

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For explanation see end of article.

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Explanation of Plates I & II.

Allmania nodiflora R. Br.

Plate I.

Fig. 1.—Black and white sketch of *Allmania nodiflora* R. Br. (Nat. size).
Fig. 2.—A dichasium, showing three flowers. (×10).
Fig. 3.—A single flower with the calycine perianth opened out to show the parts (×10).
Figs. 4 & 5.—Two views of the stamens, showing in (4) the lateral slits in the anthers for shedding of pollen. (×10).
Fig. 6.—Pollen grain in dry condition. (×10).
Fig. 7.—Pollen grain in moist condition. (x 10).
Fig. 8.—Pistil, showing the circumsciss dehiscence of the future fruit. (×15).

Plate II.

Fig. 1.—Uniseriate clothing hair on stem. (×420).
Fig. 2.—Stem-epidermis, showing stomata, an ordinary trichome and crystal-sand. (×420).
Fig. 3.—Leaf-epidermis, showing stomata, trichome and clustered crystals. (×420).
Fig. 4.—Photograph of *Allmania nodiflora* R. Br.

(To be continued).

THE DEATH EXPEDITION OF *HIBISCUS* CATERPILLARS

(larvae of *Crocallis* sp.)

BY

G. C. BHATTACHARYA,

Bose Research Institute, Calcutta.

(*With a plate*).

The migratory instinct in lower animals often appears to be very peculiar and exceedingly interesting. The migration of the little rodent lemmings offers an excellent example. These little animals colonize a hill-side and multiply at an amazing rate, so much so, that when, owing to insufficiency of food supply, starvation becomes inevitable all the inmates of the colony, millions and millions strong, rush head-long from their dwelling place. Nothing can stop or divert this impetuous flow. Thousands and thousands of them die of starvation or of injuries, many more are devoured by predaceous birds or other enemies but still the stampede continues relentlessly until the sea is reached, where this instinct still impels them to press forward to some promised land which they never reach.

This instinct of the rodents of a breakneck migratory movement, heedless of the goal, is extraordinary indeed, but the instinct evinced by the larvae or caterpillars of the moth, *Crocallis* sp., which occupies a far more backward position in the process of biological evolution, in their reckless mode of migration is still more wonderful and thought provoking.

The moth, *Crocallis* sp., lays her eggs on the leaves of *Hibiscus Rosa-sinensis, Artabotrys odoratissima* and some other plants. The young larvae or caterpillars about 4 to 5 mm. in length, hatch out after ten or fifteen days and assemble under the surface of the leaves where they scrape off all the chlorophyll bodies leaving the thin films of cellulose. After a few days, growing larger, they devour the whole of the leaf and move over to a neighbouring one. Thus within a short period all the leaves of the plant are eaten up and the caterpillars begin to migrate to a new place for food and shelter.

Once early in May, I happened to notice such a migration of *Hibiscus* caterpillars (larvae of *Crocallis* sp.). I was standing near a cemented platform, built over a cemented floor at the corner of an extensive lawn, observing the leaf movements of a sensitive mimosa plant (*Mimosa pudica*), when at the far end of the floor a procession of greenish white caterpillars, numbering about sixteen individuals, crawled forward in single file over the lawn towards the platform. The order and regularity of their movement specially attracted my attention. The procession hurriedly approached

The Caterpillars are marching in a line towards the potted plant.

The Caterpillars are seen moving along the circular rim of the pot.

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the raised platform, but finding its vertical wall too smooth to scale, changed its course towards the grassy lawn. Progressing a few feet onwards along the base of the platform, the caterpillars turned back towards the cemented floor. It was apparent from their movements that they had scented the leaves of the mimosa and were searching for a way to get at them. At last they descended to the cemented floor and now marched quickly towards the corner of the platform where the mimosa plant grew in its earthen pot. Closely following one another, the caterpillars went round the base of the platform and now, finding a suitably rough surface, climbed the vertical wall and made straight for the plant. On reaching it they dispersed and raising their heads began to smell about. After a short while they fell into line and climbed the pot, eager for their meal on the leaves of the plant. The file of caterpillars attaining the circular rim of the pot, now commenced—extraordinary to relate—what was going to be for them a continuous and interminable journey round and round the rim. The surface of the soil in the pot was somewhat below the rim necessitating a descent. While the close proximity of meal inspired them to brisker and brisker movement, the caterpillars did not take the one way which would have led them directly to the plant. They did not descend from the rim of the pot, blindly following the circular rim they were deceived into a vain and endless march.

The circumference of the rim proved too small for the whole length of the caterpillar chain. They had to squeeze themselves in for accommodation and every individual looked very much shorter in length than it did in the open space. Incessantly they marched round the rim of the pot throughout the day without a halt or rest, and their journey never came to an end.

Very carefully I removed the pot to my bedroom and watched the movement of the caterpillars every now and then during the night. As a rule, the larvae of moths refrain from eating after sunset and rest quietly until next morning, but these larvae marched through the night and carried on their unprofitable journey.[1] Through the next day, the march continued, but a slight slowing down was noticeable in the movement. On the third day, the weariness was more apparent. The inability of two or three individuals to keep pace with the others hampered the regular progress. At about 11 o'clock in the morning, one of the stragglers fell out of the line in a comatose state and expired after half an hour or so. Three hours later, another caterpillar dropped out and died. Now the death of the two individuals gave the others space to stretch out their bodies a little, so that no gap was to be seen in the file even in the absence of two members. The caterpillars were moving as usual head to tail, but their progress was very much slower than before. More deaths occurred on the fourth day, while the survivors seemed to be totally exhausted. They moved reluctantly and halted at intervals. On the afternoon of the fifth

[1] Fabre described the processionary habits of tent caterpillars of the apple tree who kept following the line all day long but slept when night overtook them and resumed their journey with the morrow's sun.

day, some of the caterpillars dropped out of the regular line and took to crawling aimlessly over the pot but they never left it, for the smell of the green leaves was a constant and unconquerable source of attraction. So after a few hours of fruitless straying those which did not succumb came back to the rim of the pot and resumed the weary march. The length of the chain was now greatly reduced owing to the death of several individuals and a gap was formed between the head and tail of the moving chain.

On the morning of the sixth day most of the caterpillars were found lying dead on the platform or on the soil of the pot. The three that were still surviving and sticking to the rim were in a precarious condition and died soon after. Lured by the scent of food, and urged by the instinct to march relentlessly towards it, all of them ultimately embraced death but did not give up their pursuit for a moment.

Later it was observed that the leaves of *Hibiscus Rosa-sinensis* planted beyond the wide lawn were infested with the caterpillars of *Crocallis* sp. These caterpillars, voracious eaters as they are, had eaten up almost all the green leaves of those plants, and scarcity of food there had compelled them to migrate elsewhere for food and shelter. On several occasions after the incident noted above I was able to persuade different processions of these caterpillars to climb to the rims of circular vessels and in everyone of these experiments, the results were the same as in my first observation.

If during migration, water intercepts the path of their progress, the leading member by raising up its head looks around and, finding other means to avoid the obstacle changes its course, the rest of the party following in a regular line. When no alternative is available but to go through the water, they enter it, but reluctantly and as a last resort. As the film on the surface of water does not break under the weight of their bodies, the caterpillars float on it like bits of cork. Like a flock of sheep unhesitatingly following their leader, the caterpillars also follow the foremost member across the surface of water, some wriggling their bodies sideways try to proceed in a zig-zag manner. Unaccustomed to swimming, most of them by indiscriminate wriggling of bodies are led out of line. Those who are fortunate enough to cross the water assemble again in a line and resume their journey.

THE MEDICINAL AND POISONOUS FLAXWORTS OF INDIA.

BY

J. F. CAIUS, S.J., F.L.S.

The LINACEÆ are herbs, shrubs or trees, broadly distributed, especially in the northern hemisphere. They consist of 9 genera with 150 species.

The medicinal and poisonous Flaxworts of the world belong to 5 genera: HUGONIA (Tropics); IXONANTHES (tropical Asia); LINUM (temperate and subtropical regions, especially Mediterranean); REINWARTIA (North India, China); ROUCHERIA (Guiana).

Ixonanthes cochinchinensis Pierre, which is used medicinally in Annam, is not found in India.

A. Petals contorted, fugacious. Perfect stamens as many as the petals. Herbs rarely shrubs
   I. Calyx glabrous or pubescent. Styles 5. Capsule 5-celled ... ... LINUM.
   II. Calyx glabrous. Styles 3-4. Capsule 3-4-celled ... REINWARDTIA.

B. Petals contorted, fugacious. Perfect stamens 2-3-times as many as the petals. Fruit a drupe. Usually scandent shrubs
   I. Sepals subacute, tomentose, ebracteolate ... HUGONIA.
   II. Sepals obtuse, bracteolate ... ... ROUCHERIA.

HUGONIA.

The genus consists of 11 species, inhabiting the Tropics of the Old World.

H. Planchoni Hook. f. is used medicinally in Liberia and Sierra Leone, *H. serrata* Lam. in La Reunion.

Hugonia Mystax Linn. is found in the Konkan and North Kanara of the Bombay Presidency, throughout the dry forests of the Madras Presidency, and in Ceylon.

The bruised roots are employed externally in reducing inflammatory swellings, and as an antidote to snake-bites. In the form of a powder, it is administered internally as an anthelmintic and febrifuge. The bark of the root is also employed as an antidote to poisons.

Mhaskar and Caius have shown experimentally that the root is not an antidote to snake venom.

Canarese: Modirakkanni—; *English*: Climbing Flax—; *Malayalam*: Moderakkanni, Motirakkanni—; *Sinhalese*: Bugatteya, Mahagetiya—; *Tamil*: Agori, Kodivirai, Modirakkanni—; *Telugu*: Gatrinta, Kakibira, Penkebedali, Pisangi, Renangi, Tivvaputiki, Ungaralapidemu, Vendapa—; *Tulu*: Mullankola—; *Uriya*: Chulijinka—.

Linum.

The genus numbers 90 species, inhabiting the temperate and subtropical regions of the world, but especially Mediterranean.

The seeds are oleaginous, emollient, and sometimes purgative.

Glucosides—linamarin, phaseolunatin—are among the products isolated. *Linin*, a peculiar drastic principle has been obtained from *L. catharticum* Linn.

The following are used medicinally in Europe—*L. alpinum* Linn., *L. angustifolium* Huds., *L. austriacum* Linn., *L. catharticum* Linn., *L. gallicum* Linn., *L. flavum* Linn., *L. hirsutum* Linn., *L. maritimum* Linn., *L. narbonense* Linn., *L. nodiflorum* Linn., *L. perenne* Linn., *L. strictum* Linn., *L. suffruticosum* Linn., *L. tenuifolium* Linn., *L. usitatissimum* Linn., *L. viscosum* Linn.—; in China—*L. perenne* Linn.—; in North America— *L. catharticum* Linn., *L. usitatissimum* Linn.—; in Brazil—*L. usitatissimum* Linn.— in Uruguay—*L. selaginoides* Lam.—; in Chili—*L. Chamissonis* Schiede, *L. Macraei* Benth., *L. selaginoides* Lam.—; in South Africa— *L. Thunbergii* Eckl. and Zeyh.—; in Mauritius— *L. usitatissimum* Linn.—.

A. Petals blue
  I. Capsule scarcely exceeding the narrowly white-margined sepals ... ... *L. usitatissimum.*
  II. Capsule much longer than the white-margined sepals ... ... *L. perenne.*
B. Petals yellow ... ... *L. strictum.*

1. **Linum perenne** Linn. is found in the North-Western Himalaya, extending westwards to the Canaries.

In Europe and in China the seeds are used as an emollient.

Country people, in England, boil the fresh herb and take it for rheumatic pains, colds, cough and dropsy.

Chinese: Ya Ma—; *English*: Perennial Flax—; *French*: Lin de Sibérie—.

2. **Linum strictum** Linn. occurs in the Punjab and the North-Western Himalaya, from Soongaria to the Mediterranean.

The seeds are used as an emollient in Spain.

Arabic: Farq, Kittan, Zir—; *Punjab*: Bab-basant, Basant—.

3. **Linum usitatissimum** Linn. is cultivated throughout India up to 6,000 feet.

The bark and the leaves are useful in gonorrhoea.

The bark when burnt and applied to wounds stops the bleeding and promotes the healing process.

The flowers are considered a nervine and cardiac tonic.

The roasted seeds are said to be astringent. Fumigation with the smoke is recommended for colds in the head and hysteria, and the tinder is used to staunch haemorrhages.

Linseed poultice is recommended for gouty and rheumatic swellings; as an emollient, the mucilage is dropped into the eye; with honey it is prescribed in coughs and colds.

The seeds are used internally for gonorrhoea and irritation of the genito-urinary system. The decoction is used extensively. Occasionally the seeds are powdered and taken with sugar.

In Iraq local druggists recommend linseed poultice for chest troubles.

An infusion of the seeds has long been given in Europe for soothing a sore chest or throat in severe catarrh or pulmonary complaints. As a domestic remedy for colds, coughs, and irritation of the urinary organs, linseed tea is most valuable. A little honey and lemon juice makes it very agreeable and more efficacious. It is taken in wineglassful doses, which may be repeated *ad libitum*.

The crushed seeds, or linseed meal, make a very useful poultice, either alone or with mustard. In ulceration and superficial or deep-seated inflammation a linseed poultice allays irritation and pain and promotes suppuration. It is commonly used for boils, abscesses and other local affections.

Tumours of a simple nature, and sprains, may be usefully rubbed with linseed oil. The oil forms, when mixed with lime water or with spirit of turpentine, a capital external application to recent burns or scalds.

Internally, the oil is sometimes given as a laxative; in cases of gravel and stone it is excellent, and has been administered in pleurisy with great success. It may also be used as an injection in constipation. Mixed with honey, linseed oil has been used as a cosmetic for removing spots from the face.

The oil enters into veterinary pharmacy as a purgative for sheep and horses, and a jelly formed by boiling the seeds is often given to calves.

Linseed has occasionally been employed as human food; but it affords little actual nourishment and is apparently unwholesome, being difficult of digestion and provoking flatulence. It has been mixed with corn for making bread, but it proved indigestible and hurtful to the stomach, and even was responsible for the death of many.

There is in England an Act of Parliament still in force which forbids the steeping of flax in rivers, or any waters which cattle are accustomed to drink, as it is found to communicate a poison destructive to cattle, and to the fish inhabiting such waters.

Cattle poisoning by linseed flowers is fairly common in Bengal and Bihar. The linseed flowers and the immature seeds contain the maximum amount of a cyanogenetic glucoside producing as much as 0.69 per cent of free hydrocyanic acid. About half a pound of flowers is sufficient to kill a bullock.

The seeds of *L. usitatissimum* Linn. and the oil from them are officinal in all pharmacopoeias, except that of Mexico.

Annam: Ho ma—; *Arabic*: Bazar-ul-katan, Bazr-ut-kattan, Kattan—; *Behar*: Chikna, Tisi—; *Bengal*: Masina, Mosina, Musni, Tisi—; *Bombay*: Alasi, Javas, Javasa—; *Brazil*: Linho—; *Bundelkhand*: Bijri—; *Canarese*: Agashi, Alashi, Alsi—; *Catalan*: Lli—; *Celtic*: Lin—; *Chinese*: Hou Ma—; *Danish*: Hoer—; *Deccan*: Alshi, Javas—; *Dutch*: Vlas—; *Egypt*: Kittan—; *English*: Common Flax, Flax, Linseed, Lint, Lyne—; *Finland*: Lin, Pellavan—; *Formosa*: Hu-ma—; *French*: Lin, Lin chaud, Lin commun, Lin cultivé—;

German : Flachs, Haarlinsen, Lein, Saatlein—; *Greek* : Linon—; *Gujerat* : Alshi, Alsi—; *Hamadan* : Basarak—; *Hebrew* : Bad—; *Hindi* : Alsi, Tisi—; *Hungarian* : Len—; *Iraq* : Kittan—; *Italian* : Lino—; *Kashghar* : Zighir—; *Kashmir* : Alish, Keun—; *Kolami* : Unshi—; *Konkani* : Sonnbium—; *Kumaon* : Alsi, Tisi—; *Kurdish* : Gosh—; *Loralai* : Alsi—; *Madagascar* : Rongonimbazaha —; *Malayalam* : Cheruchanavittintevilta—; *Marathi* : Alashi, Javas, Javasa—; *North-Western Provinces* : Bijri—; *Norwegian* : Lin—; *Persian* : Basarak katun, Bazarug, Bazr-ul-katan, Tukhm-e-katan, Zaghir, Zaghu—; *Polish* : Len—; *Porebunder* : Alasi, Javas—; *Portuguese* : Linhaca, Linho—; *Punjab* : Alish, Alsi, Tisi—; *Roumanian* : In—; *Russian* : Len, Lyon—; *Sanskrit* : Atasi, Auma, Chanaka, Devi, Haimwati, Kshauma, Kshaumi, Kshuma, Madagandha, Madotkata, Malina, Masina, Masrina, Masruna, Masuna, Matasi, Nilapushpi, Nilpushpika, Parvathi, Pichhila, Rudrapatni, San, Sunila, Suvarchala, Tailottama, Uma—; *Spanish* : Lino—; *Swedish* : Lin—; *Tamil* : Alshi—; *Telugu* : Atasi, Madanginjalu, Ullusulu—; *Turki* : Ziggar—; *Turkish* : Keten—; *Urdu* : Alasi—; *Uriya* : Pesu—; *Yugoslavia* : Lan—.

Reinwardtia.

The genus consists of only 2 species, one Indian and the other Chinese.

Reinwardtia trigyna Planch. is found along the Himalaya from the Indus eastwards, the Salt Range, Simla, Kumaon to Sikkim up to 6,000 feet, Assam, Chittagong, Bihar, Mount Abu, Bombay Konkan and Ghats, the Western Ghats, the forests of South Kanara and Mysore. It is distributed to Siam, Tongking and China.

It is used as a medicine for 'founder' in cattle.

Deccan : Abai—; *Dehra Dun* : Basant—; *Jaunsar* : Pengun—; *Kumaon* : Piuli, Piunli—; *Matheran* : Abai—; *Punjab* : Balbasant, Basant, Gudbatal, Gulashruf, Karkun, Kaur—; *Saora* : Labodatar—.

Roucheria.

The genus consists of 4 species, natives of Guiana.

Roucheria Griffithiana Planch. is found in Malaya; common in low country, Singapore, Malacca to Perak and Penang. It is distributed to Sumatra and Borneo.

The plant is used in the preparation of the dart-poison of the Sakais.

Malay : Akar biji, Akar kait putih, Akar musiang, Garam-garam, Ipoh akar putih—; *Sakai* : Bhoi—.

A STUDY OF THE COURTING HABITS OF *MYRMARACHNE PLATALEOIDES* (CAMBR.)— A SPIDER MIMIC OF THE INDIAN RED-ANT *OECOPHYLLA SMARAGDINA*.

BY

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The familiar red ant is mimicked by a few insects and spiders. Two spider mimics are fairly common and well known to naturalists in this country—the attid mimic, *Myrmarachne plataleoides* and the thomisid mimic *Amyciaea forticeps*. The habits of these spiders were studied by me, and in the course of my studies I made interesting observations on their mating habits. Comparison of these mating habits with the ordinary behaviour of these spiders in the field under different conditions, was found to be instructive. In this article the mating habits of *M. plataleoides* as observed in the field and in artificial cages, are described.

This spider moves about on plants infested by the red ants amongst which it would easily be overlooked. Though when it moves about ordinarily it is truly *Oecophylla*—like, while distrubed it betrays its arachnid and attid characters and to one who would patiently observe, the distinction becomes fairly easy.

One evening while out searching for these spiders during the Christmas holidays 1928, at Mavalikara, Central Travancore, I came across a nest outside which there was a full-grown male. It was observed for nearly half an hour: but I could not understand what it was about. Except for an occasional show of restlessness it remained patiently and calmly outside the nest. Evidently something inside was engaging its attention. As I did not want to wait longer, I thought of securing the specimen. Getting closer I was just attempting to drive it into an open tube, when, to my surprise, a female ran out of the nest and began 'staring' at me. Quite probably they were courting. Both the specimens were soon secured in tubes.

At home the specimens were placed in a large glass cage and watched closely. They wandered about the cage erratically for some time during which they met each other a number of times. At first they were too frightened to take notice of each other but later on there were signs of 'recognition'. They would pause and look at each other for a while, the male showing some signs of excitement. As the male however approached the female, the latter would run away. But after a little while they stopped and faced each other. The male raised its body on its legs and inclined the

falces downwards giving the body an arched form. In this attitude it approached the female in a series of short sudden jerks. As it drew nearer, the excitement increased and its movements became more jerky, turning now to the right and then to the left. Thus it 'displayed' itself before the female with bowed falces arched and uplifted body and with the first pair of legs lifted up; moving in sharp sudden jerks sideways and forwards. All the while the female was closely watching the 'antics' of the male, often turning in such a way as to keep it in full view. Both were in a state of great excitement. The male advanced slowly towards the female in this queer jerky manner till their front legs just touched. A few rapid mutual strokes by the palpi followed and with this the short 'dance' ceased. The arched body of the male resumed its normal position and all excitement seemed ended. The female remained quiet, slightly raising the abdomen and twisting it slightly to one side. The male moved forwards, got astride the female on one side, and felt with its palpus for the epigynum. The palpus on that side nearest to the female's abdomen was applied to the epigynum and for about five minutes they remained in this position. The male then moved backwards and then again moving forwards got astride the female on the other side and the other palpus was applied to the epigynum. The copulation over, the male moved away, while the female remained quiet for a little time.

Similar modes of courtship and pairing have been observed a number of times in my cages where mature males and females were kept together. But a few other observations which I have made on these spiders and their allies in the field have convinced me that this is not the normal way in which pairing takes place under natural conditions but that this occurs only under artificial conditions.

On several occasions I have taken males and females from the same nests and their behaviour and the readiness with which they paired when put together make one feel certain that they must have been pairing or preparing for pairing within the nests.

On one occasion I observed a male and a female of this spider moving about on the same leaf. As it was very inconvenient to watch them there I secured them and placed them in a cage. They ran about for sometime and eventually faced each other. The male soon began to pay attention to the female. It approached the latter in the usual jerky excited manner turning to one side and then to the other in regular alternation; but the female would turn round and run away. The male however persisted in paying his attentions and at last the female stopped, turned round, and faced the male. They touched each other by their forelegs and then the female stroked the falces of the male by her palpi. Some mutual recognition must have passed between them! For, this time, unlike the previous instances, no attempt was made at immediate pairing but after an 'agreement' as it were, the female hurried off to a corner of the cage and began busily to make a nest. The male showed no anxiety to pursue her. It watched the female closely, and leisurely moved towards her. When he neared, the female left off her work, came out and stroked the male with her palpi for a second and immediately hastened away to her work. The male

quietly continued waiting outside. The female worked very fast and soon got a nest ready. The next day the male was found to get in and pair.

Similar observations I have made in a mimic of the small red ant *Solenopsis* and also in certain dark mimics.

During the summer of 1930 and again in 1931 I had further opportunities to observe the courting habits of these spiders at Parur in North Travancore. While these observations generally confirmed the view given above that pairing takes place within the nest, certain other interesting details were noted.

On the 4th June 1930 I came across a nest in which were a male and a female. Closer scrutiny showed that they were not in the same chamber but were in two separate compartments of the same nest. There was a well-built nest in which the female was. This nest was completely covered over by a larger silken dome, rather sparsely woven, and within this was the male. From this chamber he had free access to the female's compartment. They remained each in its respective compartment quietly for four days. On the morning of the 8th I was surprised to note that the female had moulted and that its cast off skin was lying on a side in the nest. It was very surprising for it meant that the spider was, till then, only in the penultimate stage and was not a mature female. After some time the male who appeared to have been watching all these events showed restlessness, got out of its retreat and began to wander about the leaf for some time. Then it returned to the female's nest, was admitted into it, the female meeting it at the entrance and showing the usual expressions of excitement and then they paired inside the nest.

On the 8th June 1930 two of these spiders, a male and a female were seen on the underside of a plantain leaf. The female was very busy weaving a nest while the male was quietly observing from the outside, occasionally fastening a few strands overhead making the outer nest. In a short time the nest was completed and the female took her position in the inner and well constructed nest. The male waited outside for a long time. Then it was noticed to wander away returning in about an hour. It waited outside and made no attempt to get into the female's nest. Till the 12th June I observed them in the same position. On the 12th morning the female had moulted; the male was still waiting outside. These were not further observed but there is no doubt that soon the male must have got into the female's nest and paired.

Again at Parur, on the 8th May 1931, a female was observed in the hollow of a leaf within a nest of closely woven silk. Outside this and enclosing it, was a larger nest which was not however so carefully constructed as the inner one but consisted merely of a large number of silk strands. In this outer enclosure, was a male. They remained quietly till the 10th when the female was found moulted. The male came out of the retreat, moved about the leaf for a while and then returning to the female's nest entered the nest and paired.

On the 17th December 1931 I again observed a female in a fully formed nest with a male watching outside. The next morning

the female had moulted and by noon they were observed to pair inside the nest.

A few double nest of the same pattern as described above were observed at Mavalikara, Central Travancore, on the 16th September 1932. One of these was kept under observation. On the 19th night the female moulted and on the 20th I noticed them pairing within the nest.

Since making these observations, I have, almost every time I was out in the field searching for these spiders, come across one or more of these double nests or mating nests each having a female in the penultimate stage in the inner chamber and an adult male in the larger outer chamber. A number of times I have taken these females to examine if they are in the penultimate stage. On a few occasions they were found to be adults; but in all these cases the moulted skin lying inside the nest bore unmistakable testimony to the fact that its moulting to the adult was quite recent and took place only after she retreated into the mating nest. In the few previous instances of pairing which I observed and have recorded above, it is likely that the cast off skins in the nests were overlooked since such a phenomenon was not suspected at all.

In August 1933 I made very similar observations on the courting habits of two black mimics—*M. manducator* and another species not yet identified—from Cape Comorin and Vattakottai near the Cape. A number of mating nests with the females in the penultimate stage guarded by adult males were seen. Similar mating nests were also observed at Courtallam beyond the Ghauts, in August 1934.

In January 1932 the following observation was made. A male in the course of his wanderings came across a female still within its nest. This female was in the final stage. The male approached the nest with some jerks but without the details of courting which were observed when it took place in the open, and introduced both its first pair of legs into the female's nest. She was agitated, showed a few jerky movements and embraced the front legs a number of times. The male withdrew for a moment and then immediately returning, thrust the front legs as before into the nest. The female stroked the front legs with her palpi and front legs. This was repeated two or three times and then the male entered the nest and paired with the female.

In July 1934 the following experiments were made on *M. plataleoides* in cages. On the 14th of July I secured a mature male and also a female in the penultimate stage: these were put in separate cages for a day. At night they made their usual silken chambers and retreated into them.

The next morning I introduced into the cage in which the mature male was, a female in the penultimate stage. The female wandered about the cage and came across the male in his retreat. She moved towards the entrance of this retreat and introduced her forelegs and anterior region of her body into it. The male met her and a few rapid jerky strokes of the palpi and contacts of front legs followed. The male then hurriedly got out of the nest

and the female directly got into it. She immediately began to make the walls of the nest thicker. The male waited outside for a few minutes and then wandered away for a while. However, it soon returned and took up its position outside the retreat and spun a few silken strands over his body and enclosing the female in her retreat. The next morning the female had moulted and a little later I saw the male getting into the nest and pairing. As he got into the nest the female met him at the entrance and the usual strokes of the palpi took place.

In the other cage where a female in the penultimate stage was kept and which had made a retreat of its own, I introduced a mature male. He wandered about the cage a little and then came across the nest of the female. Without any delay he thrust the first pair of legs and his elongated chelicerae into it. The female who was resting within with the head turned in the opposite direction, immediately turned towards the male and they felt each other by their front legs and palpi. This was accompanied by a few jerky movements of the body. The male then retreated from the nest and waited outside while the female remained quietly within the nest. The next morning she had moulted and a little later the male got in and they paired within the nest.

Again, I kept a mature female in a cage. She made a retreat and rested within. The next day while the female was still in her retreat, I introduced a mature male into the cage. He wandered inside the cage a little and then came across the female's retreat. As in the previous experiment, here also the male directly introduced himself into the nest, his forelegs and falces thrust out in front. The apparently 'surprised' female felt the intruder with her palpi and front legs which immediately enabled them to recognise each other. After a little more of touches of legs and palpi, the male got into the nest and they paired inside the nest.

These observations show that the male in the course of his wanderings, *if he comes across a female which is only in its penultimate stage and is in her moulting chamber, takes charge of her and waits outside her nest patiently for her final moult to take place: that he, while thus waiting outside makes a large and loosely-woven nest outside the female's chamber and enclosing it. In this outer nest he remains. When the female has moulted and thus attained 'maturity' he gets into the inner nest without any special courtship and they pair within the nest. If however, he comes across a mature female within her nest, he directly introduces himself into the nest and pairs with her inside the nest.*

Several spiders are known to pair within 'pairing nests'[1] But the antlike spiders of the family Attidae are supposed to pair outside any nests.[2] My observations of several species of *Myrmarachne* however convince me that in this genus at any rate pairing does not take place in the open but only inside nests though in

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[1] T. H. Montgomery, 1910. *The American Naturalist*, vol. xliv.

[2] G. W. and E. C. Peckhams, 1889. Occ. Pap. of the *Nat. Hist. Soc. of Wisconsin* 2.

a state of confinement they may be noted to pair in the open. *The necessity for retreating under the shelter of the silken canopy for pairing will be obvious when we remember that they live in the company of the ferocious red ants and that if pairing takes place in the open they run the risk of being surprised by the forager ants from the ant colony.*

The observation that the males take charge of young females in the penultimate stage and wait till the latter moult, is not, however, without parallel though, as far as I could ascertain, no such observation has been recorded of any Indian spiders or, of any ant-mimicking spiders. However, one can be sure that if only the habits of spiders are sufficiently observed, many such instances would be forthcoming from the abundant spider-fauna of this land.

A number of American Attidae have been observed where the male seizes an immature female and lives with her in mating nests till she moults and becomes mature.[1] Peckham has shown such a behaviour in *Philaeus militaris*.[2] McCook has given certain additional instances[3] and Montgomery has described similar habits in *Phidippus purpuratus*.[1] They have also described members of other families such as Drassidae, Theridiidae and Lycosidae behaving in a similar manner. The commonly observed instances of the males of many orb-weaving spiders waiting near the webs of immature females must also be parallel phenomena to these. In a British clubionid, *Clubiona trivialis* the male is known to construct a nest near the nest of the female and tap upon the partition between them sometimes for days together.

Mating seems to be promiscuous; a male in the course of its wanderings may come across a female in the penultimate stage, in which case he waits outside for her to moult and then pairs with her. Or, if he comes across a mature female in her nest he gets in and pairs with her. The male may mate with a number of females successively and in the same way a female, after being impregnated by a male, may receive other males into her nest and pair with them successively.

From the above-recorded observations we may draw the following conclusions:—

1. When a mature male and a mature female are placed together in a cage the male 'courts' the female with characteristic jerky movements, uplifted front legs and bent abdomen and finally pairs with her in the open.

2. Under natural conditions however, such cases of courtship have not been observed. On the other hand males have been many times observed to come across females in their nests. The male without any formality introduces himself into the nest at the entrance of which the female meets him and there follows a few

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[1] T. H. Montgomery, 1910. *The American Naturalist*, vol. xliv.

[2] G. W. and E. G. Peckhams, 1889. Occ. Pap. of the *Nat. Hist. Soc. of Wisconsin* 1.

[3] McCook, 1890. American spiders and their spinning work, vol. ii.

'passes' of the front legs and palpi during which they appear to 'recognise' each other. If the female is an adult he gets in forthwith and mates with her. If she is only in her penultimate stage, he withdraws from the nest, and remains outside making a larger nest enclosing the female's nest and waits within it till she moults. After this event he gets in and pairs with her. If the female spider is not yet in the penultimate stage, she hastens away and escapes from the nest on feeling a male pushing himself into her nest.

3. The male is able to distinguish between a mature female and a female in the penultimate stage whom he had come into contact with and adapt his behaviour accordingly. At the same time the immature female—it is only natural that the mature females should recognise the male—which is only in its penultimate stage appears to have already attained to the 'adolescent instinct' which enables her to recognise and prepares her to receive the male.

'The Dance'.

The movements made by the male during courtship in the open, which, had not the later observations been made, would, certainly have been designated the 'courtship dance' deserves a little closer study. I have studied the behaviour of these spiders when they come across a stranger or a rival—the spider stops suddenly, looks closely at the stranger, the body is raised high on the legs, the falces are sloped downwards, and the first pair of legs are lifted upwards. A short pause in this attitude, and then he slowly approaches the other in short jerky movements or cautious measured steps. On approaching he seems to get clearer impressions about the other, for, his behaviour is modified according to it. If it is a large and formidable enemy it has faced, it suddenly darts back and escapes. If it is a rival male they both take up a fighting attitude. If it is a female he continues his jerky approach till their forelegs touch each other which appears to convey to each other the information they want. Quite possibly then, these *'courtship movements'* and their behaviour when they come across any stranger are more or less similar in their earlier phases—only later as the movements proceed and the spiders get more definite impressions of the objects engaging their attention, they take different aspects.

Some insight into this phenomenon can be got by an investigation of what are called Abnormal courtship dances of several male spiders.

Peckham has recorded a male *Phidippus mccookii* 'court' a female *P. clarus* while Locket saw a male *Tarentula barbipes* 'performing' in front of a male *Trochosa ruricola*. Berland noticed a male *Saitis barbipes* 'courting' in the absence of a female! Thus there are several recorded instances of male spiders beginning their 'courtship actions' before other males, mature or immature, of

their own species or even of another species.[1] My own observations on *Myrmarachne plataleoides* have shown that the preliminary parts of the 'courtship movements' *were exhibited by the male in the presence of other males or other spiders even if separated from it by glass partitions.* Nay, they have even on a few occasions been noticed *to begin these movements before their own images in a mirror !*

On one occasion when I casually turned towards one of my glass cages in which a mature male was kept, I saw him suddenly turn to a side and begin his 'courtship' movements. Of course, he did not continue it far but it was interesting that similar movements to 'courtship' were noted when apparently there was none nearby to cause any excitement. Probably Berland's observation of male jumping spiders courting 'nothing' is closely similar to this. He attributes this to Physiological excitement. It may be so; but while investigating this a simpler explanation that occurred to me is that the spider was not really courting 'nothing' as at first it appeared to be; but my movements in front of the glass cage either directly or by reflections on the sides of the cage gave the spider an idea of some stranger moving close by. It immediately put on its attitude of scrutiny and caution.

These 'abnormal courting phenomena' tell us that—

1. The male may *begin* the 'courtship movement' before other males, other spiders or even their own images.

2. The male does not need to 'recognise' the female by sight or by smell before he begins 'courting'. In fact the stimulus that initiates the movements of the male appears to be only something vague rather than anything definite.

3. When under these conditions 'courtship' has begun it does not however proceed to its culmination. As the male gradually approaches the object of his attentions he must certainly be getting some more definite impressions about the latter. If it is a male of another species its behaviour would be quite different; they may quietly resume their ways or the stronger would chase away the other. If it is an individual in a separate glass cage that has engaged the spider's attentions, it would soon find it physically impossible to get closer and failing to get the proper stimuli he would stop his attentions. On the other hand if it is a female whose presence has initiated these movements, as they approach they get more definite impressions of each other either by sight or smell and this would stimulate them further till their front legs touch each other. This is the climax of their effort to recognise each other; the cautious, 'on guard' attitude is given up and they prepare to pair.

Conclusion.

Our study of the courting habits of *M. plataleoides* has shown—

1. That 'courtship antics' *do not take place usually in the natural*

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[1] T. H. Savory, 1928. The Biology of spiders.

state where the male merely gets into the nest occupied by the female and pairs with her within the nest.

2. When a certain form of 'courtship' appears to take place under certain conditions, *the spiders do not seem to recognise each other fully—there being only a general impression of a stranger at first.*

3. The earlier phases of those movements which constitute this 'courtship' *are similar to those made by the male when he comes across any stranger.* In the open under confinement, these movements proceed and if the object engaging his attentions chances to be a female of the same species, the necessary impressions are sooner or later received which stimulate the sex instinct in both and they approach one another and prepare to pair.

These would partly appear to support the views of Professor Montgomery[1] in his interpretation of the courtship phenomena among spiders. He remarks that the adult male is excited by sexual desire and at the same time by fear during courtship and that the movements of the male at this time 'are for the most part *exaggerations of ordinary motions of fear and timidity*'.

Here the male, however is bigger and he need not fear his mate in any way: yet his movements are suggestive of extreme caution. When however he comes across a female in her nest—as happens under natural conditions—he does not wait for any of his 'display' but merely gets into the nest through one of its opening. At the opening of the nest they meet and 'recognise' each other. *The cautious movements which are exhibited when they meet outside any nest are to be looked upon as the spider's peculiar way of 'on guard' approach towards a stranger for the purpose of 'finding out' its real nature, his eyes at a distance having given him only a vague impression.* When a male and a female confined in a cage have once met they thereafter meet and embrace a number of times without any repetition of the special movements.

Against this view it has been pointed out that the courtship antics are not exactly the ordinary movements of excitement, self-defence and caution. It may be so in many spiders but in *M. plataleoides* which has been the subject of this study there is practically very little difference. Montgomery, however, analysing the instincts at work in the male and the female during courtship believes that the male recognises the female and is excited by sexual instinct; at the same time he is afraid of her and hence his attitude of self-defence. The latest theory of Bristowe and Lockett[2] which is only a modification of Montgomery's views is stated thus—[3]'Since the male spider runs the risk of being killed and eaten by the female the first use of his courtship antics is to enable her to recognise him as a male and not to regard him as something to be eaten. When he has begun his courtship the male spider is practically safe but it takes a varying amount of continued

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[1] T. H. Montgomery, 1910. *The American Naturalist*, vol. xliv.
[2] W. S. Bristowe and G. H. Locket, *P.Z.S.* XXII, 2.
[3] T. H. Savory, 1928. The Biology of spiders.

solicitations to stimulate the female so effectively that she submits herself to him. Recognition and stimulation are therefore both necessary before mating can take place.'

As Savory remarks[1] this later theory appears to be needlessly complex, attributing mental powers to the spider which it probably does not possess. Both the above-mentioned interpretations assume that the male is much better able to recognise the female than she is to recognise him.

The above study of 'courtship' in *M. plataleoides* shows that here at any rate a simpler interpretation is possible. *When 'courtship' begins the spiders do not appear to fully recognise each other but behave as if they are confronted by any stranger, 'recognition' taking place only as these movements have proceeded considerably, the finale of this attempt at recognition being reached when their forelegs have actually come into contact.*

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[1] T. H. Savory, 1928. The Biology of spiders.

REVIEWS

I.—A FACSIMILE OF R. H. BEDDOME'S ARTICLES ON INDIAN REPTILES 1862-1870. By Malcolm Smith. *Journ. Soc. Bibl. Nat. Hist.*; vol. I, part 10, pp. 273-334—15th May 1940. Price 15*s*.

Consisting of seven articles contributed by R. H. Beddome to *The Madras Quarterly Journal of Medical Science* and its short-lived successor, *The Madras Monthly Journal of Medical Science*, with illustrations and marginal notes, this slim brochure gives the specialist the sort of first-hand information which is usually out of his reach. It is recommended to every serious student of herpetology, and to all who are interested in the bibliography of natural history.[1]

J. F. C.

II.—THE TETRAPOD REPTILES OF CEYLON. *Volume I*: *Testudinates and Crocodilians*. By P. E. P. Deraniyagala. Pp. xxxii+412. *Ceylon*: Colombo Museum; *London*: Dulau & Co.; 1939. Price: Rs. 10 or sh. 15.

A warm welcome will be given to this book, the work of an author well qualified to deal with the reptiles of Ceylon in their many different aspects. Mr. Deraniyagala has done his task exceedingly well, and his book is a model of what such things ought to be: clear and exact statement, selected and arranged so as to give the most ready assistance.

Although the author gives much that is already known about the testudinates and crocodilians of Ceylon, his work is obviously not a thing of scissors and paste and second hand information, for the amount of new material incorporated by far outweighs the rest. For instance, the sections on the Leathery Turtle and the Estuarine Crocodile mark a great achievement in that they present so much which is entirely new.

The book contains 24 plates, 137 text-figures, 62 tables, a systematic index, a glossary of technical terms, a bibliography, and indexes of names: English, Sinhalese, Tamil, Scientific, authors. It is essentially a work of reference, and it is difficult to write about it; its thoroughness can only be tested by use.

J. F. C.

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[1] Published by 'The Society for the Bibliography of Natural History', 41, Queen's Gate, London, S.W. 7.

WANTED INFORMATION ABOUT MAHSEER.

Members who are anglers in India will be reading with much interest the series now being published in the *Journal* on 'The Game Fishes of India'.

Dr. Sunder Lal Hora discusses on pages 279 to 282 of Volume xli the why and wherefore of the hypertrophied lips of certain mahseer in certain rivers; and asks that 'To elucidate this problem it is highly desirable that anglers may kindly note the condition of the lips of the mahseer caught by them and also make a detailed note of the length,' etc., etc.

It is hoped that anglers will kindly do what they can to assist Dr. Hora in the manner suggested.

EDITORS.

MISCELLANEOUS NOTES

I.—HOW THE MONGOOSE COUNTERACTS SNAKE BITE.

With reference to my letter of the 27th of March regarding the habits of my crab-eating mongoose (*Herpestes urva*) I was told the other day by a Burman that these animals have a patch on the tongue which contains medicine to counteract a bite from a poisonous snake. I examined carefully the tongue of my mongoose and found it to be of normal red colour except for a small patch in the middle about the size of an elongated 3 penny bit. This patch is dark grey in colour and covered with fine spines of what appears to be hair. I do not know if this is recorded in the smaller species of red snake-catching mongoose. It is not altogether unlikely that this rough patch on the tongue could serve for the purpose of cleansing a wound inflicted by a poisonous snake. I would be very grateful if you would let me know if you have ever heard of this theory before and whether the small species of red mongoose has a similar rough hairy patch on the tongue.

AMHERST DISTRICT,
MOULMEIN.

A. L'E. BROWNLOW,
District Superintendent of Police.

[The idea that mongooses are immune to the bite of the cobra and resort to the eating of various roots and herbs to counteract the effect of the poison is very prevalent. But the story about the patch on the mongoose's tongue, containing medicine to cure snake-bite is a new one. The central patch on the tongue of the mongoose is composed of numerous papillae. These horny papillae are to be seen on the tongues of many carnivorous animals. They are encased in horny pointed sheaths. Their function is purely mechanical. The numerous rigid points give the tongue the action of a rasp designed to remove remnants of flesh adhering to bones, etc. These conical papillae tend to form spiny patches on the fore part of the tongue and the patch referred to has probably the function which we have indicated.

While the blood of the mongoose, like the blood of cats, has a certain resistance to snake venom, a mongoose, once injected with a fully lethal dose, will not survive. EDS.]

II.—A LARGE PANTHER.

(*A correction*).

I find that in your issue of the Society's Magazine, vol. xli, p. 656, you have been kind enough to publish an account of the World Record Panther shot by me.

I find however that owing to some oversight in my Office the name of wrong Taxidermist has been entered. The skin was

cured by Messrs. Theobald Brothers, Mysore, and not by Van Ingen & Van Ingen, Mysore.

Enclosed herewith a true copy of the Taxidermist's Certificate which I possess.

PALACE, YASHODHAR SINGH.
KHILCHIPUR,
CENTRAL INDIA.
May 22, 1940.

[In Rowland Wards Records of Big Game there is a record of a panther measuring 8′ 6″ before skinning (9′ 3″ dressed). It was shot at Banipur Kashmir by Col. A. G. Arbuthnot. EDS.]

III.—THE SHORT-NOSED FRUIT-BAT (*CYNOPTERUS SPHINX*) AS AN AGENT OF SEED DISPERSAL IN THE WILD DATE (*PHOENIX SYLVESTRIS* L.).

Standing in my garden at dusk on the 8th August (1940), I noticed a constant stream of bats flying in and out of the crown of a date palm (*Phoenix sylvestris*). The palm was laden with ripening fruit. At first I took the bats to be the Fulvous Fruit-Bat (*Rousettus leschenaulti* Desm.), but the flight did not seem to be that of *Rousettus*. Being interested, I got my torch and net and took my stand under the tree. In the fading light the crown of the palm was silhouetted against the sky and the bats could be clearly seen coming in, ferreting among the dates and then flying off. In the beam from the torch the colour of the animals soon betrayed their identity, they were the short-nosed Fruit-Bat (*Cynopterus sphinx*). Though dazzled, the bat did not seem to mind the light much. It made alighting difficult and in most cases the bats flew off again, but when the light was turned on once they had settled, they did not worry about it much. They would hurriedly select the ripest dates and fly off with one in the mouth. At no time did any of them finish its meal on the spot. I soon caught some on the return flight to the tree. An examination of the mouth revealed pieces of the scanty pulp of this date, adhering to the teeth. The stomachs contained much liquid and just traces of well-masticated pulp. From this it seems that this bat, like the Flying-Fox and *Rousettus*, relies mainly on juice and not on pulp.

By carrying off the fruit to be eaten elsewhere and there dropping the seeds when done with, the bats unconsciously become agents of seed dispersal. Bats are not unknown as agents of seed dispersal; and [1]Ridley in his book quotes several instances, though

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[1] *The Dispersal of Plants throughout the world*, p. 349.

he does not specifically mention *Cynopterus* as an agent of the date palm (*P. sylvestris*). However, he states that in Africa, where the genus *Cynopterus* is absent, *Rousettus* is known to feed on dates and disperse the seeds. While feeding the bats made no noises.

A point worth noting is that the genitals were in non-breeding condition at this season. The testes were invisible externally indicating that they 'atrophy' after breeding just as in *Rousettus*. Among the adults were a number of young adults which did not appear to exhibit the characteristic ferruginous tints of their elders. This seems to show that this bat, like *Rousettus*, breeds earlier in the year, perhaps about the same time as the latter species.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
August 10, 1940.

IV.—JUNGLE AND HOUSE CROWS AS DESTROYERS OF GAME.

This year, in the beginning of April, I noticed house crows arriving in the town of Bhavanagar in increasing numbers. Trees in which ten and twenty crows used to roost, now held at least a hundred if not more. The numbers in which they arrived was striking, reminding one of travelling parties of pilgrims. This preponderance of crows was also noticed in several large villages in the State. The increase may have been due to the famine prevailing in parts of Kathiawar, and to the scarcity of water in those districts. Here we have been fortunate this year in having good rains, but the crows have left no peace for breeding partridges and other birds.

The Jungle Crow, especially, has been a great menace to partridges, destroying their chicks. During this summer, I saw not less than half a dozen partridges robbed of their young. April and May seem to be the breeding season of the Jungle Crow here, and hence during this period the parent birds become fearless, attacking young birds, squirrels, and any living thing which they can tackle. It was a pathetic sight to see a pair of jungle crows destroying tiny partridge chicks despite the parents' vain attempts to protect them. Other small birds fared as badly. The Jungle Crow levies a heavy annual toll on young partridges. I am sure most nesting birds shudder at the call of the crow, which is a prolonged *qwauu qwauu*, generally emitted with outspread wings. Interpreted it must mean a general invitation to the robber band 'Food is here come and help yourselves'.

The House Crow does useful work as a scavenger. I have constantly observed parties of crows leave in the early mornings to visit villages ten or twelve miles away, specially to feed on dead cattle. They return to their roosts late in the evenings with full crops; but as avid destroyers of young birds and their eggs they are great criminals. And their depredations were particularly

bad on account of their abundance. House crows frequently combine in their marauding.

This hot weather, when making notes on the habits of the Common River Tern, a very interesting bird to study during the nesting season, I noticed one of these marauding parties of crows harassing a small colony, which had selected an island on our lake for their nesting. Morning and evening troops of crows would fly around the island, they were attacked immediately and vigorously by the terns, which succeeded in driving them away from time to time. The terns had the advantage of speed, and did not permit the crows to settle on their islands, nevertheless the raiders did not abandon their purpose. Reinforcements arrived, more and more crows came, and by sheer numbers, the raiders were eventually successful in stealing two eggs from the twenty-seven that were on the island. The raids continued day by day, the eggs were reduced until there were none, and the terns were compelled to evacuate their breeding grounds.

K. S. DHARMAKUMARSINHJI.

BHAVANAGAR,
April 15, 1940.

V.—NOTES ON THE NESTING OF LEGGE'S FLOWER-PECKER (*ACMONORHYNCHUS VINCENS* [SCLATER]).

(*With a plate*).

As there are no records of the nesting of this species, a description of the nest I found last February, may be of interest.

It was built about 75 feet from the ground in one of the lower branches of a *Dipterocarpus zeylanicus* which stands in a strip of jungle on this estate.

These trees are tall and straight, the trunk being bare of branches for 60 feet or more, and then breaking out into a fairly large head. The leaves are stiff, and from 5 to 8 inches long.

The nest was suspended from a leafy twig, being well protected from above by the foliage. It was larger than most Flower-peckers' nests, measuring about 4½ inches in length, and as will be seen from the photograph, had a pronounced hood over the somewhat large entrance.

It was rather fragile, being made of reddish vegetable down and cobwebs. The small furry seed cases of some plant were also incorporated, and were of the same reddish brown colour. The outside of the nest was decorated with dried leaf bracts or stipules, of varying size, two or three long ones being attached to the bottom of the nest.

Unfortunately I waited too long, and missed getting the eggs. The hen incubated for such brief periods, that I was under the impression that she was still building. It was only when I saw both cock and hen going regularly to the nest, that I realised my mistake.

There were two young. Only the hen built the nest and brooded the eggs. All observations had to be done with field glasses, and

Nest of Legge's Flowerpecker (*Acmonorhynchus vincens*).

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Nest of Legge's Flowerpecker (*Acmonorhynchus vincens*).

the nest was so well screened by leaves, that it was very difficult to get a good view of it.

The trials of getting it down were much enhanced by the large red ants which swarmed among the leaves,—and at times all over the Sinhalese climber. They give a very painful bite.

I have seen fledgelings of this Flowerpecker in August, so it is probably double-brooded.

I am much indebted to W. W. A. Phillips, Esq., for the excellent photographs of the nest, which he has kindly allowed me to use to illustrate these notes.

I found another nest of this species in June. The young were just leaving it. It was built in the same species of tree, but in a very large specimen.

It was well within the crown, and about half way up it, built in a topmost spray of an erect branchlet about 3 feet high, growing from the main portion of a large limb.

The height from the ground was estimated at 125 feet. The tree was rather isolated and in an exposed position, standing on the edge of the jungle where it adjoined tea.

This tree was about fifty yards from the tree where the first nest was found, and I have every reason to believe it was built by the same pair.

CICELY LUSHINGTON.

HOUPE,
KAHAWATTA,
CEYLON.
April 10, 1940.

VI.—THE OCCURRENCE OF THE YELLOW-BELLIED FLOWERPECKER (*PACHYGLOSSA MELANOXANTHA* HODGS.) AT ALMORA, U.P.

Among the small collection of birds made at Almora by Mr. W. A. Hewitt, is a specimen of the Yellow-bellied Flowerpecker (*Pachyglossa melanoxantha*) ♀. This specimen was obtained at Almora Kumaon District—altitude 6,800—in August 1940. The range of this species, according to New *Fauna*, is given as 'Sikkim and Nepal to Eastern Assam and the higher hill ranges south of the Brahmaputra'.

S. H. PRATER.

BOMBAY NATURAL HISTORY SOCIETY,
August 27, 1940.

VII.—THE OCCURRENCE OF THE DRONGO CUCKOO (*SURNICULUS LUGUBRIS* HORSF.) IN THE PUNJAB.

I thought it might interest you to know that I am almost certain I have seen a pair of *Surniculus lugubris* here.

The bird answers the description of the Drongo Cuckoo given in the *Fauna of British India*, vol. iii, p. 223. I should say

the birds are young though, as I did not handle them, I did not see any white feathers. I first noticed them sitting on the telegraph wire beside the golf club house, and at first glance thought they were the King Crow until I noticed the tail, which had the outer feathers considerably shorter than the rest and slightly protruding.

According to the distribution of this bird given in F.B.I. it is rare in the Indian Peninsula and this part of India is not given as a likely locality. The paragraph finishes up by saying that it is probably more widely distributed, but owing to its great resemblance to the King Crow it is apt to be overlooked. This encourages me to believe that it may be the bird, and I would be very grateful if you would tell me whether you think this is possible or not.

The King Crow itself is not a common bird here in Jullundur except in the breeding season. I only saw *Surniculus* (?) a week ago; and on four consecutive days they have been in the same place, and I venture to think they have only just arrived or I would have seen them before as I spend a great deal of time watching birds.

MRS. A. B. M. WAY.

7, NAPIER ROAD,
JULLUNDUR,
PUNJAB.

September 5, 1940.

[The Indian Drongo Cuckoo *S. l. dicruroides* is described as being found in Upper India and Assam, extending into Northern Burma. It is obviously a rare visitor to the Punjab. Col. Rattray in a paper on the Birds of the Murree Hills, (vol. xvi, 661) describes it as a very rare species, which was shot in the Murree Hills at 5,000 ft. in 1899. Then A. J. Currie, in a note on the Cuckoos of the Punjab (vol. xxiv, p. 549), states that he heard the notes of this bird in a garden in Lahore, and identifies the call unmistakably as belonging to this species. EDS.]

VIII.—A NOTE ON THE ALPINE SWIFT (*MICROPUS MELBA BAKERI* HARTERT).

In a letter to me, Mr. Humayun Abdulali has pointed out that the resident race of *M. melba* is *bakeri* Hartert, and not *M. m. melba*, a point we overlooked in the joint paper by Mr. A. R. Hughes and myself, *On the road to Gersoppa and back* (*Journ. B.N.H.S.* vol. xli, p. 446).

With regard to the breeding of this bird, we were merely quoting from the *Fauna* [F.B.I. (Birds) 2nd Ed. vol. iv, p. 325]. If the birds breed 'during June and perhaps the last week of May,' then it was quite reasonable to expect the swifts there in numbers, but this was not the case at the time of our visit in June 1938. Mr. Ali's record in the *Journal* (vol. xxxviii, p. 830), 'The male,

with fairly large salivary glands had testes measuring 18×8 mm. The female with a shelled egg in the oviduct, had the salivary glands very much more enlarged.' seems to definitely establish that this swift breeds in December at the Gersoppa Falls, and not in June as mentioned in the *Fauna*.

Commenting further on my observations Mr. Ali writes,

'But your note raises an interesting question. Where do the birds go during the rains? You found them absent in June, and I did not see them either, when I was down at Gersoppa on the 3rd August, last year (1939). A friend of mine however, was there on the 7th September and almost certainly saw the swifts. As a matter of fact, he dropped his camera lens over the ledge on the British side, he saw 'many small birds flying about in the mist'.

The birds appear to leave the falls from June to August, or, as you must have heard from the Chowkidar at the Dak Bungalow, the pigeons and swifts store large reserves of food in the crevices and thus hibernate through the monsoon'!!

As already stated in the joint article Mr. Hughes and I saw no birds in June (1938), but I have seen them in thousands in October (1919). I also stated that I shot this bird in the Pulnai Hills during June and July (1921). At that time they were about those hills in fair numbers. My observations, and Mr. Ali's subsequent visit in August, seem to suggest that there is a definite migration to other parts during the full force of the monsoon, but where the thousands of birds go to is yet to be discovered.

C. McCANN.

Bombay Natural History Society,
Bombay.
July 31, 1940.

IX.—VULTURES 'FEEDING' AT NIGHT.

Mr. Livesey's interesting experience with vultures feeding on a carcase at night—on page 55 of your *Journal* (vol. xl—No. 4—May 1939)—has prompted me to quote the following entry from my 'shikar diary' in respect of very similar proceedings witnessed by me when shooting in the Nepal Tarai and the Maharani of Khairigarh's jungles early this month with the Maharaj Kumar of Vizianagram.

'On 6-4-40 the Maharaj Kumar and I sat up for tiger in the Nepal jungles. This was in dense tree and grass jungle where it joined the *narkul* and *ratwa* grass jungles. A pair of tigers had overnight killed one of our large-size buffalo *paddas* at cross-paths some 50 yards into the tree jungle. At the crossing was a clearance some 30 × 40 yards with a few big trees and right round was dense tree and cane jungle. The kill had been dragged towards clumps of cane. We decided to sit up and so the kill was dragged back into the clearing at about 4-30 p.m. Half an

hour later we took our seats in a comfortable machan and had hopes of the tigers, which were certainly present earlier in the evening, turning up. But alas! all our hopes were blasted by vultures who must have been particularly famished! When we arrived, several of the high trees round about were full of these birds waiting patiently. Up to the time we got into the machan our men were about, but they left when we were comfortably settled in, two of them remaining hidden about 100 yards away for some time in case anything was required. The sun was high, and from 5-30 p.m. to 8-0 p.m. the men did nothing but charge the vultures, who every 10 minutes or so fell on the kill. After 8-0 p.m. no further attempt was made to get rid of them and, when we got down from the machan half an hour later, some 20/30 of them were still feeding. We flashed our torches on them and, after craning their necks at us, they continued their repast as if nothing had happened. Several of them, which had fed to repletion, were sitting about at the edge of the tree jungle and, owing to the darkness, could not fly to safety. Some of them tried to do so, missed their mark, and fell to the ground. Those on the ground were not molested by any animal and were none the worse for being on the ground on a dark night.

This episode was astonishing to me for I was always under the impression that after sun-down vultures never alighted at kills, especially in jungle where they could easily be ambushed.

On returning to camp I consulted the two head shikaris, one a local man and the other of Mirzapur, who said that nothing unusual had happened. According to them vultures, which have had even a partial feed, will not come down after sunset, but, if they have been kept off, as was the case here, they are very bold and throw discretion to the wind. They may have a shrewd knowledge of the presence of the killer, but when hungry very frequently take their chance. One of the shikaris told me that he was once watching a kill from a tree. At about 6 p.m. a few vultures, from among many that were sitting round, ventured to alight and peck at the kill. This brought the tigress out and she chased some birds for 20/30 yards. While she did this other birds, which had meantime alighted, tackled the kill. These proceedings were repeated a dozen times till the tigress left in disgust and the birds had their feed. No vulture was killed though 3/4 had been hurt by blows aimed at them by the tigress. This incident took place in Khairigarh jungles bordering on the Nepal Tarai.'

I can offer no comment beyond that I was truly surprised at the conduct of the vultures who seemed to suffer from a type of fatalism. We had had several other kills where such behaviour was not resorted to.

It would be interesting to learn of the experiences of others.

10, Rajpore Road,
Delhi,
April 28, 1940.

E. S. LEWIS.

[In volume xxxviii, p. 190 Mr. R. C. Morris published a note on 'Vultures feeding at night'. The birds descended from neighbouring trees at about 8 p.m. and by 11 p.m. they had completely demolished the carcase. It was a moon-light night.

On p. 624 of the same volume, Mr. W. Gough records an identical incident when sitting up for tiger near Neemuch. EDS.]

X.—INJURIES TO THE FEET OF A MALLARD.

Last February I shot a Mallard, the feet of which appeared to have suffered a loss of portions of the web and 'toes', the latter being in certain cases, mere stumps, and having the appearance of the ravages of 'Frost Bite', or amputation as might occur from a jaw-trap. The injuries were of no recent date, as there were no raw or open scars, and the bird—a drake—was in capital condition, being one of the heaviest of the species I've shot—well over 3½ lbs.

W. P. KEELAN.

ARCADIA T. E.,
DEHRA DUN, U.P.
July 19, 1940.

XI.—ADDITIONAL NOTES ON THE BIRDS OF BOMBAY AND SALSETTE.

Since the publication of the final part of our paper on 'The Birds of Bombay and Salsette' we have obtained several fresh records, and our attention has been drawn to overlooked data. This is an attempt to bring the paper into line with the information available today, and we hope to be able to bring out these supplementary reports from time to time.

Several of the records merely duplicate previous observations, and are entered for completeness. We are also including a number of nesting records from the adjacent country, since almost no information is available from our area, and these might facilitate further work.

We would like to place on record our appreciation of the considerable amount of data obtained by Br. Navarro at Khandāla, and we hope to be able to publish a more complete list of the mass of interesting details that he has procured in that locality.

1.—BIRDS NEW TO THE BOMBAY-SALSETTE LIST.

The Indian Pied Myna : *Sturnopastor contra contra* (Linn.).

At Dharāvi, near Sion Station, a pair of these mynas was noted several times in a localised area and one was seen singing lustily in a Bombax (April 1940). H.A. also saw another pair near Kūrla during the monsoon last year, but these records may refer to 'escapes' since this is a common cage bird.

The Pigmy Wood-pecker: *Dryobates hardwickii hardwickii* (Jerdon).

A solitary bird was observed on a *Bombax* in open deciduous forest near Borivli on 31-12-39, and a pair on the Wada Road some 20 miles North of Bhiwandi, on 27-6-37. There is also a specimen obtained by Fr. Palacios at Mūrūd, Janjira, during August, 1937. These records show that the bird is sparsely distributed throughout our area.

The European Roller: *Coracias garrula semenowi* Loudon & Tschusi.

Further to the Khandāla records mentioned in *J.B.N.H.S.* xl, p. 168, a specimen was obtained in Bombay City during December, 1938.

The Blue-winged Paroquet: *Psittacula columboides* (Vigors).

This bird was twice seen on a hillside in heavy forest at Tungar Hill near Bassein on 2-4-34. Brother Navarro has records of c/3 on 4-2-40, and c/3 on 15-4-40, both from Khandāla.

The Jungle Nightjar: *Caprimulgus indicus indicus* Latham.

A specimen obtained at Chembur on Trombay Island was sent in to St. Xavier's College during December, 1939. This species may be a rare resident in our area, as it was noted common at Kardi (near Ātgāon) on the Nāsik Road.

It is also common at Khandāla, where Navarro has taken 3 clutches of 2 eggs each during May, 1937. He records that in each clutch one egg was distinctly larger than the other.

Franklin's Nightjar: *Caprimulgus monticolus monticolus* Franklin.

A specimen was obtained by D. A. Barretto at Kūrla on 10-1-40. The characteristic *sweesh* call of this bird is too distinctive to be overlooked, and this individual may have been a straggler.

The Brown Hawk Owl: *Ninox scutulata lugubris* (Tickell).

A male, with dormant testes was shot at Bandra on 13-1-40, by Mr. Knox. The specimen, which is now in the St. Xavier's College Collection, was examined by Sálim Ali who places it with *lugubris*. The colour is intermediate between *lugubris* and *hirsuta*, while the head is darker than *lugubris*. The wing measures as 213 mm.

The Indian River Tern: *Sterna aurantia* Gray.

This tern was noted as common on flooded mud flats at Bassein on 17-9-39. There is a specimen in the St. Xavier's College Collection obtained at Trombay.

The Large Crested Tern: *Thalasseus bergii* ssp.

One was noted going over the ternlet colony at Utan Washi on 28-5-37. Considering that a sub-species of this bird is common further south and breeds on the Vingūrla Rocks, it is likely that stray birds do occasionally turn up round Bombay. It is of course essentially a bird of the sea.

The Large Indian Cormorant: *Phalacrocorax carbo* [*sinensis* (Shaw & Nodder)].

Several were seen at Tānsa Lake on 18 April 1940. The white about the head and on the thighs is unmistakable. The bird is also appreciably larger than the other cormorants and much stockier than the Darter.

The White Ibis: *Threskiornis melanocephalus melanocephalus* (Latham.).

In the St. Xavier's College Collection there is a specimen shot by Fr. Palacios in Rewdanda Creek on 8-11-33. This Ibis is also common in the Deccan, and a large flock was seen at Lake Beale on 22-10-39.

The Glossy Ibis: *Plegadis falcinellus falcinellus* (Linn.).

A bird was shot by Fr. Palacios of St. Xavier's College, in Rewdanda Creek on 8-11-33. A pair was observed by H. A. in salt pans at Bassein on 17-9-39. This species is common at Nasik and in the Deccan generally.

The Reunion Petrel: *Petrodroma aterrima.*

On 15-6-40, a specimen was sent in alive to St. Xavier's College. After some speculation regarding its identity, and in the absence of any material for comparison, it was forwarded to the Colombo Museum, and has been named as this species by Mr. G. M. Henry of that place. This bird is new to the Indian area; its distribution is given as 'Western Indian Ocean near Mascarenhas Island, and breeds at Reunion Island' (These islands are off Madagascar). The specimen was obtained by fisher-folk near Colaba Lighthouse, and considering that *Puffinus persicus* has also been procured in the same area this year, it appears that petrels may be commoner about our coast than existing records indicate, and further collaboration with fishermen might produce interesting information.

2.—Additional notes relating to Birds already mentioned in our original paper.

The Southern Grey Tit: *Parus major mahrattarum* Hartert.

Several were noted on 13-2-38, some 20 miles north of Bhiwandi, along the Wada Road. Navarro took an egg at Lonavla.

The Common Babbler: *Argya caudata caudata* (Dumont).

Navarro has a record of three fresh eggs taken in a bush in an orchard at Bandra on 2-3-40.

The Deccan Scimitar Babbler: *Pomatorhinus horsfieldi* Sykes.

On 9-11-39, Navarro took c/3 fresh and c/3 half-incubated at Khandāla.

The White-throated Babbler: *Dumetia hyperthra albogularis* (Blyth).

We took c/4 at Khandāla on 3-9-39.

The Bombay Quaker Babbler: *Alcippe poioicephala brucei* Hume.

Navarro obtained c/3 at Khandāla on 10-11-39.

Jerdon's Chloropsis: *Chloropsis jerdoni* (Blyth).

Navarro has two records of nests with 2 eggs obtained at Khandāla on 13-6-40.

The Indian Stone-Chat: *Saxicola torquata indica. (Blyth).*

Birds were seen on bushes bordering snipe country near Kihim on 19-10-32.

The Indian Shama: *Kittacincla malabarica malabarica* (Scopoli).

Navarro has taken 2 clutches of 4 eggs each at Khandāla on 15-4-38 and 27-5-38.

The White-throated Ground Thrush: *Geokichla citrina cyanotus* (Jardine & Selby).

Records appear to indicate that this bird is a monsoon visitor to Salsette, and further notes would be of interest.

The Blue Rock Thrush: *Monticola solitaria pandoo* (Sykes).

The first and last records of this bird are on 2-10-33 and 18-4-35.

The Paradise Flycatcher: *Tchitrea paradisi* [*paradisi* (L)].

The last record from Salsette is on 3-5-34, but Navarro has obtained eggs (c/2) at Khandāla on 17-3-40. The sub-species requires confirmation.

The Pale Brown Shrike: *Lanius isabellinus* Hempr. & Ehrenb.

The appearance of this species in our parts in the cold weather of 1939-40 *may* have some connection with the failure of the monsoon in its usual winter quarters further north and west. A male was shot on the mud-flats near Rewas in Dharamtar Creek on 3-12-39, and another was obtained at Ghoti, Nasik Dist. on 1-1-40. It was then noted as common. Another was seen in 'katchar-patti', Trombay Island, on 26-1-40.

The Black-headed Cuckoo-Shrike: *Lalage sykesi.* Strickland.
Navarro obtained a c/3 at Khandāla on 27-5-39.

The Bronzed Drongo: *Chaptia aenea malayensis.* Blyth.
A pair was observed in deciduous forest at Borivli on 31-12-39, where they were occasionally hawking very close to the ground; another example on 7-4-40, a few miles from Thana. It may be a winter visitor.

The Racket-tailed Drongo: *Dissemurus paradiseus malabaricus* (Latham).
A c/1 was observed along the Tulsi Flume on 18-6-39. On 7th April, 1940, the forest north of the Dahisar stream was rapidly cut down, and several Racket-tailed Drongos were seen in deforested country which can now be termed scrub, with a few stunted clumps of bamboo. Will the birds migrate to heavier forest or acclimatize themselves to scrub?

Franklin's Wren-Warbler: *Franklinia gracilis gracilis* (Franklin).
A bird was building at Vihar Lake on 3-7-38.

The Black-headed Oriole: *Oriolus xanthornus maderaspatanus* (Franklin).
Another nest with c/3 was obtained at Powāi Lake on 5-7-36, and young out of nest were also observed.

The Rosy Pastor of Rose-coloured Starling: *Pastor roseus* (Linn.).
Birds were seen at Bhyandar as early as 20th Aug. 39. This *might* be due to the drought in the North.

The Grey-headed Myna: *Sturnia malabarica malabarica* (Gmelin).
Navarro obtained a c/1 at Khandāla on 18-6-39, and this is the nearest breeding record available. In Salsette it appears to be commonest during the monsoon and cold winter.

Blyth's Myna: *Sturnia malabarica blythii* (Jerdon).
On 9-9-39, a party of four or five was observed at Trombay Island.

The Jungle Myna: *Æthiopsar fuscus mahrattensis* (Sykes).
A pair was observed at Powai on 20-4-40. By June quite a colony appear to have settled down among the palms now standing on marshy land exposed by the drainage of the lake. One pair was noted building in a hole in a headless brab. Common Mynas are also present, but these appear to keep to drier land.

The Indian Red Munia: *Amandava amandava* (Linn).
A small party, all in female plumage, was observed at Vihār on 2-2-34.

The Black-headed Bunting: *Emberiza melanocephala* Scopoli.
A small flock was observed between Mumbra and Panvel on 18-3-39. It was common near Ghoti, Nāsik Dist. on 1-1-40.

The Crag Martin: *Riparia rupestris* (Scop).
These birds were observed at Khandāla on 30-11-39. They were noted as common near Lake Beale on 1-1-40, as well as at Niphad on 17-3-40.

The Dusky Crag Martin: *Riparia concolor* (Sykes).
On 2-7-38, a pair was observed nesting over a door-way at Worli, Bombay City. Another pair was building at Kampoli—Bhor Ghat on 1-3-39. On 3-9-39, the latter nest site had been shifted by about 10′ and the birds were still building. Water was apparently seeping up to the old nest, and the material for the new nest was obtained from the old one.
We have no breeding records in the City, except during the monsoon. The nests found during March-April, are situated near springs in the Ghāts. The availability of water may therefore constitute a factor governing single or double broods.

The Indian Wire-tailed Swallow: *Hirundo smithii filifera* (Stephens).

On 28-7-40, birds were seen visiting a nest under a culvert at Bhiwandi, Thāna Dist.

The Indian White Wagtail: *Motacilla alba dukhunensis* Sykes.

It may be interesting to note that the same roosts are used year after year on migration. Does this indicate memory among birds?

The Small Indian Skylark: *Alauda gulgula gulgula* Franklin.

A c/3 was found at Colaba Reclamation on 7-9-38, while a c/2 was picked up at Godhbunder in snipe country on 8-10-39.

Tickell's Flowerpecker: *Dicaeum erythrorhynchos erythrorhynchos* (Latham).

The breeding season appears to be more prolonged than indicated by us previously, as a nest with 2 chicks was obtained at Bhiwandi, on 26-8-38.

The Southern Yellow-fronted Pied Woodpecker: *Dryobates mahrattensis mahrattensis* (Latham).

This bird was seen busy at flowers (nectar?) of *Sterculia colorata* at Kaneri, Borivli, on 19-4-35.

The Rufous Woodpecker: *Micropternus brachyurus jerdonii* (Malherbe).

On 25-6-39, Navarro obtained a c/2 from a nest alive with ants at Khandāla. A pair at work demolishing a 'live' *Crematogaster* nest interrupted work to remove the unwelcome ants off their persons. The alarm note is a quick low *'qu-uk'*. The rectrices do not appear to be as stiff as those in other woodpeckers and this may be correlated with their un-woodpeckerlike habit of perching across a branch.

The Malabar Heart-spotted Woodpecker: *Hemicircus canente cordatus* Jerdon.

On 21-5-39, a pair were seen suspiciously near a hole in dry branch along Wada Road near Sūriāmal, and another pair was observed elsewhere. We have two further sight records from Salsette: 31-3-36 and 31-12-39. The call is harsh and jerky rather like an Iynx's.

The Indian Cuckoo: *Cuculus micropterus micropterus* Gould.

This bird appears more common than indicated before, at least during the monsoon. The call is difficult to discriminate from that of the Scimitar Babbler, except that it always comes from the tops of trees, and there is occasionally an extra syllable. A male was shot on 28-7-40, at Tānsa River north of Bhiwandi.

The Common Crow-Pheasant or Coucal: *Centropus sinensis parroti* Stres.

A bird was observed carrying grass blades at Trombay, on 9-9-39. Navarro has obtained young at Khandāla on 23-5-38.

The Large Alexandrine Paroquet: *Psittacula eupatria* ssp.

A pair was shot at Bandra on 20-8-32. The specimens are in the St. Xavier's College Collection.

The Loriquet: *Coryllis vernalis* ssp.

These birds were noted as common in small parties, about 8 miles north of Bhiwandi along Wada Road, on 28-7-40.

The Indian Three-toed Kingfisher: *Ceyx erithaca erithaca* (Linn.).

A c/1 was obtained from a hole in cutting in wooded hill-side, on road-side at Powāi on 5-7-36. A newly hatched chick with 2 eggs was found in a nest in a similar situation at Suriamal during the rains in the same year.

The Indian Black Eagle: *Ictinaëtus malayensis perniger* Hodgs.

On 12-11-39, Navarro located a bird building at the top of a tall tree down in the valley at Khandāla, but it had apparently deserted the nest at a later visit.

We have several sight records of this bird in Salsette and the neighbouring area. It appears too distinctive to be confused with any other species.

A specimen was shot at Virār, a little north of Salsette on 14 Jan. 1940. (*J.B.N.H.S.* xli, 899).

The Black-winged Kite: *Elanus coeruleus vociferus* (Lath.).

A specimen was obtained in Tūlsi-Vihar area on 25-2-40. Its stomach contained a *Mabuya carinata* lizard.

The Pied Harrier: *Circus melanoleucus* (Forst.).

A specimen was shot in early November, and another observed at Panvēl, on 25-2-34.

The Indian Emerald Dove: *Chalcophaps indica indica* (Linn.).

A loud cooing, reminiscent of a large wood-pigeon, often heard in Salsette, has been traced to this bird. On 21-3-40, Navarro took a c/2 at Khandāla.

The Indian Rufous Turtle-Dove: *Streptopelia orientalis meena* (Sykes).

Several were seen at Godhbunder on 23-3-38.

The Jungle Bush Quail: *Perdicula asiatica asiatica* (Lath.).

A bird with young was seen at Powāi in March 1939. On 17th September 1939, a female with soft egg in ovary was shot in paddy stubble at Tūngar, near Bassein.

The Southern Painted Partridge: *Francolinus pictus* (Jard. and Selby).

A male shot calling off a tree near Bhiwandi on 17-9-39, had enlarged testes and was obviously breeding. The breeding of most of our game birds does not appear to coincide with the statutory close season.

The Ruddy Crake: *Amaurornis fuscus fuscus* (Linn.).

Specimen No. 266 noted in *J.B.N.H.S.* xl. 629 should be dated 21-6-36 and not November.

The Coot: *Fulica atra* Linn.

A bird was seen at Bhyandar as early as 29th Aug. 1939. On 3-9-39 there were quite a few birds on Panvel Tank. In the St. Xavier's College Collection there is a single egg labelled 'Bombay, 1910.'

The Demoiselle Crane: *Anthropoides virgo* (Linn.).

This is, of course, a common visitor to the Deccan during the cold weather.

The Indian Stone Plover: *Burhinus oedicnemus* ssp.

One was seen at Andhēri in a deserted garden on 4-2-40.

The Large Indian Pratincole or Swallow-Plover: *Glareola maldivarum maldivarum* (Forster).

On 1-9-39, a solitary bird was shot on the road at Bhyander. It appeared to be a tired straggler.

The Little Tern or Ternlet: *Sterna albifrons albifrons* Vroeg.

The colony at Utan Washi was visited again on 4-6-39, and numerous nests observed. The parents were noted wetting the eggs by dipping themselves in sea-water every few minutes. This is described in *J.B.N.H.S.* xli, p. 433.

Jerdon's Little Ringed Plover: *Charadrius dubius jerdoni* (Legge).

Navarro has had two birds taken off clutches both of 3 eggs on 24th May at Khandāla, identified as *jerdoni*.

The Eastern Curlew: *Numenius arquata lineatus* Cuvier.

Snails, mudfish and fiddler crabs appear to form a fair proportion of the food of these birds.

The Whimbrel: *Numenius phaeopus phaeopus* (Linn.).

This bird is a prominent passage migrant in Salsette. Stomach examined, contained remains of snails and crabs.

The Ruff and Reeve: *Philomachus pugnax* (Linn.).

On 29-8-39 one was shot out of a flock of 25 in a slushy maidan covered with short grass at Bhyandar.

The Curlew-Stint or Pigmy Sandpiper: *Erolia testacea* (Pallas).

This was common at Nala Sopara on tidal mud-flats on 17-9-39.

The Wood Snipe: *Capella nemoricola* (Hodgs).

One shot at Ambarnath in Jan. 1940 has been recorded in the *Journal* vol. xli, p. 665.

The Persian Shearwater: *Puffinus persicus* Hume.

A female was brought in alive by fishermen to St. Xavier's College from Colaba Light-house on 3-7-40. Legs and feet pinkish white: outer part of tarsus and outer toes including web black. Iris brown; bill brown. Wings 221 mm. cul. 31 mm. tar. 36 mm. tail 80 mm.

The Indian Spoonbill: *Platalea leucorodia major* (Temm. & Schlegel).

We have several sight records from the surrounding area, and it appears to be well known to most local shikaris as 'paat'. At Lake Beale near Ghoti it was very common on 1-1-40.

The Open-billed Stork: *Anastomus oscitans* (Bodd).

On 4-2-40 a solitary bird was seen at north end of Vihār Lake.

The Yellow Bittern: *Ixobrychus sinensis sinensis* (Gmelin).

Specimen No. 268 obtained at Powāi and recorded in *J.B.N.H.S.* xli, p. 648 should be dated 21-6-36, and not November.

The Flamingo: *Phoenicopterus ruber antiquorum* Temm.

A flock of eight was noted at Bhyandar on 20-8-39. One with downy head was shot out of a party of three at Dharamtar Creek on 12-11-39. This was a drought year in Cutch and Gujerat.

The Spot-bill or Grey Duck: *Anas poecilorhyncha poecilorhyncha* Forster.

On 7-4-40 a pair was observed at Powāi, where shooting is now prohibited. When settled the spots on the beak are distinct, while in flight the red legs are prominent. This bird breeds in Niphad, Nāsik Dist.

The Garganey or Blue-winged Teal: *Querquedula querquedula* (Linn.).

Several were shot at Bassein on 17-9-39. A small party including a male in full plumage was observed at Powāi on 7-4-40.

The White-eyed Pochard: *Nyroca rufa* Linn.

This was observed with the party of Garganeys at Powāi on 7-4-40.

The Tufted Pochard: *Nyroca fuligula fuligula* (Linn).

Mr. McCann reports seeing a party on Tūlsi Lake on 3-2-40.

BOMBAY,
September 24, 1940.

HUMAYUN ABDULALI,
SÁLIM ALI.

XII.—SOME BIRDS OF LOWER BURMA.

I record below the names of five birds that I have shot during this month in Insein and Tharrawaddy districts, which were apparently not found by Mr. Standford.

Criniger phaeocephalus (Grey Headed Bulbul). One of a pair found in dense evergreen forest in the foothills of the Pegu Yomas between Taikgyi and Gyobyu.

Hemipus picatus (Sykes Pied Shrike). A male found in deciduous forest near Taikgyi.

Aethopyga cara (Tenasserim Yellow-backed Sunbird). A male found in very dense evergreen forest near Taikgyi.

Arachnothera longirostra (Little Spider Hunter). A female found in deciduous forest near Taikgyi.

Chrysophlegma flavinucha (Goulds Yellow-naped Woodpecker). Fairly common in the teak forest foothills of the Pegu Yomas near Nyaungbinzin.

Yesterday I saw a large flock of pure white ibis flying over lake Hlawga. I think these birds must have been *Tantalus leucocephalus* (The Pelican Ibis) which Oates stated were abundant in the Plains of Pegu in his day, though Mr. Standford only records having come across *Threskiornis melanocephalus*, the white Ibis, during his 3 years.

RANGOON, J. A. M. SYMNS.
May 28, 1940.

XIII.—SOME BIRDS OF THE OILFIELDS, BURMA.

I give below the names of three birds found by me in the vicinity of Yenangyaung, Magwe District, that do not appear in Mr. MacDonald's list of birds from the Mingyan District.

Tephrodornis gularis pelvica (Nepaul Wood Shrike). One specimen shot in the open scrub country in July 10 miles outside the Oilfields was identified by Mr. Garthwaite of Maymyo as being of this species.

Picus mahrattensis (Yellow-fronted Pied Woodpecker). By far the most common woodpecker of the scrub country round Yenangyaung.

Chaliophaps indica (Bronze-winged Dove). Seen on two occasions in the thicker wooded parts of the Pin Chaung when out Jungle Fowl shooting.

RANGOON, J. A. M. SYMNS.
May 28, 1940.

XIV.—BIRDS EATING BUTTERFLIES.

I have been up in Nepal (Katmandu) for the last month and while there an incident occurred which might be worth recording in the *Journal of the Bombay Natural History Society*. I visited a Mr. and Mrs. Kilburne who have a house with a garden in the town of Katmandu and Mrs. K. said that a pair of Paradise Flycatchers lived in the garden having made a nest in the same tree for some years. They arrived each year about 30th March, and a friend of hers who had been observing these birds in Calcutta had told her that they arrived in Calcutta on the same date. I said I should like to see them, and after about one minute the birds appeared; the hen with some material in her mouth flew to the nesting tree. This was about 24th April. There were several 'cabbage white' butterflies flying about the garden and one of the birds seized one on the wing and carried it to a perch and there ate it—the wings, which I enclose, fell to the ground. The birds then made several attempts to catch another butterfly. I know birds do eat butterflies—I wrote a letter in 1930 or thereabouts to the *Journal* relating that I had seen the red-legged Falconet catch and eat a butterfly, but the extraordinary part about this incident is that the Paradise Flycatcher carried the butterfly to its perch, not into beak but in its feet like a kite. I was not the only one who saw this; there were several of us in the garden and they all saw it, but it was all done so quickly no one could say whether the butterfly was caught by the bird's beak and transferred to the feet or whether it was caught by the feet of the bird—the white wings showed up vividly under the body of the bird as it flew to the perch.

S. F. HOPWOOD, I.F.S.

C/o Messrs. Thos. Cook & Son, Ltd.,
Phayre Street, Rangoon,
April, 30 1940.

[In the December 1939 issue of the *Journal* (vol. xli, No. 2, p. 445) we published a note by Mr. Hubback on the Paradise Flycatcher eating butterflies: a discussion on birds eating butterflies will be found in the editorial comment to a note on the Red-legged Falconet (*Microhierax eutolmus*) hawking butterflies contributed to the *Journal* by Mr. S. F. Hopwood (vol. xxxi, p. 826). Eds.]

XV.—THE MANY BANDED KRAIT (*BUNGARUS MULTICINCTUS*) IN BURMA.

In his 'Poisonous Snakes of India' Wall remarks that this snake is rare in Burma and that only one specimen has been recorded, somewhat dubiously, from Rangoon.

I was therefore very interested when Mr. L. C. Glass showed me a specimen killed in his garden in Rangoon on May 21st. He says two were seen, but the larger one got away.

The specimen killed had 31 white stripes on the body and 10 stripes on the tail, and was about 2′ 4″ in length.

RANGOON, J. A. M. SYMNS.
May 28, 1940.

XVI.—EXTENSION OF THE RANGE OF THE BROWN WHIP SNAKE (*DRYOPHIS PULVERULENTUS* JAN.)

Dryophis pulverulentus has so far been recorded from Ceylon and the Anamallai Hills, South India [*vide Fauna British India* (Reptilia) p. 371, 1st Ed.]. While on a visit to Karwar, N. Kanara, I secured a male on the 14th September 1940. It measured 53 inches. This, however, is not the first record of this species from Karwar. There is a specimen in the Society's collection labelled 'Karwar' and another, 'Kanara'. Both are without the names of the donors and were collected in 1907. There are other specimens from, Castle Rock (*P. Gerhardt*, 1907); Nelliampatty Hills, S. India (*A. M. Kinlock*, Nov. 1911); Ceylon (*E. E. Green*); and, Matugama, Ceylon (*F. Wall*). Thus it is clear that *D. pulverulentus* is a lot more widespread than originally recorded.

My specimen is of interest as there are some slight differences exhibited by it when compared with the details given in the *Fauna*. In the first place there is a small ovate oblong scale bounded by the internasal, praefrontal and 2nd upper labial. Secondly, the number of ventrals is 195 as against 194 (maximum) mentioned in the Fauna—a very minor difference, indeed. Lastly there are 199 subcaudals as against 173 (maximum). These are all points of minor importance, but, nevertheless, I think, worth recording.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
September 21, 1940.

XVII.—FROG EATING A SNAKE.

I was glad to read Mr. Charrington's note on 'Snake attacked by Frogs' in the Bombay Natural History Society's *Journal* Vol. xli, No. 3, because I witnessed a similar incident a few years ago. It was during the monsoon when I was returning from a dinner party and had just entered my gate, when in the headlights of my car I caught sight of a large frog (*Rana tigrina*) and a snake close to each other on the lawn. I stopped the car keeping the headlights on the frog and the snake, and got down to see what would happen. In a few minutes the frog hopped closer and leaped onto the snake taking hold of it by the neck. The snake which was only 10 to 12 inches long made frantic efforts

to escape but could not release itself from its adversary's grip. When the snake's struggles weakened the frog slowly began to swallow it. I watched this performance for over 15 minutes until nothing but a few inches of the snake still remained. I think the snake was a wolf-snake, a harmless species.

BHAVNAGAR, R. K. DHARMAKUMARSINHJI.
July 8, 1940.

[A number of notes have appeared in the *Journal* on 'Frogs eating Snakes'. In volume xxxvi, p. 161 of the *Journal* McCann records that the Bull-Frog (*Rana tigrina* Daud.) readily devours such small snakes as it can overpower. EDS.]

XVIII.—NOTES ON THE GEOGRAPHICAL DISTRIBUTION AND LARVICIDAL PROPENSITIES OF *HORAICHTHYS SETNAI* KULKARNI.

Observations made on fish fry collected by me from the territorial waters of Cochin and Travancore at Manjummel and Cheranellore in the months of May and June, 1938, have revealed the presence, among them, of larvae of *Horaichthys setnai*, the sole known representative of a new family of fish recently described by Kulkarni (1940, pp. 379-423). Regarding the distribution of the species, Kulkarni records it as occurring in the coastal areas about '100 miles north and south of the city of Bombay'. After the larvae were found, adults were looked for and collected on various occasions from Manjummel and Cheranellore from shallow inlets within tidal influence of the backwaters. It is thus evident that the fish thrives and breeds in the coastal backwaters of Cochin and Travancore. In all probability, the fish extends throughout the western coast of Peninsular India.

Regarding the feeding habits of the fish, Kulkarni lists 'copepods, diatoms, minute crustacean larvae, etc.' as the main items, while he mentions, amidst the stomach-contents of the fish, 'fine particles of sand, pieces of grass, leaves and other debris', which evidently do not form part of its diet. Observations made by me on the larvicidal tendencies of the fish, however, show that it is destructive to mosquito larvae of the first and second instars whenever available. As the fish is small and provided with delicate mouth parts it is more successful in tackling the earlier instars than the later ones. In this respect the fish is likely to prove a valuable adjunct to other major larvivores like *Aplocheilus lineatus* (Job, 1940; John, 1940) and *A. panchax* (Job, 1940*a*) especially in the brackish waters of coastal districts.

The bionomics of *H. setnai*, as revealed from the interesting observations of Kulkarni, are quite favourable for utilising the species in anti-malarial work. While a typical backwater species common in puddles and pools of stagnant brackish-water, and breeding in sheltered places along the edges of the creeks, it extends 'to waters under tidal influence'. Even after the monsoon it is

noted to remain in large perennial pools within tidal limits to propagate the species. Covell's (1935, p. 40) requirements for larvicidal fish are to a great extent satisfied by this tiny toothed carp. Thus (1) the fish is 'small, so that it can get about in shallow water among weeds, etc.' (2) It is hardy, being recorded to be able to withstand a wide range of salinity varying from 4.363 to 1.348 per cent, and can even tolerate fresh-water within limits. (3) It breeds easily throughout the year (with a peak period during July and August). (4) It stands transport very well. A stock stood the train journey from Bombay to Calcutta[1] and thrived quite well thereafter. (5) It is an agile active fish with large eyes which are helpful in locating its prey and in detecting the approach of enemies. (6) It is absolutely insignificant and worthless as food. (7) It is carnivorous as is proved by a study of its stomach-contents as also by its short intestine. The fish is remarkably adapted for surface life. The head, which is flat dorsally and the upturned mouth are suitable adaptations. As Kulkarni has mentioned, the species, like *Aplocheilus*, occurs invariably near the surface of the water and mostly in the midst of aquatic plants, and 'is often found in swarms which move about in close formations'.

Thus it will be seen that *Horaichthys setnai* is a suitable species for use in malarious areas of coastal waters, and its efficiency lies in its capacity to destroy mosquito larvae in their early instars.'

T. J. JOB, M.Sc.,
Lady Tata Memorial Research Scholar.

LABORATORIES OF THE ZOOLOGICAL SURVEY OF INDIA, CALCUTTA.

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I. Efficiency. (In the course of publication).

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[1] Mr. Kulkarni kindly gave me some fish to experiment with from this stock which was brought by him to Calcutta, and my thanks are due to him for the same.

XIX.—NOTES ON THE EARLY STAGES IN THE DEVELOPMENT OF THE DECCAN KILLIFISH [*APLOCHEILUS LINEATUS* (CUV. AND VAL.)].

(*With 2 text-figures*)

Introduction.

The sexual dimorphism and breeding habits of the Deccan Killifish, *Aplocheilus lineatus* (Cuv. and Val.) have already been discussed by one of us (Job, 1940). Its egg and a juvenile stage of 14.7 mm. have also been described. Observations on the early devlopment of the fish made from eggs collected from natural habitat are detailed in the present paper. It may be pointed out that from the beginning of this century, when Aitken (1902, cited by Bannerman, 1910, p. 525) observed the larvivorous propensities of *A. lineatus*, the fish has attracted the attention of various workers, and several observations (*vide* Job, p. 52) point to its being of special value in anti-malarial campaigns, especially in the Deccan. Prashad and Hora (1936, p. 643) have emphasized that it is essential, for control measures to be successful, that the biology of the natural agent proposed for control work should be known in all possible details. It is hoped, therefore, that a thorough knowledge of the breeding and development of *A. lineatus* will prove helpful in the culture and use of this efficient larvivore, which is known to be of proved utility in mosquito-control.

In 1910 Willey (p. 122) wrote that *A. lineatus* lays eggs which become attached by glutinous threads to water plants, but added that he had 'not found them so attached', though he had seen them freshly extruded in the month of July. Again, Job's description of the eggs of the species was based on those laid in the month of May, 1938, under artificial conditions of the aquarium in which a few large-sized adult fish were kept.

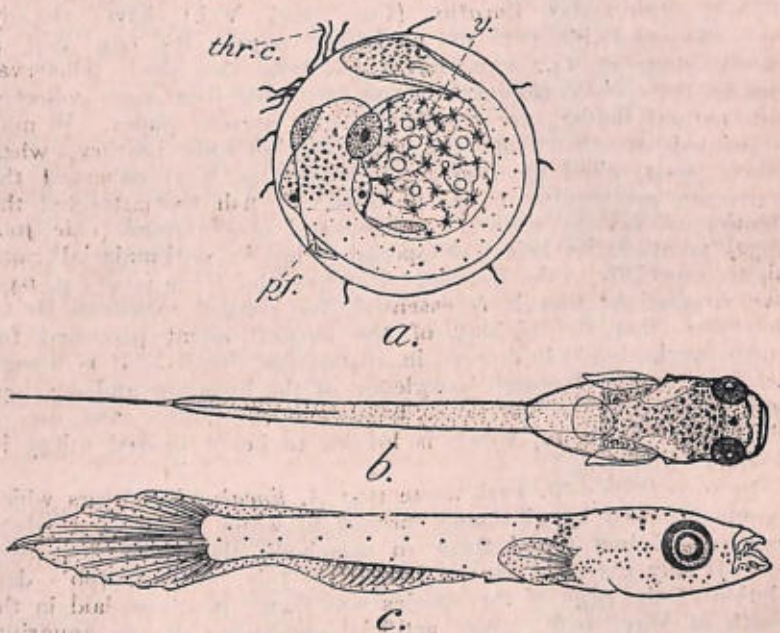
Search for the eggs laid under natural conditions was since then continued. On several occasions empty egg-cases were found attached to water weeds and roots of other aquatic vegetation. Young fry were found in the tanks and ponds in and around Trivandrum throughout the year. Eggs with healthy embryos were collected by one of us (S.J.) from the large tank in the Public Gardens, Trivandrum, in the month of September, 1939 and these were found attached singly to submerged bamboo sheaths near the margin of the tank by the tuft of anchoring filaments, which have already been described in detail by Willey (p. 122) and Job (p. 69). The eggs were carefully transferred to troughs of clean water and their development followed.

Development.

The course of development of *Aplocheilus lineatus* is so similar to that of its North Indian congener, *A. panchax*, which was

recently described by one of us, that only some of the salient features in the development of *A. lineatus* need be described.

Embryonic stages.—The fairly large eggs are transparent during the early stages, but turn brownish as the development proceeds, owing to pigmentation within and accumulation of dirt outside the egg. The period of embryonic development is variable as was observed in the case of *A. panchax*, but usually lasts for about ten days. In the course of development the central mass of oil globules gets broken up, but the Kupfer's vesicle is not distinct as in *A. panchax*.



Text-fig. 1.—Developing egg and early larvae of *Aplocheilus lineatus* (Cuv. and Val.).

a. Six days old egg × *ca.* 22;
b. Newly hatched larva (dorsal view) × *ca.* 18;
c. Larva of twelve days' growth (lateral view) × *ca.* 14;
p. f. pectoral fin, *thr. c.* cut ends of adhesive threads;
y. yolk.

The six days embryo (text-fig. 1 *a*) is well developed with large pectoral fins which are kept in constant motion. The mouth and gill openings are present, the eyes are dark, the vitelline circulation is complete, the caudal fin bears rays and the embryo wriggles actively inside the egg-membrane. The embryo is seen to occupy a greater space within the egg-membrane than that in *A. panchax*. The nature of the hatchling depends on the period of incubation, the quantity of yolk being less in late hatchers.

Metamorphosis.—In general appearance the newly hatched larva (text-fig. 1 *b*) of *A. lineatus* resembles very much that of

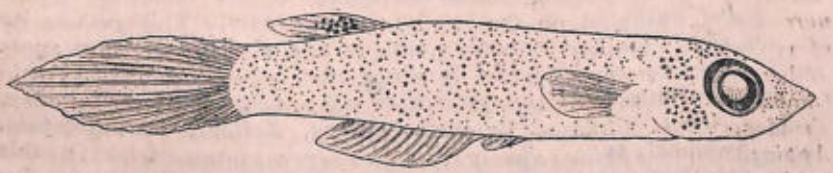
A. panchax, but exceeds the latter in length by about one millimetre. Some yolk-remnant with oil globules is present; the eyes are bright and shining, and the air-bladder is clear. The larva very seldom comes to the surface of the water. The pectorals, though without fin-rays, are large and functional. The caudal, which is lanceolate in shape possesses seven fin-rays, of which the third from above is the longest. All the median fins are continuous, and the dorsal and the anal are devoid of rays. The lower jaw extends slightly beyond the upper. The distribution of pigmentation is very much as in *A. panchax*.

A remarkable feature that has been noticed in the early larva of *A. lineatus* is its capacity to adhere to the smooth vertical sides of the aquarium by the antero-dorsal region of its head for fairly long periods. The usual position is oblique with the tail directed either obliquely upwards or obliquely downwards. Even a very careful examination has failed to reveal any special adhesive organ. Probably the adhesion is effected through adpression. The adhesive habit, however, lasts only for a couple of days after hatching. A more or less similar, though less apparent adhesive habit has also been observed in the case of *A. panchax* (Job, p. 64).

By the second day the larva makes more frequent visits to the surface. The yolk is reduced, the air-bladder becomes larger, and two more fin-rays are developed in the caudal fin.

In another day practically all the yolk is absorbed, and the larva moves about actively, feeding on minute organisms in the water at the bottom and on the sides of the aquarium. The air-bladder grows larger and extends further backwards. The chromatophores on the head turn brownish, while some of those between the eyes acquire a silvery lustre.

The main change that takes place within the next few days is in regard to the fins. The anal fin becomes gradually marked off from the caudal, and rays are formed in its posterior portion, which becomes broader. A week after hatching, the larva has fourteen rays in the caudal and ten in the anal fin. Text-fig. 1 *c* shows a twelve days old larva. It is about 7·5 mm. long. The protractile premaxillae have been protruded during fixation. Beginnings of as many as seven rays have appeared in the pectoral fin, while the number of rays in the anal has risen to eleven.



Text-fig. 2. Post-larva, 11 mm. long (lateral view) × *ca.* 9.

(The magnifications given are those on reduction of text-fig. 1 to half and of text-fig. 2 to one-third.)

Text-fig. 2 shows a fish eleven millimetres long. The anal fin has fourteen rays and the pectoral about ten. The pelvics are well differentiated with the appearance of rays. The dorsal

ocellus is conspicuous. The occipital spot, however, is not yet well formed. This stage represents the final post-larval stage which grows and leads on to the 'young adult', 14.7 mm. long, described in the earlier paper (Job, p. 69).

SUMMARY.

Some of the early stages in the development of *Aplocheilus lineatus* are described. Eyed ova were collected from a natural habitat of the fish and hatched in aquaria. The salient features in the development of the species are more or less similar to those of *A. panchax*, but the Kupfer's vesicle is not distinct in *A. lineatus*, and the developing embryo occupies a greater space inside the egg-membrane. The characters of the hatchling with its peculiar habit of adhering to objects are described. The changes undergone by the larva in its growth up to the 11 mm. size are described. The 11 mm. size represents the final post-larval stage of the fish, after which it assumes the adult characters.

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S. JONES, M.Sc.,

Travancore Central Research Institute, Trivandrum.

July 1940.

T. JOB, M.Sc.

Lady Tata Memorial Research Scholar, Calcutta.

XX.—BUTTERFLIES ATTRACTED BY MOIST EARTH.

On page 646 of volume xli No. 3 of the *Journal*, Capt. W. C. Carrot mentions coming across thousands of the butterfly *Appias nero galba* gathered on the sand near a stream. This peculiarity of collecting together in large numbers and sitting on damp spots and sucking up the moisture is a common occurrence with certain families of butterflies, though not of all species of some families. *Troides, Tros, Chilasa, Papilio, Pathysa, Zetides, Paranticopsis, Appias* and *Huphina* amongst others very commonly have this habit. But what is interesting about this habit is the reason for it. Why do these butterflies collect and suck at the damp earth in this way? The places at which they congregate are extremely local and cover a definite area small or large as the case may be,

[1] For further related literature such as Moody (1939), Stoye (1935), Mellen and Lanier (1935), Fraser (1938) and Innes (1939), see Job, 1940.

beyond which few if any butterflies will be seen sampling the moisture, although the earth or sand has the same appearance as the area on which they are sitting—at least this has been my experience. Moreover day after day butterflies will be found on the same spot but not on others adjacent to it, which have identically the same appearance. Has it ever been investigated what it is in the moisture which attracts particularly butterflies and not other insects, such as flies? I am not speaking of areas where there has been carrion or other dirt but merely plain damp areas in earth or sand. Have samples of the earth where butterflies settle in such hundreds at times ever been analysed to find out if there is any component in these patches which is not found in adjacent areas? Is there some organic substance in the earth which is particularly to their liking or is it some inorganic chemical? Do butterflies visit these spots in the same way that animals visit a salt lick? Furthermore it is only the males so far as I know which behave in this way. I have frequently experimented on a small patch by quietly placing my net over all the butterflies on it and killing them all and then watching the behaviour of other passing butterflies. It was quite apparent that these areas gave off some sort of scent for butterflies, particularly of the genus *Pathysa*, invariably exhibited great excitement when passing close to such a patch although there were no butterflies on it to give any indication of its nature. They would fly backwards and forwards over it after suddenly checking in their flight and finally they would settle—nearly always on the edge of the patch and then flutter and hop with perhaps a short flight or two towards the centre of the patch where they would start sucking in earnest occasionally ejecting drops of moisture from their anal extremities. Gradually more and more individuals would collect until there were as many as before. Another point is that I have seldom, if ever, seen these patches at heights above 3,500 feet where butterflies collect in such profusion as they do at lower elevations, particularly in the hot valleys at the foot of the hills.

Perhaps somebody has taken the trouble to investigate this matter more closely and has come to some definite conclusions. If so it would be very interesting to hear of them from other readers.

KOPJI VILLA,
AUKLAND ROAD,
DARJEELING,
BENGAL,
July 15, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXI.—ON THE LARVA OF THE MOTH (*CIRCULA TRIPERESTRATA*) AND THE DESTRUCTION OF THE COCOONS BY TREE SHREWS.

On looking through my notes I have come across the following occurrence, which is perhaps worth recording:—

One of the most common larvae to be found in and near Gauhati, Kamrup District, Assam, is that of the moth *Circula triperestrata*

Helfer; where it swarms at times on mango and one or two other trees and shrubs. I have noted two broods in the year; but there are possibly three. The last brood which spins up in about September passes the winter in the pupa and the moths emerge the following May or late April. The moth is seldom seen, although I have found the cocoons by the score and larvae by the hundred.

One morning I was watching a small squirrel-like animal hunting industriously among the leaves of a clump of orchids on a tree in our garden there. It seemed to be finding something very much to its relish and frequently sat up chewing and cracking something which looked like a nut. I investigated and found that the clump of orchids and the leaves of the tree contained numerous cocoons of the moth mentioned, on which the animal had been having a fine feed; first eating a hole through the silk cocoon and then pulling out the pupa which was chewed up in exactly the same way as a squirrel eats a nut. I later shot one of these animals, which were very common, and the Society very kindly identified it as a Tree Shrew, *Tupaia belangeri*. These animals must, in my opinion, unless kept off, cause considerable damage to the larvae of the Muga Silk Moth which are reared on trees in various parts of the District. They also dispose of any cocoons of the Muga which are accidentally left on the trees and I have frequently found empty cocoons of this moth in the Muga 'orchards' with the usual hole in the side. Such cocoons are useless for reeling of course.

Incidentally I sent some *triperestrata* cocoons to an expert who informed me they were useless for reeling purposes being too coarse. The local name of *triperestrata* in Kamrup is 'Amlodie', so I was told.

R. E. PARSONS, F.R.E.S.,
Indian Police.

KOPJI VILLA,
AUKLAND ROAD,
DARJEELING,
BENGAL,
June 23, 1940.

XXII.—*LAGERSTROEMIA INDICA* AS A FOOD PLANT OF THE SILK MOTH (*ACTIAS SELENE*).

I have recently been reminded that some years ago while I was at Sardah, in the Rajshahi District of Bengal, I obtained a female specimen of that beautiful, large, pale green, tailed Saturnid Moth (*Actias selene* Hub.), from which I got about fifty eggs. At the time I did not know what was the most usual food plant of this species and so tried various shrubs and plants from the garden without success until I gave the newly hatched larvae a sprig of that common garden flowering shrub *Lagerstroemia indica* Linn. They immediately began to eat it, and I successfully reared about a dozen to the moth stage. The only thing I noticed was that the perfect insects were somewhat smaller than they should have been.

Perhaps this note may be of use to some of your readers who may be placed in the same position as I was of not knowing what to feed the larvae of this species on. The shrub mentioned is of course exceedingly common in gardens on the plains of Bengal and Assam where it is cultivated for its flowers. A number of the larvae had died of starvation before I gave them the *Lagerstroemia*.

KOPJI VILLA,
AUKLAND ROAD,
DARJEELING,
BENGAL,
July 8, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXIII.—THE WEEPING WILLOW (*SALIX BABYLONICA*) AS A FOOD PLANT OF THE MOTH (*LOEPA KATINKA* WESTW).

Many thanks for your letter dated the 9th July 1940 regarding my enquiry about the food plants of the Moth *Loepa katinka* Westw. I had found in Seitz that the food plants of this species were stated to belong to the genera *Cissus* and *Leea* and that the larvae would probably also feed on vine. *Cissus* and *Leea* are not available in Darjeeling; I obtained some vine, but they did not appreciate it and only nibbed the edges of the leaves. They began to die fairly soon and before your letter arrived mentioning the food plants of *Loepa newara* Moore, as *Caesalpinia nuga* Aitk., *Salix babylonica* and *Acer Campbelli*. The first named is not available here, so far as I was able to find out. *Acer Campbelli* is very common, but the larvae of *Katinka* would not touch it even. I then tried weeping willow which is *Salix babylonica*, I understand, and they, or rather the remaining 19 larvae, are feeding well on it. This may interest you as you state you have nothing on record as to the life history and food plant of *Katinka*. I got the eggs from a badly battered female which I found on a bush here. She laid a fair number of fertile eggs.

KOPJI VILLA,
AUKLAND ROAD,
DARJEELING,
July 15, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXIV.—THE WOOD-CUTTING WASP (*SPHEX EDAX* BINGHAM), AND ITS PREY IN SALSETTE.

According to Bingham [*Fauna British India* (Hymenoptera) vol. i (1897) p. 251] *Sphex edax* has been recorded from 'Sikkim, Tenasserim, Ceylon.' This wasp is not uncommon in the forested areas of the Salsette Island. On 4th March (1940) I caught two

excavating an old, fallen trunk of *Zyziphus* sp., and another was seen on the same trunk. On the 14th April another was caught working on an old trunk. Again on the 12th May I saw one excavating a rotting piece of the trunk of *Erythrina stricta*. All these records were made in the Tulsi Lake area.

S. edax is an extremely active insect and moves about with rapid jerky movements. Its presence in a log is soon noticed by the heap of newly excavated, coarse, wood-dust. On breaking up the *Erythrina* log I noticed that there were several tunnels, some old, some new. The tunnels generally run in the direction of the grain of the wood, and may be several inches deep by about a little more than half an inch wide. When the tunnel is complete the provender for the future young is deposited at the far end and then the cavity is plugged with wood-dust for a distance of two to three inches. The wood-dust is packed tight. At the end of one of the tunnels I found five or six black, flightless cockroaches, [1]*Perisphaeria* sp. The cockroaches were alive, but in a stupefied condition. It is well known that some members of the *Sphegidae* collect *Orthoptera* for storing in their homes.

In life, the general colour is shining black, except for the abdominal segments which are bright red; but in the preserved state the bright red fades to dull-red or red-brown. The wings are an irridescent blue-black, somewhat like those of a scolid.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
May 13, 1940.

XXV.—LARVA OF *THERETRA LYCETUS* CR. PARASITIZED BY TACHINID FLIES.

On the 14th July (1940) while scouting round for entomological specimens in the jungles just off the road between Bapsai and Murbad, Mr. J. Alfrey spotted a large larva of *Theretra lycetus* Cr. feeding on a species of *Leea* (Vitaceae). As the larva appeared quite healthy we brought it home in the hope of getting the moth. I kept it in a case. The next day the caterpillar left the leaves and moved round as though looking for a place to pupate. On the 16th it changed colour from green to brown and lay in a corner—pupation seemed inevitable. On the 17th morning I found the caterpillar dead in the centre of the cage. It appeared rotten as it had burst and was liquefying. Inside the body was a heaving mass of several fly maggots. On the 19th no trace of the maggots was to be seen; only the skin of the caterpillar remained lying on a damp patch of earth. On the 29th three flies appeared in

[1] I am indebted to Dr. Baini Prashad for the identification.

the morning and another in the afternoon. The next day a fifth fly had emerged. On the 1st August as there was no addition to the flies I opened the case, after killing the flies, and examined the earth under the caterpillar. The pupal cases of the flies could be clearly seen just where the skin of the host was lying. The mud had become a compact mass—as a result of the putrefying liquids filtering into it, and in this were buried the pupal cases of the flies with the tops just showing at the surface. A single pupa which was apparently dead was also found which brought the total number of flies to six. These observations give the pupal life of the flies as approximately ten days.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
August 1, 1940.

XXVI.—MARCH *LEPIDOPTERA* AT GOPALPUR (DIST. GANJAM).

The following is a list of species taken in the course of a month's very superficial collecting in March 1940. The list is obviously far from complete and most of the species recorded were taken in the Casuarina jungle surrounding the Yatton Hall Hotel. The Heterocera recorded as being taken at light were caught in the Hotel itself.

RHOPALOCERA.

Polydorus hector L.—About the commonest butterfly. Also larvae.
Polydorus aristolochiae F., *aristolochiae*—Common. Also larvae.
Papilio paris L., *paris*—Common.
Papilio polytes L., *romulus* Cr.—Uncommon.
Papilio demoleus L., *demoleus*—Uncommon.
Delias eucharis Drury—Uncommon.
Cepora nerissa F., *phryne* F.—Common.
Anapheis aurota F., *aurota*—Common.
Catopsilia pomona F.,—Common. Also f. *bidotata* Fruhs.
Danais plexippus L.—Common.
Danais chrysippus L.—Not uncommon.
Euploea core Cr., *core*—Very common.
Melanitis leda L., *ismene* Cr.—One specimen.
Euthalia garuda Moore, *anagama* Fruhs.—Common.
Hypolimnas misippus L.—Common.
Hypolimnas bolina L.—Common.
Precis orithya L., *swinhoei* Btlr.—Uncommon.
Precis lemonias L., *vaisya* Fruhs.—Not uncommon.
Atella phalanta Drury—Not uncommon. Also larvae.
Ergolis merione Cr., *tapestrina* Moore—Not uncommon.
Telchinia violae F.—Very common.

excavating an old, fallen trunk of *Zyziphus* sp., and another was seen on the same trunk. On the 14th April another was caught working on an old trunk. Again on the 12th May I saw one excavating a rotting piece of the trunk of *Erythrina stricta*. All these records were made in the Tulsi Lake area.

S. edax is an extremely active insect and moves about with rapid jerky movements. Its presence in a log is soon noticed by the heap of newly excavated, coarse, wood-dust. On breaking up the *Erythrina* log I noticed that there were several tunnels, some old, some new. The tunnels generally run in the direction of the grain of the wood, and may be several inches deep by about a little more than half an inch wide. When the tunnel is complete the provender for the future young is deposited at the far end and then the cavity is plugged with wood-dust for a distance of two to three inches. The wood-dust is packed tight. At the end of one of the tunnels I found five or six black, flightless cockroaches, [1]*Perisphaeria* sp. The cockroaches were alive, but in a stupefied condition. It is well known that some members of the *Sphegidae* collect *Orthoptera* for storing in their homes.

In life, the general colour is shining black, except for the abdominal segments which are bright red; but in the preserved state the bright red fades to dull-red or red-brown. The wings are an irridescent blue-black, somewhat like those of a scolid.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
May 13, 1940.

XXV.—LARVA OF *THERETRA LYCETUS* CR. PARASITIZED BY TACHINID FLIES.

On the 14th July (1940) while scouting round for entomological specimens in the jungles just off the road between Bapsai and Murbad, Mr. J. Alfrey spotted a large larva of *Theretra lycetus* Cr. feeding on a species of *Leea* (Vitaceae). As the larva appeared quite healthy we brought it home in the hope of getting the moth. I kept it in a case. The next day the caterpillar left the leaves and moved round as though looking for a place to pupate. On the 16th it changed colour from green to brown and lay in a corner—pupation seemed inevitable. On the 17th morning I found the caterpillar dead in the centre of the cage. It appeared rotten as it had burst and was liquefying. Inside the body was a heaving mass of several fly maggots. On the 19th no trace of the maggots was to be seen; only the skin of the caterpillar remained lying on a damp patch of earth. On the 29th three flies appeared in

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[1] I am indebted to Dr. Baini Prashad for the identification.

the morning and another in the afternoon. The next day a fifth fly had emerged. On the 1st August as there was no addition to the flies I opened the case, after killing the flies, and examined the earth under the caterpillar. The pupal cases of the flies could be clearly seen just where the skin of the host was lying. The mud had become a compact mass—as a result of the putrefying liquids filtering into it, and in this were buried the pupal cases of the flies with the tops just showing at the surface. A single pupa which was apparently dead was also found which brought the total number of flies to six. These observations give the pupal life of the flies as approximately ten days.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
August 1, 1940.

XXVI.—MARCH *LEPIDOPTERA* AT GOPALPUR (DIST. GANJAM).

The following is a list of species taken in the course of a month's very superficial collecting in March 1940. The list is obviously far from complete and most of the species recorded were taken in the Casuarina jungle surrounding the Yatton Hall Hotel. The Heterocera recorded as being taken at light were caught in the Hotel itself.

RHOPALOCERA.

Polydorus hector L.—About the commonest butterfly. Also larvae.
Polydorus aristolochiae F., *aristolochiae*—Common. Also larvae.
Papilio paris L., *paris*—Common.
Papilio polytes L., *romulus* Cr.—Uncommon.
Papilio demoleus L., *demoleus*—Uncommon.
Delias eucharis Drury—Uncommon.
Cepora nerissa F., *phryne* F.—Common.
Anapheis aurota F., *aurota*—Common.
Catopsilia pomona F.,—Common. Also f. *bidotata* Fruhs.
Danais plexippus L.—Common.
Danais chrysippus L.—Not uncommon.
Euploea core Cr., *core*—Very common.
Melanitis leda L., *ismene* Cr.—One specimen.
Euthalia garuda Moore, *anagama* Fruhs.—Common.
Hypolimnas misippus L.—Common.
Hypolimnas bolina L.—Common.
Precis orithya L., *swinhoei* Btlr.—Uncommon.
Precis lemonias L., *vaisya* Fruhs.—Not uncommon.
Atella phalanta Drury—Not uncommon. Also larvae.
Ergolis merione Cr., *tapestrina* Moore—Not uncommon.
Telchinia violae F.—Very common.

Cosmolyce boeticus L.—Very common.
Spindasis ictis Hew., *ictis*—Common.

HETEROCERA.

Ocinara varians Wlk.—One specimen.
Cephonodes hylas L., *hylas*—Common. Also larvae, mostly a dark form.
Macroglossum gyrans Wlk.—Larvae not uncommon.
Lymantria ampla Wlk.—Dead pupae common, and one larva on Casuarina.
Porthesia scintillans Wlk.—One larva.
Perina nuda F.—One female at light.
Asota caricae Bsd.—A batch of young larvae.
Utetheisa lotrix Cr.—Very common.
Philagria entella Cr.—One male at light.
Agrotis spinifera Hbn.—At light, not common.
Sideridis percussa Btlr.—At light, not common.
Prodenia litura F.—At light, not uncommon.
Spodoptera mauritia Bsd.—At light, not uncommon.
Schoenobius bipunctifer Wlk.—At light, not uncommon.
Sameodes cancellalis Zell.—At light, uncommon.

CALCUTTA, D. G. SEVASTOPULO, F.R.E.S.
August 3, 1940.

XXVII.—SOME INSECTS FROM A MANGO TRUNK (*MANGIFERA INDICA* L.).

Just outside my compound wall at Andheri, Salsette Island, there is a mango tree which showed signs of withering.[1] On inspecting it I found that the trunk and branches were riddled with holes, evidently the work of *Batocera rubus* L. On one of the branches was a lively nest of the Brow Tree-Ant (*Cremastogaster rogenhoferi* Mayr.) not far from the original seat of attack. The ants were constantly moving about, and a Bloodsucker (*Calotes versicolor* [Daud.]) sat on the stem daily and 'lapped' them up as they passed near. Closer examination of the trunk revealed that the bark had split in several places. The underside of the bark had been destroyed and the space was packed tight with excreta and wood shavings. The bark was quite lose and came away easily, leaving much of the 'packing' *in situ*. In several places under the bark the ants had established themselves. In some of the large holes I found Elaterid beetles (*Agrypnus* sp.) resting on their head as though they had fallen dead and had slipped down towards the entrance, but they were quite alive—waiting for night-fall to take off.

Under the bark I found five pairs of the Brenthid beetle,

[1] The tree has since died.

Orychodes sp. These beetles were always in couples. Besides the Brenthids there was a single specimen of a Cucujid beetle, *Hectarthrum heros* F. (?), and several small larvae and pupae of other *Coleoptera* which I cannot place. On opening the bark, the ants immediately took possession of all other insects, but I soon deprived them of many of their spoils. In the packing of excreta there were numerous Book-Scorpions, *Chelifer* sp., in various stages of development, but these were more frequent where the refuse was damp. In spite of the presence of ants, life goes merrily on under the bark.

In volume xli, p. 678 of the *Journal* I recorded the presence of Book-Scorpions under the wings of *Batocera rubus*. At the time (November-December) several specimens invaded the house at night, being attracted by the lights. Later in March, the Brenthids came in, but sporadically; and yet later the Elaterids appeared from time to time in rather unusual numbers. As the drying mango is about forty feet from the verandah, it is evidently the home of the insect invaders.

Of these insects *Batocera* is known to attack mango trunks; the food of the Click-beetle appears to be uncertain; the Brenthids seem another unknown quantity as regards their diet, though it is presumed they are wood-boring: the Cucujid is a carnivorous beetle and feeds on other insects and larvae.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
May 12, 1940.

XXVIII.—INSECTS AT A STREET LAMP AT ANDHERI.

The desire to predict an event is common to most people, but how often do our calculations turn out as predicted? During the sweltering heat of the hot weather there are many prophets abroad anxious to forecast the break of the rains—even the Press indulges in a bit of fortune-telling! For the past weeks speculation had run high, but Nature pays little heed to mere human calculations, it generally upsets them, and so it was with the break of the rains in 1940. Heavy rain fell on the 3rd June. Some people insisted that the monsoon had burst, others held that it was just a storm. In fact, weather conditions were rather abnormal this year. Animal life is greatly dependent on weather conditions and accordingly in abnormal years animals also behave 'abnormally'. The fact was betrayed by the arrival of certain insects out of season; for example, certain Cantharids, which are abundant in August and September in Salsette, arrived in the latter part of April—much before their usual time. Turning to the ornithological field, a pair of Dhayals [*Copsychus saularis* (Linn.)] had brought up a family in a dead Date Palm, by the end of May. The young were on the wing—rather early for these birds in this area. Also, in the botanical field, an Aroid (*Amorphophallus commutatus* Engler) had miscalculated too. It came into full bloom before the end of May, before any rain

had fallen. This species usually blooms only soon after the first showers arrive. Nature seemed upset! Heavy rain continued to fall for a couple of days and all Nature responded to the climatic change.

The sky on the night of the 5th was almost cloudless, the ground was sodden and the temperature sticky. Millions of insects had waited for the rains to be released from their pupal stages, and take to wing on perhaps, life's last mission to reproduce or die as food for others. It was an exhibition of the struggle for existence. This struggle is, perhaps, never keener at any other time of the year than at the break of the monsoon. Life at this time is just one enormous 'tidal wave'. I took my stand under a street lamp at Andheri—a naturalist on the prowl, complete with net and sundry killing bottles.

The ground around the lamp post was teaming with large, winged ants. They had just emerged from the ground and gathered round in clusters, bidding farewell to their late home and taking leave of their 'nurses'—it was time for the marriage flights—the last flight for them all, some to fall victims to their fate, others, but few, to start a new colony. Away from their birth place they were now to brave the dangers of a new adventure. The lamp had attracted thousands of other winged ants, and conspicuous among them were *Camponotus* and *Cremastogaster*. The presence of the new arrivals did not seem to worry the groups on the ground; none were in a fighting mood, though at any other time the ants would never have tolerated such familiarity. The flying termites had appeared earlier in the evening, and by 9 p.m. were no longer around the lamp.

The air around was alive with insect forms, so numerous that frequent collisions brought many to the ground dazed. Small moths were in plenty, and a few large *Euproctidae*, all vainly trying to reach the burning filament. The magnetism of the light held them. Doom awaited most of them. Now and again a cricket would kick itself into the air, take to wing for a while and then fall clumsily to earth, to kick off once more when disturbed by another insect. The whir of thousands of small wings, the constant metallic click from the lamp shade and the dull sound of a fall to the ground, were from time to time interrupted by the deep drone from the wings of some large coleopter. The zooming noise was soon followed by a crash against the light or the post, then a thud which announced that the beetle had landed on its back, and finally a shuffling sound as it made frantic efforts to right itself. Success meant a new assault on the bewildering light. All these sounds betrayed the arrival of one of the largest of the Longicorns, *Acanthophous serraticornis* Ol., quite a formidable name for a formidable looking beetle with large punishing jaws. A suitable hold on the back soon puts its 'armaments' out of action. Before I decided to retire I had secured sixteen fine specimens—five others had been crushed by passing vehicles. This was an exceptional flight, for, in all the years I have been at Andheri, I have never known this species to appear in such numbers. Subsequent enquiry showed that the flight was rather general, for

the longicorns had been seen by many other people in Andheri.

At times wayfarers stopped and took stock of me, perhaps wondering what on earth the 'sahib' was doing at that hour of the night under the light, covered with insects, and armed with a butterfly net and several bottles. They watched me, and when they saw me make a dash for this or that insect and quickly consign it to one of the bottles, they were satisfied, though curious as to what would be the fate of the insects—were they eatable or medicinal? Any way they evidently doubted my sanity and moved off commenting. They were villagers and did not understand. Motorists hooted at me as I hastened across the road to retrieve a specimen; heads popped out to have a look—the general consensus of opinion must have been—a lunatic at large! It was not the first time that my identity and intentions have been mistaken. When following natural history pursuits, I have been often pitied as a case more suitable for a mental asylum! A naturalist must be prepared for such comments from the uninitiated, but let me return to my lamp and its fauna.

Insects spell food for many animals, so I soon discovered that I was not the only watcher under the light. The recent rain had deluded the Bull Frog (*Rana tigrina* Daud.) from its retreat. They had come up to breed, but the rain was insufficient for breeding purposes, so they hopped about the countryside in a vain search for puddles. The chorus of their sonorous voices lifted in 'prayer' for more rain, was in vain. Some of them were in their wedding garb of yellow, but not as bright as it should be—a dirty greenish yellow. Though not quite intent on food at this time, they still 'lapped' up an insect here and there. Some of the unfortunates had been run over by cars—an enemy Nature had not counted on—and were now just 'grease spots' or mangled forms. On the lamp-post were a couple of geckoes (*Hemidactylus flaviviridis* Rüppel). They had soon eaten their fill and now looked longingly at the insects they could not eat. What would they have not given for a more elastic stomach! At last, tired of looking on at the feast before them, and the constant rain of falling insects on their bodies, they decided to move off. The ground was alive with spiders, large and small, preying on the insects as they fell. Among the spiders was a single *Mygale*. The spiders too were constantly disturbed by the rain of insects, which made them retire to suck their meal in peace. Sneaking along the edge of the drain was a shrew (*Suncus* sp.) with its long snout vibrating like the free end of an agitated spring, seeking this or that 'dainty'. Now and again it would make short sallies into the arena, seize an insect and retreat to make a meal of it, only to return for another. A little way off a gentle crackling noise drew my attention, so I switched on my torch to discover a Bandicoot (*Bandicota malabarica* Shaw) gnawing at a big Longicorn (*Batocera rubus* L.) The bandicoots lurked in the shadows, and seldom came into the light. Several centipedes (*Scolopendra* sp.) moved about in the throng of insects in the drain taking toll here and there. There were numerous carabid beetles

(*Pheropsophus catoirei* Dej.) hurriedly seizing their prey and retiring immediately to deal with it. How many other insect feeders were lurking around, is difficult to imagine. Some bats occasionally visited the light, but there was evidently enough food in the air without hovering round lamps.

Flying ants seemed to predominate. Beetles, perhaps came next in numerical order, most of which were minute. Of the less minute forms the cockchafers (*Melolonthidae*) were there in their hundreds. The *Carabidae* were well represented particularly by a black species commonly found under stones. A straggler among the *Coleoptera* was a Rhinoceros Beetle (*Oryctes rhinoceros* L.), but its life was short for a passing car reduced it to a 'flat skin'. The moths were well represented by a large number of *Microlepidoptera*. Among the larger forms were specimens of *Euproctis* sp. and a few of the peculiar family *Hepialidae*, moths with long heavy bodies and clumsy flight (*Phassus* sp.). The *Orthoptera*, grasshoppers and Grillids, were fairly plentiful. The mole Cricket (*Gryllotalpa* sp.) a member of the 'under world', also hung around. The *Rhynchota*, or garden bugs and members of the *Homoptera*, mostly minute, were present in goodly numbers. A curious point about the Cotton Bug (*Dysdercus cingulatus* Fab.) is that though during the day thousands are about in the neighbourhood, very few were attracted by the light.

Near midnight I decided to retire; so I collected my belongings and went to bed after ridding myself of as many insects as I could. Next morning I visited the scene of the previous night, but there was nothing to betray the activity that had taken place. On arrival at the office with my 'bag', the insect department foresaw a busy day, there were over a hundred specimens to set. Of course, I could have multiplied this figure an hundredfold, but it would have meant much duplication.

It will not be out of place to compare the catch of this night with that of the next. Except for a considerable reduction in flying ants, most of the insects mentioned above were there. There was a noted increase in the number of cockchafers and scarabs. Of *Acanthophorus* only one turned up. A pair of beetles closely allied to *Acanthophorus* was also secured. They were *Macrotoma crenata* Fabr. This was the first time I secured this cerambycid in Salsette. Small mantids were occasional. As the weather was drier the frogs seemed fewer in numbers. The shrew was back accompanied by friends; the Bandicoot lurked in the shadows.

The 'Dance of Life' around a street light at the break of the rains and for some time after is mingled with jubilation and tragedy. Jubilation because it is the setting free of millions from the pupal life, tragedy because the majority perish—they have hardly begun life when it is snatched away from them.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
June 7, 1940.

XXIX.—SOME INDIAN SPIDERS: THEIR SEASON OF PROSPERITY.

As a class spiders occur throughout the year. There are, however, certain periods when they are at the height of their prosperity. Ecological experience reveals that, in India (especially Western India) the best part of the year for spider collection is during the few months following the rainy season. It is now most of the families of spiders are active and industrious. The scorching summer seems to be a time of distress to them. So also the torrential rains dwindle their number to an appreciable extent by washing away their delicate webs.

There are certain factors that favour the growth of spider population during the period after rainy months and before intense summer.

With a few exceptions spiders are in general moisture-loving creatures. Many of them are arboreal and wholly dependent upon plants for their abode. In India the real 'spring' season is soon after the heavy rains. The vegetation is exuberant during August and September. The increase in vegetation and the recession of destructive rains afford ample facilities for these animals to construct their webs among the plants and peacefully propagate their species. Food also is in plenty during this season. Attracted by the numerous wild flowers which appear now, insects like bees, and flies come to the plants in large numbers and get easily entrapped in the spiders' webs.

The following are some of the common families of spiders which prosper during the season referred to.

Among the arboreal groups of spiders the most important family that flourishes during the months of September and October is that of the Argyopideae. Attached to the boughs and branches of trees the giant wood spiders (*Nephila maculata*) are busily engaged in constructing their extensive snares. Along fences and thickets the beautiful *Argyope* thrives. Wherever there is vegetation the garden spiders (*Epeira diadema*) are present in hundreds, very active building their delicate webs. Walking along an open country side, during evening time, a collector can see numerous members of *Argyroperians, Araneus, Tetragnatha* and other Argyopids carrying on their web construction in full swing. These spiders remain a feature of every country part throughout the cold season. With the approah of summer, however, when the atmosphere is no longer hygroscopic but dry and the annual vegetative growths parched, the Argyopid community also dwindle little by little and confine themselves to the 'greens' by the margins of pools, tanks and rivers or other moist localities.

Oxyopideae, which generally live among grass and other small plants, increase and decrease in population with the growth of such plants after the rains and their drying away in summer. During summer many Oxyopids shift themselves to the watered fields of rice and other cultivation. A great number of them is however destroyed during the summer harvest. May, June and July are months of famine for them. Only with the onset of

the following monsoon and the reappearance of grass in the lawns do they revive.

Closely allied to the Oxyopids in their habits are the Psechrids. They can be easily distinguished from the former by their difference in shape, the extraordinary length of the anterior two pairs of legs, and the absence of spines on the body. With the increase of grass and other plant growths during monsoon and after, these spiders also multiply and spend their days among axils of leaves or spikes of grasses. They are extremely common among the inflorescence of Cyperaceae and Amaranthaceae. Just as the Oxyopids they also decrease in number with the withering away of vegetation and resort to the scanty flora in damp localities during summer.

Of Sparassideae and Clubionideae, the former seems to have more liking for moist conditions than the latter. Sparassids like *Palystes* and *Sparassus* are very fond of broad and succulent leaves for the construction of their patch like webs. During the monsoon, and prior to the advance of sultry weather and the consequent dwindling down of wild plants, they thrive in large numbers everywhere. In summer, however, there is marked decrease in their number, and they are only found on the leaves of watered garden plants like Cucurbita, Water-melons, Plantain suckers, etc.

The Clubionids also present seasonal variation and the members found in the monsoon time are healthier and larger than the summer brood. From the fact that many Clubionids reside among green leaves there is reason to believe that they have a liking for moisture.

Herseliids also seem to thrive better under moist conditions rather than in the height of summer. During the months of August and September we find plenty of them on the bark of trees—trees with fissured bark like *Pithecolobium saman*, mango trees, etc. During the hot season their number shows a definite reduction. There are however certain species which are found on old dry walls and which thrive equally well both in summer and in winter.

Pholcids, tender, long-legged spiders found in the roofs and rafters of old houses do not seem to be affected by seasonal variation.

Many Attids or jumping spiders also prosper unaffected by change of season; but those species which hunt among vegetation are affected in a similar way as the Oxyopids and Psechrids.

With a few exceptions the entire group of Lycosids require moisture for thriving. Shortly after the rains they are abundant among the low-lying, water-logged parts of any compound. They always like cool places and therefore they distribute themselves in damp and moist localities, beside water, among putrefying dead leaves and rubbish on open grounds, under stones and in damp soil. In moist fields, laid fallow, their number is enormous. During winter mornings, thousands of their patch webs can be seen on open lawns, and the members themselves running here and there with great agility. With the advent of summer they diminish in prosperity and get confined to moist areas beside fields and pools.

Eresids seem to be common during winter and summer alike.

The webs of the Indian colonial Eresids—*Stegodyphus*—are found to remain intact for more than two years and the members are active throughout the period.

Although spiders, as a group, are described as ubiquitous, Nature has her own influence upon their community. Spiders withstand climatic and seasonal variations to a greater extent than many other lower animals. They persist through Spring, Summer, Autumn and Winter; but it needs be mentioned that moist conditions are preferred by most of them.

More careful and perseverant field work will surely reveal more facts about the 'life of spiders'. The 'breeding time' of spiders is also an interesting subject for further exploration.

BOMBAY, T. V. SUBRAHMANYAM.

September 13, 1940.

XXX.—THEFT OF A WATCH BY A FIDDLER CRAB.

This is a story told by an Ajman Badawin to Lt.-Col. H. R. P. Dickson on 25-6-40 of the wonderful tracking powers of all members of the Murra tribe, and in the presence of one Muhammad al Murri.

'Muhammad al Murri, before he came along to the K. O. C. guards hut at Burgan, had been staying with Sheikh Sabah al Nasir as *subah* at his camp at Mungaf near the sea shore. One day Sheikh Sabah's motor driver complained that his wrist watch had been stolen from him while he was having a bathe. He explained how that the tide was going out when he went down, and he undressed and put his clothes on the sand and his wrist watch with them, and went into the sea. He had not noticed anyone come along the shore although he had not paid much attention. When he came out and got dressed he found his watch had completely disappeared and there was no sign of it anywhere.

Muhammad al Murri was present in the tent and heard the story. The driver did not ask him to find it for him or say anything to him.

Shortly afterwards, the Murri, being rather interested, walked down to the shore. The tide was now lower, but quite easily he found the place where the clothes had been put on the sand, and around which, and to and from it, down to the water were the driver's foot marks. After wandering about for a bit he could see no trace of any other human being having been near, the only marks there were, were those of crabs which had been running about on the sand along the shore. One track which he noticed, came towards where the clothes had lain, but he did not think anything of this, and came to the conclusion that the driver was a liar, and had himself lost his watch on some previous occasion. The Murri then returned to camp.

Next morning however, he again went down to the same spot. This time the tide was high, and all marks had gone. He sat

down near the shore and waited till the tide went out a bit, and until one by one the crabs came out of their holes and began to run around on the sand. (I might add here that these are rather small crabs with one claw much larger than the other, and they each build a sand tower just on one side of their hole.)

The Murri then walked down towards them, and they all disappeared rapidly into their holes. After looking at their tracks for a bit, he suddenly recognized from among them all, the track of the one which he had seen the previous day in the vicinity of the spot where the driver's clothes lay. He followed it carefully for about 100 yards to its hole. He then began to dig, and sure enough, down its hole he found the wrist watch.'

This I know is a true story. The point of the story is, that to any ordinary individual all crab tracks would appear the same. Yet the Murri had been able to distinguish the track of a particular crab which he had seen the previous day, from among many dozens of others.

Since this happened, Muhammad al Murri was sent for by the Military Governor of Kuwait, Sheikh Ali al Khalifa, to discover the thief in a robbery case. This case is still in progress, but the foot-prints in the sand round the tent were identified by him. It will be interesting to see if he is correct.

Note.—The Murra tribe is famous all over Arabia for their wonderful tracking lore. They inhabit the northern edge of the Rub'—al Khali.

KUWAIT, PERSIAN GULF,
July 6, 1940.

VIOLET DICKSON.

PROCEEDINGS OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

The Annual General Meeting of the Society was held at the B. E. S. T. Lecture Hall, Electric House on Thursday the 18th April 1940 at 6-15 p.m.; Rt. Revd. R. D. Acland, M.A., presiding.

AGENDA.

1. Reading of the Annual Report of the Committee.
2. Presentation of the Balance Sheet and Statement of Accounts for the past year.
3. Election of the Committee.

The Honorary Secretary announced the election of 33 new members since the last meeting held on 18th April 1939:—

Mrs. Camar Tyabji, Bombay; His Highness the Marawat Sir Ram Singhji Bahadur, K.C.S.I., Partabgarh State; Mr. M. Zinkin, I.C.S., Sholapur; H. H. the Maharaja Jagaddependra Narayan Bhup Bahadur, Cooch Bahadur; Maharaja Pateshwari Prasad Singh of Balrampur, District Gonda, Oudh; Mr. C. G. Baron, Shillong; Mr. N. D'O. Finnis, Quetta; Mrs. C. M. Van Allen, Bombay; Mr. H. E. Ormerod, Bombay; Mr. J. Lockhart, Bombay; Mr. A. G. Sandeman, Meerut; Mr. J. S. Anderson, Bombay; Major Allen Block, Allahabad; Mr. Q. F. Rahman, I.S.E., Moradabad; Mr. B. L. Rawat, M.Sc., Ph.D., Ajmer; Mr. V. M. Vasu, Porbander; Mr. M. St. J. Kelly, Lohardagar, B. N. Ry.; Mr. B. W. Budd, I.C.S., Mirpurkhas; Mr. E. C. Cameron, Nilgiris; Mr. B. F. Patuck, Bombay; Mrs. M. D. Wright, Amraoti; Mr. D. Nilsson, Bombay; Mr. T. J. Phillips, Waziristan; Major F. H. W. Ross-Lewin, Bombay; Major W. L. D. Veitch, R.E., Roorkee; Mr. John Leslie, Calcutta; Mr. F. Potter, Bombay; His Excellency Sir Maurice Hallett, K.C.S.I., C.I.E., I.C.S., United Provinces; His Excellency the Governor of Bengal; Major J. M. Bruce-Steer, Bombay; Capt. Jafferali Khan G. Agha, Dharwar; His Excellency the Governor of Madras; Major R. C. Nicholas, Poona.

BOMBAY NATURAL HISTORY SOCIETY.

Office Bearers—1940.

The following gentlemen were elected to serve on the Managing Committee for the ensuing year:—

President.—H. E. Sir Roger Lumley, G.C.I.E., D.L.

Vice-Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. Fr. J. F. Caius, S.J., F.L.S.; and Rt. Revd. R. D. Acland, M.A.

Executive Committee.—Mr. Salim A. Ali, Mr. Farrokh E. Bharucha, Mr. A. Ferrington, Mr. I. B. Greaves, M.L.A.; Mr. M. J. Hackney, Mr. R. E. Hawkins, Mr. D. G. Hill, Dr. M. Shariff, D.Sc., Ph.D., F.L.S.; Lt.-Col. W. C. Spackman, I.M.S.; Lt.-Col. S. S. Sokhey, I.M.S.; Mr. F. Wadia, and Mr. H. M. McGusty (*Hon. Secretary and Treasurer*).

Advisory Committee.—Dr. C. F. C. Beeson, D.Sc., M.A., I.F.S.; Lt.-Col. R. W. Burton, I.A., (Retd.); Mr. C. H. Donald, F.Z.S.; Dr. F. H. Gravely, D.Sc.; Mr. C. M. Inglis, B.E.M.B.O.U., F.Z.S.; Mr. R. C. Morris, F.R.G.S., F.Z.S.; Major E. G. Phythian Adams, F.Z.S., I.A. (Retd.); Dr. Baini Prashad, D.Sc.; Mr. H. C. Smith, I.F.S.; Lt.-Col. C. G. Toogood, C.I.E., D.S.O.; Mr. J. H. Williams.

Staff.—S. H. Prater, M.L.A., J.P., C.M.Z.S. (*Curator*); and C. McCann, F.L.S. (*Assistant Curator*).

The proceedings concluded with an interesting lecture by Mr. S. H. Prater on 'Camouflage in Nature and in War'.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER 1939.

ADMINISTRATION.

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THE HONORARY SECRETARY'S REPORT FOR THE YEAR 1939.

The Society's Journal.—The Fortieth Volume of the *Journal* was completed during the year and two numbers of Volume xli were published.

MAMMALS.

Mr. Theodore Hubback contributed an interesting article on the Asiatic Two-horned Rhinoceros (*Dicerorhinus sumatrensis*). His note, based mainly on personal observations, summarises what is known about the habits of this rhinoceros, the terrain in which it is found, its food, and the many legendary beliefs and superstitions attaching to the species. Mr. Hubback's paper is supplemented by additional notes by Mr. S. H. Prater on the genera, species and races of the Asiatic Two-horned Rhinoceros, as described by various authors. He summarises the available data regarding the external physical characters of the species and discusses the basis of the various beliefs and legends recorded by Mr. Hubback. Of general interest is the theory that traces the origin of the unicorn, from which the rhinoceros inherited its fabled attributes, not to a four-footed beast such as the oryx, or the wild ass but to *Cerastes*—the Horned Viper, which figures prominently in Assyrian and Hebrew Religion and Art, and which poetic fervour and imagination endowed with wings, limbs and claws. If the poisonous viper gave origin to the belief in the Unicorn—then the supposed efficacy of the horn of the Unicorn, and of its successor the Rhinoceros—against poison is associated with the ancient well-known belief that poison counteracts poison; while the fabled power of a virgin over the unicorn and the rhinoceros may be traceable to 'the Woman's domination over the Serpent' proclaimed in the Bible. These wondrous attributes have passed from the Horned Viper to the unicorn and from the unicorn to the rhinoceros.

Mr. Hubback's article ends with a plea for the more rigid protection of the rhinoceros, which is now on 'the threshold of extinction'. Its extermination must inevitably result from absence of undisturbed conditions, which is now the case. A species, which has survived from past geological epochs to our day, is finding itself unable at last to withstand the intrusion of modern Man into its domain. The only hope that remains of saving these animals from extinction in Malaya and Burma, adds Mr. Hubback, is to constitute inviolable sanctuaries in their own habitat, where a suitable environment is known to exist. An appropriate pendant to Mr. Hubback's comment is Mr. D'Arcy Weatherbe's memorandum on the Kahilu Sanctuary in Burma, which deals with the reports of the survival of the rarest of all Rhinoceros—the Lesser One-horned Rhinoceros (*R. sondaicus*) within its limits. In 1929 a fragment of a skull and in 1933 a complete skull, both of which undoubtedly belong to this species, were obtained in this area and presented to the Society. Mr. Weatherbe shows that genuine evidence is lacking of the continued existence of this rare rhinoceros in the sanctuary. Further, he makes clear that terms and conditions under which this sanctuary has been established render ineffective what might otherwise have been a permanent and valuable refuge for wild life. In the present temper of the legislatures the possibility of enacting suitable legislation for the establishment of inviolable Sanctuaries appears remote. Nevertheless such sanctuaries are a *sine qua non* and the present half measures introduced by Government will do little to achieve their purpose. An offset to this sorry position is the record of the work of the Nilgiri Game Association—1879-1939 by Major E. G. Phythian Adams. The Association is to be congratulated upon its achievements during the 60 years of its being. The result of its activities show what can be done by private effort, when proper official backing is forthcoming. Sambhar and chital in the areas controlled by the Association have not only maintained their numbers but have very appreciably increased, while the Nilgiri Tahr, reduced to a bare dozen when the Association was formed, now exceed 500 head. Starting with a fauna, in the case of some species, on the verge of extermination, the Association has by careful control built up as fine a stock of game as is to be found anywhere in India. The recent action of the Madras Government asking this Association to surrender half the shooting and fishing fees, is therefore all the more to be deplored and, if insisted on, will impair considerably the Association's efforts and reduce to impotence what is perhaps the most successful organization of its kind in the East. It is hoped that wiser counsels will prevail, and that the Association will continue to receive in full, the support which it deserves.

Birds.

Among the many notes and articles on Indian Birds is Mr. Sálim Ali's Report on the Birds of Central India which is based on surveys carried out in the Central Indian States of Bhopal, Gwalior, Indore and Dhar. The financial grants generously proffered

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by the Governments of the States concerned have made this valuable work possible. The area covered by the survey had not been systematically studied previously. While no fresh discoveries were expected, the material collected provides useful data for determining the racial status and distribution of species in correlation with parallel data obtained in surveys carried out in other provinces of India. Mr. Ali has done his work with his usual efficiency and thoroughness. We have once again to thank Mr. Whistler for his work on the material obtained. We should like to take this opportunity to express our sorrow and our sympathy with Mr. Ali on his recent loss. The death of his wife has removed from his side a comrade who shared in his work, braving the discomforts that attended it, to give him her help, care and companionship.

Central Indian bird life features again in Mr. C. E. Hewitson's 'Bird Year in Betul' which presents a picture of the bird life of the district from month to month and provides a model which other students of local faunas might well follow.

With the publication of Part VI, the serial by Messrs. Sálim Ali and Humayun Abdulali on the Birds of Bombay and Salsette is concluded. The work has been generally commended. It provides students and laymen not only with an up-to-date working list, but with a readable and interesting account of the local bird life, deriving much of its merit from well written descriptions of the breeding and general habits of the species. As previously indicated, it is intended to publish the serial in pamphlet form in conjunction with other pamphlets on the fauna of Bombay and Salsette, issued by the Natural History Section of the Prince of Wales Museum.

Mr. C. McCann's paper on the Flamingo, based on observations made during an expedition to the Rann of Cutch is an original and interesting study of the habits of this species. One interesting fact revealed is that the existence of the breeding colony depends upon the brief outburst of a brackish water plant (*Ruppia rostellata*) in the Rann, which is initiated by the flooding of the area by rivers from the mainland, the seeds providing the food for the young. Another interesting discovery is the early deserting of the young by the majority of parent birds; the guardianship of the chicks being left to a few adults who act as 'sentries' and, finally, the march of the chicks across the desert in the wake of the receding water—a tragic retreat in which hundreds perish. Where exactly these chicks go to on leaving the Rann and their subsequent history still remains to be discovered. It would also be interesting to study specimens of these birds at a stage exhibiting the passage from the brown juvenile plumage to the adult white and crimson. The question as to whether the pink plumage is attained by moult or canescence requires further study in the field.

Reptiles and Fishes.

Dr. Hora continued his serial on the Game Fishes of India. Parts VI, VII and VIII were published during the year. Parts VI and VII describe two Fresh Water Sharks—the Goonch

(*Bangarius bangarius*), which has the best title to the name, and the Mulley, *Wallago*—now *Wallagonia attu*. In Part VIII, Dr. Hora deals with the mahseers or large-scaled barbels of India. How many different species now go under the name *Barbus tor*—the Mahseer, we do not know. Dr. Hora's study is an attempt to answer this question and his present paper deals with the mahseer found in the Himalayan Streams—from Kashmir to Darjeeling. To this fish he gives Hamilton's specific name *Barbus putitora*. Subsequent parts will deal with Mahseer from other areas in India and will, it is hoped, provide a clearer idea of true status of the various fishes now generally confused under the name *Barbus tor*.

Mahseer—from the standpoint of their breeding habits—form the subject of a paper by Dr. Hamid Khan. His study of the sex organs of specimens examined by him leads to the conclusion that Mahseer spawn three times a year and that all the eggs in the ovaries are discharged at each spawning season. The author's interesting investigations help to emphasize the need of Dr. Hora's work: since it is not known whether the conclusion relative to breeding habits of Mahseer were drawn from the studies of one or more species.

Another sporting fish which received special attention in the *Journal* during the year is trout. Little attention has been given to the disease of these fish in the various areas in which they have been introduced and established in India. The subject is one of considerable importance to the development of trout fisheries in this country. Dr. Hamid Khan in his paper discusses diseases encountered at the Mahili Hatchery, Punjab, i.e., fin-rot, goitre, inflammation of the intestines, and fungus and gives an account of the remedial measures employed. The diseases of trout were also investigated in the Harwan Hatchery at Kashmir, where a very large number of fish died in 1934. An investigation was then undertaken by the Zoological Survey of India at the instance of this Society. The results of the investigation are published in Mr. Gulam M. Malik's paper in volume xli, No. 2. It is shown that the heavy mortality was due to lipoid or fatty degeneration of the liver, induced by the fatty foods and developed in epidemic form owing to shortage of water, insanitary conditions of the pens and overcrowding. Mr. Malik's paper is supplemented with notes by Brigadier A. Campbell Ross, who contributes an interesting article on Trout Fishing in Kashmir. His recommendations, based on experience of nearly 20 years, merit the serious attention of the Game Preservation Department of the State. Much improvement could be effected if the efforts of the Department were now directed more to the quality of the fish than to the quantity. The author holds that overstocking of the streams and the resulting shortage of food has caused deterioration. A reduction in the numbers of trout is recommended. A second point needing attention, is the enormous stock of other species of fishes present in rivers and streams. While their fry provide food for the trout, the adults themselves reduce the food supply, interfere with the growth of weed and cause unhealthy overcrowding. The need for a reduction in their numbers is stressed. Lastly and

most important of all is the improvement in the natural food supply available to the trout. As most of the rivers are now stocked to capacity it is recommended that a large proportion of the money now spent on trout hatcheries may be devoted with greater advantage to breeding of food supplies. This in our opinion, is a most cogent point, covering as it does the damage done to food supplies by coarse fish, and the necessity of increasing the Trout food supply. Any one with any experience of Trout culture knows that an excess of coarse fish in the water is a serious matter.

The economic aspect of Indian fisheries also forms the subject of two papers by Dr. S. B. Setna on the Marine Fisheries of Bombay. In an article on Bombay's Fishing Industry the author discusses the inadequacy of the supply and the generally neglected condition of the industry, which at the present time is carried out solely by certain impoverished castes and does not attract the educated elements of the population or external capital. The primitive methods employed limit the fishing field to a few miles from the coast: facilities for landing and marketing of fish are poor; while the meagre earnings of the fishermen provide little incentive to enterprise. The Government of Bombay are to be congratulated therefore on the attempt at improving at least one aspect of the Industry by a practical demonstration of the effectiveness of more rapid methods of transport. The work done in Bombay in this respect is the subject of a second article by Dr. Setna which gives the results attained by introducing fast power-propelled launches for bringing in the catches to Bombay. Seven hundred tons of fish over and above the accustomed quantities were brought to the Bombay market in prime condition, and the radius from which the city draws its supplies was increased by 2-3 hundred miles. The success attending this experiment led to a rapid development of power transport and has brought into being quite a fleet of private-owned launches to the benefit of the industry. But increased supplies in Bombay has led to a corresponding decline in the fish available at the fish curing yards and at other coastal ports and no fundamental improvement can be expected until an improvement can be made in the present primitive method of exploitation. If more fish is to be obtained then fishing operations must extend over a wider field, and if the Industry is to develop better then more adequate facilities for the landing, storage and marketing of fishes must be provided. The author discusses measures which should be taken to secure a more general development of the local fisheries which, if followed, should materially benefit an industry of first rate importance to this maritime Province.

Another important section of Indian fisheries was dealt with in Dr. Chopra's paper on Food Prawns and Crabs of India in which the author discusses the various species available in the markets of large towns. The value of the fisheries is not generally realized by the public. The author estimates the yield of the prawn fisheries of India at, at least 3 crores of rupees per annum. Impressive though it may seem, the figure falls into insignificance when compared with other smaller countries where shell fisheries

are conducted on scientific lines. The author discusses the various methods employed in the capture and marketing of Shell fishes.

Insects.

During the year we published Parts VI and VII of Mr. Mosely's serial on Indian Caddis Flies which deal with the *Sericostomatidae*. A number of new genera and species are described, and the papers as usual are illustrated with a very large number of fine plates. Mr. D. G. Sevastopulo's notes and observations on the Early Stages of Indian Lepidoptera were issued in three papers during the year.

Butterflies of Burma form the subject of two papers. Capt. W. C. Carrot lists the species taken by him in the Shan States—an interesting area with an abundant and varied butterfly fauna; while in the December number, we published Part I of Notes on New and Interesting Butterflies from Burma by the late Major-General Sir Harry Tytler. General Tytler's long service in many parts of the East gave him opportunity to develop his bent for Natural History. His chief interest lay in Butterflies and he brought together one of the finest collections ever made in India. He published a number of papers on Indian butterflies in the Society's *Journal*. The editing of Part II of Tytler's Notes has been taken over by Mr. G. A. Talbot, F.R.E.S., of the British Museum.

Messrs. C. Cherian and M. S. Kylasam published their studies on the *Laphygma exigua* and its natural enemies. The caterpillars of this moth, which has a world-wide distribution, are well known as pests of crops. In India lucerne, onion, chillies and many other plants suffer from their depredations and the present paper deals with the species in a new role—as a pest of tobacco, and gives the result of investigations conducted to discover suitable predators and parasites which might effectively provide a control over these pests.

Botany.

During the year we commenced publication of a serial on Beautiful Indian Climbers and Shrubs under the joint authorship of Dr. N. L. Bor and his colleague Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun. Two parts were issued dealing with *Ipomoea* and *Aristolochia*. Mr. G. Singh's beautiful coloured illustrations are a feature of the work which will be issued as a companion volume to *Beautiful Indian Trees* by Blatter and Millard. The first edition of the latter work published by the Society in 1938 was sold within 8 months. Unfortunately under present war conditions the issue of a second edition would prove too expensive and must be postponed till better times prevail.

Another serial commenced during the year, deals with Common Indian Herbs by Prof. M. Sayeedud-Din of the Osmania University. The serial will describe and illustrate a number of the common species found in India and give supplementary notes on their anatomical characters.

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Father Caius continued his interesting serial on Indian Medicinal and Poisonous Plants. Three papers were published dealing with the Crucifers, the Capparids and the Flacourtiads.

In another paper Father Caius publishes the results of his survey of the local trade in Gum Arabic with a view to ascertain the source of the commodity and the uses it is commonly put to.

A contribution of particular interest to botanists is Mr. C. McCann's Additions to the Description of *Frerea indica*, a rare species found only once since its discovery in 1864. The author provides a detailed description of the fruit, seeds and other parts of the plant.

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Forthcoming Publications.—We have been to much trouble to ascertain whether a reprint of the Snake Chart would be welcome. This chart was issued some twenty years ago to hospitals, dispensaries, schools and colleges throughout the country and the reply to enquiries has been so encouraging that the chart is already under weigh, and will appear very shortly. It is already more than paid for. As a companion volume we have decided to issue a fifth edition of Wall's book on the Poisonous Terrestrial Snakes of India, but it will be revised in the light of recent discoveries. The book will, we believe, fill a very real need, and the price will be kept as low as possible.

Common Indian Birds.—Some years ago we published a chart of Common Indian Birds. What we did *not* publish was a commentary on each bird.

We now intend to publish a popular book, showing 200 birds, in colour, with a commentary on each bird by Mr. Sálim Ali.

This book will, we hope, 'Catch 'em Young', and help to inspire an interest in Natural History which, where it exists, has little at present on which to batten.

Revenue Account.—Once again we have managed to balance our budget, and we are able to record a surplus revenue of Rs. 4,466-13-11 as compared with Rs. 3,341-4-9 in 1938.

Total income was Rs. 37,091-9-0 and expenses were Rs. 332,624-11-1; but it must be borne in mind that we have to thank H. E. H. the Nizam, H. H. the Gaekwar of Baroda and H. H. the Maharaja of Patiala for the present state of our finances, as our regular income is not sufficient to cover expenses.

Membership.—67 members resigned during the year and 26 new members were elected, making a total membership of 845 as against 886 at the end of 1938.

Income from publications shows a drop, as the *Tree Book* was sold out fairly early in the year. We have a number of orders booked, and with a little more encouragement a second edition will be undertaken.

Staff.—The Committee wish to record their appreciation of the good work done by the Curator and his staff during the past year.

April 10, 1940.

H. M. McGUSTY
Honorary Secretary.

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS, 18 CHURCH ROAD, VEPERY, MADRAS

EDITORS: H. M. McGUSTY, J. F. CAIUS AND S. H. PRATER, 6 APOLLO STREET, FORT, BOMBAY

Father Caius continued his interesting serial on Indian Medicinal and Poisonous Plants. Three papers were published dealing with the Crucifers, the Capparids and the Flacourtiads.

In another paper Father Caius publishes the results of his survey of the local trade in Gum Arabic with a view to ascertain the source of the commodity and the uses it is commonly put to.

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BOMBAY NATURAL HISTORY SOCIETY.

BALANCE SHEET AS AT 31st DECEMBER 1939.

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Life Membership fees :		52,675 0 0	*Investments—At holding value or Market value whichever is lower :—*		
Donations for specific purposes unexpended :			Rs. 35,000 3½% Loan 1947/50 at 102⅛% ...	35,787 8 0	
Show Cases, Models of Fish, etc. in Prince of Wales Museum—Account No. 1 ...	336 10 7		,, 15,000 5% do. 1945-55 at par ...	15,000 0 0	
Show Cases, etc., in New Building, in Prince of Wales Museum—Account No. 2.	145 15 11		,, 10,000 3% do. 1951-54 at 98% ...	9,800 0 0	
Special Journal Fund	2,885 5 4		,, 14,000 4% Bombay Port Trust Bonds at 77%	10,780 0 0	
Ornithological Survey	2,346 8 0		,, 15,000 4% Bombay Improvement Trust Bonds at 76% ...	11,400 0 0	
		5,914 7 10	,, 5,000 3½% Pro-Note 1954-55 (out of donation received from H. E. H. Nizam)	4,997 4 7	
Sundry Creditors :			Rs. 94,000		87,764 12 7
Brig. W. H. Evans, Account Butterfly Books	118 8 10		*Cash—*		
The Diocesan Press, Madras	2,678 10 11		With National Bank of India, Ltd., Bombay. (inclusive of Rs. 2-11-5 out of donation received from H.E.H.Nizam.)	7,479 14 2	
For Expenses (Audit Fee)	250 0 0		With National Bank of India, Ltd., London, £40-18-8 at 1/6	565 12 5	
		3,047 3 9	On hand	150 9 0	8,175 10 7
Donation from H.E.H. Nizam for Expenses :		5,000 0 0	*Sundry Debtors :*		639 15 0
Surplus Assets :			*Advances to Staff :*		105 0 0
Balance as per last Balance Sheet ...	27,607 2 0		*Furniture :*		
Add.—Surplus on Revenue Account ...	4,466 13 11		As per last Balance Sheet	1,527 0 0	
		32,073 15 11	*Less* Depreciation	25 0 0	1,502 0 0
			Publications excluding Journals : Stock on hand as certified by the Hon. Secretary		150 0 0
			Bird Charts and Albums : Stock on hand as certified by the Hon. Secretary		20 0 0
			Book on Climbing Shrubs : Stock on hand as certified by the Hon. Secretary		353 5 4
Total ...		98,710 11 6	Total ...		98,710 11 6

Note.—A stock of 21,000 old Journals and the valuable research collection and Library of 2,650 volumes have not been taken into account on the asset side of the Balance Sheet.

We have prepared the above Balance Sheet from the Cash Book and from the information given to us, and have verified the Investments.

In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and the explanations given to us.

BOMBAY, *15th March, 1940.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors

H. M. McGUSTY,
Honorary Treasurer.

BOMBAY NATURAL HISTORY SOCIETY.

Dr. *REVENUE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1939.* *Cr.*

	Rs A P	Rs A P		Rs A P	Rs A P
To Salaries	19,005 0 0		By Subscriptions	18,253 10 8	
,, Society's Contribution to Staff Provident Fund	1,480 0 0		,, Entrance Fees	290 0 0	
,, General Charges	379 9 5		,, *Sales of :*		
,, Rent	2,436 0 0		Old Journals	1,414 7 3	
,, Stationery and Printing	343 10 8		Game Books, Vols. I, II & III ...	595 12 8	
,, Postage	908 2 6		Society's Publications	187 11 0	
,, Library	313 2 0		Tree Books	1,518 8 5	
,, Audit Fee	250 0 0		,, Interest on Investments and Fixed Deposits	3,279 5 0	
,, Fire Insurance	199 2 0		,, Profit on outside works	1,342 2 0	
,, Depreciation on Furniture	25 0 0		,, Donations from Vice Patrons available for current expenditure	10,000 0 0	
,, Cost of Printing Journals	7,285 0 6				
		32,624 11 1			37,091 9 0
,, Surplus carried to Balance Sheet ...		4,466 13 11			
Total ...		37,091 9 0	Total ...		37,091 9 0

PUBLICATION ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1939.

	Rs A P	Rs A P		Rs A P	Rs A P
To Expenses during the year on Bird Chart and Albums		60 0 0	By Sales of Bird Charts and Albums ...	40 0 0	
			,, Stock on hand (31st December, 1939) ...	20 0 0	
					60 0 0
,, Book on Climbing Shrubs		353 5 4	,, Stock on hand (31st December, 1939) ...		353 5 4

Dr. *Cr.*

INCOME AND EXPENDITURE ACCOUNT OF DONATIONS FOR SPECIFIC PURPOSES FOR THE YEAR ENDED 31st DECEMBER, 1939.

	Rs A P	Rs A P		Rs A P	Rs A P
Fund No. 1					
To Expenditure on Fish Gallery, etc. ...	760 0 0		By Unexpended Balance as per last Balance Sheet		1,096 10 7
,, Balance carried to Balance Sheet ...	336 10 7	1,096 10 7			
Show Cases Fund No. 2					
,, Balance carried to Balance Sheet ...		145 15 11	,, Unexpended Balance for Show Cases in New Building as per last Balance Sheet		145 15 11
Special Journal Fund					
,, Expenditure on Journals	4,132 11 0		,, Unexpended balance (Special Journal Fund) as per last Balance Sheet ...	6,314 11 0	
,, Balance carried to Balance Sheet ...	2,885 5 4	7,018 0 4	,, Donations received during the year ...	703 5 4	7,018 0 4
Ornithological Survey					
,, Expenditure on Ornithological Survey ...	4,953 8 0		,, By Unexpended balance as per last Balance Sheet	2,000 0 0	
,, Balance carried to Balance Sheet ...	2,546 8 0	7,500 0 0	,, Donations received during the year ...	5,500 0 0	7,500 0 0

BOMBAY, *15th March, 1940.*

Examined and found correct.
(Sd.) A. F. FERGUSON & CO.
Chartered Accountants, Auditors.

(Sd.) H. M. McGUSTY,
Honorary Treasurer.

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MUSSÆNDA FRONDOSA Linn.
Paperchase Tree or Dhoby's Tree (Nat. Size)
93·4 per cent.

JOURNAL
OF THE
Bombay Natural History Society.

1941. VOL. XLII. No. 2.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

N. L. BOR, M.A., D.SC., F.L.S., I.F.S.,

Forest Botanist,

AND

M. B. RAIZADA, M.SC.,

Assistant Botanist,
Forest Research Institute, Dehra Dun.

PART VI.

(*Continued from Vol.* xlii, *No.* 1 (1940), p. 12).

(*With* 1 *coloured and* 3 *black and white plates, and* 3 *text-figures*).

Rubiaceae

A very large family of over 4,500 species, comprising herbs, shrubs, climbers, and large trees. A small number are epiphytes. Many beautiful shrubs belonging to this family are cultivated in our Indian gardens for their handsome, occasionally fragrant, flowers.

The leaves are opposite or whorled, stipulate, usually entire, with pinnate nervation. The stipules are interpetiolar, that is, the two adjacent stipules are joined together across the node, forming a half sheath, simple or divided into lobes or fringed. The flowers are variously arranged, sometimes in globular heads, sometimes in corymbose cymes or panicles, axillary or terminal. Calyx often campanulate, adnate to the ovary, truncate or with 5 lobes. Corolla gamopetalous, seated on the top of the ovary, more or less tubular with spreading lobes; lobes 4-10, imbricate or valvate. Stamens as many as the lobes seated on the corolla and alternate with the lobes. Disk present, annular or lobed; lobes as many as the ovary cells. Ovary inferior, 2- or more-celled with axile, basal or apical placentation. Ovules one to many. Fruit a capsule, berry or drupe.

The family takes its name from *Rubia cordifolia*, a well-known Himalayan plant, which used to be the source of madder before the days of synthetic dyes. It is still largely used by the hill tribes to dye thread.

Apart from plants of ornamental value there are many species of *Rubiaceae* which are of economic importance. Quinine, so widely used in malarial cases, is a product of *Cinchona ledgeriana* and other species of *Cinchona*, which are indigenous in South America.

The drug, quinine, is of such importance in all tropical malarial countries that it will be of interest to retail briefly in narrative the history of this plant and its introduction into India. A great deal of the information contained in this account has been obtained from *Travels in Peru and India* by C. R. Markham (afterwards Sir Clements Markham), who had a great deal to do with the introduction of this genus of plants into India. His book may be recommended as a first class travel book, full of curious information apart from its worth as botanical history.

The genus *Cinchona* was erected by Linnaeus in honour of the Countess of Chinchon, of whom more later. As there has been some dispute regarding the correct spelling of this name, it will perhaps be better to settle the matter at once. Some hold that the spelling should be *Chinchona*, on the grounds that *Cinchona* implies a mark of disrespect to the Counts of Chinchon, the hereditary Alcaides of the Alcazar of Segovia.

A reference to the Species Plantarum of Linnaeus, Vol. I, page 172, shows that the famous Swede spelled the name *Cinchona*, a spelling which, following the rules of International Botanical Nomenclature, must stand. Linnaeus mentions one species, *Cinchona officinalis*, and in addition informs us that it is also called Quinquina and 'habitat in Loxa Peruviae'.

The name 'quinquina' is the Peruvian name for the tree and means 'bark of bark', a circumstance that Markham uses to refute the idea prevalent at the time that the Peruvians had no knowledge of the febrifugal properties of what afterwards came to be known in the trade as Peruvian bark. The reasons of this belief were that this bark was not found in the wallets of the Peruvian doctors nor did they communicate their knowledge of its virtues to their conquerors. This, however, can be easily explained by their hatred for the Spanish invader.

Whether the inhabitants of Peru knew of the febrifugal properties of the bark of quinquina or not, it is certain that the Spaniards must have known of them before 1638. In that year the wife of Luis Geronimo Fernandez de Cabrera Bobadilla y Mendoza, fourth Count of Chinchon, lay ill of intermittent fevers in the palace at Lima in Peru. 'The Corregidor of Loxa, Don Lopez de Canizares, on hearing of her illness, sent a parcel of powdered quinquina to her physician, Juan de Vega, who was also captain of the armoury, assuring him that it was a sovereign and never-failing remedy for tertiaria' (Markham). The gallant captain fortunately was able, despite his duties at the armoury, to administer the drug to the Countess, and the result was a

complete cure. As we have already seen Linnaeus immortalized the lady by calling the genus *Cinchona* after her, doubtless influenced by the extraordinary belief of those days that a person of rank conferred an honour upon a drug by kindly consenting to be cured by it. The lords of Chinchon are, however, said to have made history in another direction by giving Charles I of England in 1623 a supper of 'certaine trouts of extraordinary greatnesse'.

Following the cure of this important personage the Jesuits were entirely responsible for the introduction of Peruvian bark into Europe. In 1670 it appears to have been largely used with success in Rome to cure fevers of all kinds. Apparently it was at that time known as 'Jesuits' bark' and as such was naturally avoided by all good Protestants. Gradually, however, prejudice was overcome and by 1726 the bark was held in high repute in all European countries as a cure for various fevers.

The popularity of Peruvian bark naturally led to the destruction of hundreds of thousands of trees to provide for the European trade so that in time the trees were threatened with extinction.

The Dutch apparently were the first to take steps to introduce the tree into their colonies and *Cinchona* plants were landed in Java in 1854. Sir Clements Markham led an expedition from England to the Andes in 1855, and the seeds and plants of *Cinchona* obtained by him and his assistants reached Kew in 1860; and the same year Markham landed in Bombay with 125 seedlings. These were planted in the Nilgiris but all died. Others, however, arrived from Kew and extraordinary progress was made, so that by 1862 there were something like 30,000 plants established. From these beginnings the cultivation of *Cinchona* spread all over India and has reached enormous proportions. In 1937-38 the total amount of quinine products sold in Bengal was in the neighbourhood of 30,000 lbs.

Ipecacuanha, which contains among other alkaloids the valuable emetine, largely used as a specific in cases of amoebic dysentery, is obtained from *Cephaelis (Psychotria) ipecacuanha* Rich. This plant has not had nearly so important a career as the noble *Cinchona*, as it only came to light through the travels of a Portuguese priest, Manoel Tristaon, in Brazil during the sixteenth century. The properties of the drug became known in Europe during the 17th century. The plant was introduced into India in 1866.

In addition to *Rubia cordifolia*, mentioned above, another genus *Morinda*, is well-known as a source of fast dyes. The colours obtained from it range from yellow to red, purple and chocolate.

Coffee is obtained from *Coffea arabica* Linn., an African plant, now largely cultivated in South India. The well-known tanning material, called Gambier in the trade, is furnished by the climber, *Uncaria gambir* Roxb.

The climbing genus *Uncaria* (from *uncus*, a hook) climbs by means of axillary hook-shaped tendrils. *Paederia foetida*, a common jungle plant in India, is a twiner.

Little is known of the mechanism of pollination of the species of this large family. In *Ixora* the anthers are pressed against the style in the bud. Before the flower bud opens the anthers dehisce and large quantities of pollen are left adhering to the tip of the 2-lobed style. The stigmatic surfaces of the stylar lobes are pressed together at this time and effectively prevent self-fertilisation. The unexpanded style is supposed to act as a perching rod for insects which carry away the pollen to older flowers. Subsequently the stigmatic lobes become recurved and expose the receptive surfaces to a visitor carrying pollen from another flower. This genus which has very highly coloured flowers would appear to favour cross fertilisation.

Key to the Genera.

Shrubs without thorns.
- Flowers with one calyx lobe expanded into a white leaf-like structure; flowers orange or pale yellow ... ... 1. *Mussaenda.*
- Flowers with calyx lobes not so expanded.
  - Plant foetid when bruised, leaves small. ... 2. *Serissa.*
  - Plant not foetid when bruised.
    - Flowers white.
      - Flowers fragrant ... ... 3. *Gardenia.*
      - Flowers not fragrant ... ... 4. *Coffea.*
    - Flowers coloured.
      - Flowers red, yellow or orange.
        - Corolla salver-shaped.
          - Corolla lobes pointed ... ... 5. *Ixora.*
          - Corolla lobes rounded ... 6. *Rondeletia.*
        - Corolla tubular ... ... 7. *Hamelia.*
      - Flowers mauve or white ... ... 8. *Hamiltonia.*

Thorny shrub with greenish flowers ... ... 9. *Catesbaea.*

Part I.

1. **Mussaenda** Linn.

(*mussaenda* is the Sinhalese name for the species of this genus).

Shrubs or undershrubs, sometimes scandent, with opposite or ternately whorled leaves. Stipules free or joined together, persistent or deciduous. Flowers usually yellow in terminal cymes. Calyx oblong, top-shaped or globose, with 5 lobes, one of which is expanded in a large white or coloured leaf. Corolla tubular below, funnel-shaped above; throat villous; lobes five, valvate in the bud, with everted margins, spreading in the open flower. Stamens in the tube or throat; filaments very short; anthers linear. Ovary 2-celled; ovules many on peltate fleshy placentae. Fruit a berry. Seeds many, pitted.

Key to the species of Mussaenda.

Flowers pale yellow ... ... *M. luteola.*
Flowers orange red ... ... *M. frondosa.*

Photo by *M. N. Bakshi*

Mussaenda luteola Del.
New Forest, Debra Dun.

Mussaenda luteola Del.

(*luteolus* means yellowish in Latin, and refers to the colour of the foliaceous sepal of this species).

Fig. 1.—*Mussaenda luteola* Del. × 1/1.

Description.—A small, erect, twiggy slender shrub. Branches green, somewhat compressed, covered with a hoary, appressed pubescence. Leaves 1.5-2 in. long, petiolate, elliptic-lanceolate or oblong-lanceolate in shape, acuminate at the tip, narrowed at the base, membranous, olive-green above, pale below, sparsely hairy above, covered on the nerves below with short appressed pubescence; petiole short. Stipules subulate.

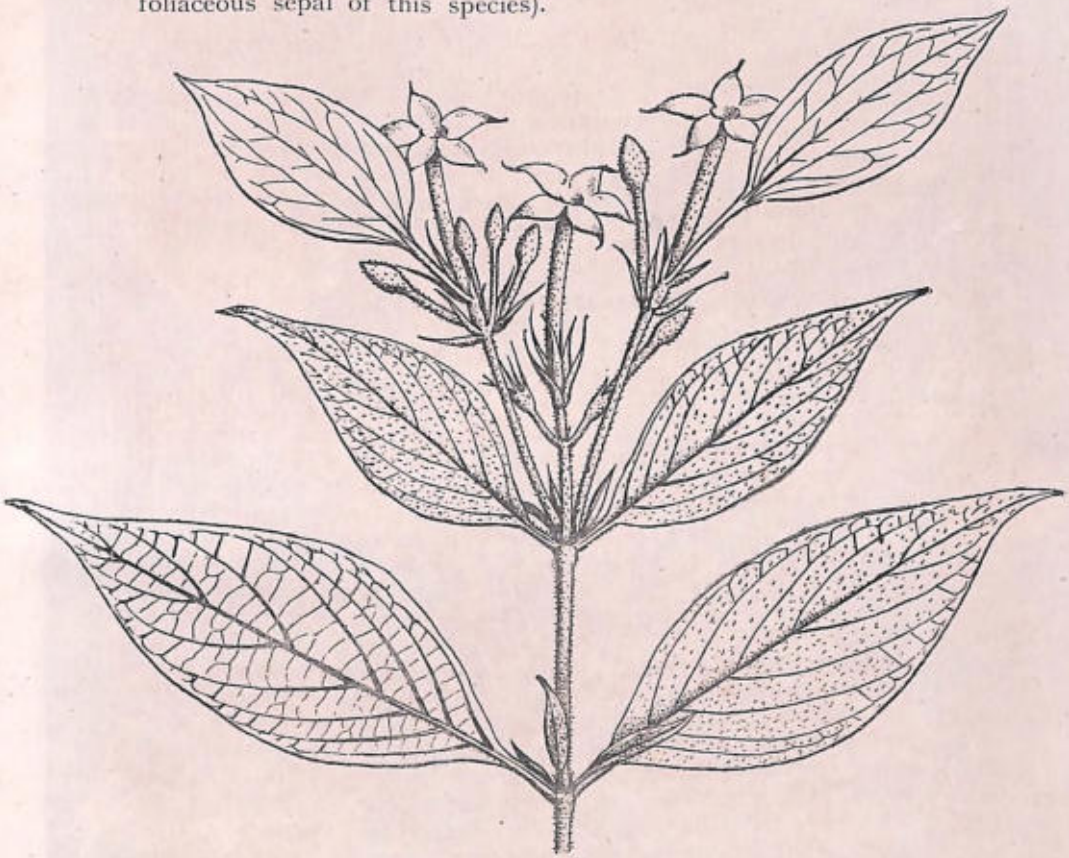
Inflorescence of few flowered corymbs. Calyx tube 5-angled, .1 in. long, shortly hairy, 5-lobed; lobes subulate .2 in. long except one which is often produced and expanded into an elliptic-acuminate or ovate foliar structure, .75-1 in. long, yellowish in colour, seated on a 'petiole' .4 in. long. Corolla tube 1 in. long, densely velvety pubescent at the mouth, greenish, pubescent, swollen about 1/3 the way down at the insertion of the stamens, 5-lobed; lobes pale

Photo by *M. N. Bakshi*

Mussaenda luteola Del.
New Forest, Dehra Dun.

Mussaenda luteola Del.

(*luteolus* means yellowish in Latin, and refers to the colour of the foliaceous sepal of this species).



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yellow in colour, broadly ovate, long acuminate. Stamens 5, sessile; anthers linear, included. Ovary 2-celled; ovules numerous. Style slender, glabrous, divided at the top into two stigmatic lobes.

Flowers.—Hot and rainy season. *Fruits.*—This shrub seldom fruits in Dehra.

Distribution.—Native of tropical Africa, but now commonly cultivated in gardens throughout the plains of India.

Gardening.—A pretty bushy shrub with dense dull-green foliage and pale yellow foliaceous sepal. Propagated usually by layers, as cuttings are less successful. According to J. D. Hooker it was first introduced into Europe about 1860 by Capt. Grant from the head-waters of the Nile.

Mussaenda frondosa Linn.

Paperchase Tree or Dhoby's Tree.

(*frondosa* is a Latin word meaning leafy).

Description.—An erect shrub. Branches green, angled when young, covered with a coarse brown pubescence. Leaves opposite, shortly and stoutly petioled, ovate or elliptic in shape, obtusely acute or acuminate at the tip, narrowed or rounded at the base, membranous, glabrous or sparsely hairy above, softly hairy on the lower surface, 6-9 in. long, by 3-4 in. wide; petiole stout, .5 in. long, coarsely hairy. Stipules large, broadly ovate-obtuse, often splitting at the apex into two lobes, covered with longish hairs.

Inflorescence in terminal cymes supported by two reduced leaves. Peduncles stout, very hairy; bracts and bracteoles present. Individual flowers subsessile. Calyx tube .2 in. long, adnate to the ovary, glabrous or sparsely hairy, oblong in shape, 5-lobed; lobes linear or subulate, .4 in. long, ciliate with long hairs. One lobe is occasionally produced into a hairy petiole, .75 in. long, to which is attached a leaf-like, white, elliptic-lanceolate appendage, 1 in. long or more. Corolla tube cylindrical, slender below, widened above the position of the stamens, covered with silky hairs, pale green in colour, yellowish hairy at the mouth, 5-lobed; lobes thick, fleshy, ovate-acute, yellowish green outside, inside of a beautiful orange-red colour, covered with a minute golden glandular excretion. Stamens 5, linear, sessile, included within the glandular hairy tube about half way down; the filaments are slightly adnate to the tube for the whole of their length, making the anthers sessile, but they can be easily separated. Ovary 2-celled; ovules numerous. Style short; stigmas 2.

Flowers.—Hot and rainy season. *Fruits* at the end of the rains.

Distribution.—Indigenous in Assam, Upper Burma, South India and Ceylon.

Gardening.—This is one of the commonest shrubs to be found in Indian gardens. The white foliaceous sepal in contrast to the deep green colour of the foliage makes it an ornamental and conspicuous shrub. It is advisable to prune it in the cold weather when it is

Photo by *M. N. Bakshi*

Mussaenda frondosa, Linn.
New Forest, Dehra Dun.

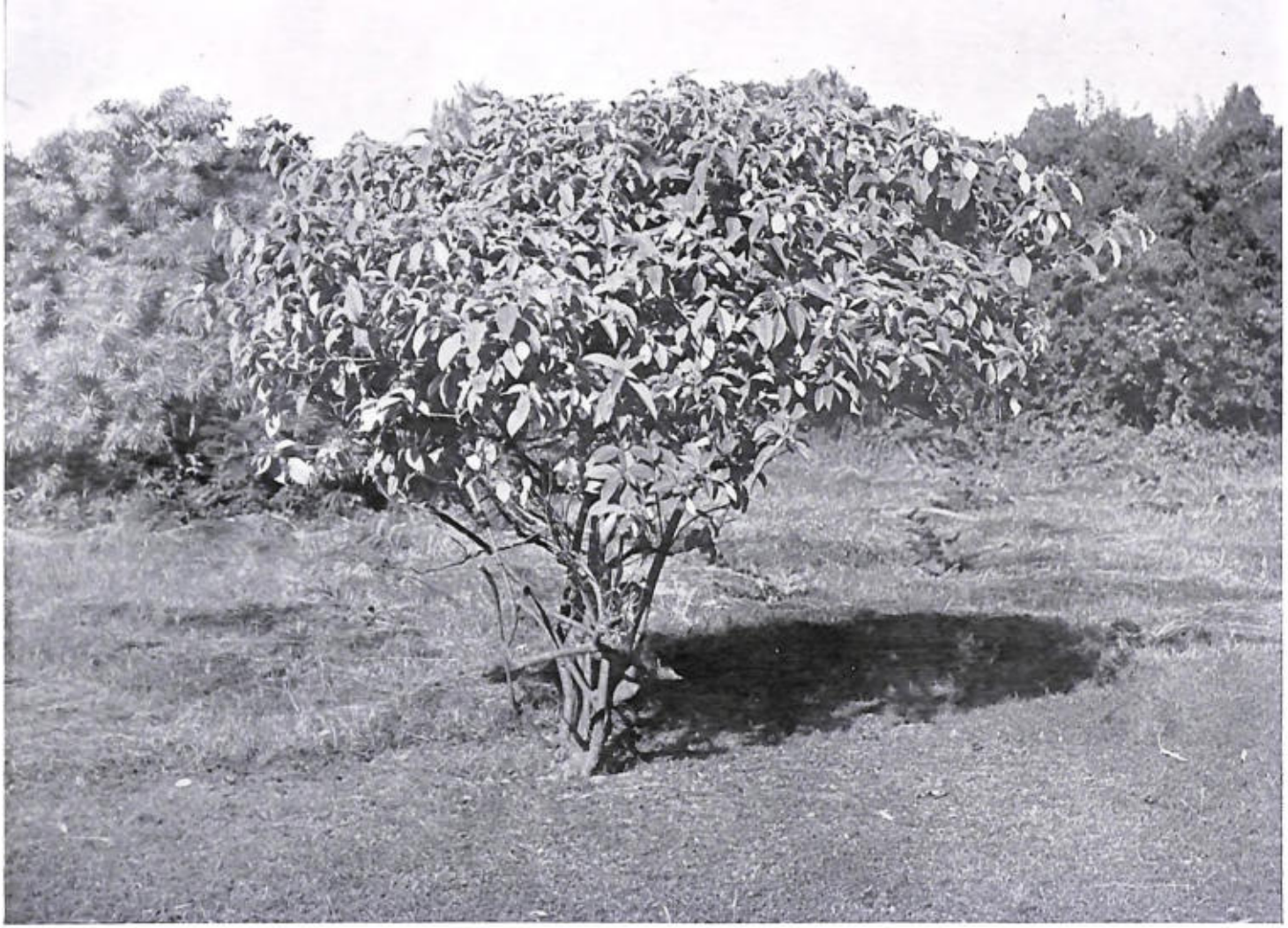

Photo by *M. N. Bakshi*

Mussaenda frondosa, Linn.
New Forest, Dehra Dun.

deciduous. It is popularly known as the 'Paperchase' tree or Dhoby's tree on account of the fancied resemblance of the white foliaceous leaf to handkerchiefs or bits of paper. Easily raised by cuttings.

2. **Serissa** Comm.

(Bailey[1] remarks that the generic name comes from the Indian name of this plant. On the other hand, Roxburgh says that this plant was introduced from China and hence there is no Indian name for it).

A branchy shrub. Leaves opposite, subsessile, subcoriaceous, ovate-acute, foetid when bruised. Stipules cuspidate, interpetiolar, persistent. Inflorescence of solitary or fascicled flowers, axillary or terminal, sessile. Hypanthium obconic, ending in 4-6 lobes which are subulate-lanceolate in shape, persistent. Corolla infundibuliform, hairy outside and in the throat; lobes 4-6, short, induplicate-valvate in the bud. Stamens 4-6, inserted at the base of the tube; filaments very slender; anthers linear-oblong, included. Ovary 2-celled; ovules 1 to each cell, basal. Style slender, ending in two subulate stigmatic lobes. Fruit fleshy, containing two seeds.

Serissa foetida Lamk.

(*foetidus* means evil smelling in Latin, and refers to the unpleasant odour of the leaves and flowers when bruised).

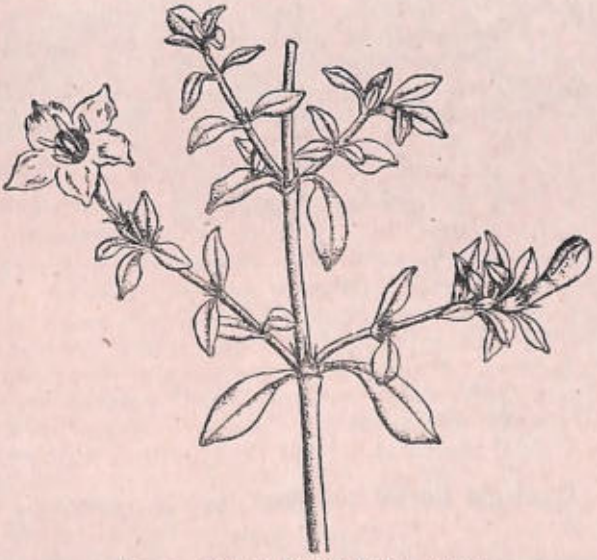

Fig. 2.—*Serissa foetida* Lamk. × 1/1.

Description.—A shrub with many glabrous branches. Young branches quadrangular, brown, covered with sparse hairs, becoming round, greyish in colour, and glabrous. Leaves small, .3-.75 in.

[1] The Standard Cyclopedia of Horticulture.

long by .2 in. wide, oblong or oblong-lanceolate in shape, acute at both ends, olive-green above, paler beneath, coriaceous in texture; nerves 3-4 main pairs, ascending obliquely, prominent below, hardly visible on the upper surface; petiole .05 in. long. Stipules interpetiolar, sheathing at the base, divided above into several setaceous lobes.

Inflorescence of terminal fascicles of flowers, with an involucre of leaves. Flowers seated on very short pedicels; bracteoles broad and membranous at the base, connate into a sheath surrounding the flower, ending above in 2 long sharp, setaceous, ciliate lobes. Calyx tube very short, 4-5-(rarely 6-8-) lobed; lobes .1 in. long, lanceolate-acute, with ciliate margins. Corolla tube .2 in. long, cylindrical at the base, funnel-shaped above, hairy within; lobes 4-5, less than .1 in. long, ovate-obtuse. Stamens 5, inserted in the lower third of the tube or above; filaments short; anthers linear-acute, about .1 in. long, included or slightly emergent. Ovary 2-celled; ovules 1 in each cell, basal; style slender ending in 2 stigmatic lobes. Fruit a berry with 2 seeds.

Flowers.—Practically all the year round.

Distribution.—Indigenous to China and Japan. It has long been cultivated in gardens in India.

Gardening.—A small shrub about 2 ft. high. It is nearly always in bloom with its sparkling rather small white flowers which, like the leaves, when bruised emit a foetid stench. Single- and double-flowered forms are both quite common in gardens. According to Aiton's Hortus Kewensis' it was introduced into England in 1787. Propagated by cuttings.

Medicinal uses.—The stem and leaves are said to be used by the Chinese for the treatment of carbuncles and cancer.

3. **Gardenia** Linn.

(A genus erected by Linnaeus in honour of Dr. Alexander Garden of Charleston S.C., one of his correspondents).

Trees or shrubs, thorny or not. Leaves opposite, rarely ternate; stipules connate or not. Flowers solitary, fascicled or collected into cymes, usually large. Calyx lobes usually long, persistent in fruit. Corolla tube cylindrical or campanulate, 5-12-lobed; lobes twisted in the bud. Stamens as numerous as the lobes of the corolla and alternate with them; anthers linear, inserted on the tube, included, sessile or subsessile. Ovary 1-celled; ovules in two series on parietal placentae. Fruit fleshy with a leathery epicarp.

Gardenia florida florida Linn. (*G. jasminoides* Ellis).

Cape Jasmine.

(*florida* is a Latin word meaning many-flowered).

Description.—A shrub reaching 6 ft. in height. Young branches brown, becoming covered with a greyish bark, striate. Leaves opposite or ternate, oblong-elliptic or obovate-lanceolate in shape, obtusely acuminate, wedge-shaped and decurrent at the base, shining, 3-6 in. long by .5-2 in. wide. Stipules about .5 in. long, acute, membranous.

Inflorescence of terminal solitary, white, very fragrant flowers, seated on 6-winged pedicels, .3 in. long. Calyx tube .3 in. long, bearing 6 longitudinal wings, 6-lobed; lobes up to .75 in. long, oblong, acute, persistent. Corolla tube 1.75 in. long, glabrous inside and out, 6-lobed; lobes up to 1 in. long, obovate, obtuse or

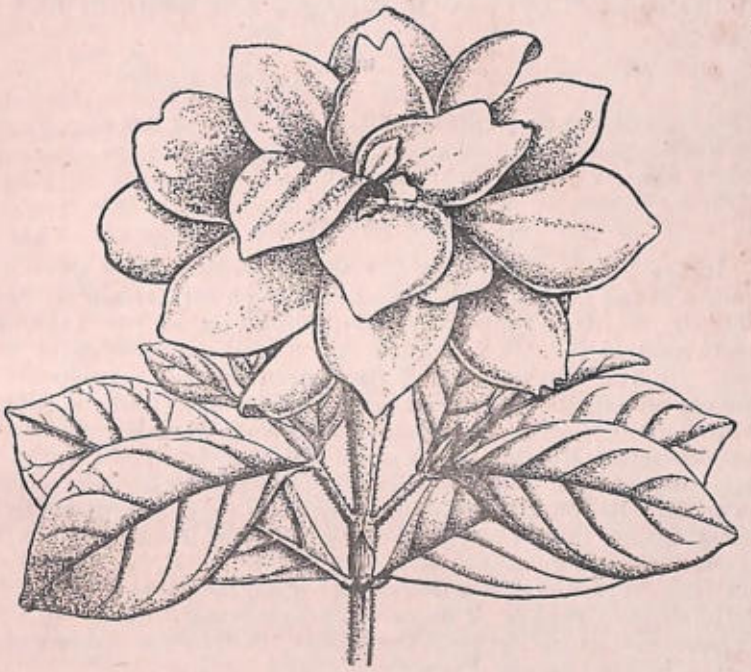

Fig. 3.—*Gardenia florida* Linn. × 1/1.

rounded at the top, narrowed at the base, fleshy. Stamens 6, long exserted; filaments short; anthers .6 in. long, linear-obtuse. Ovary incompletely 2-celled; ovules very numerous on 2 placentas. Fruit 1-1.75 in. long, .5-.75 in. wide, ovoid or elliptic, surmounted by the calyx-lobes, winged on 6 ridges.

Flowers.—March-April. *Fruits.*—Cold season.

Distribution.—Native of China, now widely cultivated in gardens throughout India.

Gardening.—A pretty shrub with handsome, dark green, glossy foliage. It produces at the beginning of the hot season numerous, double, creamy-white, strongly and sweetly scented flowers which resemble those of a double Camellia. It usually grows to about 6 ft. or so but may be kept to any convenient size by pruning. Easily propagated by cuttings during the rains. It is suitable for hedges and cut flowers.

Medicinal and economic uses.—The pulp of the fruit gives a yellow dye. A decoction of the leaves and roots with or without sugar, is used to alleviate fevers.

SOME ORNITHOLOGICAL RESULTS OF THE VERNAY-CUTTING EXPEDITION OF 1938/39 TO NORTHERN BURMA.

BY

MAJOR J. K. STANFORD, O.B.E., M.C., F.R.G.S.,

Indian Civil Service (Retired).

(With two plates).

It has been suggested that I should write a brief account for readers of the *Journal* of the expedition which Mr. Arthur S. Vernay and Mr. Suydam Cutting of New York led to the Laukkaung subdivision of the Myitkyina district in the cold weather of 1938/1939. A full account from the ornithological standpoint of this expedition, the other members of which were Captain Kingdon Ward, F.R.G.S. and Dr. Harold Anthony, Mammal Curator of the American Museum of Natural History is appearing in the pages of the *Ibis*. We were most ably assisted by four skinners under Mr. Joseph Gabriel, whose services were lent to us by the authorities of the Prince of Wales Museum, Bombay. We also received invaluable local assistance from Mr. R. E. McGuire, I.C.S., and the Assistant Superintendent at Laukkaung, Mr. J. W. McGuinness, Burma Frontier Service and many of their subordinates, as we did from the Rev. L. R. Dudrow and numerous officers of the Burma Frontier Force.

Captain Kingdon Ward and I left Myitkyina on November 16 and marched 11 stages to Htawgaw with 80 mule-loads of stores and equipment. From there he went on to Gangfang (5,000 feet) on the upper reaches of the Ngawchang stream to establish a base camp while I returned to Myitkyina to meet the other members of the party. This preliminary trip, made in perfect weather just after the conclusion of the rains, was a very fortunate one, as on it without moving from the mule-path and within the space of a few days we obtained a number of very rare birds including four specimens of *Harpactes wardi*, (the dark Trogon which had been once previously obtained by K. W. in the Seinghku Wang in the far north of Burma,) *Emberiza tristrami*, a small dark bunting which was new to the avifauna of India, *Pteruthius rufiventer*, and a specimen of the rare sandlark of Tibet, *Alaudula rufescens;* a number of hill-birds were found at remarkably low altitudes in the N'Mai Valley, and the steep Pyepat ridge above Laukkaung which had yielded several rare birds to me in previous briefer trips over it, produced a series of the little Green Tit Babbler (*Pseudominla cinerea*) and two rare finches, *Procarduelis nipalensis* and *Propyrrhula subhimachala*. In addition to this, I obtained an avocet on a village pond near Myitkyina, and a series of twelve dusky

thrushes (*T. obscurus*) which were apparently migrating. I am no botanist and have no hope of attempting to describe to readers of the *Journal* the very numerous botanical discoveries made by Captain Kingdon Ward, but I cannot forget his excitement at finding a new Cypripedium on the Pyepat ridge which had only once previously been found 600 miles further south in the Dawnas of Tenasserim. Throughout the journey, his great experience of travel, his eye for fruiting trees, and, beyond all, his painstaking work on the 'stomach-contents' of birds were of the highest value to me.

On December 12 Messrs. Vernay, Cutting and Anthony arrived at Myitkyina and we set off next day for Laukkaung where a week later we met the advance party who had returned from Gangfang. We secured some notable birds on the second journey including a scarlet finch (*H. sipahi*) and a specimen of the rare white-headed black bulbul, a shy and elusive bird which I had pursued unsuccessfully in these hills for 3 or 4 years. I was also lucky enough to secure four martins (*D. cashmiriensis*) of which one or two large flocks seemed to haunt the hillside near Laukkaung. I shall, however, always regret losing a large fruit-eating bat, as big as a woodcock, which gave me two easy chances at dusk near Tamu on the N'Mai:

'What is hit is history
and what is missed is mystery.'

This adage, alas! was too often in my mind all along; the owls, in particular, and the raptorial birds eluded us more or less throughout the trip.

We stayed for Christmas at Htawgaw and here several more rare birds were obtained. I shot a black finch (*Pyrrhoplectes epauletta*) and some Tibetan siskins, and also obtained a fine series of black bulbuls in two colour-phases. These, like most other birds in Htawgaw, were coming in in large numbers to flowering *leucospectrum* (dead nettle) and the dark grey birds obtained were all females and the black birds males.

We then moved on to Gangfang but halted for three days on the way to photograph an immense and picturesque gathering of Kachins, Chinghpaws, Marus, Lashis and Lisus which had come in to Gamhkawn for a feast and a congress organised by the Baptist Kachin Mission. Here numerous laughing-thrushes were seen on dead nettle and two of the rare striated laughing-thrushes were obtained. We reached Gangfang, our base-camp at the junction of the Ngawchang and Hpawte streams, on January 1, Dr. Anthony obtaining a specimen of *Emberiza cia* along the path.

While at Gangfang fresh takin-droppings were brought in from the hills behind Vijawlaw and a party consisting of Messrs. Vernay, Cutting and Kingdon Ward went after them without success, though a specimen of the rare *Myzornis pyrrhoura* was obtained. The writer camped alone on a stream above Hpawshi and spent three days after a bear in magnificent but very steep oak forest at the head of this stream. A fine male black bear was eventually obtained, and a skinner also shot, close to camp, a specimen of the

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rare shortwing (*Brachypteryx stellatus*). This forest seemed however curiously empty and bird life, apart from a few hill partridges, very scarce, though the Lashis sometimes contrived to call up a number of small birds by uttering the four-fold note of the spotted owlet on a bamboo pipe. This note is used by both Lashi and Lisus throughout these hills. I never got above 9,500 feet on this trip but a pheasant which I believe to have been a *monàl* was heard and the villagers here had many traps out for tragopan on cleared ground under the oak-trees. While we were at Gangfang, a Lisu brought in from Vijawlaw a live specimen of the slender-billed scimitar babbler (*Xiphiramphus superciliaris*), new to the Burma avifauna and the only one we saw throughout the trip.

On January 14 we started for Imaw Bum, with a long train of coolies in heavy rain which powdered the hills around with snow as low as 7,000 feet. On the second day we camped at 8,000 feet in moss-covered oak forest in which we saw many of the dark *Leioptila pulchella*, the Nepal cutia (*Cutia nipalensis*), and a flock of Blyth's suthora (*Suthora poliotis*).

On the following morning we crossed the Nyetmaw Pass (10,200 feet) into the Imaw basin, three blood pheasants (*Ithaginis c. kuseri*) being obtained on the way and a specimen of the rare yellow-browed tit (*Sylviparus modestus*) which was found, later, to be not uncommon in this forest.

North of the pass we came at once into heavy snow and the temperatures at 9,500 feet for the next week were extremely low. Bird life was scarce but the few birds met with made up in rarity what they lacked in numbers; the environs of one small alpine meadow, about an acre in extent, in which stood a few crab apple trees, produced the following: the allied grosbeak, the brown suthora, the great parrotbill (*Conostoma aemodium*) the dark rose-finch, (*Carpodacus edwardsii*), the black-faced laughing thrush, the Nepal tree creeper (*Certhia himalayana*) and the yellow-billed magpie (*Urocissa fl. flavirostris*). We also obtained at about 10,500 feet a specimen of the white-throated redstart (*Phoenicurus schisticeps*) and one of a flock of the little *Suthora fulvifrons*, a parrotbill of the high bamboo. Captain Kingdon Ward also shot a white-bellied dipper on the snow and icebound stream which flanks Imaw Bum and saw a Himalayan Kingfisher. A pair of very wild dippers seen by me on the same stream were, I think, the brown dipper (*Cinclus cinclus*).

The snow stopped us above 10,500 feet and we did not attempt the ascent of Imaw Bum. We saw no large mammals, though a few tracks (those possibly of the small panda and also of some ungulate) were seen in the snow.

A forest-fire, deliberately lit by Chinese traders, greatly disturbed the eastern face of this valley while we were here.

On January 26, the expedition divided; Messrs. Vernay, Cutting and Kingdon Ward crossed the northern edge of the Imaw ridge at 11,000 feet to Luktang and so down to the Ngawchang and round again to Htawgaw. They were, for the greater part of this trip, collecting at altitudes below 4,000 feet but met with several rare birds including the first Burmese specimen of the

Imaw Bum from near the Chimili. Typical Tragopan country.

An unknown valley near Imaw Bum.

Takin country at 12,000′ near Chimili Pass.

View up the Hpawte Valley towards Chimili Pass.

Himalayan crossbill (*Loxia curvirostra*). Dr. Anthony and myself recrossed the Nyetmaw Pass and spent a week in the forest south of it at 8,700 feet; the feature of this camp were the huge, grotesquely writhen, trees of *Rhododendron magnificum*, whose mossy trunks attracted many birds and whose huge leaves, two and a half feet long, provided shelters for our coolies. Birds on the south side of the pass were much more numerous and among them we met almost daily tits of three species, including Chinese black-headed tit (*Aegithaliscus bonvaloti*), many hoary barwings (*Ixops nipalensis*), *Herpornis xantholeuca* and vast numbers of stripe-throated yuhinas (*Yuhina gularis*). Other birds which had hitherto been accounted extremely rare in this part of Burma were the golden-breasted fulvetta (*Lioparus chrysotis*), the little chestnut-throated shrike-babbler (*Pteruthius melanotis*) and the nutcracker. The bulk of the birds here were feeding on *aralia* berries, the trees of which were in great abundance. On the last two days a pair of the beautiful white-spotted laughing thrush (*Garrulax ocellatus*) were shot in bamboo and a Trogon at 8,500 feet which turned out to be a new high altitude form of the red-headed trogon (*Harpactes erythrocephalus*).

Once again as we found throughout the trip, bird life above 9,000 feet was extremely scarce even in quite undisturbed forest land. At about 10,000 feet we saw tracks which were either of serow or gooral, and very numerous mouse-hare holes: pig undoubtedly occurred as high as our camp, and the only mouse-hare met with was trapped at that altitude. Dr. Anthony 'hi-jacked' at night with a lamp but the only mammal obtained in this way was a fine specimen of the large flying-squirrel.

We returned to the base camp on January 31, and two days later set off for the Chimili Pass. At Gangfang I obtained a solitary Ibisbill which had been seen on the river in January. We spent one night at Hpawte, a big Lisu village standing on a bare rock-strewn hillside and here, among the hundreds of little buntings which thronged the grass and bracken, I managed to secure a specimen of the rare rufous-breasted hedge-sparrow (*Prunella strophiata*), a dark and very wary bird which was not uncommon in bracken and rocks elsewhere, and also two or three of the equally rare Manipur Fulvetta. This latter is found at much lower altitudes than Oustalet's Fulvetta which is the common bird of the cane above 10,000 feet.

We camped next night at 10,500 feet about two hours march from the Chimili Pass. As elsewhere at such an altitude it was possible to be out for many hours between 10,000 and 12,000 feet and think oneself lucky to see one bird, but we found the avifauna of the Chimili hills very similar to that of the Imaw hills forty miles away. All the three rare parrotbills, (*Conostoma aemodium*, *S. unicolor* and *fulvifrons*) were obtained at between 11,000 and 12,000 feet, and a flock of tits passed daily within a few yards of camp. These tits included *Parus ater*, *rufonuchalis* and *dichrous*, also *Aegithaliscus bonvaloti*. We also obtained three of the little-known shrike-babbler (*Pteruthius xanthochloris*). A yellow-browed tit (*Sylviparus modestus*) was seen in a pine tree with a flock of

Parus at about 11,500 feet. The common bird of the cane and the upper limit of the tree was the beautiful little Oustalet's fulvetta (*F. vinipectus*). I saw no pheasants but a pair of Temminck's tragopans were brought in by a Lashi and on the last morning I again heard the strange loud cry which I took to be that of a *monàl*. Every morning at dawn we used to hear the forlorn note of the spotted owlet, and a pair of jungle crows were frequently seen near camp. A pair of black eagles flew one evening along the ridge at 12,000 feet and quartered over the great cliff which flanks the Hpawte stream headwaters. I also saw a buzzard at this altitude. The larger mammals were again very scarce here though snow stopped us exploring the 2 big valleys north and south of the pass-road where takin undoubtedly occur.

It snowed very heavily on our last three days in this camp but we were surprised to find that life in a single-fly tent warmed with a hurricane lamp was not intolerable at that altitude. The skinners however suffered severely and also our cook, a Mugh from Chittagong, into whose philosophy no dream of snow had ever entered.

After a week here we were recalled to Gangfang to meet the rest of the expedition. A fine red serow, shot by Lisus in the snow behind Vijawlaw, was brought into camp at Hpawte on the journey back.

On our return to Gangfang, it was decided to abandon our original proposal to visit the Sajyang Pass and the high hills at the headwaters of the Ngawchang stream. New birds were secured daily which included a solitary snipe and Elwes's crake on a tiny pond close to the base-camp. Teal were seen apparently on migration and large flocks of Tibetan Siskins and Nepal House Martins.

We then spent a few days at 7,500 feet in the abandoned cantonment of Hpimaw. Spring was now upon us and the Hpimaw pass road was almost blocked with several feet of snow. Birds obtained at this camp included a fine series of bull-finches (*P. erythaca*), the black woodpecker (of the very large form *forresti*) and a dusky thrush (*Turdus n. eunomus*). I spent much time on the pass-road with indifferent success but saw here a pair of jays and a pair of allied grosbeaks (*Perissospiza icteroides*). I subsequently saw jays at between 8,000 and 10,000 feet in two other places but they eluded me throughout the trip. They were probably Rippon's jay which Lord Cranbrook obtained in the Adung. I also saw close to me at 9,000 feet an immense wild-boar and hoolocks were heard at about this altitude on the day we left.

One rare bird which escaped me here was *Emberiza elegans*, a dark bunting with a conspicuous yellow head. A Lisu had brought in one to us at Gangfang, and I had a good view with glasses of another at Hpimaw, but it was nearly a month later when I managed to shoot two at Htawgaw which I had seen four or five times. As this bird was observed or obtained at four widely-separated camps it cannot be uncommon in these hills but it is quite new to the Indian avifauna.

We then returned to Htawgaw and marched southwards to a

camp near the Panwa Pass. At Hparè a fine male Lady Amherst pheasant (*Chrysolophus amherstiae*) was brought in by villagers and Dr. Anthony also saw a wolf, unfortunately just too far to shoot. Wolves undoubtedly occur in small numbers in Yunnan and the villagers in the neighbourhood of the Hparè and Panwa passes say they come over at infrequent intervals. There is a record of two being shot near the Spimaw Pass by sepoys after the Four Years War. The country now became much more open and our camp at Changyinhku was on the edge of scattered oak and alder forest, with great patches of scarlet flowering *Rhododendron delavayi*. This forest was full of birds we had not met with before, and on the alder cones we obtained Himalayan crossbills and Tibetan siskins while the oak forest held woodpeckers of four or five species, tree creepers, the small minivet and nuthatches. At one patch of flowering rhododendron the birds seen searching for the nectar included jungle crows, red-billed magpies, Chinese barbets, yuhinas of two species, rose-finches and the little scarlet Dabry's sunbird, also two forms of pied wood-pecker and cinnamon sparrows. Under the oaks we got *Emberiza cia*, and others on the open meadows near the pass, and saw many Stone's pheasants (*Phasianus elegans*). This pheasant, in all its notes and ways most closely resembling the pheasants of home, was the only one we had any opportunity to observe or shoot throughout the trip. The bare round hills of Changyinhku, where there were occasional patches of potato cultivation, also held many skylarks (*Alauda arvensis*). These were mostly in pairs and the males were singing as were stonechats, and white wagtails. I have little doubt all three nest there.

Close to the pass I obtained three woodcocks, two of which were feeding at a stream in open meadows near noon. Two of these birds, a male and a female, were by their organs, about to breed, and I have no doubt that it is here, if anywhere in Burma, that the first Woodcocks' eggs will be obtained. On the short grass near the pass my orderly also obtained a single water pipit (*A. spinoletta*) though the majority of the pipits here were Indian tree-pipits (*A. hodgsoni*).

On March 12, Messrs. Vernay and Cutting departed for Myitkyina and the rest of the expedition returned to Hparè. We spent three very wet days on the way in the oak forest near Zuklang at 8,500 feet and found it alive with wrens. We obtained a single chestnut-headed wren (*Tesia castaneocoronata*), which was not uncommon, and three of the rare long-tailed wren (*Spelaeornis souliei*). As a rule these birds were either quite invisible or offered a momentary chance at about thirty inches range.

On a bramble-covered hillside on the way to Hparè I saw Rippon's bullfinch, the black finch and the red-headed rose-finch at close quarters but they were difficult to shoot and still more difficult to retrieve though I managed to obtain a single specimen here of *Procarduelis nipalensis*.

Captain Kingdon Ward and myself then did a final camp close to the Hparè Pass. We saw here a blood pheasant and jays and obtained some of the tits and tree creepers we had got near the

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Chimili, as also specimens of the Manipur Fulvetta which were about to breed. I had the good fortune to have a momentary glimpse of two fine male tragopans and a mouse-hare, but was stupid enough to miss at fairly close range with a shot gun and S. G., a head-on chance at a Michie's deer, on the hillside at 9,500 feet close to the Hparè Pass. Two specimens in the iron-grey winter coat had been brought in to us by natives but this was the first chance any member of the expedition had had of observing one. In flight it looked completely black with a very noticeable white 'flag'. The ordinary red barking deer certainly occurred up to 7,000 feet in the country traversed by the expedition and was seen or obtained both near Changyinhku and Gangfang. We also saw many sambhur tracks and picked up an immense shed horn at over 9,000 feet: one stag was seen but not obtained. On the last day I obtained the female of a pair of Ward's trogon which was about to breed and also shot a pair of the red-headed trogon at approximately the same altitude a mile away. A mole, a creature which Dr. Anthony had made many attempts to trap, was brought in by a Lashi from the pass and on our return to Hparè we found that Dr. Anthony had been extremely successful in obtaining a series of a rare *Nectogale*, a water shrew which the villagers caught by damming streams and poisoning them with aconite. Another mole was caught in a mouse-trap on the Pyepat ridge on the way home.

The return journey was uneventful, except for an immense gathering of black bulbuls on the Pyepat ridge. We obtained here both the dark and whiteheaded forms, as also the brown and scaly-breasted wrens: I saw enough to convince me that the Pyepat ridge and the 'Valley of Death' which adjoins it together form as fine a natural sanctuary for birds as any that exists in Burma. Blyth's parrotbill, the golden-breasted fulvetta, and the striated laughing-thrush were all obtained at Pyepat, as also one of a pair of the rare and silent *Columba pulchricollis*. Tree creepers were seen but not obtained.

At Laukkaung immense numbers of the common rose-finch were seen feeding on wild raspberries and still more on the journey down the N'Mai valley. On the way down from Chipwi I paid a brief visit to the caves about four miles away of which I had heard sensational accounts from previous travellers in these hills. They are not by any means as extensive as I had expected; the entrance is a hole about 3 feet high and the largest cavern is about 30 yards long by 30 feet high. They harboured an immense congregation of bats and we secured a good series of two forms for Dr. Anthony.

At Tanga, on the journey down, two very large flocks of Short-toed Larks were encountered on the small open space by the rest-house. They kept flying away south and returning, but we managed to secure five. They were *Calandrella brachydactyla*, which I had once previously obtained near Myitkyina itself.

We reached Myitkyina on April 12. We had collected 1,000 mammals and 1505 birds. The mammals were mainly small ones and, though many were new to Burma, and others of extreme

rarity, it is impossible for me to define here the actual results, with which Dr. Anthony expressed himself well satisfied. The birds consist of 299 species (not counting racial forms in some of which we got 2 in different parts of the hills. Of these 53 I had not previously met with in Burma and of 23 I could not find any published Burma records.

PART II.

The following are the more important birds obtained. The nomenclature is that used by Dr. Ernst Mayer. Of those marked* there are no previously published Burma records.

Urocissa fl. flavirostris.

6 specimens between 5,500 and 9,500 ft.
A rare hill and forest form of *U. erythrorhyncha*.

Nucifraga caryocatactes yunnanensis.

1 at 8,700 ft.

Parus ater æmodius.

2 at 10,500 ft.

Parus rufonuchalis beavani.

5 at 9,500 to 11,000 ft.

Parus d. dichrous.*

4 at 10,500 ft.

Sylviparus m. modestus.

14 between 8,500 and 10,500 ft.

Aegithaliscus iouschistos bonvaloti.

6 between 7,000 and 10,500 ft.

Conostoma æmodium.*

3 between 9,200 and 11,000 ft.

Paradoxornis unicolor.

7 between 9,200 and 11,000 ft.

Paradoxornis p. poliotis.

10 between 8,000 and 9,000 ft.

Paradoxornis fulvifrons albifacies.*

2 at 10,500 ft. in cane.

Sitta h. himalayensis.

8 specimens. The common nuthatch above 8,000 ft.

Garrulax ocellata similis.*

2 in oak-forest at 8,700 ft.

Garrulax rufogularis.

1 specimen.

Trochalopterum subunicolor.

8 specimens. Common at 7,000 ft. on Pyepat ridge.

Trochalopterum affine oustaleti.
21 specimens. The common Laughing-Thrush up to 9,500 ft.

Grammatoptila striata austeni.
6 specimens. 5,000 to 7,500 ft.

Babax l. lanceolatus.
1 specimen. a rare or very shy bird.

Xiphiramphus superciliaris forresti.*
2 specimens (? 7,000 ft.)

Alcippe cinerea.
3 specimens: common on Pyepat ridge at 7,000 ft.

Fulvetta vinipectus perstriata.
22 specimens. the common small bird of the cane above 9000 ft.

Fulvetta cinereiceps manipurensis.
8 specimens. a bird of scrub jungle between 5000 and 8000 ft.

Fulvetta chrysotis forresti.
4 specimens: usually seen with Suthora poliotis at about 7000-8000 ft.

Leioptila desgodinsi.*
1 specimen at Htawgaw. (6000 ft).

Leioptila pulchella cæruleotincta.
23 specimens. Common from 7,000 to 9,000 ft.

Actinodura nipalensis saturatior.
26 specimens. Common from 8000 ft. in oak and rhododendron forest.

Yuhina g. gularis.
25 specimens, the commonest bird of the oak forest above 8,000 ft.

Yuhina diademata.
5 specimens.

Yuhina occipitalis obscurior.*
4 specimens.

Yuhina nigrimentum.
1 specimen.

Yuhina bakeri.*
1 specimen.

Cutia nipalensis.
13 specimens. Usually in oak forest above 7,000 ft.

Pteruthius erythropterus yunnanensis.*
9 specimens.

Pteruthius m. melanotis.
8 specimens, mainly in oak forest above 8,000 ft.

Pteruthius xanthochloris pallidus.*
3 specimens—10,000 to 11,000 ft.

Pteruthius r. rufiventer.*
6 specimens, 6,000 to 8,700 ft.

Microscelis sp.
31 specimens, comprising black, dark-grey and whiteheaded forms.

Certhia discolor shanensis.
3 specimens in oak and alder forest at 7,200 ft.

Certhia nipalensis.*
5 specimens, 8,000 to 10,000 ft.

Troglodytes t. nipalensis.
4 specimens.

Spelæornis souliei.
3 specimens at 8,000 ft.

Spelæornis longicaudatus kauriensis
2 specimens.

Pnœpyga a. albiventer.
3 specimens 7,000 ft.

Cinclus cinclus.*
1 at 9,200 ft. near Imaw Bum.

Brachypteryx stellatus.*
1 at 7,000 ft. in bamboo.

Microcichla s. scouleri.
1 specimen.

Phœnicurus frontalis.
16. The common redstart of the middle hills between 4,500 and 7,000 ft.

Phœnicurus schisticeps.*
2 specimens, 1 at 10,500 ft.

Tarsiger chrysaeus.
2 specimens. Others seen at 7,000-8,000 ft.

Tarsiger cyanurus.
28 specimens: one of the few common birds of the road from 4,000 to 7,000 ft.

Tarsiger indicus yunnanensis.
11 specimens, 9,000 to 10,000 ft. in cane.

Turdus rubrocanus gouldi.
7 specimens, and others seen 5,000 to 7,000 ft.

Turdus naumanni eunomus.
2 specimens.

Turdus obscurus.
12, all in November and December along the mule-road.

Turdus dixoni.
8 specimens all along the mule-road.

Turdus m. mollissimus.
1 specimen.

Prunella strophiata.
2 specimens: not uncommon in rocks and bracken at 7,000 ft.

Cyornis concretus cyaneus.
1 specimen.

Horeites fortipes.
3 specimens: common in spring 6,000-7,000 ft.

Phylloscopus proregulus.
5 specimens.

Phylloscopus pulcher.
1 specimen.

phylloscopus subaffinis.
15 specimens.

Perissospiza icteroides.
3 specimens at 9,200 ft.

Pyrrhula erythaca.
13. Common on budding willow etc. at 7,000 to 8,000 ft. in February.

Pyrrhoplectes epauletta.
1, in a flock at 6,000 ft. Others seen at 7,000 ft.

Loxia curvirostra.
3 specimens, 5,000 to 7,200 ft.

Hœmatospiza sipahi.
One shot, another seen at 5,000 ft.

Propyrrhula subhimachala.
4 specimens, not uncommon above 6,000 ft.

Carpodacus edwardsii.
10 specimens from 7,000 to 9,500 ft.

Procarduelis nipalensis.
2 specimens, one at 7,000 ft.

Spinus thibetanus.
4 specimens: several large flocks seen 5,000 to 7,000 ft.,

Emberiza tristrami.
1 at 6,000 ft. on Pyepat ridge.

Emberiza cia.*
2 near Panwa pass, 7,000 ft.

Emberiza elegans.
3 obtained at Gangfang and Htawgaw and seen in two other places all above 5,000 ft.

Delichon nipalensis.
7 specimens. Large flocks near Gangfang at 5,000 ft.

Delichon dasypus cashmiriensis.
3 out of a large flock frequently seen at 4,000 ft. near Lankkaung.

Anthus spinoletta japonicus.*
One near Panwa pass at 7,500 ft.

Alauda arvescens.
14 specimens. In pairs singing near Panwa pass.

Calandrella rufescens.*
1 specimen.

Calandrella brachydactyla.
1 specimen.

Aethopyga dabryi.
7 specimens. Common at 7,200 ft. near Panwa pass.

Dicæum concolor.
1 specimen in N'Mai Valley.

Pitta oatesi.
1 specimen.

Hypopicus hyperythrus.
1 specimen at 7,200 ft. near the Panwa pass.

Dryobates major.
5 specimens.

Dryobates darjillensis.
5 specimens.

Dryobates cathpharius.
4 specimens.

Blythipicus pyrrhotis.
2 specimens at 6,000 to 7,000 ft.

Thriponax javanensis.
1 specimen at 7,000 ft.

Pyrotrogon wardi.
5 specimens, 5,000-7,000 ft.

Chætura gigantea.
1 specimen.

Buteo burmanicus.
1 specimen.

Accipiter gentilis.
1 specimen at 250 ft.

Accipiter trivirgatus.
2 specimens at 5,000 ft.

Accipiter virgatus.
1 specimen at 5,000 ft.

Columba pulchricollis.
2 and others seen on Pyepat ridge, 7,000 ft.

Phasianus colchicus.
6 specimens.

Chrysolophus amherstiæ.
1 specimen.

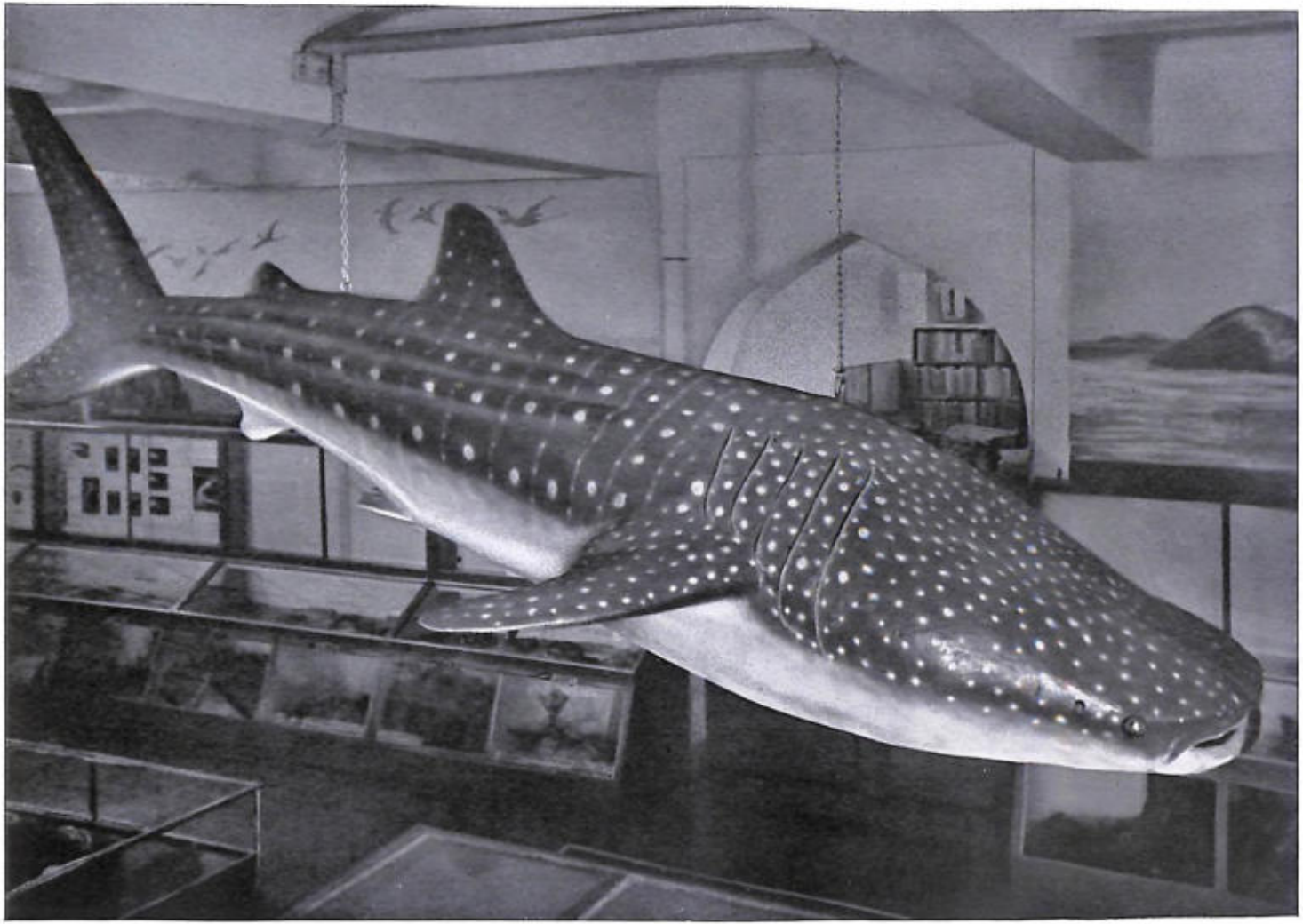
Ithaginis cruentus kuseri.
3 specimens 9,500 ft.

Porzana bicolor.
1 at 5,000 ft.

Recurvirostra avocetta.
1 near Waingmaw.

Ibidorhyncha struthersii.
1 near Gangfang, 5,000 ft.

Capella solitaria.
1 near Gangfang.



Whale Shark (21′ 6″) caught in fishing nets 15 miles from Bombay, 7th February 1938.

Photo of a cast in the Prince of Wales Museum, Bombay.

THE WHALE SHARK (*RHINEODON TYPUS* SMITH) IN INDIAN COASTAL WATERS.

WITH NOTES ON ITS WANDERINGS IN OTHER AREAS.

BY

S. H. PRATER, C.M.Z.S.

Curator, Bombay Natural History Society.

(With 1 map and 7 plates).

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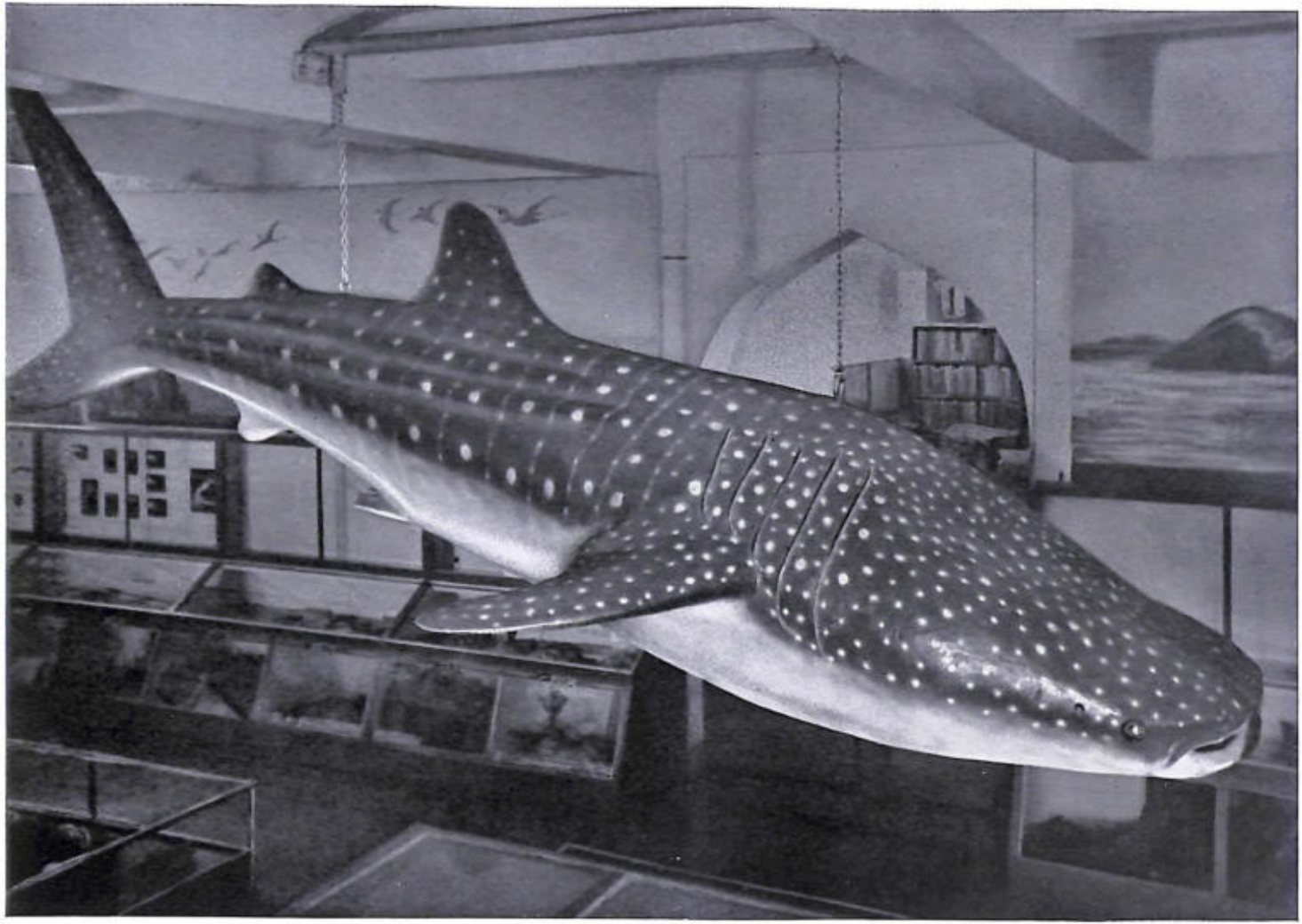
INTRODUCTION.

The Whale Shark (*Rhineodon typus*), the largest of existing sharks, grows to a length of over 50 ft. It ranges through the tropical and sub-tropical waters of the Pacific, Indian and Atlantic Oceans. Mr. E. W. Gudger (1934) has brought together, from numerous sources, records of whale sharks, captured or seen in the wide area of their distribution. As regards the coastal waters of India, his paper adds considerably to the single record noted by Day in his volume on Fishes in the *Fauna of British India* series. Enquiries subsequent to the capture of a whale shark off the Ratnagiri coast in October 1938, have enabled me to add a number of new records to the list made by Gudger. The following notes on the occurrence and distribution of whale sharks in the coastal waters of India include previous records noted by



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INTRODUCTION.

The Whale Shark (*Rhineodon typus*), the largest of existing sharks, grows to a length of over 50 ft. It ranges through the tropical and sub-tropical waters of the Pacific, Indian and Atlantic Oceans. Mr. E. W. Gudger (1934) has brought together, from numerous sources, records of whale sharks, captured or seen in the wide area of their distribution. As regards the coastal waters of India, his paper adds considerably to the single record noted by Day in his volume on Fishes in the *Fauna of British India* series. Enquiries subsequent to the capture of a whale shark off the Ratnagiri coast in October 1938, have enabled me to add a number of new records to the list made by Gudger. The following notes on the occurrence and distribution of whale sharks in the coastal waters of India include previous records noted by

Gudger, supplemented with the data now made available. I have numbered the records in the order in which they are listed in the table which appears on p. 260.

Distribution of the Whale Shark in Indian Coastal Waters.

West Coast of India.

Sind.

No. 1. In his introductory note to the Order, Selachoidea, Day (1889) refers to Dr. Buist's (1850) note on shark-fishing at Karachi, where an export trade in sharks' fins was then, and is yet carried on. Dr. Buist describes the methods employed in the capture of a 'basking shark', known to the local fishermen as the *mhor*, which is usually found floating or asleep on or near the surface of the sea. Dr. Buist's informant told him that the *mhor* is often 40 to 60 ft. in length, with a capacious mouth reaching 4 ft. in width. As a result of enquiries made at Karachi, I ascertained that fishermen still know of a fish called *mhor* which, as Buist describes, is occasionally harpooned while basking on the surface of the sea. My correspondent was unable to give any figures as to the actual number of *mhor* caught. He was told by the fishermen that in some years they took several of these sharks and in others they were not seen at all, but as a *mhor* realised about Rs. 15 from the oil obtained from its liver, it was hardly worthwhile making special efforts to capture them.

The question arises what species of shark is known as the *mhor*?

Gudger (loc. cit.) commenting on Buist's description of the general characters and habits of the fish concludes that the *mhor* is none other than the whale shark. He says:—

> 'though no mention of spots is made, its gigantic size and cavernous mouth would seem to make it the Whale Shark, which like *Cetorhinus*, the true Basking Shark, is frequently found at the surface of the water. Further more *Cetorhinus*, which has a comparatively small mouth, has (so far as I know) never been taken in the North Indian Ocean. It is primarily a cold water shark. The Mhor must have been the Whale Shark'.

While Buist made no reference to spots—an obvious and striking character in the colouration of the whale shark—the term *mhor*, the local name for the fish, is in itself descriptive of this character (vide notes on local names p. 270). Apart from this, actual confirmation of Gudger's views as to the identity of the *mhor* is now obtained by the recent captures of so called 'Basking Sharks' at Karachi, which proved to be whale sharks.

The history of these captures is as follows:—

No. 2. Mr. B. D. Ashworth, in a letter to the *Times of India*, (kindly forwarded to me by the Editor) enclosed two photographs of a Whale Shark caught at Karachi in April 1932. The fish was harpooned by fishermen from a small boat and, after a protracted struggle, was brought under control and killed with an axe. The axe marks on the fish's head can be seen in the photo (Plate II, No. 1).

No. 3. On the 27th March 1937, Capt. Heygate of the 1st Bttn., Royal West Kent Regiment and Lt. Heirsch, Royal Scot's Fusiliers harpooned a whale shark, 18 ft. in length, off Cape

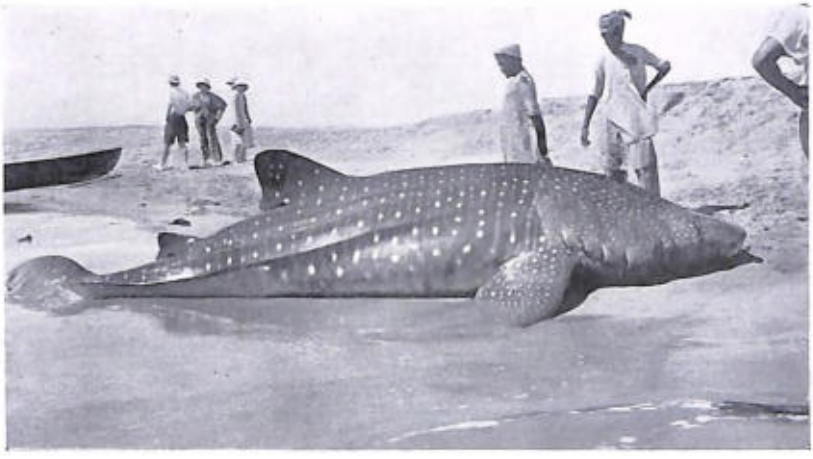
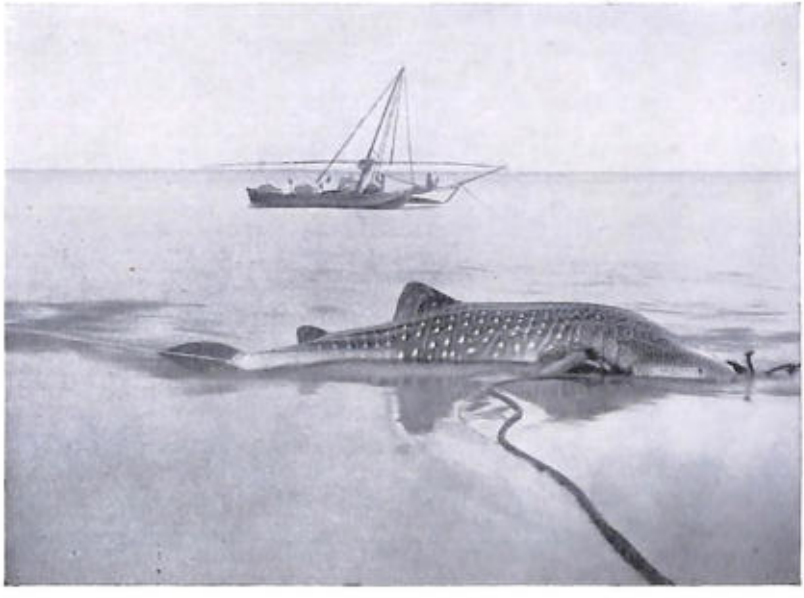


Photo by *B. D. Ashworth.*

1. Whale Shark caught at Karachi, April, 1932.



2. Whale Shark (18 ft.) harpooned by Capt. Heygate and Lt. J. L. Heisch off Cape Monze, Karachi, 27th March, 1937.

Photo by P. K. Gogote *The Times of India.*

Whale Shark (20 ft.) caught in the fishing nets near Jaygad, Ratnagiri, Bombay Province, on 3rd October, 1936.

Monze, some 20 miles north of Karachi. The shark was towed into Karachi harbour. The photo shows the fish after it was beached (Plate II, No. 2).

No. 4. In April of the same year, the two officers named above, harpooned a scond specimen some three miles off Karachi. The harpoon worked loose and the fish got away. They were however able to get a good view of the shark, when it was swimming on the surface of the sea, and again when beneath their boat. They state, in a note sent to me, that it was identical with their first capture having the 'same spotted skin and spade-shaped head'.

Bombay Province.

No. 5. On October 3rd, 1936, a whale shark, caught in the fishing nets near Jaygad, Ratnagiri, about 100 miles south of Bombay, was brought ashore by the fishermen. Mr. P. K. Gogote, the local correspondent of the *Times of India,* sent a photograph of the fish to this paper with a note saying that the fish was over 20 ft. in length. He adds—

'the special feature of this fish was that it could not be cut, i.e. the cut effected showed no trace owing to the rejoining of the skin'.

Owing to the elasticity of the skin and the deep underlying layers of fat, any incisions made in the body of this fish rapidly close up and leave little or no trace. The unexpected result so impressed the fisherfolk, that they returned the fish to the sea rather than be held accountable for its life. Mr. Gogote says that it was towed into deep water and released 'owing to superstitious fears.' A photo of the fish, originally published in the *Times of India,* is reproduced here. (Plate III).

No. 6. On Sunday, February 13th, 1938, a whale shark, 21′ 6″ in length, was caught by fishermen 15 miles from Bombay. It had fouled their nets and was towed into Sassoon Dock, Bombay. I was informed of the capture of this fish by Dr. S. B. Setna, Fisheries Officer, Bombay. When we arrived at the dock a great crowd of people had already assembled round the shark, which had been dragged up the slip way. An enterprising cooly *mukadum* (overseer) had covered it with a tarpaulin and was now demanding a fee of 1 anna from all who desired to see the 'god' under the canvas. To impress doubters, preliminary homage had been paid to the deity, with a sprinkling of flowers and turmeric powder, and the burning of incense sticks. It is a common practice when whales or large fish are cast up upon our coasts or taken out of the sea. The derelict becomes *'massa dev'* the fish-god and receives homage from all believers to the material gain of the presiding genius. A complete plaster mould was taken of this fish, over 2,000 lbs. of plaster being used in the process. Its cast is now exhibited in the Fish Gallery of the Prince of Wales Museum. To present the correct contours and to overcome as far as possible the distortion of form arising from a heavy body pressed against the ground, the undersurface of the fish and parts of the mid-body were remodelled. The cast is as true and accurate a representation of this rare fish as is obtainable (Plate I). The Museum is greatly indebted to Mr. J. R. Kaka

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who presented this fish to the Museum, to Dr. S. B. Setna and to the Port Trust Authorities for the assistance which they gave to the Museum staff.

No. 7. On Tuesday, 16th January 1940, a whale shark (male) 18 ft. in length was landed at Chowpatty beach, Bombay. It was seen on the night of the 15th several miles out at sea, floating on the surface. The shark subsequently fouled the nets of the fishermen who secured it and hauled it ashore. (Plates IV and V).

Travancore Coast.

No. 8. Mr. R. Shankara Narayan Pillay (1929), in his list of the fishes taken in Travancore between 1901 and 1915, says that a whale shark, measuring 29 ft. in length was stranded at Trivandrum in 1900.

No. 9. Mr. Pillay also referred (loc. cit.) to the cast of a 13 ft. 7 ins. specimen, now exhibited in the fish gallery of the Trivandrum Museum. Mr. R. V. Poduval, the Curator of the Museum has since sent me the history of this shark. It was caught in fishing nets off Travancore in February 1909.

No. 10. In a letter, Mr. Poduval provides a further record of the capture of a whale shark in March 1934, when a specimen, 13 ft. in length, was captured off Trivandrum. He adds that the capture of small specimens like this is by no means uncommon.

Ceylon.

No. 11. The earliest reference to the occurrence of the whale shark in the coastal waters of Ceylon, which I have been able to find, is by Sir Emerson Tennant (1801). Writing of the export trade in sharks' fins from the gulf of Mannar, he says that the skin of the 'Basking Shark' is also sent to be converted into shagreen'. The basking shark referred to by Tennant could be none other than whale shark, as we have no evidence of the occurrence of the true basking shark (*Cetorhinus*) in these warmer seas.

No. 12. The second reference is by Capt. James Stewart (1862). In his account of the Pearl Fisheries of Ceylon he says that sharks are common and that on two occasions his attention was called to 'spotted ones' of such monstruous size as to make the common sharks at their sides look like 'pilot fish'. The 'spots' and the size again indicate that Stewart's monster sharks were whale sharks.

No. 13. Haley (1883) recorded the capture of a whale shark, 23′ 9″ long, which was taken in the fishing nets at Moratuva, 12 miles south of Colombo on the 11th January, 1883. The specimen was mounted and is now exhibited in the Colombo Museum. This is the record referred to by Day in his *Fauna* volumes, then the only example known from the Indian waters.

No. 14. The capture of a second specimen 18′ long was again recorded by Haley (1884). It was taken off Negombo, north of Colombo. The skin was sent to the British Museum and is now exhibited there.

No. 15. A third capture from Ceylon, a 14′ 5″ example, taken

Photo by

Whale Shark (28 ft.) lan

Felicitas Studio.

...ded at Chowpatty Beach, Bombay, 16th January 1949.

Photo by *Felicitas Studio.*

Whale Shark (under surface), landed at Chowpatty, Bombay, 16th January 1940.

off Bampalapittya (a southern suburb of Colombo), was recorded by Thurston (1894).

No. 16. To these records of the actual taking of whale sharks in the seas round Ceylon, we can now add a fourth. Mr. P. E. Deraniyagala (1936), Acting Director of the Colombo Museum, in an article on Big Game Fishing off Ceylon says, that on the 10th July, 1935 the *S. S. Katori Maru* ran into a whale shark off the Ceylon Coast. According to the Captain the specimen was 40′ long.

'It was the size of a whale, differing from that animal in shape, spotted like a leopard in a very beautiful manner. It came along under the stern of the ship during a calm, we had a magnificent opportunity of viewing it. It had a large dorsal fin, which it moved about with great rapidity when angry, in consequence of the large stones we threw down upon it, rashly for it possessed sufficient strength to have broken the rudder and to stove in the stern of the ship. Several large fish (seemingly dog-fish), about a cubit in length and upwards, were gamboling about the monster entering its mouth at pleasure and returning to the water again. The mouth was very large. Dorsal fin black or dark brown. Tail also boldly covered with brown spots like a leopard. Head, lizard-shaped.'

Mr. Deraniyagala in his letter to me says, that since his article appeared in print, there was at least one other *Rhineodon* struck by a ship in Ceylon waters, but unfortunately he had kept no record of it.

No. 17. Gudger (1940) records the ramming of a whale shark by the Dutch Ship '*Johan van Oldenbarnvelt*' about 15-18 miles off Colombo on the 24th November, 1932. Second Officer H. W. Hemmes, who reported the incident, says that:—

'The bow of the ship had pierced into the body of the shark for about three feet. The part of the ship with the tail hanging was on our starboard side and was about 25 ft. long. The fish was bleeding, but was apparently dead. When the ship got clear of the fish, the body dropped down into the water.'

East Coast of India.

No. 18. Foley's (1835) account of an unusual sea-monster in the Bay of Bengal, is, as far as I know, the earliest published reference to this shark. On a voyage to Madras, when his ship was presumably nearing port, he saw what he describes as an 'unusual sea monster' of the size of a whale, but differing from that animal in shape. He refers to its large mouth and to its body covered with brown spots like a leopard. Foley's description is sufficient to establish the identity of his monster.

No. 19. The second record from the Bay of Bengal is by Thurston (1890). He writes of a specimen 20′ long which was washed ashore at Madras in February 1889. In a subsequent publication (1894) he corrected the measurement to 22′.

No. 20. The third record from the Bay of Bengal was noted by R. E. Lloyd (1908) who reported the harpooning of a whale shark swimming on the surface at the mouth of the Hoogly, on March 23, 1908. The specimen was presented to the Indian Museum, Calcutta.

The various records of whale sharks from the coastal waters of India are shown below in tabular form. Records previously noted by Gudger (1934) are marked with an asterisk.

Records of Whale Sharks in the Coastal Waters of India and Ceylon.

West Coast of India and Ceylon

Locality	Date	No.	Reported by	Recorded by
*1. Karachi ...	...		...	Dr. Buist, 1850.
2. ,, ...	April, 1922 ...	1	B. D. Ashworth.	S. H. Prater.
3. ,, ...	27th March, 1937...	1	Capt. Heygate ...	,,
4. ,, ...	April, 1937 ...	1	,, ...	,,
5. Bombay ...	13th February, 1938 ...	1	Dr. S. B. Setna...	,,
6. ,, ..	1st January, 1940.	1	J. Jacobs ...	,,
7. Jaygad ...	3rd October, 1936.	1	P. V. Gogote ...	,,
*8. Travancore.	... 1900.	1	...	S. N. Pillay, 1929.
*9. ,,	February, 1909 ...	1	...	S. N. Pillay, 1929.
10. ,,	March, 1934 ...	1	S. K. Poduval ...	S. H. Prater.
*11. Moratuva, Cyelon ...	January, 1883 ...	1	...	Hailey, 1883.
*12. Negombo, Ceylon ...	,, 1890 ...	1	...	,, 1890.
*13. Colombo ...	February, 1889 ...	1	...	Thurston, 1890.
14. Off Ceylon ...	...	...	...	Tennant, 1861.
*15. Gulf of Mannar ...	...	...	...	Stewart, 1862.
16. Off Ceylon ...	...	1	...	Deraniyagala.
17. Off Colombo.	24th November, 1932 ...	1	...	W. E. Gudger, 1940.
Total, West Coast ...		14+		

East Coast of India and Ceylon

Locality	Date	No.	Reported by	Recorded by
*18. Madras ...	February, 1889 ...	1	...	Thurston, 1890.
*19. ,, ...	...	1	...	Foley, 1835.
*20. Mouth of Hoogly ...	23rd March, 1908...	1	...	Lloyd, 1908.
Total, East Coast ...		3		

A reference to the table printed above shows firstly, that practically all the recorded occurrences of whale sharks in our coastal waters are from the West Coast of India and Ceylon. During the long period over which these records extend, there are only three records from the East Coast and fourteen actual records from the West Coast of India and Ceylon, exclusive of references to specimens seen in this area.

The second fact which emerges is, that practically all the records fall between the months of January and April. In considering the distribution of the Whale Shark in our coastal waters two factors have then to be accounted for—

1. Their seasonal appearance on our coasts between January and April.

2. Their occurrence mainly on the West Coast of India and Ceylon.

To my mind, these factors provide important clues to an understanding of the movements and wanderings of these fishes. I am of opinion that the appearance of whale sharks on our coasts, during the particular season when they occur, is associated with the special abundance of their food at this particular period. Secondly that, the limitation of their range, mainly to the west coast of India and Ceylon, is due to the particular direction and movements of surface currents in the Bay of Bengal and the Arabian Sea at this period. Before taking up the evidence in support of these views, it is necessary to consider briefly the food and feeding habits of the Whale Shark.

Food of Whale Sharks.

Gudger (1915) has brought together such observations as have been made on the food of the Whale Shark. Because of its minute teeth, it was first thought that these great sharks were purely herbivorous. The large masses of algae found in the stomach led Wright (1870) to this conclusion. It is now definitely known that the Whale Shark, like the Basking Shark, feeds on plankton, strained out of the water by its peculiar gill apparatus. In some sharks, fringe-like structures, located on the pharyngeal walls, are modified to form what are known as 'gill-rakers'. In the Basking Shark and the Whale Shark, the gill-rakers are remarkably specialised to form a highly complex straining apparatus. They are closely set in a row on the inner extremity of the gill-arches, and, as they project into the inner cleft, leading to the gullet, they function effectively as a strain or sieve to food or water entering the alimentary tract. Their function is thus similar to the function of the long hair-like fringes on the baleen plates of the whale-bone whales, and as such they provide a striking example of parallelism—of the evolution of similar structures, designed to serve the same ends in totally unrelated groups of animals.

The manner of feeding of these great sharks is simple. Smith's (1849) account of the feeding habits of the Whale Shark is similar in every way to the description of the feeding habits of the Basking Shark. Both sharks swim or float leisurely with the mass of drifting plankton, and with widely open mouth, take in great quantities of water, and with it, the myriads of floating organisms it contains. On the closure of the mouth, the water is forced out through the gill-clefts, leaving the food adhering to the inner walls of the gullet and to the sieve-like gill-rakers.

RECORDS OF WHALE SHARKS IN THE COASTAL WATERS OF INDIA AND CEYLON.

West Coast of India and Ceylon

Locality	Date	No.	Reported by	Recorded by
*1. Karachi ...	...	...	...	Dr. Buist, 1850.
2. ,, ...	April, 1922 ...	1	B. D. Ashworth.	S. H. Prater.
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Total, West Coast ...		14+		

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During the process, masses of algae and other flotsam may be taken in. The stomach of the specimen landed at Sasson dock, Bombay, contained a mass of green algae. Kishinouye (1901) records that an oaken pole was found in the stomach of a specimen caught near Japan. The diet of the basking shark is known to consist almost entirely of zoo-plankton—of shrimp-like crustaceans, and other minute animal organisms, which swim about on the surface of the sea, and which, at certain seasons, constitute the dominating element of the plankton. Whale sharks also derive their nourishment from minute crustacean and other animal forms which, as will be presently shown, form the dominating element in the plankton of our off-shore waters when these sharks visit our coasts.

Influence of Plankton Outbursts on Movements of Whale Sharks.

Arabian Sea. Such investigations as have been made of plankton in Indian waters show, that in the Arabian Sea and the Bay of Bengal, plankton productivity is wholly dominated by the alternation of the north-east and south-west monsoon and, that plankton outbursts are far more seasonal in our seas than in most tropical waters. Writing of plankton on the Malabar Coast, Hornell and Nayudu (1923) have shown that on this coast there are two peak periods of productivity. There is a maximum production of plant forms (phyto-plankton) between May and September, in response to conditions brought about by the south-west monsoon; while a second outburst, takes place between January and February, favoured by conditions produced by the north-east monsoon. Factors favouring the first outburst are the vast quantities or organic and inorganic matter washed into the sea by the south-west monsoon floods, which bring to the surface waters the manurial elements necessary for plankton growth. Reduced salinity, occasioned by the out-flow of these flood waters, also brings about that increased stability which is favourable to plankton growth. The calm conditions which prevail during the north-east monsoon, while they again favour the growth of phyto-plankton, appear to be also favourable to the development of animal organisms (zoo-plankton), which, during this season, constitute the dominating element of the plankton. Sewell (1913) states, that a study of the plankton constituent in Indian seas leads to the conclusion that, compared with temperate seas (North-Atlantic), marine animal organisms occur at a somewhat later period, and that there seems to be a general tendency for marine organisms to have their breeding season during the cold weather rather than during the hot months of the year. The reason suggested is the disturbed conditions of the sea during the south-west monsoon. Hornell and Nayudu's investigations of the off-shore plankton on the Malabar Coast support this view and reveal the abundance of zoo-plankton during the cold weather. They write :—

'In November copepods begin to appear in much greater numbers than at any time since the preceding May, and finding an abundance of food, multiply very rapidly, with them in November, appear swarms of Napuli and a host

of other rapacious organisms to feed upon the diatoms and dino-flagellates. *This miscellaneous assemblage remains the characteristic feature of the off-shore plankton till the rains in May kill or drive away from the shore these forms and replace them with swarms of diatoms.* (Italics are mine.)

It is shown that there is clearly a super-abundance of zoo-plankton in the off-shore waters of the Malabar Coast between January and April, when whale sharks appear. Conditions on the Malabar Coast are repeated on the Bombay Coast. Through the courtesy of Dr. Lele of the Royal Institute of Science, Bombay, I had the opportunity of consulting an unpublished thesis by a Miss A. P. Gae, recording month to month plankton investigations carried out at Bombay between October 1932 and March 1934. These investigations, again reveal an abundance of zoo-plankton between January and March, enriched, the author observes, by forms not present at other seasons of the year. The investigations revealed that copepods, in particular, swarm in myriads during these months. We have no data of plankton on the Sind Coast; but the seas in the neighbourhood of Karachi must receive a considerable quantity of nutrient matter brought by the river Indus, and probably provide a rich field for the development of plant forms and the succeeding invasion of animal organisms.

These optimum conditions of food supply are repeated off the west coast of Ceylon and in certain tracts of the Arabian Sea during the North-East Monsoon. Thompson and H. Carey Gilson (1937) in their report on chemical and physical investigations in the Arabian Sea, carried out by the John Murray Expedition, express the view that, with the resumption of calm conditions in September, there is a considerable growth of phyto-plankton, particularly where upward water movements cause a renewal of nutrient-salts in the surface layers. This occurs principally near Seychelles and in the strong currents near the African coast about Lat. 1.3° N., which sweep northwards to the Gulf of Aden and the coast of Arabia. Note, that the two areas where whale sharks have been recorded from the Arabian Sea, i.e., Seychelles and the mouth of the Gulf of Aden are, as the authors show, areas of great plankton productivity. Recorded occurrences from the Straits of Babel Mandeb and the southern extremity of the Red Sea have probably a similar explanation.

Equally significant is the fact, that whale sharks have never been recorded from the Persian and Mekran coasts. This has been described by Sewell as an area of scanty plankton production—a 'desert area' as far as plankton is concerned.

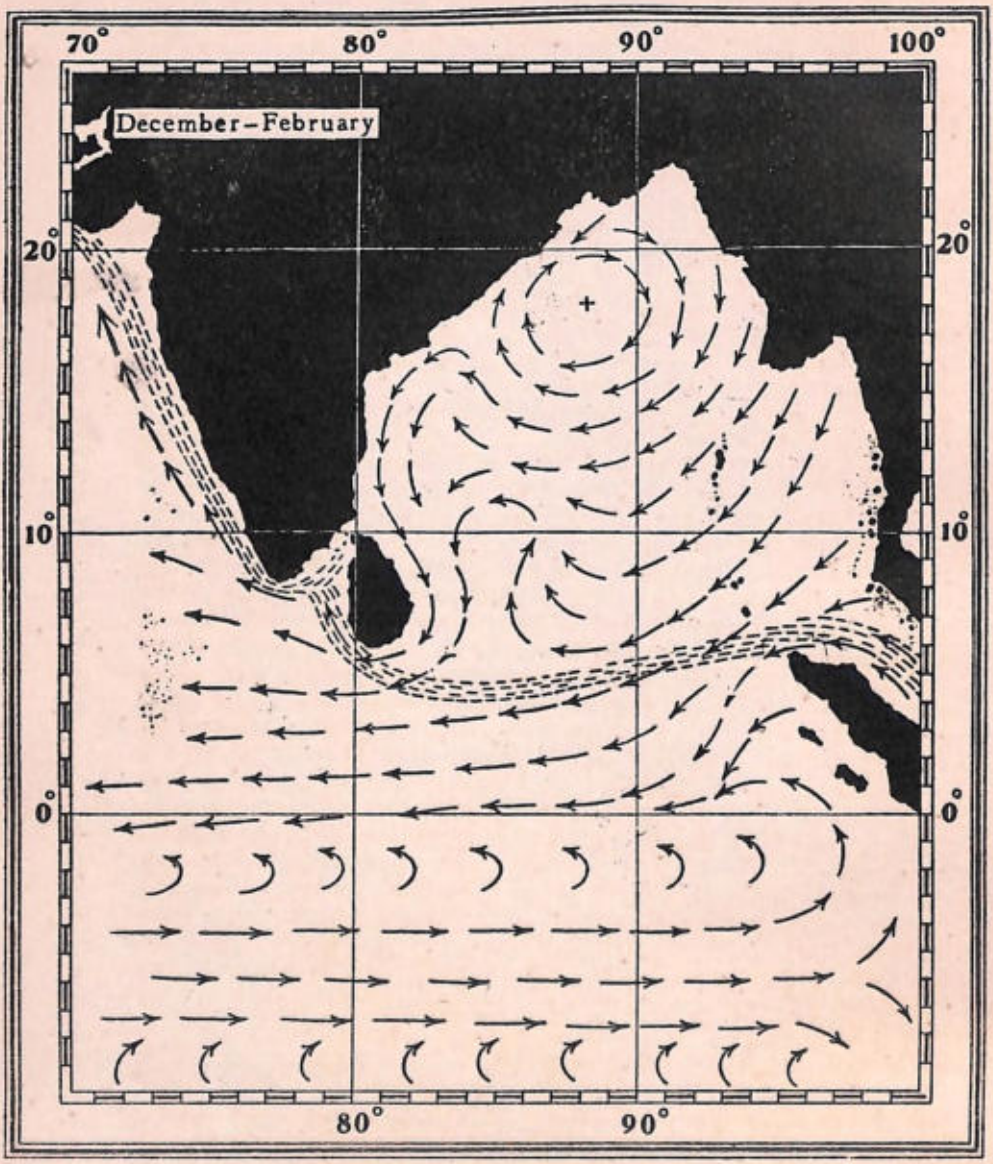
Plankton productivity in the Bay of Bengal. Menon (1931) has shown, that owing to the more limited influence of the south-west monsoon, favourable conditions for the production of plankton are not produced on the East Coast till September, when productivity commences, reaching its peak in January. From thence on there is a slight decline followed by an abrupt rise in March, which reaches its maximum in May. These phyto-plankton outbursts are, as always, followed by a rich influx of zoo-plankton, which, commencing in October, reaches maximum conditions in December, January and February and then commences to decline.

It has been shown, that between December and March, the off-shore waters of India and Ceylon provide, a super-abundant harvest of animal organisms, which become the dominating element in the plankton. The abundance of this drifting food attracts to our coastal waters, during this season, numerous surface feeding fishes, such as devil rays, sail fish, etc., and, among them, whale sharks, whose appearance on our coasts coincides with this season of plenty. There follows the second point for consideration :—If whale sharks visit our waters because of the abundant food supply why do they confine themselves mainly to the West Coast?

The Influence of Surface Currents on the movements of Whale Sharks.

Why are whale sharks so rare on the East Coast, where at the time of their migration, food conditions are as favourable as on the West Coast? Why again have they never been observed in the eastern reaches of the Bay of Bengal, or along the coasts of Burma and Tenasserim? Data provided by Sewell (1913) show that plankton decidedly increases in these waters from early November to the beginning of January, and that the plankton is very rich in animal organisms, which provide food for these sharks. Yet, during a period extending over a century, we have only three records from the East Coast, and none from the shores of Burma and Tenasserim. The explanation, I believe, is to be found in the direction and movements of the surface currents in the Bay of Bengal and along the coasts of India and Ceylon at the time when whale sharks commence their seasonal visitation to our waters. Gudger (1934), in explaining the appearance of whale sharks on the coasts of India, says that during the northern summer (i.e. June to August) there is a monsoon drift from the south-west to the north-east, which might carry whale sharks from the Seychelles Archipelago, where they are known to be permanently resident, to India. The answer to this is, that whale sharks do not visit our coasts between June and August, when the south-west monsoon is established. As shown by the records, their visits are timed between January and March, during the north-east monsoon. Sewell (1937) has indicated, that the north-east monsoon is a period when the bulk of the waters of the Arabian Sea converge upon the African coast. The movement of these sharks from Seychelles to India, at this season, would be contrary both to wind and surface currents. The sharks which visit the coasts of India during the north-east monsoon, if they follow the drift of the currents, must come to us not from the West but from the East. This, an alternative route suggested by Gudger, is the correct one. Sewell (loc. cit.) states, that with the establishment of the north-east monsoon (about December), there is a strong flow of water from the Pacific into the Indian Ocean through the Straits of Sumatra. This current known as the north-east monsoon drift, moves across the Andaman Sea and the lower reaches of the Bay of Bengal and sweeps by the south coast of Ceylon. Whale sharks, moving with this drift, would arrive off the south coast of Ceylon. From

SURFACE CURRENTS OF THE BAY OF BENGAL: (after Sewell).



How whale sharks following the flow of the north-east monsoon drift and of coastal currents are brought from the Pacific to the West Coast of India and Ceylon. It will be noted that the waters which converge upon the East Coast of India and Ceylon do not come from the Pacific but from the head of the Bay of Bengal.—Route followed by fish shown in dotted lines.

this area a coastal current, which sweeps up the west coast of Ceylon, at this time of the year, would bring them to the Gulf of Mannar; from the Gulf, their progress northward, along the west coast of India, would again be aided by the coastal current, which at this season, begins to run from south to north. This north flowing coastal current would bring these sharks to the coasts of Travancore, Bombay and Sind.

The question arises, why whale sharks, if they come from the Straits of Sumatra, across the Bay of Bengal, do not first converge upon the east coast of India and Ceylon. The answer here again is to be found in the direction and movements of surface currents in the Bay of Bengal, at the time of their westerly migration. Sewell (1938), has given in some detail, an account of the movements of surface currents in the Bay of Bengal at various periods of the year. A reference to his map, which is reproduced here, will indicate that the north-east monsoon drift from the Straits of Sumatra does not flow towards the east coast of India. It runs in lower latitudes. It crosses the lower reaches of the Bay of Bengal and flows past the south of Ceylon. The waters, which impinge upon the Coromandel coast at this time of the year, (i.e. December to February), do not come from the Straits of Sumatra at all. They come from the head of the Bay, where, owing to the north-east monsoon winds, the surface waters are driven off the coasts of Burma, westwards across the Bay, to the northern section of the Coromandel coast. There, due to the rotation of the earth, and the configuration of the coast, the westward flowing current divides; one branch flows northwards, producing at the head of the Bay a cyclonical circulation; the other flows southwards along the Madras coast and the east coast of Ceylon, then, rounding the island, the current flows up the west coast of the island to the Gulf of Mannar.

Whale sharks arriving at the south of Ceylon with the north-east monsoon drift would be aided by the northward movement of this coastal current up the west coast of the Island. On the other hand, progress up the east coast of Ceylon and India, as is seen, would be contrary to the flow of the coastal currents which at this time of the year run down the east coast of India and Ceylon from north to south.

We have one record of a whale shark off the Madras coast in February, and one in March, from the mouth of the Hoogly. A directional change which takes place in the surface currents in the Bay of Bengal, late in February or early in March, may explain these records. Sewell (loc. cit.) shows, that a decided change now takes place in the directional flow of the surface currents. Between February and March, a double cyclonal circulation sets in at the head waters of the Bay of Bengal, and a current sweeps up from below Ceylon up the Coromandel coast to the coast of Bengal. The reversal in the direction of the current at this time of the year, might easily bring whale sharks up the Madras coast to the mouth of the Hoogly.

It is impossible to assume, that the movements of so powerful a fish as the whale shark are controlled entirely by the direction

of the wind and the surface currents. But knowing the nature of their food, and their peculiar feeding habits, one might say, that these sharks, like some other surface feeding fishes,—sun fishes for example,—in the calm weather which prevails in our seas during the north-east monsoon, float with the currents in order to follow more easily their drifting food. It is clear, that a general convergence upon the coasts of India, from the surrounding seas, would not explain the peculiar and limited distribution of these fish on the coasts of India. The actual distribution of whale sharks on the coasts of India, the concordance of this distribution with the direction and flow of surface currents, during the season when they appear, is clear evidence of the influence of current upon their movements. The direction of surface currents explains how these sharks, coming to us with the inflow of waters from the Pacific, converge upon the west coast of India and Ceylon; why they are so rare upon the east coast, and why they have never been recorded from the coasts of Burma and Tenasserim. The purpose of their migration is indicated in the abundance of their food in these waters at this season. It is a time of the year when these waters contain an abundance of zoo-plankton.

Seasonal Movements of Whale Sharks in other Areas.

This seasonal movement of whale sharks to the coastal waters of India is apparently repeated in other areas. It is known that whale sharks, in numbers, visit the seas off the coast of Hondo, Japan, every summer. Again, at Seychelles, it has been observed that whale sharks visit the inshore waters every year between May and August. As on the coast of India, the movement appears to be associated with the particular abundance of planktonic food in the areas visited. I have not been able to consult any papers dealing with plankton productivity in the seas off Japan. Plankton conditions in Seychelles, an area of high productivity have not been studied between May and August. Nevertheless, there is interpretative evidence to indicate that the visits of whale sharks, both to Japanese waters, and to the inshore waters of Seychelles take place during periods of high plankton productivity. Whale sharks, it has been observed, visit the Japanese waters at a time when the *bonito* fishing is at its height. At Seychelles, it was noted, that the whale sharks come inshore between May and August with numbers of horse-mackerel and great shoals of sardines and other small fry. In the Bay of California, whale sharks were again observed at certain seasons in company with tunny.

Gudger explains the association of whale sharks with bonito, tunny and horse-mackerel (*Carangidae*) as the natural tendency of these smaller fishes to shelter or follow in the wake of giant fishes. Bonito and tunny, as is well known, will even follow passing ships. Be this as it may, the point relevant to the present discussion is the reason for the presence of these carnivorous fishes in great numbers in the areas visited by these sharks. The presence of highly predatory fishes like tunny, bonito and horse-mackerel in large numbers may be connected with breeding activities; but

may also be due to an equal preponderance of sardines, herrings, mackerel, and other small fry upon which they feed; and great assemblages of these small fishes can be ascribed to the existence of a super abundance of plankton. Hornell and Nayudu (loc. cit.) have shown how the visit of myriads of sardines to the inshore waters of the Malabar Coast coincides with a peak period of plankton productivity. Gadsden (1899) shows how in the seas round Aden in April, countless millions of small fishes appear, accompanied by troops of larger fishes chiefly, tunny, and albacore, and seer, which spend their time in preying upon the smaller fry. The presence of these smaller fishes in great numbers, in the Gulf of Aden is again explained by the abundance of plankton during this period, as is evidenced by the researches of the Murray Expedition. It is probable that whale sharks and hordes of smaller fish are attracted seasonally to Japanese waters by an abundant harvest of plankton, and the *bonito,* which swarm at this season, by the abundance of their prey.

Similar circumstances account probably for the abundance of whale shark, tuna and small fish off the coast of California about which Gudger (1940) writes. He says 'The small fish go in schools and are followed by both tuna and whale sharks'. The Bay of California and the west coast of America in general is known to be an area of rich plankton productivity.

From what has been written it will be seen that seasonal visits of whale sharks take place in various parts of the world; particularly in areas, such as the coasts of India, where plankton productivity is more definitely seasonal. The basking shark (*Cetorhinus*), which recalls the whale shark in its habits, also appears to undertake similar seasonal migrations. These movements, says Norman (1937), are as yet imperfectly understood, but there appears to be a regular annual migration along the west coast of Ireland to the Western Isles of Scotland and thence northwards, the shark approaching Ireland during the spring and reaching Norway during August. It is not improbable that the seasonal movements of these basking sharks are associated with the abundance of planktonic food in the area of their wanderings during this particular time of the year. The period of their migration coincides with the great spring outburst of plankton which in these highly productive waters is generally maintained till late in the summer; the plant outburst being shortly followed by the usual invasion of animal forms. Like the Whale Shark—the Basking Shark in its quest for its food follows the course of warm surface currents, in this instance the branch of the Gulf Stream which sweeping up the west coast of Ireland flows between the Faeroe and the Shetland Islands to the coast of Norway.

Seasonal migrations for purposes of feeding, aided by the flow of favourable warm currents, thus provide an explanation of whale sharks excursions into areas far from their natural habitat. These sharks, essentially fish of warm seas, have been recorded from as far north as New York and the Seas of Japan and from as far south as the Cape of Good Hope.

We must consider the coasts of India, and all such areas where

the occurrence of whale sharks is sporadic or seasonal as areas of nominal distribution, and as such, distinct from areas, where whale sharks are permanently resident.

Centres from which Whale Sharks migrate.

A study of the occurrence of whale sharks in the various parts of the world, brought together in Gudger's valuable paper, reveals an interesting fact. These sharks have been observed all the year round only in the island-studded seas of archipelagoes, where alone they are known to be permanently resident. In the Pacific, there are three centres in which whale sharks are known to occur all the year round. These are the East Indian Archipelago, the Philippine Archipelago, and the Islands at the mouth of the Bay of California. In the Indian Ocean, there is but one such area—the Seychelles Archipelago. In the Atlantic—the island studded seas of the Carribean and the Gulf of Florida are the only areas where these sharks are recorded as being permanently resident. We can then look upon these island seas as productive centres of distribution; centres from which a certain number of whale sharks, driven by exigencies of food supply or other causes, migrate regularly or irregularly into waters where food is plentiful, aided in their migration by favourable currents flowing outward from these sheltered seas.

From the circumstances of their distribution on our coasts, we know that the north-east monsoon drift brings the whale sharks to the coasts of India. This drift is caused by an inflow of waters from the Pacific, which come *via* the East Indian Archipelago, and enter the Indian Ocean through the Straits of Sumatra. Similarly, whale sharks from the Philippines, following the Kuoro Sivo current, would be brought to the coasts of Japan. These Archipelagoes, the Philippines and East Indies, appear to be the centres from which whale sharks, aided by the flow of currents, migrate seasonally to the waters of Japan and to the coasts of India. The same factors may provide the explanation for the occurrences of whale sharks along the west coast of Mexico, Panama and Peru. These areas of nominal distribution may derive their source from the Islands of the Gulf of California, where whale sharks are known to be permanenly resident. The Mexican coastal current would provide the aegis of the southward movement.

In the Indian Ocean, the Seychelles Archipelago would be the centre from which the whale sharks, recorded from the Gulf of Aden, and the Cape of Good Hope, travelled, assisted, in the former instance, by the northward flow of the East African coastal current, and in the latter by the westward flow of the Aghulas current, which sweeps past the Cape of Good Hope. In the Atlantic, the islands of the Carribean Sea and the Gulf of Florida are apparently the centres from which whale sharks migrate periodically along the eastern coasts of the United States, or southwards to Brazil and to the West Coast of Africa, which, like the west coast of America, is a region of rich plankton productivity.

Judging from their appearance on the coast of India, it would appear that the numbers taking part in these migrations vary.

The visiting sharks are more numerous in certain years than in others.

The records of their world distribution further indicate, that these sharks, in the course of their migrations, follow the coast lines, or take advantage of chains of islands. They are not fish which roam the open seas. All records are from coastal or confined waters. It is significant that they have never been encountered in the mid ocean steamer lanes, which criss-cross the oceans of the world, where these great surface swimming fishes would not have failed to have been observed at some time or other. Gudger (1940) has brought together various records of the ramming of whale sharks by ships at sea. All these records are from coastal waters or from confined or archipellagian seas.

The fact of these seasonal movements being established, the question arises whether whale sharks, after their journeys in quest of food, return to the places from which they came. We know that whale sharks, after a temporary appearance in our coastal waters, disappear from our coasts during the disturbed conditions of the south-west monsoon. Do they spend this period of their absence roving the stormy seas? The suggestion seems unlikely, in the case of a coast hugging fish, which selects the sheltered waters of island seas for a permanent habitat. On the other hand, does this period of absence from our shore coincide with their breeding time and do these sharks return to their spawning grounds? If so, where do they breed? We know them to be permanently resident only in certain archipelagoes. Not only are they most numerous in such areas but they have been seen assembled there in great schools. Two such assemblages have been recorded from the East Indian Archipelago—one, off the coast of Papua; the other was seen, in the month of September, in the Straits of Buton. Schools have been observed also in the Philippine Archipelago. The basking shark, which, is a kin to the whale shark in most of its habits, at certain times assembles in schools of 60 to 100. Norman (loc. cit.) suggests that these assemblages may be associated with breeding. Unfortunately, we know nothing about the breeding of the whale shark or of the basking shark. The young of these fishes have never been taken. But it is safe to assume that these archipelagoes, where these sharks are most numerous, and where they are found throughout the year, are also their breeding grounds. Wanderings for food followed by assemblages for spawning is not an uncommon habit among fishes. Many species of fish with circumscribed breeding areas, after temporary wanderings for food-getting, return to their breeding grounds to spawn, and it is probable that whale sharks belong to this class and return to their spawning grounds. Gudger in discussing the place of origin of the whale shark and the mode of its dispersal, indicates the Philippine Archipelago as the centre from which the species originated—the centre from which, with the aid of favourable currents, it has extended its range and permanently established itself in various parts of the world. It would appear that this dispersal was brought about, in the first instance, by the circumscribed area of the breeding habitat and the need for finding food and space for an increasing

population, and, that wanderings, associated with food getting initiated and brought about this dispersal. The fish in the course of their wanderings established themselves wherever suitable conditions of life prevailed, i.e., in other archipelagoes. These archipelagoes in their turn became centres of productive distribution from which, at appropriate seasons and aided by suitable currents, whale sharks wander for food returning whence they came for purpose of spawning.

Local Names.

The many local names for the whale shark indicate that the fish is well known on the west coast of India and in Ceylon. In the following list an attempt has been made to give the derivation and meaning of the names used.

Sind. *Mhor.* The name *mhor* is an Arabic word meaning 'stamp' or 'seal'. Its application to the whale shark probably has reference to the spots or 'stamp-like' markings which ornament its head and body.

Bombay. *Karanj* (Marathi). Derived from Sanscrit *karanga* meaning a tree. The name is also applied in Bombay to the tree *Pongamia glabra.*, whose seeds produce a medicinal oil. I am not able to suggest a reason for the application of this name to the whale shark. Local fishermen use oil extracted from the liver of the shark for medicinal purposes. The name may have some such significance.

Bhariat (Marathi). *Bhari*: meaning great or big.

Travancore Coast. *Pulli-udoombu* (Tamil). Mr. Poduval, Curator of the Trivandrum Museum, says that the term means 'spotted reptile'; *pulli* meaning spotted; while the term *udoombu* is commonly applied to the Monitor Lizard (*Varanus*) and may have been suggested by the 'lizard-like' shape of the head.

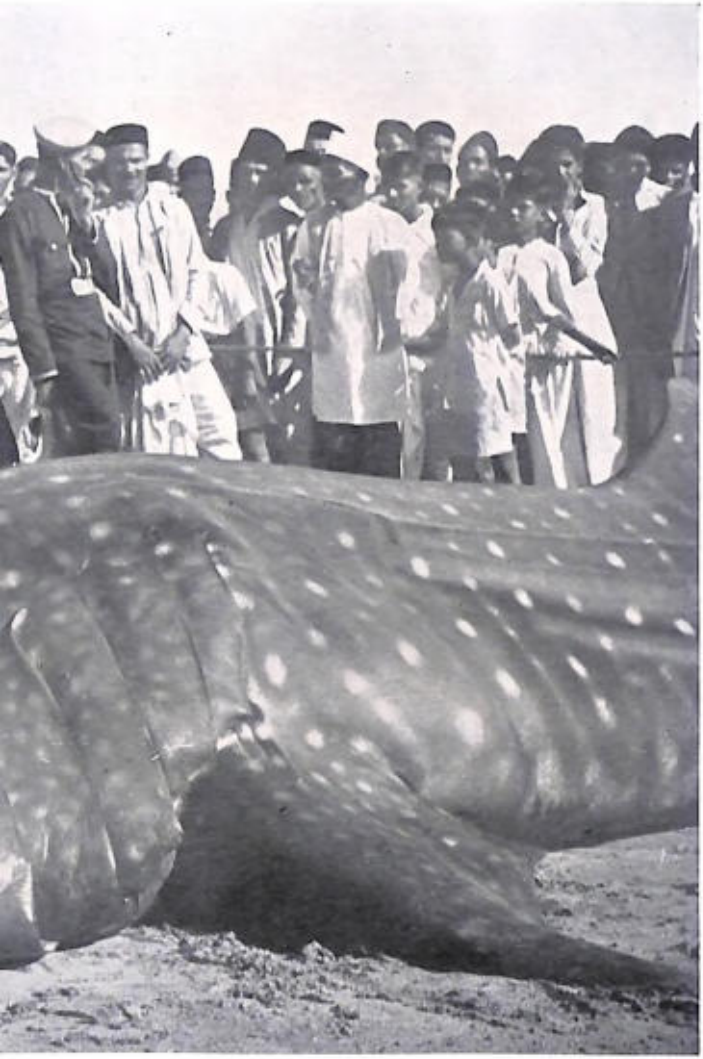
Makara shiravu (Malayalam). Mr. Narayan Rao, Superintendent of Fisheries, Travancore, tells me that this is the most common name for this fish in Travancore. His explanation of the derivation of the term is interesting, as it provides confirmation of the seasonal migrations of these sharks to the Malabar Coast. *Makara* is the 6th month of the Malabar Era, which corresponds more or less to a period commencing with the middle of January and ending with the middle of February in the Roman Calendar. *Shiravu* means shark. Interpreted, the name would be 'January-February' shark. The period of occurrence sometimes provides the local name for a fish. On the Norwegian coast, the Piked-Whale or Lesser Rorqual (*Balaenoptera acutirostra*) is called the 'Summer Whale' because it appears more frequently during that season.

Osman Shira (Moplah). Poduval states in a letter that this is also one of the names by which the fish is known in Travancore. It is used by the Moplah fishermen.

Ceylon. *Muni-muthu-mora* (Singhalese). *Muni* means 'corpse' and *muthu* = pearl, and *mora* = shark; translated, the name would mean 'corpse-like-pearl-spotted shark'. 'Corpse-like' from the whale shark's habit of floating on the water, while 'pearl-spotted' has reference to the markings.

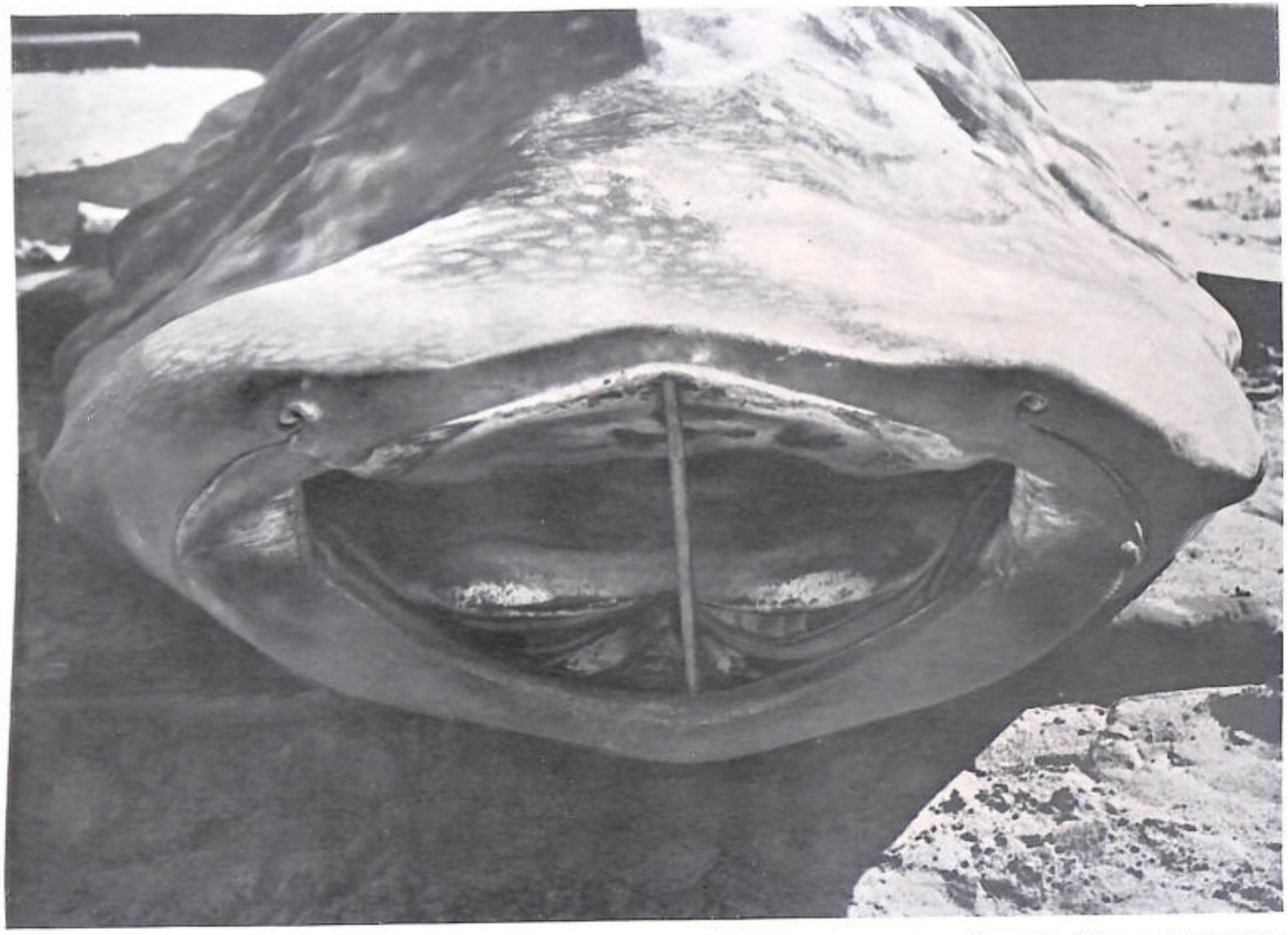
Photo by

Whale Shark landed at Chowpatty Beach, Bombay



Felicitas Studio

City, 16th January 1949. Close up view of head



Frontal view of the 18ft. Whale Shark landed at Bombay, 16th January 1940. Note the enormous gape. The width of the mouth is 2ft. 8 ins.

Description.

Smith's (1849) description fully covers the external appearance of the fish. Certain details may be amplified. Reference should be made to the marked concavity of the inter-orbital space (Plate VI). It is this concavity which masks the flat wedge-shaped form of the head giving it when seen or photographed in profile a deceptive fusiform appearance. The nasal flaps are well developed and extend in a crescentic fold from the nostril to under the rim of the lip (Plate VII).

Body keels. Smith's description is as follows:—

> 'Sides of body irregular from two distinct longitudinal keels which commence together a little in front and considerably above the extremity of the first branchiae, and recede a little from each other as they proceed backward: of these the lowermost pursues a waved direction and at last is lost or coalesces with the keel on each side of the caudal fin. The upper again pursues a more direct course, becomes forked posteriorly, and both its branches terminate under and anterior to the dorsal fin'.

In Smith's plate of *Rhineodon typicus* (Plate 26, Illustrations of South African Zoology) the two lateral keels are well shown and the bifurcation of the upper keel is illustrated. In both specimens I had the opportunity of examining in Bombay, 3 distinct keels were present on either side of the body. A dorso-lateral keel, commencing above the branchiae and extending to below the second dorsal, and a median keel commencing anterior to the first dorsal and extending to the region of the tail. The third, the lowest keel, is the strongest and most pronounced. It commences behind the last gill-slit and reaches to the tail, coalescing there with the keels on its axis. Apparently, there is some variation in the disposition of keels. The three keels may remain distinct, or the upper and median keel may coalesce anteriorly, as in Smith's South African example.

Claspers. Both specimens stranded in Bombay were males. In the larger of the two specimens (21′ 6″) the claspers are well developed and extend backwards as far as the hind edge of the ventral. In the second specimen, a smaller shark (18′ 7″) the claspers fall short of the posterior edge of the ventrals and correspond in this respect with the description by Mulle and Henle (1841) of the 15′ example exhibited in the Paris Museum.

Colouration.

Such observations as have been made on the colouration of whale sharks reveal a certain variation, understandable in a fish of so wide a range. The data are too meagre to connect such variation with geographical distribution. But in reading the notes on colouration one is struck by the fact that in all the examples from the Central and Eastern Pacific and the Atlantic the prevailing tone of the upper surface of the body is described by various observers as brown or some shade of *brown*. This colouration is noted in examples from Cape Inubo, Japan (Kishinouye 1901), the Gulf of Panama (G. Chierchia 1884), the Gulf of California

(Gill, 1902) and in examples from Florida Bay (Gudger 1915) and Bean (1902). On the other hand, in colour descriptions of specimens taken in the Indian Ocean the prevailing tone of the dorsal surface ranges from deep *bluish-grey* to *lavender purple*. This was the colouring of the specimen taken at the Cape of Good Hope (Smith 1849), and of the example taken at the mouth of the Hoogly, Bay of Bengal (Lloyd 1908). A deep purplish blue was again the colour of the two specimens which I examined in Bombay. The colour of the dorsal surface of the Bombay specimen agreed with Smith's description of the Cape of Good Hope example. The under surface of the body in both Bombay specimens was 'dead white'—not 'reddish white'. The same flush of red or pink, which Smith noted, appeared under the head and on the margins of the fins. The dorsal surface and the head were covered with a profusion of white spots. On the body, these spots are arranged in a regular series of vertical rows. In the Bombay specimens, there were 27 of these rows. In each alternate row, the spots are fainter and tend to coalesce into linear markings (*vide* Plate I), so that, as a whole, the markings tend to present a pattern of rows of large, well spaced spots, alternating with linear bands. The anterior dorsal fin was spotted and faintly marked with transverse lines produced by a coalescing of spots. Second dorsal, without spots. Pectorals profusely and caudals sparsely spotted. The presence of these markings provide a further indication of the shore haunting habits of this fish, markings of this nature being, as a rule, absent from species which live in the open sea.

Size.

The largest specimen obtained so far on the Indian coasts measured 29 ft. and the smallest about 13 ft. Mr. Poduval, Curator of the Trivandrum Museum, informs me that captures of still smaller specimens are quite familiar to the fishermen. The whale shark is known to attain a length of 60', this being the dimension of a specimen captured on the east coast of the Gulf of Siam (Smith 1925). All examples taken or stranded on our coasts are then, far from full-grown. The probable explanation is that the smaller sharks enter the shallower waters where they are more likely to be caught or stranded—most of the records from our coasts are the result of captures by fishermen, and fishing in our waters is largely limited to a zone a few miles from the coast. Such large specimens as have been observed on our coasts have been observed from ships at sea. There is the 40' specimen, which was run down by a steamer off the Ceylon coast and Captain Foley's observation of a monster, 'as big as a whale' which was seen from a ship approaching Madras. The larger whale sharks avoiding the shallower inshore waters run less risk of capture in fishing nets or of stranding.

I give below detailed measurements of the two examples taken at Bombay, and include measurements recorded by other writers of whale sharks taken on our coasts.

PLATE V
JOURN. BOMBAY NAT. HIST. SOC.

Table of Measurements.

Detailed Measurements of Whale Sharks Taken on the Coasts of India

—	Prater. Bombay 1940	Prater. Bombay 1939	Thurston. Madras 1894	Hailey. Ceylon 1883
Body	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Length over all	18 7	21 6	22 0	23 9
Girth behind pectorals... ...	8 7	...	...	13 0
Mouth to base of 1st dorsal ...	8 2	9 6	9 10	10 0
Distance between 1st and 2nd dorsal	1 8	2 2	2 3	2 8
2nd dorsal to root of caudal ...	1 10	2 4	...	..
Fins				
First dorsal, anterior edge ...	1 7½	1 9½	1 10	1 10
,, base	1 9	1 10	2 0	...
,, height	1 4½	1 5	...	...
Second dorsal, anterior edge ...	0 10½	0 11	0 11	0 11
,, base	0 10	0 11	...	...
Pectoral, anterior edge... ...	3 1½	3 5	3 2	3 6
,, base	2 2	1 10	1 8	...
Ventrals, anterior edge ...	0 10	1 0	...	1 0
,, base	1 3	1 3	...	...
Anal, anterior edge	0 8	0 8	...	0 9
,, base	0 6	0 6	...	0 9
Caudal, upper lobe	5 0	5 0	5 0	5 0
,, lower lobe	2 8	2 8	2 6	2 7
Head				
Width of mouth	2 8	2 8	2 6	2 7
Width between nostrils ...	1 9	2 1	...	...
Width of head 1 ft. in front of 1st gill-slit	4 4	4 6	...	...
Diameter of eye	0 1½	0 1½	0 1½	0 1¼
,, spiracle	0 1½	0 1½	...	...
Distance, eye to tip of snout ...	0 6½	0 10	0 10	...
Tip of snout to 1st gill-slit ...	2 10½	3 3	3 4	...
Gill-slits				
Length of 1st gill-slit	1 7	1 8	1 11	...
,, 2nd ,, ...	1 10	1 11	1 11½	2 7
,, 3rd ,, ...	1 9	1 9	1 9	...
,, 4th ,, ...	1 8	1 8	1 8	...
,, 5th ,, ...	1 6	1 7	1 7	...

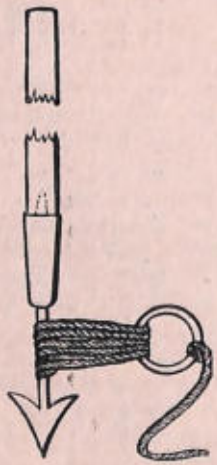
Remoras or Sucker Fishes and Whale Sharks.

Remoras or sucker fishes are commonly known to attach themselves to sharks and other marine animals, or even to floating objects. They do not attach themselves solely to the external surface

of the fish but are often found in the mouth or under the gill covers. With the whale shark the interior of the mouth is a common place of attachment. The whale shark landed at Sassoon dock, Bombay, had a Sucker-Fish (*Remora remora*) cleaving to its palate, well inside the mouth. Several of these fishes escaped from the mouth of the second Bombay specimen as it was being beached. Chiercha also records the finding of several remoras adhering to the inside of the mouth of a whale shark taken in the Gulf of Panama. The whale sharks' habit of feeding open mouthed give the remoras an opportunity of freely leaving and returning to their cavernous perch. In his account of the ramming of a whale shark off the coast of Ceylon (p. 259) the skipper speaks of 'several large fish (seemingly dog-fish), about a cubit in length, which were gamboling about the monster entering the mouth at pleasure and returning to it again'. His 'dog-fish' were obviously remoras, which in their association with whale sharks obtain comfortable carriage to feeding grounds where there is always an abundance of small fish to prey upon. That they sometimes pay for their temerity in selecting the mouth of the giant as a place of attachment is shown in Kishinouye's finding of a remora in the stomach of a whale shark taken off the coast of Japan. The fish was probably inadvertently swallowed by its 'host'.

Harpooning and Capture of Whale Sharks in Indian Coastal Waters.

Dr. Buist (1850) gives an account of the harpooning of whale sharks at Karachi. He published an illustration of the type of harpoon used, which is reproduced here. He states that the fish, once struck, is allowed to run till tired out and beaten with a club till stunned. The following is Lt. J. L. Heisch's account of the two whale sharks harpooned by him at Karachi in March and April 1936:—



Line, 600 fathoms
cane shaft, 8 ft.
iron shaft, 1 ft. 6 ins.
Barb 5 ins.

'The waters of Karachi have some reputation for the large fish they contain, and encouraged by tales of rays and sharks of considerable size, which were said to come up and bask on the surface, Capt. Heygate of the Royal West Kent regiment and myself decided to see if it was possible to harpoon them. We arranged to hire a *bundar* boat for two days. It was captained by a venerable gentleman with a grey beard, who persuaded us that he had harpooned very large fish for very many years. He was assisted ably by five *adonis*. We succeeded in reducing the crew to five with some difficulty, the old man being anxious to take more, since, as he said 'Big shark very dangerous'. We felt however that he was merely trying to impress, and two *sahibs*, one bearer and six fishermen, seemed more than enough for comfort in a boat so small. We had no experience of the type of tackle we should need, but the fishermen produced two large iron harpoons, which, with their heavy wooden handles, looked as if they would pierce and hold anything. These were laid out in the bows with a large quantity of stout rope attached. We had planned to start at 2 a.m. on 27th of March and try to reach Cape Monze, some 20 miles north of

Karachi, in time to spend most of the day looking for big fish. Cape Monze is said to be one of the best grounds to find them. As it happened we did not finally get away until about 6-30 a.m. owing to the roughness of the sea, which forced us to put back on our first attempt. When we did start, it was still rough, and by no means comfortable in our small boat. Another disadvantage was the difficulty of spotting the fish. The sea went down by degrees, much to the relief of our bearer who had retired to the side and stayed there, after heroically preparing breakfast. By noon, with the stiff breeze blowing, Karachi looked very far away. Upto this time we had seen nothing except a whale blowing some distance away. A little later we saw a large bat-ray jump, an amazing sight, for though it was too far away to estimate its size, it must have been jumping ten feet clear of the water, and made a tremendous splash on landing. Nothing had appeared for us to harpoon, however, and we began to realise that our chances of meeting a shark or a ray basking were rather less than we had supposed. We accordingly made for a fishing ground some four miles off the coast and about 12 miles north of Karachi. Here we somewhat ignominiously let down our lines and caught small fish with inordinate pleasure. We gave this up at about 3 p.m., and sailed towards the coast with the intention of camping for the night. The sea was now quite smooth, and porpoises were to be seen playing between us and the land, which was about 2 miles away. When we were within 200 yards of them, this peaceful scene was disturbed by a shout by our look-out man up the mast. The rest of the crew were on to the target at about the same time, for all at once everyone was shouting and rushing about the boat. The *sahibs*, however, perhaps less experienced in marine matters, sat in simple dignity and waited to be told what it was all about. Suddenly we saw bearing down upon us two fins, about 12 feet apart the forward one hardly visible, and the rear one rising to a sharp point a foot or so above the water. It was plain that the impossible had happened and we had met a shark. Moreover a big one as far as could be seen, and one that slept peacefully on the surface. The shark was now about fifty yards to our right front, and moving very slowly across our path. Meanwhile the old captain, looking less venerable and very fierce, had stationed himself in the bows with a harpoon, while the crew stood by to lower sail if we succeeded. As we bore down on the fish, the atmosphere became electric. It seemed that it must take alarm and dive too soon. But fortunately this shark was blessed with an almost infinite capacity for sleep, and in another moment would have bumped our bows with its head. However, when he was about a yard from the boat, and heading straight for it, our old man plunged the harpoon in just behind the head, and since the fish was so close, put his weight behind it. It took a good half hour to dig that harpoon out. Now the shark woke up with a vengeance. Out went the rope and down came the sail. The rope ran out quickly to about fifty yards, and was made fast. For about 15 minutes he put up a grand fight, swimming deep, and he towed our 20 feet boat with ease. When he wanted to go somewhere, he went, and we went too in no uncertain manner. Once he came to the surface with a terrific struggle, leaping nearly clear of the water and beating up a foam with his tail. He was bleeding freely, and seemed to be much larger than the tiger and hammer-head sharks found in these waters. After this effort there was less struggle, and he became a dead weight. Little by little, with the combined effort of the crew, the rope was pulled in with no active resistance, until we could see the huge bulk beneath the boat. We got a distinct shock when we looked over the side for it was only a foot or two shorter, and the tail looked formidable. It was a handsome brute in the water, with a dark skin and white green spots. We could now see its head which looked square, and its body seemed broader than that of the common shark. In fact it looked odd, but we were not disposed to grumble. We pulled him in a little closer, and put in another harpoon. The shark then broke surface just by the boat, beating the water with its tail. This moment had its excitement, as the size of the brute made its struggles seem more dangerous than they were. It was at its last gasp however, and soon the fishermen were able to administer the *coup de grâce* with long knives. We lashed our catch to the side of the boat, and towed it in to shore, where we dragged the body as far up the beach as we could. It was impossible to pull it right out of the water, but we were able to take our first photograph. Most

unfortunately the camera jammed while the fight was in process. The head was spade-shaped with the eyes set right forward on the extreme corner. Opening the mouth was like lifting the lid of a box. There were no teeth deserving the name, but rows of very tiny ones of the roughness of coarse sandpaper but sharper to the touch. The skin was also very rough when rubbed the wrong way, quite smooth with the grain. It was dark and spotted with white. There were two dorsal fins, both comparatively small and rounded at the point. Ridges parallel with the curve of the back extend along either side of the body, giving it, for all its bulk, a streamlined effect. The tail fin is vertical when the fish swims and the top half in this case was about three feet in length, the lower half much smaller. It is the point of this fin which is most easily visible when the fish is basking. Two powerful flippers are situated just behind the gills on each side. The length of the shark from tip to tail was 18 ft. We eventually took it back to Karachi and hoisted it on a crane. The weight was then estimated at about two tons. Unfortunately we had no idea at the time that this was a whale shark, and rare in these waters, and allowed the fishermen to take the carcase away. They can sell the oil and get, I believe, about Rs. 20 for it. They do not see these fish often enough to make a trade. Sometimes they see one a year, sometimes none. We were more fortunate, for strangely enough on our next trip a few weeks later, we harpooned a similar type of shark, about 3 miles off Karachi. We were in a larger boat and could not approach closer than 10 feet or so. The harpoon had to be thrown this time and later proved insecure. We spotted the fish by the tail fin again, and had a good view of it on the surface and swimming just beneath the boat. We could see the same spotted skin and spade-shaped head. This time we had a short but spirited performance. We were towed for 10 minutes in a very rough sea, and twice our 40 foot fishing boat was turned completely round. However, the constant jerking with the rise and fall of the bows eventually worked the harpoon free. One is naturally cautious in estimating the size of any fish that gets away. I think one could safely say that it was not smaller than the first, and seemed more powerful. The best times of day to find these fish, and others which come up to bask, are between 5 a.m. and 10 a.m., and again from 3 p.m. to 6 p.m. On both occasions all our fun started at 3-30 p.m. There are a large number of ray about if one can find them. We had a shot at one smallish one, about 4 feet across, but the harpoon missed. It is an amusing game, this harpooning, and one fight per trip, makes it worthwhile. We feel though, that ours is a fine example of beginners' luck.'

The methods employed in hunting the great basking shark (*Cetorhinus*) off the coast of Ireland are very similar. For the benefit of those interested in the hunting of these monster sharks Couch's graphic description of the harpooning of the basking shark (Norman, 1937) is published below:—

'The boat . . . approaches the fish with a man in the bow ready to harpoon it; the line attached to the harpoon is 200 fathoms long, and is coiled up in the bow; a man stands by with a hatchet, ready to cut it, should it get entangled or foul of anything in running out. When the fish is struck, he will at the first dart carry out from 70 to 150 or 200 fathoms of line; he makes this rush to the bottom, where he rolls himself, and rubs his wound against the ground to free himself from the harpoon. The fishermen generally allow him an hour to tire himself before they begin to haul upon the harpoon line; they coil up the slack of it again, ready for him to make another rush, and play him in this way, sometimes for eight or nine hours, before they can get him to come to surface; and when he does so they are ready to strike him with two or three more harpoons; and when these are fixed in him, they are able to pull him alongside the vessel with the harpoon lines; they then stretch him fore and aft along the vessel's side, and get a jowl rope round his head, and the bight of a hawser round his tail; they then give him two deep cuts, one one each side of the tail with a hatchet. In his agony and his efforts to get free, he works his tail so hard, that he snaps

the bone across where the cuts were made; they then cut flesh holes in the body of the fish on both sides, that will take a large rope through them; they then reeve ropes through these holes, and by hauling taut on the side of the fish next the vessel, and slacking away rope to the other side of the fish, it will cant him over on his back. They then split down the stomach, take out the liver, which is the only part they use for oil, and let the rest of the fish go adrift.'

'. . . . These fish are most powerful in the water, and if harpooned in the shoulder they are very hard to kill, often carrying off the whole harpoon line; but experienced harpooners strike them in the body near the dornal fin, rather low down, where it will go through into the intestines, or near the vertebrae towards the tail. They must be struck with great caution, as they will stave in the boat with a blow of their tail, if it is at all within their reach'.

Captures of whale sharks on our coasts result commonly from these monster fishes fouling the fishing nets. Mr. S. R. Kaka gives the following account of the capture of the specimen presented by him to the Prince of Wales Museum:—

'My sailing boat, with a crew of six fishermen, which I am running on experimental fishing, left Bombay for deep sea fishing, but due to a heavy storm on the 7th instant (Feb. 1938) they were forced to take refuge at Alibaugh. Whilst returning on the 12th, they halted at a place about 15 miles from Bombay and on finding the depth of water to be 11 fathoms, they cast the nets for fish. Here they encountered the thrilling incident. When the men tried to haul up the net in the noon, they found it impossible due to tremendous weight of the monster which had got entangled within. As it felt the net being drawn, the monster started moving in the opposite direction, and here a tug-of-war between the men and monster ensued. Towards evening, after a desperate struggle lasting some hours, the men, succeeded in drawing the shark close to the boat and captured it alive by fastening slip knots with ropes round its neck and tail and so tied it up alongside the boat. They then sailed for Bombay and arrived at Sassoon Dock on the 13th morning. The shark, however, died *en route* just a few hours before landing, and it required sixty men to haule up to the shore.'

From what has been written it will be seen that the whale shark is a peculiarly inoffensive creature. Its only reaction to attack is the effort to escape, and any danger in hunting these sharks could only arise from the struggles of the animal to get away. Like the basking shark, the whale shark is apparently indifferent to the approach of a boat thus offering every opportunity for the effective placement of the harpoon.

Summary.

Whale sharks visit the coastal waters of India between January and April, attracted by the abundance of zoo-plankton in these waters during this time of the year. Their occurrence mainly on the West Coast of India and Ceylon cannot be explained by a general shoreward movement from the surrounding seas. It is due to the directional movements of surface currents in the Bay of Bengal and the Arabian Sea at this period. Coming with the inflow of water from the Pacific, which sets in through the Straits of Sumatra with the establishment of the north-east monsoon, whale sharks follow the north-east monsoon drift, which flowing across the lower reaches of the Bay of Bengal, brings

them to the south of Ceylon. From thence their journey along the west coast of Ceylon and India is aided by northward flowing coastal currents. Their comparative rarity on the East Coast of India and Ceylon is explained by the absence of favourable currents. The waters which converge upon the Coromandel Coast come from the head waters of the Bay of Bengal and not from the Straits of Sumatra, through which the whale sharks enter Indian seas. The whale sharks which visit our coast *via* the Straits of Sumatra probably come to us from the East Indian Archipelago, where they are known to be permanently resident. Similar seasonal migrations of whale sharks take place from the Philippine Archipelago to the seas off Cape Inubo, Japan, aided in this instance by the north-eastward flow of the Kuro Sivo current. It is proposed that the various archipelagoes in the Pacific, Indian and Atlantic Oceans, where whale sharks are permanently established, are centres from which numbers of these sharks, following the drift of favourable currents, migrate at appropriate seasons into areas where peak periods of plankton productivity provide them with an abundance of food; their appearance in these areas of nominal distribution being more regular wherever plankton productivity is more definitely seasonal. The archipelagoes, where alone whale sharks are known to be permanently resident, are breeding grounds to which these fishes return after their wanderings. A limited breeding habitat has impelled the spread of the species through the three Oceans, the sharks following the drift of warm surface currents in search of food, have established themselves wherever suitable conditions prevailed. The newly acquired places of permanent habitat became in their turn centres of productive distribution from which the geographical range of the fish has been extended.

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SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

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(With two plates).

(Continued from page 163 of Vol. xlii, No. 1).

VI.—LOCHNERA PUSILLA K. Schum.

(APOCYNACEAE).

SYNONYMY AND SYSTEMATIC DESCRIPTION.

Lochnera pusilla K. Schum. in Engl. & Prantl, Pflanzenf. V. 4, Pt. 2 (1895) p. 145; Cooke. Fl. Pres. Bomb. V. II, Pt. I, 129; Gamble. Fl. Pres. Madras, Pt. V, 809; Syn: *Vinca pusilla* Murr.; H.F.B.I., V. III, 640; Dalz. & Gibs. Bomb. Fl., 144; Trim. Fl. Ceyl. V. III, 130; Watt. Dict. Econ. Prod. Ind. V. IV, Pt. 4, 243. *Vinca parviflora* Retz.; Roxb. Fl. Ind. II, 1. *Catharanthus pusillus* G. Don, Gen. Syst. V. IV, 95.

A much-branched annual herb, branches spreading from the base, stem and branches quadrangular. Leaves 1½-3 in. long, opposite, lanceolate, acute, glabrous, membranous, margins rough; axillary glands long, subulate. Flowers small, white, mostly solitary, axillary, on short stalks. Calyx-segments 5, lanceolate-subulate. Corolla salver-shaped; tube slender, inflated above the stamens; mouth constricted, hairy; lobes 5, oblong-obovate. Stamens 5, on the corolla-tube; anthers elliptic or ovate-lanceolate, acute. Pollen grains furrowed, rectangular when dry, and spherical when moistened. Disk replaced by two linear glands. Carpels 2, free; ovules numerous, 2-seriate; style filiform; stigma capitate, with a reflexed hyaline frill at base, and a minute 2-lobed apiculus. Fruit of two slender divergent, striate follicles 1½-2 in. long. Seeds numerous, small, oblong, with many muriculate ribs (Plate I). Flowers Aug.—Nov. Mayuranathan (7) mentions the flowering season as Nov.-March, which is rather unusual for other parts of India. Medicinal (Kirtikar, 6).

INDIAN NAMES.

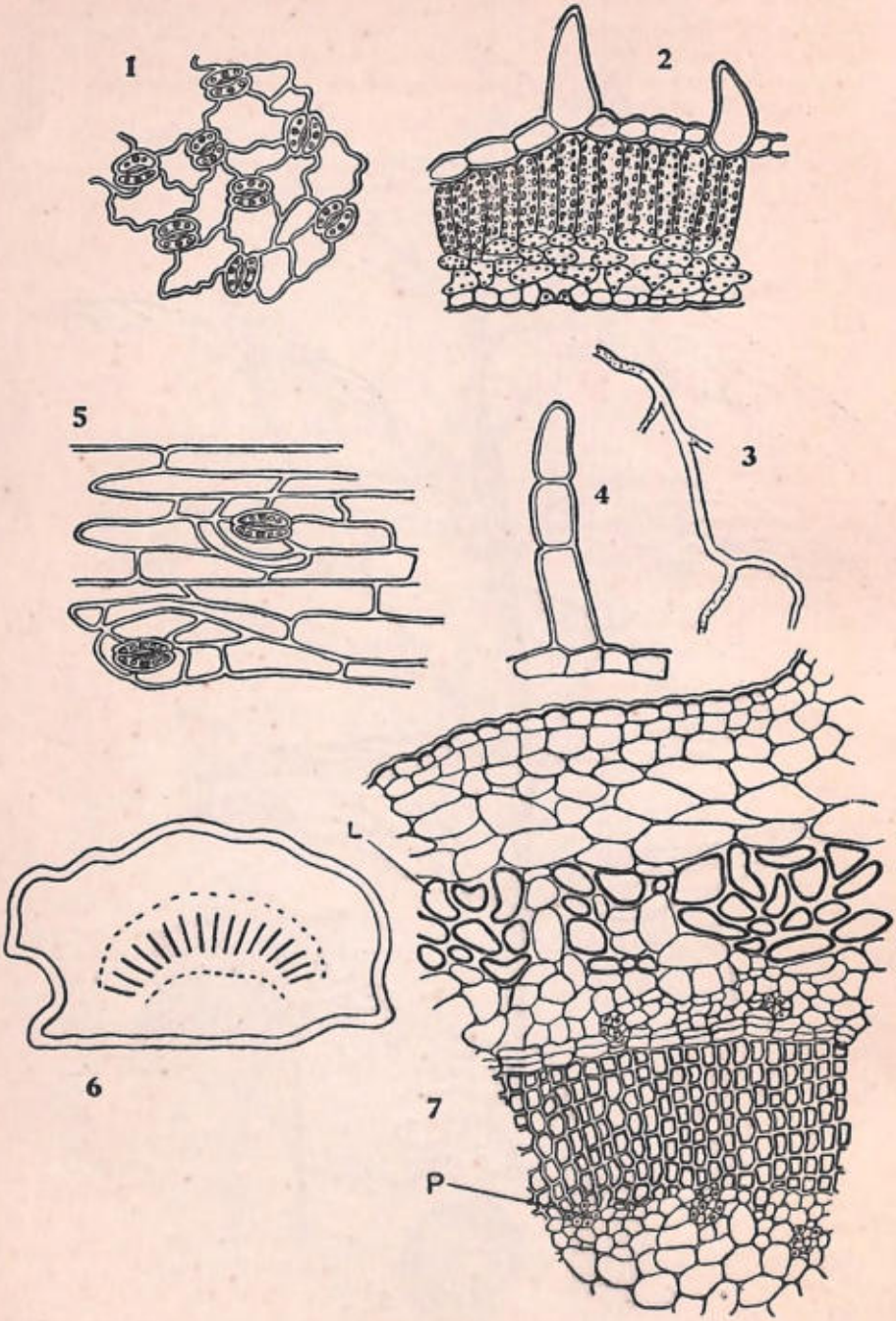
Sanghaphuli, Sankaphi, Sangkhi (*Sans.*); Kapavila (*Malayalam*).

HABITAT.

Common in Deccan (Dalz. & Gibson, 3). Poona, Gujarat (Cooke, 1). Plains Districts of the Circars, Deccan and Carnatic, up to 2,000 ft., a common weed, more scarce on W. Coast (Gamble, 5).

Sayeedud-Din—*Lochnera pusilla* K. Schum.

For explanation see end of article.



Sayeedud-Din—*Lochnera pusilla* K. Schum.

For explanation see end of article.

A weed of cultivated ground (Mayuranathan, 7). A common weed in the beginning of the rainy season (Sayeedud-Din, 8).

Distribution: India (W. Himalaya, Upper Gangetic Plain; W. Peninsula); Ceylon.

Anatomical Notes.

Structure of the leaf. (Plate II, Figs. 1 & 2). The leaf-structure is bifacial. Stomata occur on both the sides, but are much more numerous on the lower side. They are surrounded by two or more ordinary epidermal cells, and lie in a level with the epidermis. The epidermal cells on the upper side are larger than on the lower. These observations conform to those recorded by Solereder (9) in other species. No special features have been observed in the mesophyll, viz., gelatinization of the cell-walls of the spongy tissue or sclerosed palisade cells.

Oxalate of lime occurs in the form of ordinary solitary crystals.

The hairy covering (Plate II, Figs. 2 & 3) consists of simple unicellular and uniseriate hairs. Some are very small, resembling papillae. Glandular hairs are absent.

In the stem non-articulated thick-walled laticiferous tubes are found in abundance mostly in the cortical region (Plate II, Fig. 7), but in the leaf they occur in the veins, and run freely in the mesophyll, as in *Vinca major* (Solereder, 9). The thick-walled tubes by taking up a faint colour of safranin are apt to create some confusion, but chemical reactions show that the walls are composed of cellulose. The contents do not show any reaction for starch.

Structure of the petiole and stem (Plate II, Figs. 4-6). The petiole contains a single arc-shaped bicollateral bundle. Stomata which occur in the furrows are accompanied by two or more subsidiary cells parallel to the pore, that is they are of the Rubiaceous type. The epidermis of the ridges is composed of thick-walled cells. The cortex is composed of chlorenchyma and collenchyma, and as will be naturally expected the latter is more confined to the ridges. Intraxylary phloem is present in the form of isolated bundles at the margin of the pith.

Conclusions.

The chief features revealed by the study of this plant are characteristic of the family Apocynaceae to which it belongs. As it is closely allied to Asclepiadaceae many features are in common. The following is a brief summary of the characteristic features of *Lochnera pusilla*:

1. In the leaf the stomata are surrounded by ordinary epidermal cells, but in the stem they are surrounded by two or more subsidiary cells parallel to the pore, thus revealing the Rubiaceous type of stomatal apparatus.

2. Oxalate of lime occurs in the stem as well as in the leaves in the form of solitary crystals.

3. The hairy covering consists of simple unicellular and uniseriate hairs.

4. Occurrence of non-articulated thick-walled laticiferous tubes.

5. The petiole contains a single, bicollateral arc-shaped bundle. In the stem intraxylary phloem is present in the form of isolated bundles at the margin of the pith.

Acknowledgments.

I am thankful to Mr. Sri Ramloo for the drawings which were made under my supervision, and to Mr. Moinuddin for the trouble which he took in preparing several microscopic slides.

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Explanation of Plates.

Lochnera pusilla K. Schum.

Plate I.

Fig. 1.—Black and white drawing of *Lochnera pusilla* K. Schum. (Nat. size).
Fig. 2.—Corolla opened out. (×10).
Fig. 3.—Pistil with calyx attached. (×10).
Fig. 4.—Pollen grain in dry condition. (×40).
Fig. 5.—Pollen grain, moistened. (×40).

Plate II.

Fig. 1.—Leaf-epidermis, showing stomata surrounded by ordinary epidermal cells. (×215).
Fig. 2.—T. S. Leaf, showing two unicellular hairs on the upper epidermis, a stoma on the lower epidermis, palisade and spongy tissue. (×215).
Fig. 3.—A latex-tube from the leaf. (×215).
Fig. 4.—An uniseriate hair from leaf-epidermis. (×215).
Fig. 5.—Stem-epidermis, showing stomata surrounded by subsidiary cells. (×215).
Fig. 6.—T. S. Petiole, showing an arc-shaped vascular bundle, diagrammatic. (×50).
Fig. 7.—T. S. Stem. L. laticiferous tubes in cortex; P. intraxylary phloem in groups. (×215).

(To be continued).

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART VI.

(*Continued from page 44 of this volume*).

RHOPALOCERA.

SATYRIDAE.

Mycalesis visala Moore, *visala*

Moore, *Lep. Ind.*, i, 189, pl. 64, figs. 1, 1a-1i. 1890-92.

Ovum spherical, the base slightly flattened, pearly white, minutely punctate. Deposited 6-viii-40. Hatched 9-viii-40.

Newly hatched larva white, the head black. Head with a short tooth projecting subdorsally. Anal somite ending in two short processes. A few hairs. After feeding the body becomes green and later a dark crimson dorsal stripe appears on the posterior third of the body, this stripe broadens considerably on the anal somite and extends along the anal processes. Moulted 12-viii-40.

2nd instar—Similar. The cephalic and anal processes proportionately rather larger. Under a lens there is a faint yellowish white subdorsal line and the dorsum is sprinkled with minute yellow dots. Moulted 14-viii-40.

3rd instar—Similar. Moulted 16-viii-40.

4th instar—Head blackish brown, the backs of the processes dull greenish. Body dull green, shagreened with minute yellowish white dots. A dark dorsal stripe, becoming dull crimson on the 10th somite and continuing up the anal processes. A pale subdorsal and sublateral line. Legs and prolegs green. Head and body finely pubescent. Moulted 19-viii-40.

Final instar—Head blackish brown, the backs of the processes dull pinkish buff, and with four brownish spots frontally forming a semicircle. Body pinkish buff, granular and finely pubescent. A dark dorsal stripe, without any trace of crimson. A yellowish subdorsal stripe, edged below with darker, and a yellowish sublateral stripe. A series of oblique dark stripes arising subdorsally and ending in the lateral area. 1st pair of legs blackish brown, the others and the prolegs pinkish buff. Anal processes and venter pinkish buff. As the larva ages, the colour darkens to purplish brown, the markings remaining unchanged. Immediately before pupation the markings fade and the larva becomes a bright green. Pupated 24-viii-40.

There is probably a green form of larva also, but I have not bred it.

Pupa bright apple green in colour. 2nd to 5th abdominal somites with paired subdorsal yellow dots. A subtornal yellow dot

on the wing case. Under a lens, the abdomen with very minute yellow speckling. Head straight in front. Thorax slightly keeled. Wing cases slightly dilated across the dorsum. Cremaster long and pinkish in colour. A female emerged 30-viii-40.

Food-plant—Grasses.

Described from larvae bred from ova from a Calcutta caught female.

LYCAENIDAE.

Tarucus nara Koll.

Head pale brown, retractile and very small. Body flattened and with the lateral edge slightly scalloped by the intersegmental divisions. Ground colour very pale green, in some cases more or less tinged with purplish. A white dorsal stripe beginning from the 2nd somite, and sometimes edged, either wholly or partly, with crimson, and sometimes with a central crimson line, which may be confined to the first few somites or extend the whole length of the dorsal stripe. The green forms with a subdorsal pattern formed of four white specks on each somite, the purple with a subdorsal series of single crimson dots. A lateral line, white in the green forms, crimson in the purple. Body densely covered with minute white granules and white pubescence. Legs and prolegs green. Venter green, even in the purple forms. Ant gland and tubercles not prominent.

Ants do not seem necessary to the larva's wellbeing as, although thickly attended when found, some lived for a week before pupation without their attentions.

Pupa on a thin carpet of white silk and supported by a girdle. Of the usual Lycaenid shape. Colour yellowish green, the wing cases less tinged with yellow, and more or less speckled and shaded with black, some pupae having no more than a dorsal and spiracular series of black specks, whilst others are almost completely black shaded.

Food-plant—*Zizyphus Jujuba*. The larva feeds on the under-surface of the leaf, leaving a semi-transparent track about an eighth of an inch wide.

Described from a number of full-fed larvae found in Calcutta 24-x-40, one of which pupated 26-x-40 and a male emerged 2-xi-40.

Bingham quotes de Niceville's description of the larva of *T. theophrastus* F., of which species *nara* was previously considered a subspecies, which tallies substantially with mine He adds that the ants attending the larvae have been identified by Dr. A. Forel as *Camponotus rubripes* Drury (*sylvaticus* Fabr., subspecies *compressus* Fabr.) and *Phidole latinoda* Roger.

Zizeeria trochilus Freyer, *putli* Koll.

Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 366. 1907.

Head black, small and retractile. The usual woodlouse-shaped Lycaenid larva with the segments rather deeply cut. Colour bright grass green with a darker green dorsal stripe edged with paler and a white sublateral line. A series of very faint oblique pale lines subdorsally. Body thickly covered with white pubescence. Ant gland and tubercles small and inconspicuous.

Ants do not seem essential to the larva's development as mine lived for ten days without their attentions and pupated successfully.

Pupa formed on a leaf of the food-plant on a carpet of white silk and supported by a girdle. Green with a darker dorsal stripe along the abdomen. Thorax domed. The anal end rounded and slightly flattened. With the exception of the wing cases, densely clothed with longish white hair.

Food-plant—*Rhynchosia minima* DC. (Leguminosae).

Described from a full-fed larva found in Calcutta 12-x-40, pupated 15-x-40, and a male emerged 19-x-40.

Bingham, quoting de Niceville, writes:—'Larva when full-grown a little over a quarter of an inch in length, onisciform as usual; the head very small, black and shining, entirely hidden when at rest, being covered by the second segment; the colour of the body grass-green, with a dark green dorsal line from the third to the twelfth segment; two subdorsal series of short parallel streaks, each pair being divided from the next by the segmental constriction, these streaks paler than the ground colour; an almost pure white lateral line below the spiracles, which is the most conspicuous of all the markings; the segmental constrictions rather deep; the whole surface of the body shagreened, being covered with very small whitish tubercles, from which spring very short colourless hairs. Dr. George King, Superintendent of the Royal Botanical Gardens, Sibpur, near Calcutta, has identified its food-plant as *Heliotropium strigosum*, Willd. Professor A. Forel identified the ant as *Pheidole quadrispinosa*, Jerdon. Pupa about three-sixteenths of an inch in length, pale green, of the usual Lycaenid shape, densely covered everywhere, except on the wing-cases, with somewhat long white hairs.'

HETEROCERA.

SYNTOMIDAE.

Syntomis passalis F.

Ovum white, unsculptured, spherical with the base slightly flattened. Laid in a large batch but with the individual ova not touching each other. Deposited 24-viii-40. Hatched 29-viii-40.

Larva with the head bright reddish chestnut, rather small. Ground colour of the body deep blackish purple. Each somite with a transverse series of six rosettes of short blackish-grey spinous hair, arising from blackish warts. Legs bright reddish chestnut. Prolegs purple.

Pupa in a slight cocoon of brown silk interwoven with a few of the larval hairs; the bulk of the hairs, however, are not shed and remain attached to the cast skin. Dark reddish brown, the abdominal somites with a central ring of conjoined black spots. Wing cases black with the veins red-brown. Leg cases red-brown streaked with black. Antenna cases red-brown but unstreaked. Apex of the abdomen blunt and densely clothed with hooked golden-brown hairs.

Food-plant—Dahlia and Orange Cosmos.

on the wing case. Under a lens, the abdomen with very minute yellow speckling. Head straight in front. Thorax slightly keeled. Wing cases slightly dilated across the dorsum. Cremaster long and pinkish in colour. A female emerged 30-viii-40.

Food-plant—Grasses.

Described from larvae bred from ova from a Calcutta caught female.

LYCAENIDAE.

Tarucus nara Koll.

Head pale brown, retractile and very small. Body flattened and with the lateral edge slightly scalloped by the intersegmental divisions. Ground colour very pale green, in some cases more or less tinged with purplish. A white dorsal stripe beginning from the 2nd somite, and sometimes edged, either wholly or partly, with crimson, and sometimes with a central crimson line, which may be confined to the first few somites or extend the whole length of the dorsal stripe. The green forms with a subdorsal pattern formed of four white specks on each somite, the purple with a subdorsal series of single crimson dots. A lateral line, white in the green forms, crimson in the purple. Body densely covered with minute white granules and white pubescence. Legs and prolegs green. Venter green, even in the purple forms. Ant gland and tubercles not prominent.

Ants do not seem necessary to the larva's wellbeing as, although thickly attended when found, some lived for a week before pupation without their attentions.

Pupa on a thin carpet of white silk and supported by a girdle. Of the usual Lycaenid shape. Colour yellowish green, the wing cases less tinged with yellow, and more or less speckled and shaded with black, some pupae having no more than a dorsal and spiracular series of black specks, whilst others are almost completely black shaded.

Food-plant—*Zizyphus Jujuba*. The larva feeds on the under-surface of the leaf, leaving a semi-transparent track about an eighth of an inch wide.

Described from a number of full-fed larvae found in Calcutta 24-x-40, one of which pupated 26-x-40 and a male emerged 2-xi-40.

Bingham quotes de Niceville's description of the larva of *T. theophrastus* F., of which species *nara* was previously considered a subspecies, which tallies substantially with mine. He adds that the ants attending the larvae have been identified by Dr. A. Forel as *Camponotus rubripes* Drury (*sylvaticus* Fabr., subspecies *compressus* Fabr.) and *Phidole latinoda* Roger.

Zizeeria trochilus Freyer, *putli* Koll.

Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 366. 1907.

Head black, small and retractile. The usual woodlouse-shaped Lycaenid larva with the segments rather deeply cut. Colour bright grass green with a darker green dorsal stripe edged with paler and a white sublateral line. A series of very faint oblique pale lines subdorsally. Body thickly covered with white pubescence. Ant gland and tubercles small and inconspicuous.

Ants do not seem essential to the larva's development as mine lived for ten days without their attentions and pupated successfully.

Pupa formed on a leaf of the food-plant on a carpet of white silk and supported by a girdle. Green with a darker dorsal stripe along the abdomen. Thorax domed. The anal end rounded and slightly flattened. With the exception of the wing cases, densely clothed with longish white hair.

Food-plant—*Rhynchosia minima* DC. (Leguminosae).

Described from a full-fed larva found in Calcutta 12-x-40, pupated 15-x-40, and a male emerged 19-x-40.

Bingham, quoting de Niceville, writes:—'Larva when full-grown a little over a quarter of an inch in length, onisciform as usual; the head very small, black and shining, entirely hidden when at rest, being covered by the second segment; the colour of the body grass-green, with a dark green dorsal line from the third to the twelfth segment; two subdorsal series of short parallel streaks, each pair being divided from the next by the segmental constriction, these streaks paler than the ground colour; an almost pure white lateral line below the spiracles, which is the most conspicuous of all the markings; the segmental constrictions rather deep; the whole surface of the body shagreened, being covered with very small whitish tubercles, from which spring very short colourless hairs. Dr. George King, Superintendent of the Royal Botanical Gardens, Sibpur, near Calcutta, has identified its food-plant as *Heliotropium strigosum*, Willd. Professor A. Forel identified the ant as *Pheidole quadrispinosa*, Jerdon. Pupa about three-sixteenths of an inch in length, pale green, of the usual Lycaenid shape, densely covered everywhere, except on the wing-cases, with somewhat long white hairs.'

HETEROCERA.

SYNTOMIDAE.

Syntomis passalis F.

Ovum white, unsculptured, spherical with the base slightly flattened. Laid in a large batch but with the individual ova not touching each other. Deposited 24-viii-40. Hatched 29-viii-40.

Larva with the head bright reddish chestnut, rather small. Ground colour of the body deep blackish purple. Each somite with a transverse series of six rosettes of short blackish-grey spinous hair, arising from blackish warts. Legs bright reddish chestnut. Prolegs purple.

Pupa in a slight cocoon of brown silk interwoven with a few of the larval hairs; the bulk of the hairs, however, are not shed and remain attached to the cast skin. Dark reddish brown, the abdominal somites with a central ring of conjoined black spots. Wing cases black with the veins red-brown. Leg cases red-brown streaked with black. Antenna cases red-brown but unstreaked. Apex of the abdomen blunt and densely clothed with hooked golden-brown hairs.

Food-plant—Dahlia and Orange Cosmos.

Described from a number of full-fed larvae bred from ova from a Calcutta caught female, one of which pupated 8-x-40 and a male emerged 16-x-40.

ARCTIIDAE.

Amsacta lineola F.

Ovum creamy white, spherical with the base slightly flattened. Minutely punctate. Laid in fairly large batches, the ova touching each other. Hatched on the fourth day.

Larva with the head honey brown, the clypeus filled in with smoky black and with a smoky black stripe outlining it. Body with a broad black dorsal stripe with a median pale line on the thoracic somites. The lateral area brownish grey. Hair fairly short, that on the dorsum black and arising from a double dorsal series of small and a subdorsal series of larger dull blackish blue warts; on the lateral area grey and arising from a lateral and sublateral series of greyish warts. Spiracles white and set in a broad pinkish ring. Venter blackish. Prolegs honey brown. Legs blackish.

Food-plant—Orange Cosmos.

Described from a full-fed larva bred from ova deposited by a Calcutta caught female in August 1940. The larva died when preparing for pupation.

LYMANTRIDAE.

Laelia exclamationis Koll.

Butlr., *Ill. Het.*, vii, 123, pl. 138, fig. 6. 1889.

Hamps., *Fauna Brit. Ind.*. Moths, i, 442. 1892.

Head dull brownish, the clypeus filled in with blackish. Ground colour of body blackish, a pale brownish subdorsal stripe, the sub-spiracular area greyish brown. Densely clad with brownish grey hairs arising from a subdorsal, supra- and sub-spiracular, and sublateral series of greyish brown warts. 4th to 7th somites each with a dense dorsal brush of silky hairs, dark brown in colour but appearing an almost silvery brown in certain lights. 11th somite with a similar dorsal brush. Legs pale brown. Venter and prolegs greyish brown. Spiracles white.

Pupa in a cocoon of brown silk mixed with larval hair. Wing, leg and antenna cases bright chestnut brown, the thorax and dorsum darker, the ventral surface of the abdomen paler. Thorax and first five abdominal somites with scar-like dorsal ridges of a pale brown granular appearance.

Food-plant—Coarse grasses.

Described from a full-fed larva found in Calcutta 2-x-40, spun 4-x-40, and a male emerged 14-x-40.

Hampson's description is 'Larva brown, with tufts of long grey and brown hair; dorsal tuft of short brown hair on 3rd to 6th somites; a subdorsal series of very short orange tufts, three to each somite; a lateral pale line.' Butler writes 'Larva blackish; head pale buff; two dorsal stripes of contiguous yellow and red spots interrupted on each segment by a whity-brown spot or tubercle bearing long hairs, on the fifth to eighth segments these

tubercles are very large, prominent and woolly, and bear long hairs; those on the thirteenth segment are not prominent, but bear long tapering pencils of hair; the tenth and eleventh segments bear a small central dorsal carmine tubercle; an imperfect rose-pink stripe bearing tubercles of the same colour emitting pale brown hairs; a broad lateral rose-pink band, on and below which are small tubercles bearing white hairs; ventral surface yellow, streaked in front and at the sides with black; legs shining vermilion-red. Length of preserved larva 28 millim.' The figure appears to have been drawn from a blown larva.

NOTODONTIDAE.

Turnaca acuta Wlk.

Ovum spherical, chalky white freckled with ochreous. Micropyle a dark spot. Laid in small batches or in twos and threes.

1st instar larva—Head yellowish brown. Body green with three dark brown lateral lines. Head and body with sparse black hairs. Shape rather broad anteriorly, tapering towards the rear.

Ova laid by a female in Calcutta 6-viii-40, hatched 11-viii-40. The female refused to lay until a bamboo leaf was put in the box. In spite of Seitz' suggestion that the larvae feed on Monocotyledons, they refused various species of grasses, bamboos and palms and died without feeding.

LIMACODIDAE.

Thosea loesa Moore.

Hamps., *Fauna Brit. Ind.*, Moths, i, 379. 1892.
Hering Seitz, *Indo-Austr. Bombyces*, x, 712.

Head green, marked with brown round the jaws, retractile. 1st. somite retractile. Shape oval and flattened. Colour bright grass green. A narrow white dorsal stripe, edged with an interrupted dark blue line and running through a pink spot on the 7th somite. A series of eight subdorsal red spots. A subdorsal series of nine tufts consisting of four or five very short green bristles. A lateral series of eleven scoli, increasing in size from front to rear, first and second very short, crimson with black bristles and directed forwards, third to ninth longer, green tipped with pink and with green bristles and pointing sideways, tenth and eleventh similar but directed backwards.

Cocoon almost spherical, slightly longer than broad. Dark brown in colour veined with lighter, of the usual hard Limacodid type. One cocoon was almost black. Empty pupa skin yellowish brown.

Food-plant—Areca Palm.

Described from a full-fed larva found in Calcutta 6-x-40, spun 9-x-40, and a male emerged 4-xi-40.

Hampson's description, which is given under the name *sinensis*, is as follows:—'Yellow or green, with a white or yellow dorsal stripe, sometimes with a red spot at middle, subdorsal and sublateral series of spinous tubercles reddish towards tips. Cocoon purplish grey.' Seitz gives substantially the same description and adds that the larva lives on a great number of cultivated plants.

Altha nivea Wlk.

Head retractile, pale greenish marked round the jaws with brown. 1st somite retractile and edged with black anteriorly. Body pale green, a paler narrow dorsal and subdorsal stripe, a similar lateral stripe and one between it and the subdorsal. A yellow sublateral stripe defining the ventral area. Body oval, highly convex, without visible segmentation. The skin translucent in appearance and slightly granular in texture but without hairs or tubercles. The markings appear to be well below the surface of the skin and vary in intensity with the angle from which the larva is viewed. Spiracles round, yellow with a yellow ring.

Cocoon hard, compact, chocolate brown in colour and flecked with buff specks, particularly towards the front. These specks are white when the cocoon is newly spun. Shape round, slightly longer than broad. Empty pupa skin yellowish brown in colour.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a full-fed larva found in Calcutta 21-viii-40, spun 23-viii-40, and a female emerged 9-ix-40.

PSYCHIDAE.

Amatissa cuprea Moore.

Brahmachari, *Journ. Bomb. Nat. Hist. Soc.*, xl, 56. 1938.

Head dark brown, streaked and speckled with paler. First three somites dark brown, mottled with paler, and with a dorsal, subdorsal and sublateral pale stripe. Abdominal somites very slightly chitinised and pinkish grey in colour. A whitish lateral line. Anal claspers and flap more heavily chitinised and yellow brown in colour. Abdominal prolegs very small. Legs brown marked with paler and increasing in size from 1st to 3rd pair.

Male pupa reddish brown, rather slender. The abdominal somites with the posterior edge rather wider than the anterior edge of the somite following and forming a ridge round it. 10th to 12th somites each with a transverse spined ridge posteriorly. End of the abdomen turned under and the cremaster consisting of two short cone-shaped processes each ending in a sharp point. Female pupa rather paler in colour, the usual type of chitinised maggot without leg, antenna or wing cases, broader behind and tapering anteriorly.

Case cylindrical, tapering from mouth to apex, and made of greyish silk covered with minute fragments of vegetable matter. Larger pieces of leaf and twig are also attached, these are fixed by the upper end, the lower hanging loose. Before pupation a slender peduncle, about a quarter of an inch long, is spun fixing the case to a leaf or twig. As usual, the imago emerges from the bottom of the case.

Food-plant—Found on *Ipomoea palmata*, but fed readily on *Lagerstroemia indica*. Brahmachari records it as a pest on Banana in Southern India.

Described from a larva and pupae from cases found in Calcutta 28-ix-40, from another of which a male emerged 5-x-40.

Brahmachari describes the larva as having the head and thoracic somites grey in colour with patches of brown, the abdomen

of darker hue. He gives a figure of the male pupa, but does not shew the expanded abdominal rings nor the spinous ridges and makes no mention of them in the text.

NOCTUIDAE.

Beara dichromella Wlk.

Moore, *Lep. Ceyl.*, ii, 116. 1882-83.

Head reddish brown, marked with darker above. 1st to 3rd somites with the dorsum greyish white with a longitudinal and transverse black lines. 4th somite with the dorsum black with a crescent-shaped yellow mark. 5th somite with a black dorsal hump. 6th to 10th somites with a broad creamy yellow dorsal stripe with a purplish black median line. 11th somite with a black dorsal hump edged on each side and posteriorly with orange. 12th and 13th somites orange yellow. The lateral area black with two indistinct and broken yellowish lines. A broken orange sublateral stripe from 2nd to 10th somite. Sparse white hairs arising from white specks. Spiracles black ringed with white. Venter greyish green. Legs and prolegs greyish green.

Cocoon of papery yellow silk. Supported by a short stalk spun about two-thirds from the front of the cocoon. Canoe-shaped, the front sloping backwards and slightly ridged and rising into a backward pointing curved projection. A small point about the middle and the posterior end terminating in a small double point. The imago escapes through a slit in front.

Food-plant—*Zizyphus Jujuba.*

Described from a full-fed larva found in Calcutta 28-x-40, spun 30-x-40 and a female emerged 6-xi-40.

Moore's description is as follows:—'Larva pale purple, with a purple-red dorsal tubercle on sixth and another on twelfth segment; anterior segments with minute black-bordered white tubercular spots, and two lateral rows of similar spots on all the segments, from each of these and the dorsal tubercles project short fine whitish hairs; a dorsal yellow band from anterior to posterior tubercle. Cocoon pale purplish-red, attached by a silken peduncle to a leaf or twig, truncated and with a conical projection at one end. Feeds on *Celtis orientalis.*'

Chalciope hyppasia Cr.

Ovum spherical, olive green speckled with rusty red. The micropyle sunken and with sculptured ridges running from micropyle to base. Laid singly. Hatched on the third day.

Newly hatched larva very long and slender. 1st and 2nd pairs of abdominal prolegs absent. Resting position and mode of progression very Geometer-like. Head yellowish brown, body brownish green.

Half-grown larva with the ground colour greenish and three lateral purple brown lines. Venter with a dark median stripe and two purple brown lines on either side.

Full-grown larva—Head with the central portion yellowish with three purple brown lines, a semi-circular olive brown patch striped with yellowish on either side. Ground colour of the body pale yellow with the following longitudinal stripes composed of

Altha nivea Wlk.

Head retractile, pale greenish marked round the jaws with brown. 1st somite retractile and edged with black anteriorly. Body pale green, a paler narrow dorsal and subdorsal stripe, a similar lateral stripe and one between it and the subdorsal. A yellow sublateral stripe defining the ventral area. Body oval, highly convex, without visible segmentation. The skin translucent in appearance and slightly granular in texture but without hairs or tubercles. The markings appear to be well below the surface of the skin and vary in intensity with the angle from which the larva is viewed. Spiracles round, yellow with a yellow ring.

Cocoon hard, compact, chocolate brown in colour and flecked with buff specks, particularly towards the front. These specks are white when the cocoon is newly spun. Shape round, slightly longer than broad. Empty pupa skin yellowish brown in colour.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a full-fed larva found in Calcutta 21-viii-40, spun 23-viii-40, and a female emerged 9-ix-40.

PSYCHIDAE.

Amatissa cuprea Moore.

Brahmachari, *Journ. Bomb. Nat. Hist. Soc.*, xl, 56. 1938.

Head dark brown, streaked and speckled with paler. First three somites dark brown, mottled with paler, and with a dorsal, subdorsal and sublateral pale stripe. Abdominal somites very slightly chitinised and pinkish grey in colour. A whitish lateral line. Anal claspers and flap more heavily chitinised and yellow brown in colour. Abdominal prolegs very small. Legs brown marked with paler and increasing in size from 1st to 3rd pair.

Male pupa reddish brown, rather slender. The abdominal somites with the posterior edge rather wider than the anterior edge of the somite following and forming a ridge round it. 10th to 12th somites each with a transverse spined ridge posteriorly. End of the abdomen turned under and the cremaster consisting of two short cone-shaped processes each ending in a sharp point. Female pupa rather paler in colour, the usual type of chitinised maggot without leg, antenna or wing cases, broader behind and tapering anteriorly.

Case cylindrical, tapering from mouth to apex, and made of greyish silk covered with minute fragments of vegetable matter. Larger pieces of leaf and twig are also attached, these are fixed by the upper end, the lower hanging loose. Before pupation a slender peduncle, about a quarter of an inch long, is spun fixing the case to a leaf or twig. As usual, the imago emerges from the bottom of the case.

Food-plant—Found on *Ipomoea palmata*, but fed readily on *Lagerstroemia indica*. Brahmachari records it as a pest on Banana in Southern India.

Described from a larva and pupae from cases found in Calcutta 28-ix-40, from another of which a male emerged 5-x-40.

Brahmachari describes the larva as having the head and thoracic somites grey in colour with patches of brown, the abdomen

of darker hue. He gives a figure of the male pupa, but does not shew the expanded abdominal rings nor the spinous ridges and makes no mention of them in the text.

NOCTUIDAE.

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Moore, *Lep. Ceyl.*, ii, 116. 1882-83.

Head reddish brown, marked with darker above. 1st to 3rd somites with the dorsum greyish white with a longitudinal and transverse black lines. 4th somite with the dorsum black with a crescent-shaped yellow mark. 5th somite with a black dorsal hump. 6th to 10th somites with a broad creamy yellow dorsal stripe with a purplish black median line. 11th somite with a black dorsal hump edged on each side and posteriorly with orange. 12th and 13th somites orange yellow. The lateral area black with two indistinct and broken yellowish lines. A broken orange sublateral stripe from 2nd to 10th somite. Sparse white hairs arising from white specks. Spiracles black ringed with white. Venter greyish green. Legs and prolegs greyish green.

Cocoon of papery yellow silk. Supported by a short stalk spun about two-thirds from the front of the cocoon. Canoe-shaped, the front sloping backwards and slightly ridged and rising into a backward pointing curved projection. A small point about the middle and the posterior end terminating in a small double point. The imago escapes through a slit in front.

Food-plant—*Zizyphus Jujuba.*

Described from a full-fed larva found in Calcutta 28-x-40, spun 30-x-40 and a female emerged 6-xi-40.

Moore's description is as follows:—'Larva pale purple, with a purple-red dorsal tubercle on sixth and another on twelfth segment; anterior segments with minute black-bordered white tubercular spots, and two lateral rows of similar spots on all the segments, from each of these and the dorsal tubercles project short fine whitish hairs; a dorsal yellow band from anterior to posterior tubercle. Cocoon pale purplish-red, attached by a silken peduncle to a leaf or twig, truncated and with a conical projection at one end. Feeds on *Celtis orientalis.*'

Chalciope hyppasia Cr.

Ovum spherical, olive green speckled with rusty red. The micropyle sunken and with sculptured ridges running from micropyle to base. Laid singly. Hatched on the third day.

Newly hatched larva very long and slender. 1st and 2nd pairs of abdominal prolegs absent. Resting position and mode of progression very Geometer-like. Head yellowish brown, body brownish green.

Half-grown larva with the ground colour greenish and three lateral purple brown lines. Venter with a dark median stripe and two purple brown lines on either side.

Full-grown larva—Head with the central portion yellowish with three purple brown lines, a semi-circular olive brown patch striped with yellowish on either side. Ground colour of the body pale yellow with the following longitudinal stripes composed of

minute dots—a dorsal lavender line in continuation of the central dark line of the head, a dark violet brown subdorsal stripe with an internal lavender line in continuation of the inner edge of the dark lateral patch of the head, a dark violet brown lateral stripe with a double lavender line between it and the subdorsal stripe,—and with a clearer yellow stripe containing a double rust-red line below it. 11th and 12th somites each with a black subdorsal dot. Venter sprinkled with minute reddish brown dots, a dark median stripe and indications of two slightly darker stripes on either side. Spiracles black. Legs yellow brown. Prolegs like the body.

Pupa in a slight cocoon of white silk spun among leaves. Pale purplish brown and covered with a white bloom. Apex of abdomen blunt with a ring of short teeth round it and ending in a few hooked spines.

Food-plant—*Rhynchosia minima* DC. (Leguminosae).

Described from a full-fed larva, bred from ova from a Calcutta caught female, 20-x-40, pupated 25-x-40, and a male emerged 3-xi-40.

Ophideres fullonica L.

Moore, *Trans. Zool. Soc.*, xi, 64, pl. 12, figs. 1, 1a.
Hamps., *Fauna Brit. Ind.*, Moths, ii, 560. 1894.

2nd instar—Head and body black. A white lateral streak on the 9th and 10th somites. Resting attitude with the legs and prolegs gripping close together and the body between looped, the hinder part held erect.

The ocelli on the 5th and 6th somites are indicated in the 3rd instar by orange red crescents. The rest of the adult markings developing in the 4th and 5th instars.

Full-grown larva—Head velvety black. Ground colour of body velvety black. Sublateral area sprinkled with minute white dots, which join into an irregular streak from the 5th somite backwards. 1st somite with a subdorsal line of minute white dots. 2nd somite with a pair of minute bright blue subdorsal specks anteriorly and a transverse median line of six similar specks. 3rd somite with a median transverse line of six bright blue specks. 4th somite with a divided creamy white lateral blotch with three minute blue specks above and three below arranged in the form of a triangle. 5th and 6th somites each with a black lateral ocellus surrounded by a wide ring, creamy white above and orange red below, and containing a bright blue spot as pupil. Two minute blue specks above and two below each ocellus. A deep maroon subdorsal stripe with a black central stripe, starting on the 5th somite in some larvae and on the 6th in others and extending to the anal flap. 7th to 10th somites each with a subdorsal triangle of minute blue specks and with two similar specks in front of each spiracle. 9th and 10th somites with an irregular and very broken creamy white lateral blotch. 10th and 11th somites with a creamy white sublateral streak in continuation of the sublateral speckling. 11th somite rising into a short cone dorsally, the apex maroon and interrupting the black ground colour

between the maroon subdorsal stripes, and with a creamy white stripe along the sides. Two bright blue dorsal dots in front of and one on each side of the maroon apex. 12th somite with three lateral and one subdorsal bright blue speck and marked with creamy white posteriorly. Spiracles orange red and set in bright maroon patches that increase in size from front to rear. Legs black banded with maroon. Prolegs black with the apex maroon, the 1st pair partially aborted, 2nd pair dotted externally with creamy white, 3rd and 4th pairs with a creamy white stripe. Venter black, some specimens with a double maroon median stripe.

Pupa in a cocoon of thin white silk spun between leaves. Dark purple mahogany, coarsely punctate and very highly polished. The apex of the abdomen with the cuticle wrinkled longitudinally and the cremaster consisting of four longish hooked spines with four shorter ones round them.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a full-fed larva found in Calcutta 24-viii-40, pupated 27-viii-40, and a male emerged 4-ix-40.

Hampson's description, which is presumably based on Moore's but makes no mention of the fact, is as follows:—'11th somite dilated and surmounted by a tubercle; colour dark purplish brown, the dorsum brown from 6th to 11th somites; legs red; spiracular scarlet patches largest posteriorly and with some irregular white markings round them, on somite 9 in the form of an oblique white bar; a yellow subdorsal mark on 4th somite; black ocelli with yellow iris and white pupils on 5th and 6th somites, and two yellow patches on 11th somite.'

Argadesa materna L.

Ovum spherical, the base flattened. Pale yellow green without sculpturing and very small for the size of the insect. Laid singly or in twos and threes on the food-plant.

1st instar—Head brownish green. 1st somite with a brownish green dorsal plate. Body yellowish green and rather oily in appearance. A few short black hairs. 1st pair of prolegs completely aborted. Resting attitude with the true legs and abdominal prolegs gripping, the forepart of the body between them looped and the posterior portion held erect.

2nd instar—Head and body blackish brown. 2nd to 6th somites each with a pair of orange red lateral specks and a subdorsal orange red speck on each somite from 4th to 6th.

The adult markings develop in the subsequent instars.

Full-grown larva—Head black. Ground colour of body blackish brown. A double dorsal and double subdorsal red brown line, the latter interrupted by the ocelli on somites 5 and 6. 1st somite with two black-ringed bright blue dots at the base of the leg, an anterior lateral and posterior subdorsal black-ringed blue dot. 2nd and 3rd somites each with a pair of black-ringed blue dots subdorsally in front and a transverse series of six similar dots centrally. 4th somite with a sublateral and subdorsal triangle of three black-ringed blue dots. 2nd to 4th somites each with a double orange red sublateral speck. 4th somite with an orange red subdorsal

spot. 4th and 5th somites with a small cream-coloured dorsal spot. 5th and 6th somites with a lateral ocellus; this consists of a black spot, the lower part of which contains a blue crescent-shaped mark edged above with reddish, and which is surrounded by a broad ring, the upper anterior quarter creamy white, the rest orange red, and the whole ringed with black. Sublateral area speckled with white. Two black-ringed blue dots above and two below each ocellus. 7th to 10th somites each with a subdorsal and sublateral triangle of three black-ringed blue dots. A subdorsal line of whitish specks backwards from the 7th somite. 10th and 11th somites each with a cream-coloured dorsal spot. 11th somite rising into a cone, with a double yellowish pink blotch on each side and marked with cream behind, a black-ringed blue dot on either side of the apex and two more in front. 12th somite with a lateral triangle of black-ringed blue dots, a dorsal and subdorsal yellowish pink blotch with a black-ringed blue dot between them. Spiracles black. Legs and prolegs blackish brown, the 1st pair of prolegs completely aborted. Venter black brown with a dark median stripe, edged on each side with paler, and expanding into a black spot between each pair of prolegs, and with a dark stripe separating the ventral and sublateral areas. 2nd and 3rd somites with a pair of black-ringed blue dots in front of each leg, and 3rd to 5th and 9th with a submedian triangle of three similar dots, 10th and 11th somites also with similar markings but the apical dot very much separated from the two basal.

Another form is very similar in markings but with the ground colour velvety black and without the double dorsal and subdorsal lines. 11th and 12th somites with the markings cream instead of yellowish pink.

A third form has the head clay brown. The ground colour of the body clay brown with a darker dorsal stripe. The ocelli brownish purple with an indistinct pinkish crescent-shaped mark for pupil and surrounded by a double black ring, the upper quarter between the rings crimson, edged above and below with white, the other three quarters purplish brown. 7th to 11th somites with a dark subdorsal stripe with a central line of whitish dots. The sublateral area from the 5th somite backwards pinkish instead of speckled with white. Other markings similar to the first form.

Pupa in a thin cocoon of white silk spun between leaves. Rich mahogany brown, minutely punctate and very highly polished. The intersegmental areas of the abdomen darker. The spiracles almost black. The apex of the abdomen with the cuticle wrinkled into a honeycomb pattern and with the cremaster consisting of two longish hooked spines with a very short hooked spine on either side.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a number of full-fed larvae found in Calcutta 24-viii-40, one of which pupated 27-viii-40 and a female emerged 4-ix-40.

Hyblaea puera Cr.

Moore, *Lep. Ceyl.*, iii, 81, pl. 154, fig. 2a. 1884-87.

Hamps., *Fauna Brit. Indi.*, Moths, ii, 372. 1894.

Head smooth, bright reddish chestnut. 1st somite with a chestnut dorsal plate with a white median line through it. A broad golden fulvous dorsal stripe with a white median line and edged on each side with white. A broad whitish lateral line, the area between it and the subdorsal line golden fulvous with a large quadrate black spot on the forepart of each somite, the thoracic somites with this area almost entirely black. 4th to 11th somites each with a white-ringed black dot posteriorly immediately below the subdorsal line. 11th somite with a transverse yellowish white stripe between the subdorsal lines. 12th somite with a similar, but narrower, stripe with two black dots immediately in front of it. 13th somite with the anal plate yellowish brown with black dots. The area below the lateral line greenish yellow with two yellow lines. Venter greenish yellow. Legs pale chestnut brown. Prolegs yellowish green. Spiracles pale brown ringed with black. A few hairs. Lives in a spun together leaf and ejects a brownish fluid from the mouth when disturbed.

Pupa in a folded leaf lined with white silk. Rather slender, bright reddish chestnut. The cremaster fairly long and ending in a bunch of hooked spines, which are attached to the silk of the cocoon.

Described from a full-fed larva found in Calcutta 18-viii-40; pupated 20-viii-40 and a male emerged 26-viii-40.

Moore's description is 'Larva with a few short silky hairs; dark purplish grey above, olive-green below; with dorsal and lateral white lines, a subdorsal row of minute white dots and rings; a row of black dots on lateral line; head and second segment, and front legs black. Pupa dark purple-brown. Feeds on Bignoniaceae.' His plate shews a larva with the upper half deep violet and the lower yellow green. Hampson's description is based on that of Moore.

GEOMETRIDAE.

Petelia medardaria Herr.-Schaff.

Moore, *Lep. Ceyl.*, iii, 396, pl. 193, fig. 2b. 1884-87.

Head yellowish green, marked at the sides and on the vertex with brown. Ground colour of body bright green. A pinkish buff subdorsal stripe and an indistinct triple yellowish dorsal line. Spiracles red. Legs yellowish brown. Prolegs green, the feet reddish brown. Venter green frosted with white. Turns purple before pupation.

Pupa subterranean. Dark olive green in colour, the ventral surface of the abdomen slightly tinged with yellow. Cremaster a single stout spike, ending in several hooked spines.

Food-plant—*Zizyphus Jujuba*.

Described from a full-fed larva found in Calcutta 24-x-40, buried itself 27-x-40, and a female emerged 3-xi-40.

Moore gives the following description:—'Larva with 10 legs; smooth; purplish red, with slender longitudinal black lines; spiracles white. Pupa red, greenish in front, segments ringed with yellow.'

Scopula emissaria Wlk., *emissaria*.

Head slightly flattened in front, pale greenish brown with a paler sub-median stripe. Body yellowish green with a darker green dorsal stripe. Thoracic somites with an indistinct subdorsal and lateral whitish stripe. Spiracles black. Legs and prolegs greenish. Shape very long and slender, broadening slightly posteriorly. Resting attitude straight, but when alarmed the anterior portion of the body is coiled up.

Pupa in a slight web spun, in captivity, among litter. Slender, bright green with a slightly darker green dorsal stripe along the abdomen. Spiracles dark chestnut. Cremaster and last somite chestnut brown, the cremaster consisting of a bunch of hooked spines.

Food-plant—*Aeschynomene indica* Linn. (Leguminosae).

Described from a full-fed larva found in Calcutta 4-viii-40, pupated 6-viii-40, and a female emerged 10-viii-40.

(To be continued.)

PHOTOGRAPHING IN CEYLON'S BIRD SANCTUARIES.

BY

W. W. A. PHILLIPS, F.L.S., F.Z.S.

(*With 6 plates*).

For the better protection of the bird-life of the Island of Ceylon, a number of areas have been proclaimed, during the past few years, as sanctuaries—wherein no animal life, other than fish, may be wantonly destroyed or disturbed. Most of these areas are either brackish lagoons, near the sea coast, or large artificial irrigation reservoirs, commonly called 'tanks', scattered about the dry-zone provinces. All of them teem with bird-life, large and small, and all of them are of absorbing interest to the naturalist and to the bird-photographer. To the latter, however, it is the 'tank' sanctuaries that are of the greatest interest, for it is in them that he is able to come to intimate terms with so many of the larger wading birds—the storks, herons, spoonbills, ibises etc. and here too, he can see, at close quarters, that most grotesque and famous bird, the pelican—the Asiatic spotted-billed pelican—soaring with effortless flight far overhead or balancing himself, clumsily, on the top of some lofty tree.

Of all the sanctuaries that I have visited, Giant's Tank, on the Indo-Ceylon Railway, in the north-west of the Island and Kumana, tucked away, far from the beaten track, in the jungles of the south-east, have proved the most interesting and the most productive of good photographic results.

Equipped with several hessian 'hides', a boat and my cameras, I have spent many vastly entertaining days watching the fascinating cavalcades of bird-life that flow, unceasingly, past the well-concealed 'hide', planted in the midst of a common nesting ground of those numerous species that seek the seclusion of flood-girt heroneries in which to raise their families.

At Giant's Tank, one of the largest of our sanctuaries, storks breed earlier than at any other place known to me. By Christmas-time, well-grown young are often in the nests but sometimes, when the rains are late, eggs are still being laid or nest-building is yet taking place at that date. The nests, when built, are congregated together in a large area, of several acres in extent, on flat-topped bushes standing in 4 ft. or so of water, at the end of the enormous tank. From a distance, the bushes are densely dotted with white, as with masses of marvellous white blooms, but, on closer approach, these flower-like dots resolve themselves into a vast concourse of birds, taking their ease on the bush-tops. Egrets, pond-herons and night-herons are on the outer ramparts; the larger species—white-ibises, with their curious, black, scimitar-like beaks; spoonbills, with their shovel-shaped bills; darters, with their long snaky necks; grey herons; purple herons; shags;

cormorants; more egrets and lastly, in the inner-most keep, open-billed storks by the acre, are sitting or standing upon their nests or engaged in their other lawful vocations.

Our arrival causes a diversion. With a roar of wings, vast numbers of birds fly up, to wheel screaming their protests into the unheeding air. The open-billed storks are, however, moderately tame and soon cease to take more than a passing interest in our movements. We erect our 'hides' and leave them in position for the remainder of the day—to return the following morning to take our photographs.

The open-billed storks are the most noteworthy of the birds in this sanctuary. They are large white storks, with black flight feathers like the European storks, and most curious beaks—the mandibles not meeting each other closely, as in self-respecting beaks, but having a wide gap between them for the greater part of their length—caused, it is said, by the constant attrition due to the crushing of the shells of the fresh-water molluscs on which these storks feed. Undoubtedly the gap tends to widen, the older the stork becomes—the nestlings have no signs of it.

Smaller in size but of even greater interest, is the Kumana sanctuary in the remote jungles of the south-east corner of the Island. This sanctuary is a permanent, fresh-water lagoon. Tree-girt, it is surrounded and protected by a dense ring of mangroves and bull-rushes, which effectively screen from view all signs of bird-life until the barrier ring is penetrated.

In this sanctuary, the most notable residents are the pelicans and the handsome painted storks. One would reasonably expect pelicans to nest, swan-like, on islets or in reed-beds or at least on low-growing bushes. But no! they choose the branches of tall trees and sometimes build their nests even as much as 40 or 50 ft. above the water-level. They are weird, grotesque-looking birds but very sociable with their own kin. Dozens of pairs nest in the Kumana Sanctuary, on the tops of the lofty trees. Generally, their stick nests are in small groups of three or four, either balanced in a line along a stout branch or bunched together, touching one another, so that the brooding birds may gossip away the weary hours, discussing the day's topics and the shortcomings of their neighbours. Beside them sit their mates, awaiting their turn upon the eggs or lazing away the day till the night-fishing recalls them.

It is amusing to watch a pelican alight on the topmost twig of some high tree; the twig bends, with the unaccustomed weight, and much flapping, with the outstretched wings, and much clutching, with fully webbed feet, is required before steadiness and a well-balanced seat are acquired.

But of all the multitude of birds gathered together, in this small sanctuary, with the common object of propagating their species, the sedate and dignified painted storks are, to me, the most attractive and the most fascinating. Large numbers nest in the trees at the far end of the swamp, amongst or below the pelicans but above the lesser folk—the night-herons, egrets, pond-herons and the little black cormorants. Their nests are

Photo by *W. W. A. Phillips*

Open-bill Storks standing upon their nests.

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Photo by *W. W. A. Phillips*

Open-bill Storks standing upon their nests.

Photo by *W. W. A. Phillips*

Pond-Heron settling down to brood its chicks.

Photo by *W. W. A. Phillips*

The Spoonbill with his shovel-shaped beak.

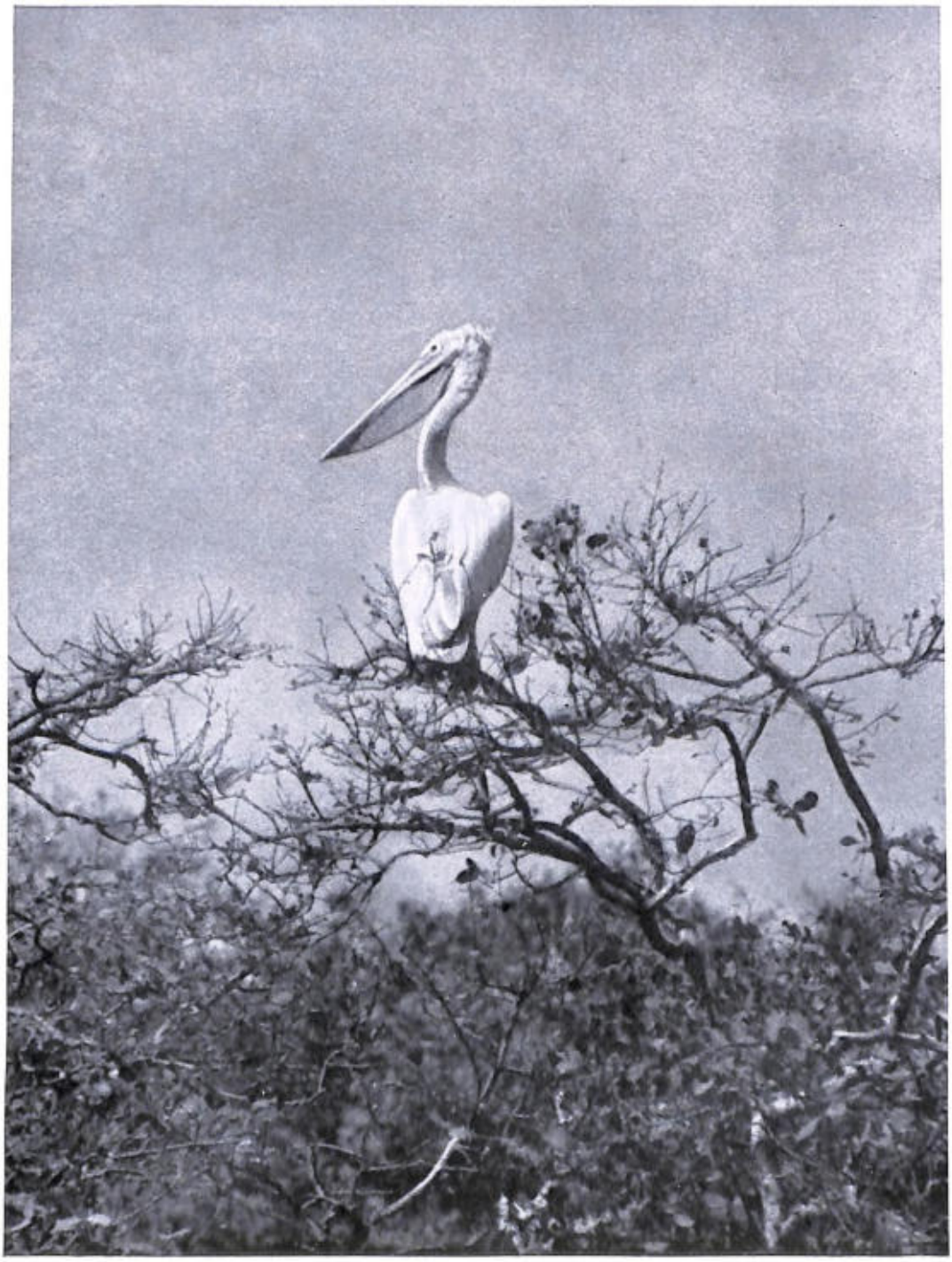


Photo by *W. W. A. Phillips*

Pelican balanced on a tree-top.

Photo by *W. W. A. Phillips*

'Sedate and dignified Painted Storks.'

Photo by *W. W. A. Phillips*

Grey Heron on nest.

ludicrously small for such large birds but evidently they are quite adequate for their purpose. To watch and photograph these handsome storks, from the close proximity of a well-placed 'hide', is a delight. Their colours blend wonderfully—the flamingo-pink of the back plumes and wings fades into the delicate pinkish-white of the upper plumage; the iridescent greenish black of the wing-coverts blends with the glossy black of the flight feathers and tail and these, together with the bright orange of the bill, head and face, make up a colour scheme most pleasing to behold.

During the heat of the day, these storks rise up from brooding their eggs and stand, with wings outstretched and bills half open, panting with the heat. In this statuesque posture they remain for five or ten minutes cooling themselves down and, at the same time, shading their eggs or their small young from the direct rays of the burning sun. Also, incidentally, they display themselves to perfection to the unseen watcher.

To bring back permanent records of this wonderful wealth of bird-life, has been one of the principal objects of my visits to these remote sanctuaries. This object has been achieved for, in addition to securing pictures of pelicans and painted storks, photographs of spoonbills, white ibises, greater and lesser egrets, white-necked storks, grey herons and purple herons, pond herons and night herons, cormorants, shags, darters, little cormorants, blue coot and teal have been secured as the birds have sat brooding or feeding their young.

Bird photography is always a fascinating pursuit, whatever the species that is being photographed. But I am inclined to think that, on a short trip, the most satisfying results are to be obtained in our 'tank', sanctuaries where the teeming and varied bird-life gives one so much scope for photographing species after species, all within a few yards of one another. To watch the various individuals engaged, quite unconscious of the photographer's presence, in their own peculiar domestic activities, is a pleasure that never fades.

A CONTRIBUTION TO THE STUDY OF THE BIOLOGY AND PHYSIOLOGICAL ANATOMY OF INDIAN MARSH AND AQUATIC PLANTS.

BY

J. F. R. D'ALMEIDA, B.A., M.SC.,

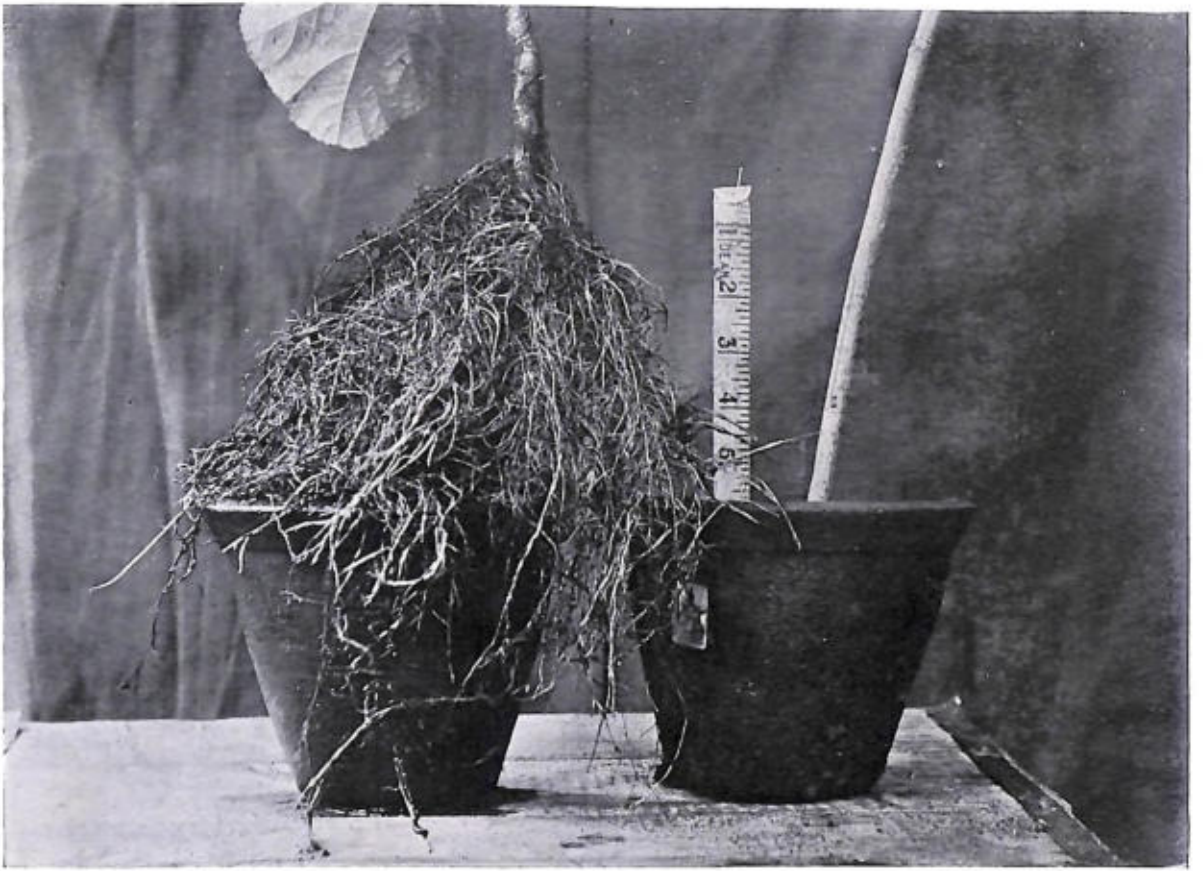
St. Xavier's College, Bombay.

(*With two plates*).

INTRODUCTION.

General Remarks.—In the present series of articles the writer has embodied investigations made in the course of his studies on Indian marsh and aquatic plants. The majority of these fall in the category of plants which have been regarded by various botanists as amphibious or semi-aquatic, or as helophytes or marsh plants. It is proposed to put forward in these notes a few facts which will throw some light on the biology and physiological anatomy of the Indian plants belonging to these two important ecological groups; for, with the exception of a recent contribution by Biswas and Calder (4), there seems to be very little information available.

Special attention has been paid to the morphological and anatomical differences induced by growth in water and in air, and to the differences observable in the same plant during its aquatic and land stages. Such a study is not a new one. Several writers such as Costantin (5, 6, 7, 8, 9), Schenck (26, 27), Askenasy (2) and Gluck (17) have proved that the plant is extremely plastic, and that external factors, chiefly the presence or absence of water in the soil or about the plant, can bring about numerous morphological and anatomical changes. Such a comparative study acquires a special significance in the case of the plants described in these pages in view of the fact that in India, as Saxton (24, 25) has pointed out, two different sets of conditions prevail during the year at any given spot, and these constitute two or three entirely different habitats, with the result that in one and the same spot different plants belonging to different ecological groups may thrive at different times of the year. Thus during the first period which starts with the burst of the rains mesophytic plants may flourish; if, at the end of this period the soil becomes water-logged or covered with water, swamp conditions or aquatic conditions prevail giving rise to marsh or aquatic vegetation. After the rains the water rapidly dries up, so that about a month after the end of the monsoons a period of intense drought sets in, and in places which during the rains are either water-logged or under water, a xerophytic vegetation finally establishes itself. The effect of the change of conditions on our waterside plants must therefore



Malachra capitata L.

The plant on the left is grown in water; its stem is swollen and adventitious roots have developed on the submerged portion. The plant on the right, grown as a land plant, has developed normally.

be to induce rapid and profound morphological and anatomical modifications, so that the same plant which at one period has hydrophytic or helophytic adaptations, may in the next period be rapidly transformed into a typical terrestrial plant, or, should the plant survive long through the dry season, into a typical xerophyte.

As far as the writer is aware this aspect of our Indian waterside plants dealing with the morphological and anatomical modifications induced by periodic changes in the environment has received scant attention from Indian botanists. The papers read by the writer before the Botanical Section of the Indian Science Congress in 1926 and 1934 (10, 11, 12, 13, 14, 15) were merely intended to indicate the lines along which further useful work on the subject of marsh and aquatic plants could be pursued. Since then there have appeared two contributions by Mullan (21, 22) on investigations done by him on certain Indian amphibious plants.

Arrangement and Method.—In the course of this work, as it is not always possible to separate the true water plants from marsh plants, the terms aquatic or water plants will be deemed to include also marsh plants. The plants are dealt with family by family. In each family an attempt is made to co-ordinate information regarding the occurrence of its aquatic representatives in the world as well as in India. Then follows a description of the plants which form the special subject matter of our study.

These descriptions are substantiated by observations in the field, experiments conducted in certain cases, and anatomical examination. As far as possible, the whole is illustrated by photographs and diagrams presenting the special morphological or biological features on which stress is laid in the description, and by camera lucida drawings or photomicrographs showing the anatomical structure of the tissues or organs described. The interpretations of the various structures observed and described, as well as the conclusions drawn therefrom, are embodied in the description of each plant. Facts appearing in one description have been restated in another. This seems to be unavoidable, unless other important considerations are sacrificed; such as, for instance, avoiding excessive cross reference.

For purposes of anatomical examination fresh material was for the most part employed and hand sections taken. Such a method was found to be both practicable and convenient. The paraffin method has its drawbacks when employed in the case of plants having large air-spaces, owing to the difficulty of driving away air from the tissues and the resistance offered to the penetration of paraffin to all parts of the tissues. It was also found that in the case of plants living in water, unless a very delicate fixative was employed, plasmolysis of the cells inevitably took place resulting in their shrinkage and the consequent obliteration of the original structure of the tissues. Moreover, the utility and convenience of hand sections is obvious in those cases where it is desirable to trace the development of tissues or to observe the effects of the environment on various parts of the plant. As these changes are very gradual and cover long distances on the stem

or root, they cannot all be detected within the short lengths of tissue employed in the preparation of microtome blocks. For this purpose it is necessary to take serial sections at considerable distances apart, and this is best done by means of hand sections. In a few cases, however, microtome sections gave good results.

DESCRIPTION.

Malvaceae.

The *Malvaceae* include 35 genera, and over 700 species distributed chiefly in the warmer regions of both hemispheres. Of these, only two genera are known to have aquatic representatives, viz. *Althaea* Tourn., a genus of 15 species inhabiting the temperate regions of the Old World, and *Malachra* Linn. consisting of 6 species natives of the warmer regions of America and of the West Indies. Two of these are naturalized in Asia and Africa.

Key to the Genera.

A. Branches of style as many as carpels.
Involucral bracts 6-9, connate at base.
Flowers axillary, solitary or clustered, or arranged in terminal racemes..... 1 *Althaea*
B. Branches of style twice as many as carpels.
Involucral bracts 4, large leafy.
Flowers densely capitate..... 2 *Malachra*

The genus *Althaea*, so far as our information goes, has only one aquatic representative, viz. *Althaea officinalis* Linn., the Marsh Mallow. This plant occurs in marshes, especially in maritime districts in Europe, extending to England and Ireland and eastwards to India. In America it is said to occur only as an escape. In India it is found wild in Kashmir. As its distribution in this country is limited, and it is more a plant of the temperate regions we will not take it up for special study.

The whole genus *Malachra*, on the other hand is reputed to be aquatic; its members being usually found in marshy places within the tropics. One species, *Malachra capitata* L., is widely distributed in India. It is dealt with in detail below.

Malachra capitata Linn. Syst. ed. 12, II (1767), 458.
=*M. conglomerata* Turcz.
=*M. alceaefolia* Jacq.
=*M. mexicana* Schrad.
=*M. rotundifolia* Schrank.

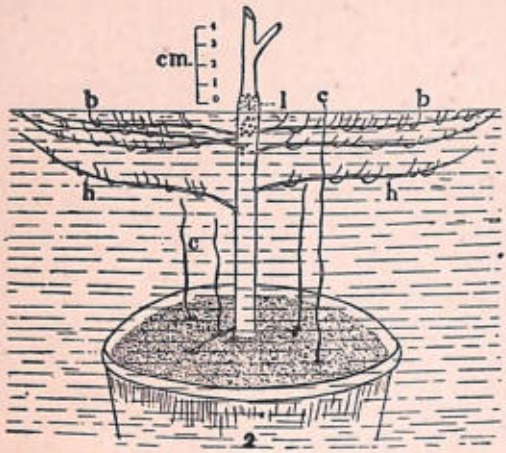
Vernacular Names.—*Bombay*: Ranbhendi; *Marathi*: Ranbhendi; *Porebundar*: Pardeshibhindo,

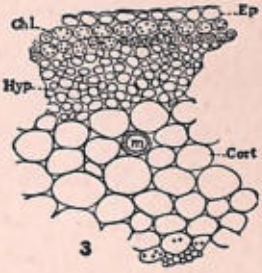
Malachra capitata L. is a native of Tropical America, cosmopolitan in the tropics. Though not indigenous, the plant is completely naturalized and a weed in many places in India. Judging from the fact that it has not been mentioned by Roxburgh, Wallich or Wight it must be a recent introduction. It is now plentiful throughout the damp tracts of India, and is very common in waste places in Bombay and Salsette, especially by the sides of tanks, pools of water, and rice-fields.

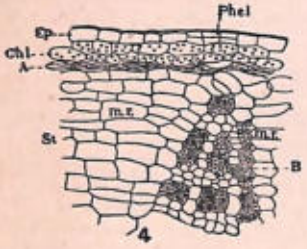
About sixty years ago the plant attracted considerable attention in Bombay as a possible source of fibre that might compete with the Bengal Jute (31). Though the efforts then made to *cultivate* the plant were pronounced a failure, the reports on the *quality* of the samples of fibre obtained from it would justify a fresh interest being evinced in the plant.

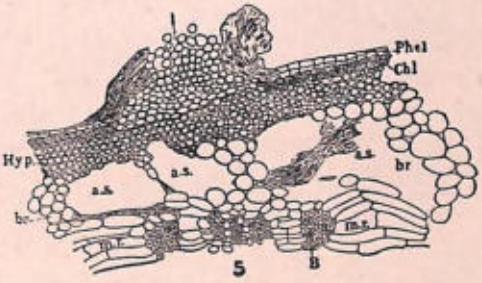
The rigid sturdy habit of the plant and its frequent occurrence on soil which is not water-logged would make one least suspect it to have aquatic tendencies. But *Malachra capitata* usually grows on ground that is liable to be inundated in the rains, so that often plants are found standing with their stems partly under water to various depths, and these plants show certain modifications due to the environment.

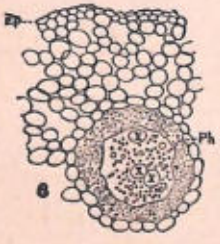
To determine the influence of the environment two plants of almost the same size were transplanted in pots. In about the middle of July one of

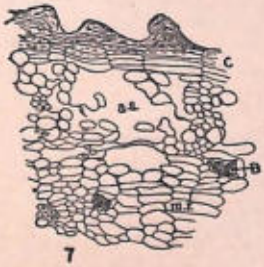












Malachra capitata L.

For explanation see end of article.

these was immersed to a depth of 15 cm. in a tub of water, while the other was left to grow as a land plant. Two months later the differences between the two plants were recorded and the plants photographed (Plate I, fig. 1). While no change had taken place in the control plant, the plant growing in water showed a number of adaptations which are more clearly represented in diagrammatic form (Plate II, fig. 2).

The stem was swollen up to a little above water level, and the submerged portion was covered with a large number of white lenticels (*l*) which extended to a little above the surface of the water. These lenticels were very strongly developed on the stem just below and above water level, where they showed protruding masses of soft white tissue. In addition to this, long white roots (*h*) spread out horizontally from the submerged portion of the stem into the surrounding water. It was observed in the course of the experiment that the lenticels first made their appearance, and a little later the lateral roots were seen to be given out through the lenticels. A similar sequence of lenticels and roots has been observed in other plants (19). In all such cases it seems obvious that the extraordinary development of lenticels is the first expression of the immersion in water, and the growth of lateral roots a subsequent manifestation thereof. These lateral water roots bore, among others, delicate branches (*b*) which bent upwards towards the surface of the water. The lateral underground roots also sent up erect branches (*c*) which likewise grew up to the water surface. As a matter of fact, in nature, wherever the plant grows in water-logged areas, large numbers of similar roots may be seen peeping out of the soil, and they strongly suggest comparison with the pneumatophores of certain mangroves, like *Avicennia*. This phenomenon of roots being directed upwards is not a case of negative geotropism. It is due rather to their sensitiveness to gases (aerotropism) induced by the air above the soil or, in the case of soil which is completely covered by water, by the more aerated surface layers of the water towards which the roots bend and grow and from which they probably also draw their supplies of oxygen. These roots are therefore, like pneumatophores, respiratory in function. Aeration, no doubt, first takes place through the lenticels, but when the lateral roots are given out these also help in the process. But respiration must not be taken to be the exclusive function of these water roots. Their profuse branching which subsequently takes place in all directions as the result of prolonged submergence and the extremely fine divisions of the rootlets thus produced makes them well adapted also for absorbing nutrient solutions from the surrounding medium; lastly the presence of chlorophyll in some of the older roots points to the photosynthetic role of such roots.

A comparative anatomy of plants growing under ordinary terrestrial and marsh conditions shows differences in their histological structures.

The transverse section of the young stem of a plant growing out of water (Plate II, fig. 3) shows an epidermis (*Ep.*) of more or less tabular cells. The cortex is distinguishable into two parts:—(*a*) an outer zone of small collenchymatous cells (*Hyp*) and (*b*) an inner zone of much larger parenchymatous elements (*Cort*) with triangular spaces between them. Two or three layers (*Chl*) immediately abutting on the epidermis are not collenchymatous and contain chloroplasts. The innermost layer or two of the cortex also contains chloroplasts. Isolated cells (*m*) in the parenchymatous cortex have their cell-walls transformed into mucilage. As regards the vascular ring it need only be mentioned that, as the stem grows older, the portions of the medullary rays lying in the phloem broaden outwards as in the case of other *Malvaceae*. The pith also consists of parenchyma with triangular intercellular spaces. Isolated mucilage cells also occur in the pith. Serial sections of older stems reveal that, while the vascular cylinder is increasing in diameter, the cells of the inner zone of the cortex collapse (becoming at first flattened in a tangential direction) and finally disappear; later on the greater part of the collenchyma also disintegrates in a similar manner; but the two or three sub-epidermal layers which contain chlorophyll grains always persist. Owing to the growth in diameter of the vascular cylinder the latter comes almost into contact with the superficial layers which are expanding less rapidly. As a result the spaces occupied by the intervening cortical cells which have been destroyed become obliterated or reduced to mere crevices which are seen to extend in a tangential direction. In Plate II, fig. 4 the destroyed cells of the cortex are seen as a narrow shaded

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band (*A*) between the chlorophyllous sub-epidermal layers (*Chl*) and the stele (*St*). The phellogen (*Phel*) which arises much later in the development of the plant has its origin in the epidermis. In its formation an epidermal cell divides into two cells; the inner of these remains merismatic whilst the outer becomes suberized. In this way a thin band of cork is developed which replaces the epidermis. Apparently no phelloderm is formed.

The transverse section of the submerged portion of the stem of a plant growing in water (Plate II, fig. 5) shows lysegenously formed lacunae (*a.s.*) in the region of the inner parenchymatous cortex, the outer collenchymatous band of cells remaining connected with the central portion of the stem by radial bridges of tissue (*br*) which correspond to portions of the cortex which have escaped disintegration. In the stem of *Malachra* growing as a land plant we have seen that owing to the more rapid growth of the vascular cylinder the latter comes almost into contact with the superficial layers. The occurrence then of large lacunae in the case of the stem of a plant growing in water can only be understood on the assumption that the growth of the superficial layers (including the collenchyma), which seems to receive an extra stimulus by immersion in water, keeps pace with the growth in diameter of the vascular cylinder.

We have already noted the extraordinary development of lenticels on the submerged parts of the stem. Like the normal lenticels occurring on the aerial parts these (Fig. 5, *l*) are seen to be developed from a phellogen which is continuous with the ordinary cork-forming phellogen (*Phel*) derived from the epidermis, but the complementary tissue differs from that of normal lenticels (1) in being more pronouncedly formed, (2) in the cells being more loosely applied to one another, (3) in their having living contents, and (4) in the cell walls not being brown and suberized, although they may be somewhat altered (since they stain yellow with chlor-zinc-iode). This hypertrophy of the lenticels in adaptation to water which has also been observed in some other plants (16) is a phenomenon similar to that which takes place on a larger scale when the ordinary cork-tissue is replaced by massive air-containing tissue called aerenchyma which is so marked a feature of certain marsh plants on which Lewakoffski (20), Schenck (27), Rosanoff (23), Scott and Wager (29), Schrenk (28), Witte (32), Batten (3) and others have worked.

It has been suggested (18) that the stimulus that causes the phellogen to develop aerenchyma in lieu of cork is the lack of oxygen in the inner tissues, or as Arber (1) puts it 'the presence of some minimum oxygen is possibly a necessary condition for the process of suberisation, which is inhibited when the oxygen-content of the cell-sap falls below a certain point'. This explanation does not seem to meet the case of lenticels, at any rate. It is well known that the surface waters contain more dissolved air, and consequently more oxygen, than the layers deeper down, and that dissolved air is richer in oxygen than atmospheric air. The fact that in this, as in other plants growing under marshy conditions, normal lenticels are concentrated at the water level, and lenticels are rarely, if ever, present lower down the stem, seems to suggest that for the production of lenticels a minimal amount of oxygen is necessary and that the further growth of lenticels is in proportion to the amount of this gas in the surrounding medium. On the other hand, as the aerial lenticels have suberized complementary cells and suberisation is absent in the submerged lenticels it would appear that suberisation of the lenticel tissue is correlated to the exterior condition of humidity, the drier the condition the more suberised the walls, and *vice-versa*.

Both the aerial and the submerged lenticels serve their purpose efficiently. The aerial lenticel permits of a direct access of atmospheric air to the inner tissues which, at the same time are kept from drying up by the loose plug of powdery suberised complementary tissue, while the living cells of the submerged lenticels are adapted for taking in dissolved air from the water which bathes them.

The transverse section of a young adventitious floating root which is given off from a submerged stem (Plate II, fig. 6) has a solid stele of xylem (*X*) surrounded by phloem (*Ph*), and a lacunar cortex. The young soil root has also a similar structure, the sizes of the lacunae depending upon the extent of humidity of the soil. An old soil root growing in water-logged soil (Plate II, fig. 7) or in ground covered with water shows large lysegenously formed air spaces situated between the outermost cortical region which develops cork and the

vascular cylinder. In soil roots growing under land conditions, however, these cortical air-spaces are obliterated, as in the case of the aerial stem, and the cork layers and the vascular cylinder are so juxtaposed as to make it appear that the cork-forming phellogen—which is actually superficial in origin—is derived from a deeper layer of cells situated immediately outside the pericyclic group of bast fibres. Another feature which distinguishes old soil roots growing in water-logged soil from those which live under dry land conditions is that in the former the peripheral region of wood shows large radially arranged gaps due to what appears to be a mucilaginous disorganization of cell groups in this part of the wood. Such gaps are not seen in the wood of roots growing under drier conditions.

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Explanation of Plates.

Plate I

Fig. 1.—Photograph of two plants of *Malachra capitata* L. grown: one (*left*) in water, the other (*right*) as a land plant. In the first the stem has swollen up and adventitious roots have developed on the submerged portion. The control plant to the right is quite normal. The scale is in inches.

Plate II

Fig. 2.—A habit drawing of *Malachra capitata* L. growing in water. *l*, lenticels; *b*, aerotropic roots borne on the horizontal roots *h* arising from the submerged portion of the stem; *c*, aerotropic roots sent up by the lateral underground roots. For clearness sake only a few roots are shown.

Fig. 3.—Portion of the transverse section of a young stem of *Malachra capitata* L. *Ep*, epidermis; *Hyp*, collenchyma; *Chl*, sub-epidermal chlorophyllous layers; *Cort*. inner parenchymatous cortex; *m*, mucilage cell. (× 45).

Fig. 4.—Portion of the transverse section of an older stem of *Malachra capitata* L. growing as a land plant, *A*, destroyed cells of the cortex; *Chl*, chlorophyllous sub-epidermal layers; *St*, portion of the stele represented in the fig. by the medullary rays (*m.r.*) and a portion of the hard bast (*B*); *Phel*, epidermal cells dividing to form the phellogen, (× 45).

Fig. 5.—Portion of the transverse section of the submerged part of a stem of *Malachra capitata* L. growing in water. *l*, lenticel; *Phel*, cork-forming phellogen derived from the epidermis; *Chl*, sub-epidermal chlorophyllous layers; *Hyp*, collenchyma; *a.s.* air-space; *br*, remains of the parenchymatous cortex forming bridges of tissue separating the air-spaces; *m.r.*, medullary ray; *B*, hard bast. (× 20).

Fig. 6.—Portion of the transverse section of an adventitious root of *Malachra capitata* L. given off from the submerged portion of the stem. *l*, lacunae in the cortex; *X*. xylem; *Ph*, phloem. (× 45).

Fig. 7.—Portion of the transverse section of a ground root of *Malachra capitata* L. growing in water-logged soil. *C*, cork; *a.s.*, air-space formed in the cortex; *m.r.* medullary rays; *B*, hard bast. (× 62).

(*To be continued*).

The Bokar of the Assamese and Katli of the Nepalese,
BARBUS (LISSOCHILUS) HEXAGONOLEPIS McClelland.

THE GAME FISHES OF INDIA.[1]

BY

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(With one colour plate and seven text-figures).

(Continued from page 88 of Vol. xlii, No. 1).

XII.—THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

5. The Extra-Indian Distribution of the Bokar of the Assamese and Katli of the Nepalese, *Barbus* (*Lissochilus*) *hexagonolepis* McClelland.

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INTRODUCTION.

In the list of synonymy of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland given in the preceding article (**12**, p. 81)[2] only Indian references to the species were included, and it was stated that its extra-Indian records could be dealt with in the next article. A careful study of the current literature on *Lissochilus* has shown that a heterogenous assemblage of species of the *Barbus*-group is at present included under this generic denomination. Though it is not within the scope of the present series of articles to discuss the systematic position of all such forms, in order to define the generic limits of the BOKAR of the Assamese it has been found necessary to make a few general comments on some of the allied species, especially those having affinities with the Indian fauna.

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[1] Published with permission of Director, Zoological Survey of India.

[2] Numerals in thick type within brackets refer to the serial numbers of the various publications listed at the end of the paper.

A number of species of *Lissochilus* described from Southern China, Siam, Burma, the Malay Peninsula and the Archipelago seem to us to be identical with the Nepalese KATLI, and have, therefore, to be regarded as synonyms of *B.* (*Lissochilus*) *hexagonolepis*. The list of synonymy given below and the discussion that follows indicate briefly our views concerning the systematic position of such forms. As a result of a careful examination of a large amount of material of *Lissochilus*, we have also discussed the value of certain specific characters generally relied upon for separating the species of this genus.

SYNONYMY.[1]

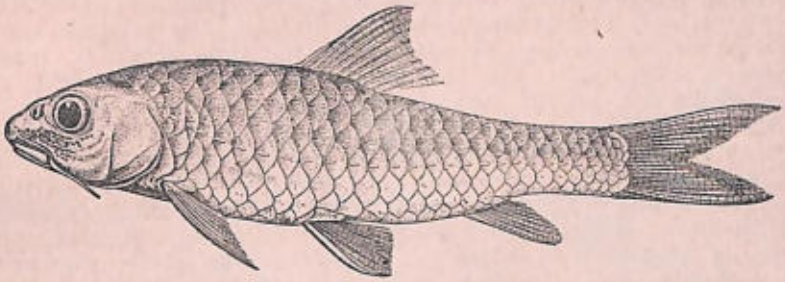
Barbus (**Lissochilus**) **hexagonolepis** McClelland.

1898. *Barbus Dukai*, Boulenger, *Ann. Mag. Nat. Hist.*, (6) XII, p. 201. (S. Shan States, Burma.)
1904. *Barbus soroides*, Duncker, *Mitt. Naturhist. Mus. Hamburg*, XXI, p. 178, pl. i, fig. 7. (Sumatra and Pahang, Malay Peninsula.)
1916. *Lissochilus dukai*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.*, III, p. 168. (Sumatra.)
1916. *Lissochilus sumatranus*, Weber & de Beaufort, *ibid.*, p. 169, figs. 68, 69. (Sumatra.)
1918. *Barbus dukai*, Annandale, *Rec. Ind. Mus.*, XIV, p. 35. (S. Shan States, Burma.)
1923. *Barbus* (*Lissochilus*) *dukai*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI, p. 155. (Siam.)
?1925. *Barbus caldwelli*, Nichols, *Amer. Mus. Novitates*, No. 185, p. 2. (Fukien and Hainan, China.)
?1928. *Barbus* (*Spinibarbus*) *caldwelli*, Nichols, *Bull. Amer. Mus. Nat. Hist.*, LVIII, art. 1, p. 12, fig. 3. (Fukien and Hainan, China.)
1929. *Barbus hexastichus*, Prashad & Mukerji, *Rec. Ind. Mus.*, XXXI, p. 200, text-fig. 7. (Indawgyi Lake, Burma).
?1933. *Lissochilus caldwelli*, Lin, *Lingnan Sci. Journ. Canton*, XII, p. 214.
1934. *Lissochilus dukai*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, lxxxvi, p. 120.
1934. *Lissochilus hutchinsoni*, Fowler, *ibid.*, p. 120, figs. 76, 77. (Siam.)
1936. *Lissochilus dukai*, Suvatti, *Index Fish. Siam*, p. 55. (Siam).
1936. *Lissochilus hutchinsoni*, Suvatti, *ibid.*, p. 55. (Siam.)
1936. *Lissochilus sumatranus*, Suvatti, *ibid.*, p. 55. (Siam.)
1937. *Lissochilus tweediei*, Herre & Myers, *Bull. Raffles Mus. Singapore*, No. 13, p. 61, pl. v. (Perak, F.M.S.)
1937. *Lissochilus dukai*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, LXXXIX, p. 188. (Siam.)
1938. *Lissochilus dukai*, Fowler, *Fisheries Bull.*, No. 1, p. 66. (Malay Peninsula.)
1940. *Lissochilus hendersoni*, Herre, *Bull. Raffles Mus. Singapore*, No. 16, p. 10, pl. iv.

The first extra-Indian record of *Lissochilus hexagonolepis* (=*Barbus dukai* Day) is by Boulenger (3, p. 201) from Nampandet, S. Shan States, Burma; he had two specimens in which the number of scales along the lateral line varied from 26 to 28. The species was next recorded by Duncker (4, p. 178, pl. i, fig. 7) from the Malay Peninsula and Sumatra as *Barbus soroides*. He examined 12 specimens in all and noted that the number of scales

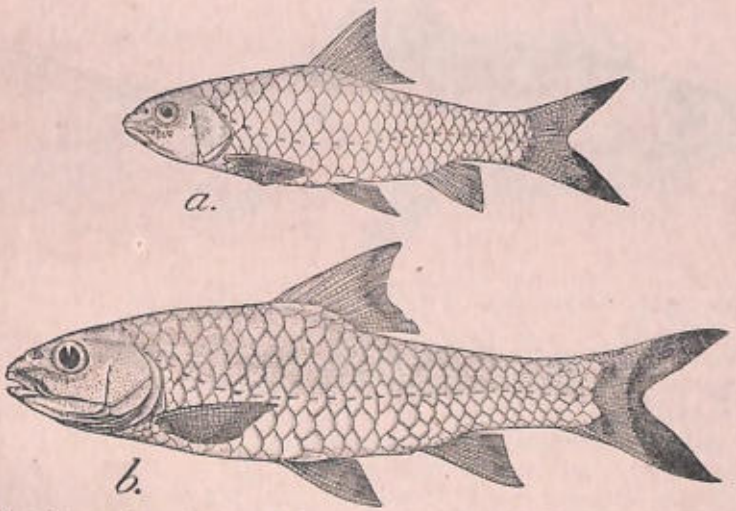
[1] In the list, references are included only of the extra-Indian records of the species.

along the lateral line varied from 26 to 29, while the number of predorsal scales was found to be 9 in all of them.



Text-fig. 1.—Lateral view of *Barbus soroides* Duncker. (After Duncker).

His figure of the species leaves no doubt that he was dealing with a true KATLI. The identity of this species with that of Day's *B. dukai* was pointed out by Weber and de Beaufort (**23**, p. 168), who also described another new species of *Lissochilus*, *L. sumatranus*, from Sumatra. The description of this new species was based on a single specimen, 148 mm. in length; it was distinguished from *L. dukai* by the smaller number of scales along the lateral line



Text-fig. 2.—Lateral view of *Lissochilus sumatranus* Weber and de Beaufort, and of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from the Siju Cave, Garo Hills, Assam, showing black pigmentation on the lobes of the caudal fin.

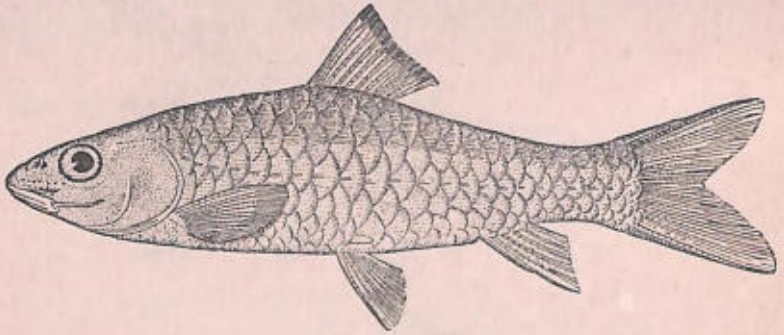
a. *Lissochilus sumatranus* Weber and de Beaufort. (After Weber and de Beaufort.); *b*. A specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from Assam. ×2/3.

(24-25 in *L. sumatranus* versus 26-29 in *L. dukai*). Hora (**12**, p. 82) has already shown in the case of the Indian specimens of *B. hexagonolepis* that the scales along the lateral line may vary

from 22 to 32, and in consequence no reliance can be placed on small variations in this character.

The only other striking point about *L. sumatranus* is the black colour of both the lobes of the caudal fin, but this feature is also partly shared by a specimen from the Siju Cave (2000 ft. from entrance), Garo Hills, Assam, in which the lobes of the caudal fin are darkish and there is a faint lunate dark band in the distal half of the dorsal fin. Suvatti (**22**, p. 55) recorded *L. sumatranus* from 3 localities in Siam, presumably on colouration and smaller number of scales along the lateral line. Without an examination of the Siamese examples, it is not possible to make any further observations on Suvatti's record of *L. sumatranus* from Siam, but a careful study of Weber and de Beaufort's description of the species and its comparison with the Indian specimens of *Lissochilus* have left no doubt in our minds that *L. sumatranus* is a synonym of *L. hexagonolepis*.

Annandale (**1**, p. 35) in 1918 and Hora (**10**, p. 155) in 1923 recorded the species from Burma and Siam respectively without any comments, but we have examined their material and find that it was correctly identified.

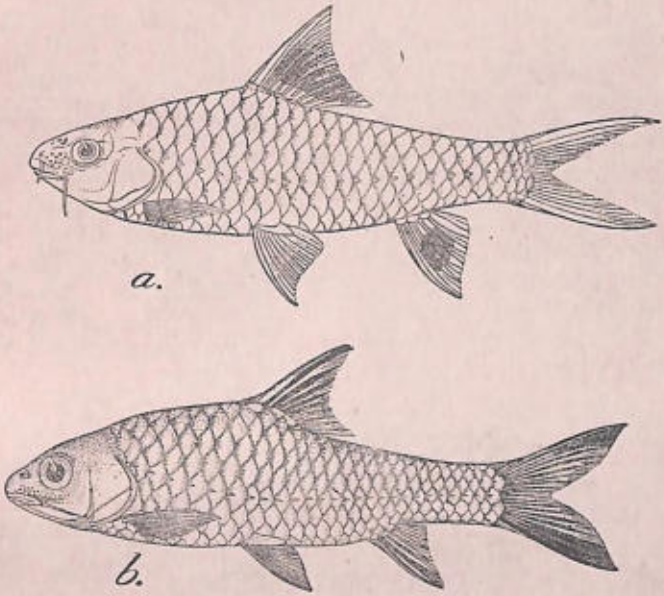


Text-fig. 3.—Lateral view of *Barbus caldwelli* Nichols. (After Nichols.)

In 1925, Nichols (**19**, p. 2) described a species of *Barbus*, *B. caldwelli*, from Fukien, China, characterized by 24 scales along the lateral line and 'left side of snout only with a band of small, crowded, warty points above the maxillary'. Later, he (**20**, p. 12, fig. 3) figured the species and included it in the subgenus *Spinibarbus* Oshima, but Lin (**15**, pp. 210, 214) placed it in the genus *Lissochilus*. From the description and figure of this species we are inclined to regard it a very close ally of *L. hexagonolepis*, if not absolutely identical with it. We have included references to *L. caldwelli* in the synonymy with a query so as to elicit further information about this form.

In 1934, Fowler (**5**, p. 120) described *L. hutchinsoni* from Nakon Sritamarat, Siam, from a specimen 148 mm. in length and stated 'Closely related to *Lissochilus sumatranus* Weber and de Beaufort, but that species figured and described with black ends to its caudal lobes, color uniform and ventral nearly reaching

anal.' This species is provided with 23 scales along the lateral line and 7 before the base of the dorsal fin. The membranes between the rays of the dorsal fin are stated to be dusky medially while those of the anal are dusky to blackish.



Text-fig. 4.—Lateral view of *Lissochilus hutchinsoni* Fowler, and of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland, showing the dusky colour of the interspinous membranes of the dorsal fin, etc.

a. Lissochilus hutchinsoni Fowler. (After Fowler.); *b.* A specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from Balipara Frontier Tract, Assam. × *ca* 3/5.

We have noted that in fresh specimens the membranes of the dorsal, anal and caudal fins are dusky, but they never form a dark blotch on the anal fin as shown in Fowler's figure. The intensity of the colour-markings is an individual variation generally dependent on the nature of the habitat and, in consequence, we do not attach any specific value to it. Attention may also be directed to the fact that the individuals of the same species are generally more brightly coloured in Burma and the Far East as compared with those residing in the Indian waters. In the present state of our knowledge we regard *L. hutchinsoni* as a synonym of *L. hexagonolepis*. Fowler also recorded *L. dukai* from Siam.

In 1937, Herre and Myers (8, p. 61) described *L. tweediei* from the River Yum, Perak, F.M.S.; the description is based on 4 specimens from 64 to 92 mm. in length. This species is provided with 26 scales along the lateral line and 8 predorsal scales and is distinguished from the other species of the genus 'in the very broad, sharp, horny edge to the lower jaw and the almost complete suppression or reduction of the lower lip.' This species is evidently based on very young specimens and the character of the lower

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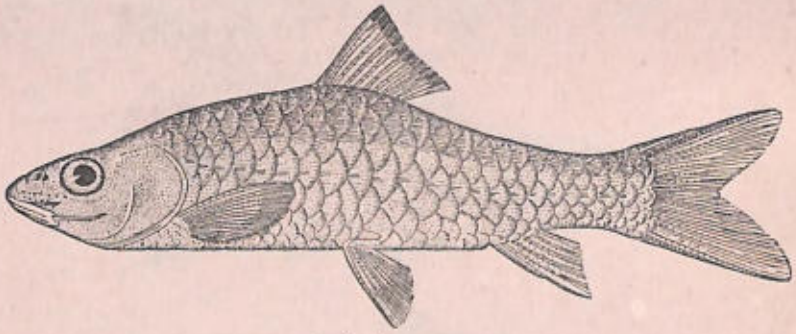

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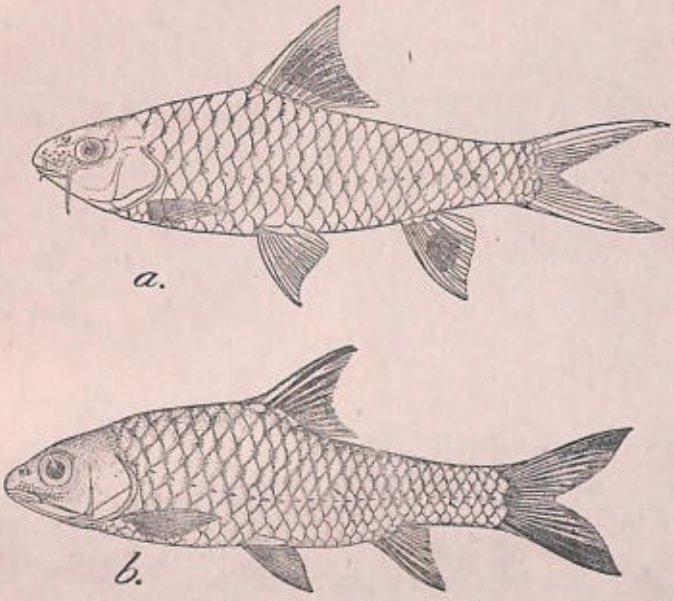

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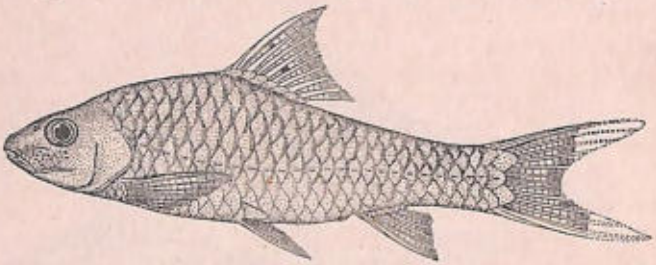
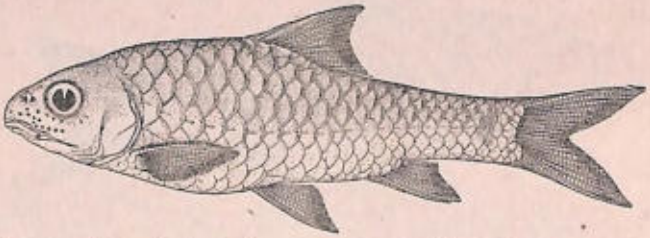
jaw and lip, as judged from the large number of Indian specimens of *Lissochilus* of all sizes examined by us, is not very constant. It not only varies with the nature of the environment but is also



Text-fig. 5.—Lateral view of *Lissochilus tweediei* Herre and Myers. (After Herre and Myers.)

liable to be affected by preserving fluid (**23**, p. 168). We have not found any other distinguishing feature in its description for separating it specifically from *L. hexagonolepis*.



Text-fig. 6.—Lateral view of a paratype of *Lissochilus hendersoni* Herre. *Nat. Size.*

Recently Herre (**6**, p. 10) described another species of *Lissochilus, L. hendersoni,* from Malaya (Penang Island). His description is based on 28 specimens from 59-70 mm. in length. This species is also based on juvenile examples in which the number of scales along the lateral line is 23 and the predorsal scales are 5-6. We have examined paratypes of this species and find that it cannot be separated specifically from the young of *L. hexagonolepis*. There are 23-24 scales along the lateral line and 6-7 before the base of the dorsal fin. Its so-called strong dorsal spine is not quite as strong as the spines of certain Indian specimens collected from the streams flowing through the limestone rocks. We showed such specimens to Dr. Herre during his recent visit to Calcutta and generally discussed with him the status of the extra-Indian species of *Lissochilus* described from the Malay Peninsula. He informed us that when describing *L. tweediei* and *L. hendersoni* he was not aware of the fact that these fishes attained a huge size and a weight of many pounds. In view of the great range of variation exhibited by the Indian specimens of *L. hexagonolepis* he was also of the opinion that all the Malayan species referred to above should be treated as synonyms of *L. hexagonolepis*.

STATUS OF THE CHINESE SPECIES OF *Lissochilus* WEBER & DE BEAUFORT AND THE SYSTEMATIC POSITION OF *Poropuntius* SMITH.

There is a group of Chinese, *Barbus*-like forms which have been assigned by various authors to *Lissochilus*. In recent years Herre and Myers (**7**, pp. 242-247), Myers (**18**, pp. 257, 258) and Lin (**15**, pp. 209-215) have discussed the systematic position of these species, but as we have not examined any specimen from China we are not in a position to deal with the matter further, except to make a few general comments on the information contained in the published accounts.

Herre and Myers, and Myers included the following 9 species from China in the genus *Lissochilus*:

1. *Lissochilus labiatus* (Regan).
2. *Lissochilus monticola* (Günther).
3. *Lissochilus hemispinus* (Nichols).
4. *Lissochilus barbodon* (Nichols and Pope).
5. *Lissochilus kreyenbergii* (Regan).
6. *Lissochilus formosanus* (Regan).
7. *Lissochilus invergatus* (Oshima).
8. *Lissochilus fasciatus* (Steindachner).
9. *Lissochilus paradoxus* (Günther).

Lin did not include species Nos. 6, 7 and 9 in his synoptic table of the genus, but added *L. styani* (*Boulenger*), *L. rendahli* (Lin) and *L. caldwelli* (Nichols) to the genus *Lissochilus*. Later, he (**16**, p. 307) described another species in this genus—*L. clivosius*. We have already referred (*vide supra*, p. 308) to the systematic position of *L. caldwelli* and indicated its close affinity to *L. hexagonolepis*. In the remaining species the number of scales along the lateral line is generally 40 or more. They are not stated to grow to a very large size and most of them are characterized by the possession of short vertical bars across the body. The nature of the dorsal spine (weak or strong; smooth or serrated), and the character of the lower jaw and lips are variable. Reliable information regarding the position and extent of the tubercles on the snout of the Chinese species is not available. In *L. styani* they are stated to be present on the tip of the snout while in true *Lissochilus* they are between the maxillaries and the eyes. While agreeing with Herre and Myers that in recognising genera among the Cyprinidae a difference of 10 scales in the count along the lateral line is not a valid generic character, we feel that this difference coupled with the geographical position of the two groups merits some sort of distinction. Species of *Lissochilus* of the *hexagonolepis*-type are not only large-scaled but also grow to a large size and are mostly confined to the Brahmaputra and Chindwin drainages in India, Burma, Siam, Malay Peninsula and the Archipelago. The species with the small scales are mostly confined to Southern China. In his treatment of the Cyprinoid genera with a procumbent predorsal spine, Hora (**11**, pp. 311-319) recognised groups on geographical distribution and assigned them subgeneric ranks. We consider that a somewhat similar procedure will meet the need of the situation here, for the time being at least.

There is yet another group of species usually referred to *Lissochilus* for which H. M. Smith (**21**, p. 14) had proposed the name *Poropuntius* and remarked:

'This genus resembles *Lissochilus* from Southern Asia and Sumatra, in having the lower jaw covered with a horny sheath and a deep sulcus separating it from the lower lip. The pores on the snout in *Lissochilus* are surmounted by horny tubercles which extend to below the eye, and the last simple dorsal ray is weakly ossified and not denticulated. There is no rostral groove.'

The type-species of the genus, *P. normani*, was described from Siam from a single specimen 10.5 cm. in length; it is characterized by the possession of 31 scales along the lateral line and 11 before the dorsal fin. Another species of this type was described by de Beaufort (**2**, p. 34) from Johore, Malay Peninsula, and placed in the genus *Lissochilus*, *L. smedleyi*. He observed that:

'This species is closely allied to *Poropuntius normani*, recently described by H. Smith (*Proc. U. S. Nat. Mus.*, Vol. 79, 1931, p. 15) from Siam. This species differs from *L. smedleyi* in the following points: 14 scales round caudal peduncle, interorbital space flat, osseous part of dorsal spine equal to head less snout, ventrals and pectorals subequal 1.25 in head.'

Before considering the generic validity of *Poropuntius* reference may be made to other species of *Barbus* of the *Poropuntius*-type. In 1923, one of us (**10**, p. 155) referred three specimens from Koh Chang, Siam, to *Barbus deauratus* Cuvier & Valenciennes,[1] and included them in the subgenus *Lissochilus*. Evidently no importance was then attached to their serrated dorsal spine or the position

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[1] There seems to be a certain amount of confusion regarding the nature of the dorsal spine of *Barbus deauratus*. Cuvier and Valenciennes (*Hist. Nat. Poiss.*, vol. xvi, p. 188, 1842) noted that 'le rayon de la dorsale est grêle, lisse'. The length of the specimen (? specimens) examined by them is stated to be 'quatre pouces et demi'. Günther (*Cat. Fish. Brit. Mus.*, vol. vii, p. 128, 1868) gave a very brief description of the species after Valenciennes and noted that 'The osseous dorsal ray is slender and smooth.' Sauvage [*Nouv. Archiv. Mus. Hist. Nat. Paris*, (2), vol. iv, p. 183, pl. vi, fig. 5, 1881] redescribed the species from a specimen 125 mm. in length, and made the following statement regarding the dorsal fin:

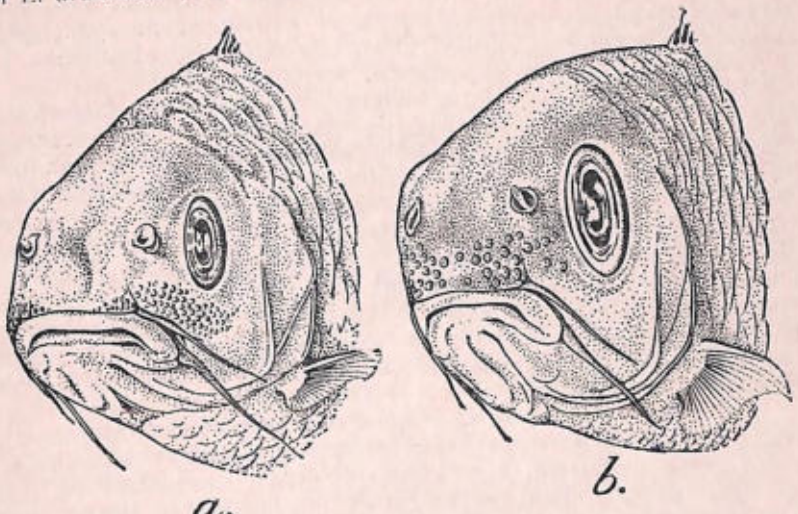
'Dorsale placée plus près de l'extrémité du museau que de l'origine de la caudale, insérée au-dessus des ventrales; troisième rayon osseux, faiblement denteló, aussi long que la tête, sans le museau.'

The Koh Chang specimens assigned by me (**10**, p. 155) to *B.* (*Lissochilus*) *deauratus* possess strongly denticulated dorsal spine and in other respects also agree very closely with Smith's (**21**, p. 14) description of *Poropuntius normani*. Suvatti (**22**, pp. 55, 56) recorded both *L. deauratus* and *P. normani* from Siam but it is not stated how he distinguished the two species. The presumption is that Suvatti's specimens of *L. deauratus* from the Pattani River, Khau Banthat, Ko Chang and Pak Chong are characterized by a smooth dorsal spine.

It is not possible under the present conditions to get any further information regarding the nature of the dorsal spine in the type-specimen of *B. deauratus*. If on a re-examination the dorsal spine is found to be smooth and the anterior part of the snout is free from pores, then it will be synonymous with *B.* (*Lissochilus*) *hexagonolepis*, but if the dorsal spine is denticulated and the pores cover the anterior part of the snout, then it will be congeneric with *P. normani*. Mr. Misra, relying on the descriptions of Valenciennes and Günther, is of the opinion that *B. deauratus* is a synonym of *B. hexagonolepis*, the range of which will be thus extended to Cochin-China also.

S. L. Hora.

of the tubercles on the snout. We find that H. M. Smith's description of *P. normani* agrees very closely with the specimens of *L. deauratus* in the collection of the Zoological Survey of India.



Text-fig. 7. *Lissochilus* Weber and de Beaufort, and *Poropuntius* Smith, to show position of tubercles on the snout.
a. Barbus (*Lissochilus*) *hexagonolepis* McClelland from Tavoy. *Nat. Size*; *b. Barbus* (*Poropuntius*) *normani* Smith. × 3.

Barbus clavatus McClelland, redescribed by one of us (**9**, p. 185) from Assam is also a *Poropuntius*, though in the description no mention is made of the tubercles on the snout. We have now examined large series of specimens from different localities in Assam, and find that the presence of tubercles in the anterior part of the snout is a constant feature of the species. It is provided with 40-42 scales along the lateral line and 14 in front of the dorsal fin. A variety of this species, *B. clavatus burtoni*, was described by Mukerji (**17**, p. 64) from the Myitkyina District, Burma. This variety was distinguished from the typical form by 'its longer snout, shorter third spine of the dorsal fin, fewer scales along the lateral line, in a transverse series and before the dorsal fin, and by the colouration which is more dark than bright and silvery'.

Attention may here be directed to the fact that in South India also there are certain species of *Barbus* (*sensu lato*), *B. mysorensis* Jerdon for example, in which the snout is covered with horny tubercles and the number of scales along the lateral line is in the neighbourhood of 40. We have not investigated the exact generic limits of these fishes, but they seem to bear close affinities to certain Chinese species referred to above.

From the foregoing account it is clear that *Poropuntius* is fairly widely distributed in South-Eastern Asia—Assam (*P. clavatus*; L. l. 40-42), Burma (*P. clavatus burtoni*; L. l. 35-38), Siam, Cochin-China, Malay Peninsula (*P. deauratus*; L. l. 31) and Malay Peninsula (*P. smedleyi*, L. l. 27-28). It is remarkable that the

scales become larger and fewer as we travel away from India to the east and south. The same conclusion was reached by us (**13**, pp. 268, 269) in our studies on *Barbus* (*Puntius*) *ticto* and *Rohtee cotio* (**14**, pp. 166-171), and the same is true of the large series of specimens examined by us of *Lissochilus hexagonolepis*. As to the significance of this change in lepidosis, we are not in a position to give any explanation.

An examination of a large number of specimens of *Lissochilus* and *Poropuntius* has convinced us that both the names can be regarded as valid subgenera which can be distinguished on the character of the dorsal spine and on the position of the tubercles on the head. Whether the *Poropuntius*-type of *Barbus* is represented in the Chinese and South Indian species referred to above requires further elucidation. In the absence of any Chinese material we refrain from discussing this matter further, but there seems a possibility that some of the Chinese species may belong to *Poropuntius*, and in that case some earlier generic name, such as *Lissochilichthys* Oshima and *Acrossocheilus* Oshima will have precedence.

As regards *Lissochilus*, we propose to restrict it to comparatively large-scaled Barbels of the *hexagonolepis*-type with from 22 to 32 scales along the lateral line, a smooth dorsal spine and with the tubercles not extending to the tip of the snout. In the present state of our knowledge there seems to be only one widely distributed species of this genus.

Variations and Bionomics.

The head is proportionately larger in young specimens and its length with reference to the standard length varies from 3.27 in a specimen 76.5 mm. long to 4.32 in a specimen 208 mm. long. The height of the head and its width also vary in the same way. Similarly the eyes are considerably larger in young specimens. The tubercles on the snout begin to appear at a very young age; we have noted two tubercles above the origin of maxillary barbels in a specimen 27 mm. in standard length. The arrangement and number of tubercles vary considerably even in specimens from the same locality, and it seems probable that sexual differences may be responsible for this variation. The barbels are also proportionately longer in young specimens. In the preceding article of this series reference has already been made to the great variation exhibited by the dorsal spine, and the same has been found to be true in the case of the extra-Indian specimens. The size and strength of the dorsal spine seems to vary with locality. The lepidosis varies with age and locality, there may be 22-32 scales along the lateral line, 7-11 predorsal scales, 12-14 scales round caudal peduncle and $2\frac{1}{2}$ to $3\frac{1}{2}$ series of scales between the lateral line and the base of the pelvic fin.

Reference has been made in the earlier article to the great variation in colouration exhibited by this species. In the two colour illustrations reproduced here some further differences may be noted. In a specimen from Pegu, 204 mm. in standard length, Mr. D. E. B. Manning noted that the back was of a deep olive colour followed on

Ad.) grows to about $\frac{3}{4}$ in. in height. Some Eulimids are parasitic on 'sea-cucumbers' to which they attach themselves so firmly that considerable force is required to dislodge them. These shells are washed up during the south-west currents between March and August each year.

Another attractive genus is the familiar wentletrap or *Epitonium*, of which a dozen or more species may be gathered during the same season; also two species of the little *Ringicula*, and the iridescent *Minolia impressa* (Nevill). These last three, and other small fry such as *Bullina*, *Pupa*, *Cylichna*, should be sought for amongst the scum and weeds of high-water mark on the seaward bend of the estuary at Ennur as well as in deep cracks in the water-sodden timbers of old catamarans.

The Scaphopoda are represented at Madras by two species of *Cadulus* and by six or seven of the well-known *Dentalium* or elephant's tusk-shell. Beach specimens of the latter are usually broken and should not be collected unless the posterior or smaller end is intact, the margin of the small opening being often notched on the convex side. In addition, several species are furnished with a small supplemental tube protruding from the apical end, easily broken. Besides the smooth forms, *D. octangulatum* Don. may be found with seven, eight, and nine main ribs. A six-ribbed shell of stout *octangulatum* form and one of 16 ribs, have still to be identified.

The Class Cephalopoda comprises creatures of the type of squid, octopus, etc., in which the shell is internal or absent. The calcareous 'cuttlefish bones' which litter our beaches at all times belong to *Sepia* and *Sepiella*. *Sepia prashadi* Winckworth whose pink-backed shells, up to 110 mm. in length, are to be found from January to early in April each year, has only recently been described. *Sepia andreanoides* Hoyle (*Doratosepion*) also occurs, measuring $2\frac{3}{4}$ inches, of similar colouring towards the spine but narrower in shape and with the dorsal longitudinal depressions undeveloped; rare here, it is common on Khor Maksar beach at Aden. *Loligo* is very common; a live individual must be secured in order to obtain a specimen of its transparent and perishable 'pen'.

The shells of the three external shell-bearing Cephalopods are also to be found at Madras. Those of the deep-sea *Spirula spirula* (L.) (Plate II, fig.2) and of *Nautilus pompilius* L. are thrown up in stormy weather, the latter always in fragmentary condition. I once picked up a young Nautilus shell measuring 1 inch in length about eight miles south of Elliot's Beach and I have also found one *Argonauta hians* Sol. (Plate II, fig. 1) in what appears to be fresh condition. This indication of the presence of a Nautilid nursery off the Coromandel Coast must not be accepted too readily as these shells are very buoyant and may be brought to our shores from other parts by monsoonal currents.

The arrival of large numbers of the seed pods of *Carapa obovata*, also stated to be *C. moluccensis*, during the early months of each year when north-easterly winds have already been blowing for two or three months, may be cited as an instance of the carrying power of the winds and sea currents. The Carapa tree grows

in the tidal forests and mangrove swamps of Malaya, on the Aracan Coast of Upper Burma and, doubtless, in the Nicobars and Andamans and it seems likely that some of the pods which reach Madras may have come from the last-named place which is a known habitat of *Nautilus*. The nearest location of Carapa to Madras is fully 200 miles to the north, in the Guntur forest division, so that in any case the pods in question must have travelled by sea for a considerable distance.

The Carapa pods should be examined as they frequently harbour a nest of ship-worms (*Teredo*) which, as free-swimming fry, have attached themselves to the floating homes so conveniently offered and dug themselves in to such good purpose that during the long sea voyage they have developed and grown to full capacity, supplanting the kernel and filling the entire shell with a closely packed twist of their strange tubular casings. Inside these tubes will be found the palettes and shells of *Teredo clava* Gm. Similarly, waterlogged branches or pieces of timber often house *Martesia* and should not be passed by unchallenged.

Amongst the less common lamellibranchs should be recorded the watering-pot shell (*Brechites*), with aberrant valves which fail to function in a normal manner at an early age, the unhappy inhabitant thus being left to 'think again'. The result is an amazing travesty consisting of a cylindrical tube, 4 or 5 inches long, terminating at the lower extremity in a perforated convex shield surrounded by a frilled border of tubes branching out like the petals of a flower, the perforated centre being reminiscent of the rose of a watering-pot. An examination of the tube, immediately above the rose, will locate the useless bivalve shell embedded *in situ*. *Cucurbitula cymbium* (Spengler) is another lamellibranch whose shell is even more effectively disguised. *Cucurbitula* creates for its burrow a pear-shaped encasement, moulded of sand and shelly matter, generally attached to another shell or piece of loose coral wherein to pursue undisturbed its placid philosophy of life—*'non omnia possumus omnes'*.

The months of May to August, when southerly winds prevail, provide us with an interesting series of juveniles in the earlier stages of shell development, i.e. at the commencement of the enlargement of their homes from the embryo or veliger stage. A powerful magnifying glass is essential in order to be able to note and appreciate the delicate beauty of these embryonic shells.

During the periods of storm, particularly in the autumn, Aviculids (Pteriidae) may be found still clinging to the branches of sea-fans which have been torn from the ocean bed, the shells varying in tone between yellow and red according to the colour of the particular Gorgoniid adopted for their life-long dwelling place. At these times some of the larger worn and broken shells which are washed ashore, such as *Ficus*, (Plate III, figs. 1 and 2) *Turritella*, etc., usually contain a family of the flat slipper limpet, *Crepidula walshii* Herrm., as many as a dozen often being crowded together into a wholly inadequate space, the neat circular baby shells clinging to the backs of their elders. The apices of the young shells show clearly the original spiral formation. It is advisable to boil these

the sides by a band of light prussian blue below which the body was silvery white. The head was of a reddish brown colour, somewhat lighter in the opercular region. In the sub- and post-opercular regions and along the edges of the scales the colour was light cadmium. The iris was light cadmium orange. The dorsal and the caudal fins were of a light reddish brown while the other fins were of a light purplish grey colour. Mr. Manning characterised this species as the 'Olive Mahseer' and noted that he caught the fish in the Pathi stream, a feeder of the Sittang river. 'A clear granite boulder stream which holds mahseer up to about two pounds in weight. The fish take a dry spoon freely. Burmese name in the locality is *Nga-Dank-Ma'*. Mr. Manning noted its great resemblance to the 'Gold' or 'Red Mahseer' of the Tavoy District, but stated that it 'is perhaps not quite so golden and it appears to have 25 scales along the lateral line'.

In the 'Red Mahseer' of the Tavoy District, Mr. Manning noted that the back was darkish greeny brown which looked purple while under water. Below this up to the lateral line the scales were golden with deep antwerp blue bases and madder brown margins. In the region of the lateral line the scales were of a lighter golden colour. The lower part of the body was silvery white and the scales were encircled with brown spots. The sides of the head were light golden yellow while the opercular region was reddish golden yellow. The iris was light orange yellow. The dorsal fin was yellowish brown while the other fins were of a light raw umber colour. The bases of the pectoral, pelvic and anal fins were pinkish.

Mr. Manning supplied the following notes on the habitat and bionomics of the 'Red Mahseer':—

'Very common in the clear rocky streams of Tavoy and Mergui. They run very small and the best I have ever seen could not have been over 20 pounds. The average is nearer 7 pounds as a limit in most streams. The fish normally lie up in the deep still pools and only exceptionally will they be taken in rapid water. Shoals roam round the pools preferring those that are deep and black and rocky. The fish do not normally lie in the rocky fast headwaters but drop down to the slow deep rocky pools.

'They run up to spawn about the end of May to June and stay up till the end of September when they go down on one of the late rises. At these times they are found in the rocky swift headwater streams. Throughout the year they appear to be in grand condition and appear to be very fat in comparison with the Indian mahseer.

'They take best in the hot weather and I suggest that this is a matter of scarcity of food and nothing else. In the rains and early cold weather the food is plentiful. All the fish in Tavoy take better in the hot weather.

'*Food.*—They are very partial to *thingan* (*Hopea odorata*) leaves which blow down in plenty in November to January with the morning north-east winds. At such times the Karens catch them with leaves baited on to hooks which are allowed to dangle on the surface from fixed rods. I have seen them jumping out of the water to get the leaves of a *Ficus* tree which had fallen. All the leaves within about 6 inches of the water were stripped. They also eat small fish, insects, etc., but the main part of their diet appears to be green food. They take spoons freely preferring a silver and gold or silver and copper spoon in my opinion. I have never taken them on a fly.

'There appear to be two different mahseer from the pores over the mouth. This is thought to be a matter of sex and Burmans tell me that the female has very numerous pores and the male but few.'

MEASUREMENTS IN MILLIMETRES AND SCALE-COUNTS OF SPECIMENS OF *BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS* McCLELLAND FROM BURMA

	Kamaing, Myitkyina Dt.	Taloktwin, Sittang drainage	Pegu				Tavoy				
Total length	...	191·5	...	212·0	...	...	...	310·0	335·0	342·0	460·0
Standard length	202·0	144·5	116·0	161·0	204·0	235·0	230·0	240·0	265·0	270·0	365·0
Length of head	51·5	39·0	30·3	41·0	48·5	56·0	55·0	58·5	64·5	68·4	92·5
Height of head	36·5	30·0	24·5	31·0	39·0	45·0	42·0	44·3	50·0	53·0	67·5
Width of head	32·8	26·8	19·5	28·5	35·0	41·5	39·0	37·0	41·1	44·0	61·2
Diameter of eye	13·5	11·0	10·5	13·0	14·0	15·3	39·0	16·2	17·5	17·5	22·5
Length of snout	14·0	11·0	9·0	12·0	13·5	18·0	15·0	20·0	22·0	20·9	31·0
Interorbital distance	19·5	15·0	11·0	17·0	21·5	24·5	17·5	21·1	29·0	28·2	39·0
Width of body	30·5	26·5	22·0	31·5	36·5	46·5	22·0	34·2	42·5	43·5	63·5
Depth of body	51·4	42·5	37·0	53·1	65·3	70·5	40·0	62·0	81·0	83·0	93·5
Length of caudal peduncle ...	35·0	24·5	18·5	25·5	30·0	34·0	68·0	40·0	44·0	39·0	54·0
Least height of caudal peduncle ...	23·0	17·0	15·0	22·0	25·0	29·0	41·0	27·0	32·5	33·5	38·4
Length of dorsal fin	D.	34·0	D.	D.	33·0	41·3	28·0	43·0	49·0	48·0	64·0
Length of pectoral fin	38·5	30·0	24·0	35·0	41·0	47·0	50·5	49·0	54·0	58·5	70·0
Length of pelvic fin	31·0	27·0	21·5	31·3	35·5	40·5	42·0	41·5	41·0	41·3	57·5
Length of anal fin	29·0	27·0	21·0	28·3	35·5	45·0	35·0	46·0	51·0	57·0	72·0
Length of rostral barbel ..	13·0	12·5	9·0	13·0	14·5	17·0	17·5	13·0	14·0	19·0	21·5
Length of maxillary barbel ...	14·5	13·5	9·5	16·0	21·5	24·0	23·5	16·0	23·5	25·0	22·5
No. of predorsal scales ...	8	9	9	9	8	8	9	D.	8	8	8
No. of scales along L. l. ...	26	26	26	25	24	25	26	25	24	22	24
No. of scales between L. l. and V.	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½

MEASUREMENTS IN MILLIMETRES AND SCALE-COUNTS OF SPECIMENS OF *BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS* McCLELLAND FROM MALAY PENINSULA AND SIAM

	Malay Peninsula														Siam
	R. Ketil, Kelantan			R. Sepia, Pahang	Kuala Terla, Pahang			R. Mertang, Negri Sambilan		W. of Ginting Sempak, Selangor			Penang Island		Nakon Srita-marat
Total length	141·0	219·0	327·5	372·0	130·0	144·5	159·0	91·0	100·5	82·6	104·5	107·0	85·0	87·0	...
Standard length ...	110·0	167·0	252·5	287·0	99·5	110·0	120·0	69·0	74·0	63·0	76·5	83·0	66·0	67·0	147·5
Length of head ...	27·5	43·5	64·5	75·0	27·5	30·0	32·5	19·0	21·0	17·5	23·2	24·0	18·0	18·0	42·3
Height of head ...	20·5	34·0	49·5	58·0	20·0	22·0	23·0	15·0	15·5	13·5	16·5	18 0	13·9	14·0	31·5
Width of head ...	17·2	29·0	41·0	51·5	14·5	17·0	18·0	12·5	12·5	10·0	13·5	15·0	10·5	11·0	29·0
Diameter of eye ...	9·0	12·0	16·0	18·0	8·5	9·5	9·5	7·3	7·5	6·3	7·3	7·3	6·3	6·3	11·0
Length of snout ...	9·0	13·5	21·0	25·0	8·5	8·5	11·0	6·0	6·0	5·0	7·0	8·0	5·0	5·2	13·0
Interorbital distance ...	10·0	16·5	27·0	31·7	9·5	10·0	10·5	6·0	7·0	5·6	7·0	8·0	6·0	6·0	15·5
Width of body ...	17·2	29·0	41·0	51·5	14·5	17·0	18·0	11·5	11·5	9·5	12·0	14·0	10·5	11·0	22·5
Depth of body ...	31·0	51·0	72·5	91·0	26·5	24·5	32·5	21·0	21·5	17·5	21·0	23·0	21·0	20·5	38·3
Length of caudal peduncle	22·0	29·0	42·5	55·0	16·0	17·0	20·5	12·5	13·5	13·0	14·9	15·0	12·0	13·0	24·0
Least height of caudal peduncle	14·0	20·0	31·5	35·0	10·3	12·5	12·5	9·0	9·0	8·0	9·0	9·0	8·5	8·5	15·5
Length of dorsal fin ...	25·0	38·0	55·0	66·5	21·0	25 0	26·5	20·0	19·5	16·0	19·0	18·5	18·0	18·0	29·0
Length of pectoral fin ...	23·0	34·0	50·0	70·0	20·0	23·0	25·0	17·5	17·5	15·0	17·0	18·0	15·5	15·7	28·0
Length of pelvic fin ...	20·5	29·5	38·5	52·5	16·0	17·5	21·5	13·0	15·0	13·2	16·0	15·0	14·0	12·0	21·0
Length of anal fin ...	21·5	29·5	49·5	67·0	16·5	18·0	21·5	13·0	16·0	13·0	15·0	15·5	13·5	13·0	26·5
Length of rostral barbel...	7·5	12·5	19·0	24·0	8·0	8·0	10·0	7·5	8·5	5·5	7·0	7·0	5·5	5·5	13·5
Length of maxillary barbel	9·5	14·0	25·5	32·5	9·0	12·0	11·0	8·0	9·0	6·0	7·5	7·5	7·0	6·5	14·5
No. of predorsal scales ...	9	9	9	8	8	8	8	6/7	8	8	8	7/8	8	7/8	8
No. of scales along L. l...	27	27	27	26	25	27	25	22–24	24	26	25	24	24	24	25–26
No. of scales between L. l and V	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½

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Explanation of Plates.

Barbus (*Lissochilus*) *hexagonolepis* McClelland.

The two colour drawings reproduced on this plate were made from sketches, notes and specimens supplied by Mr. D. E. B. Manning, Divisional Forest Officer, Burma, and portray variation in colouration exhibited by the species in different waters.

The upper illustration is from a specimen of the 'Olive Mahseer' of the Pegu District, while the lower one represents the 'Gold' or 'Red Mahseer' of the Tavoy District. However, both the colour varieties represent the same species and show that much reliance cannot be placed on colouration alone in distinguishing species of the large-scaled Barbels of India.

For details of colouration see pp. 314, 315 above.

A NEW SPECIES OF COLEUS

BY

K. CHERIAN JACOB, L.Ag., F.L.S.

(*With a plate*).

Coleus vettiveroides K. C. Jacob, sp. nov. Labiatae—Ocimoideae.

Ab aliis speciebus differt radicibus, 'quae sunt aromaticae dum sint integrae.' Herba succulenta, 45 cm.-53 cm. altitudine, fruticosa, ramis aliquantulum decumbentibus. Truncus 1.25 cm. diametro, leniter sub-purpureus, pubescens, cum albis, brevibus capillis, axis primaria plus minus quadrilateralis, ramis fere teretibus. Folia opposita; petioli 4-6 cm. longi, pubescentes, subpurpurei, ventro sulcato dorsoque tereti; lamina crassa, fere rotunda, 8-10 cm. longa, 9-12 cm. lata, superiori superficie sparse pubescens, inferiori superficie dense pubescens; nervi palmati; nervi praecipui 12, insuper demersi, desuper valde elati et prominentes; superficies rugosa; margines dentati. Radices fibrosae; 35 cm.-50 cm. longae si arenoso solo crescant, stramineo colore, post unum alterumve diem nigri evadentes, aromaticae dum sint recentes.

Plantae flores nemo unquam vidit.

Coleus osmirrhizon Elliot nomen tantum in Herbarium Madras (Coimbatore) No. 40, 797.

Herb succulent, 45 cm.-53 cm. in height, bushy with slightly decumbent branches; stem 1.25 cm. in diameter, slightly purplish, pubescent with white short hairs, main stem more or less four-sided and branches nearly terete; leaves opposite; petioles 4 cm.-6 cm. long, pubescent, purplish, ventrally furrowed, dorsally rounded (terete); lamina thick, nearly rounded, 8 cm.-10 cm. long, 9 cm.-12 cm. broad, sparsely pubescent on the upper surface and densely pubescent below; nerves palmate, main nerves 12, sunk above and very much raised and prominent below; surface puckered; margins dentate. Roots fibrous, 35 cm.-50 cm. long when grown in sandy areas, straw-coloured, turning dark after a day or two, aromatic when fresh.

The plant has so far been seen only under cultivation at Shiyali, Tanjore District; Palni in Madura District; Conjeeveram in Chingleput District, etc., in the Madras Presidency and it has not been seen in flower anywhere at any time. The plants were specially grown at Shiyali in Tanjore District, South India, a natural habitat and at Coimbatore. All attempts at inducing flowering have failed at both places. There is a specimen of this plant in the Madras Herbarium at Coimbatore labelled *Coleus osmirrhizon* Elliot. Tamil: Kuru Veru, collected at Mahabalipuram, Chingleput District, by T. Abboy Naidu on the 25th May, 1879. This name (*Coleus osmirrhizon* Elliot) could not be traced in any of the literature available here. The Curator of the Herbarium, Royal Botanic Gardens, Sibpur, Calcutta, considers it as only a manuscript name. This specimen also is without flowers.

There is a good deal of confusion in the local names of the scented roots of *Vetiveria zizanioides* Nash. (a grass) and those of this species of Coleus, the specific name of which has not been determined. With a view to clarify this confusion, a questionnaire was sent to some of the most important places where these two roots are very well known locally, and information obtained through the Agricultural Departmental Officers. Four local names, viz., Vetti ver, Kuru ver, Velamichai ver and Ramacham were reported to be in common use for these two scented roots. The consensus of opinion is that Vetti ver and Kuru ver are synonyms and are used for the roots of the Coleus species and Velamichai ver and Ramacham are two linguistic names for the grass, *Vetiveria zizanioides* Nash., the former in Tamil Districts, and the later in Malayalam speaking Districts and States.

Coleus vettiveroides K. C. Jacob. sp. nov.
Plant about four months old. Height 1½', Spread 2¼'.

The roots of this Coleus species are known as Vettiver in Tanjore, North Arcot, Coimbatore, Madura, Tinnevelly and Ramnad Districts. The same root is known as Kuru ver in Chingleput, Tanjore, North Arcot and parts of Madura Districts. Vetti ver and Kuru ver are synonymously used in Tanjore, North Arcot and parts of Madura Districts.

In Shiyali Taluq of the Tanjore District where this Coleus species is extensively cultivated on the sandy banks of the Coleroon river, the names Vetti ver and Kuru ver are synonymously used. At Palni in Madura District where it is under cultivation in sandy garden lands it goes by the name Vetti-ver and at Conjeeveram in Chingleput District where it is cultivated on the banks of the Vegavathi river it is known as Kuruver.

The fresh fragrant roots of Vettiver (Kuruver) are used from time immemorial in the decoration of the idols in the South Indian temples of the Tamil Districts and also in the ladies' toilet for dressing hair.

The well-known Khus-khus or Cuscus of Commerce is known as Velamichai or Velamichaver in all the Tamil Districts, viz., Tanjore, North Arcot, Madura, Tinnevelly, Coimbatore, etc. In parts of Tinnevelly District it is also known as Lamacham or Ramacham ver. Ramacham is the well-known name for this root unmistakably used throughout the Malayalam speaking area. It is called Vetti ver at Vellaikulam in Chingleput District adjoining the Telugu area.

The fragrant dried roots of the Khus-khus are used for making mats, chick-thatties, fancy fans and 'Kavadies'. It is also employed in the adulteration of Vettiver at Srivilliputtur, Ramnad District. These roots are scented only at certain seasons of the year (*Madras Agricultural Department Year Book* 1918, pp. 67-69). It is extensively cultivated on the coastal regions of the Ponnani Taluq of the Malabar District. It is also grown to a limited extent at Srivilliputtur in Ramnad District mainly for adulterating with the roots of Vettiver (*Coleus* sp.). This grass is found commonly in swampy or moist situations in Mysore, South Kanara, Malabar, Coimbatore, Chingleput, South Arcot, Nellore, Kistna, Godaveri, Vizagapatam and other Districts. But the extraction of Khus-khus at the proper season and the manufacture of chick-thatties, fans, etc., are carried on as a cottage industry by the moplah community (Malayalam speaking Muhammadans) of the Ponnani taluq in the Malabar District.

The dried roots of this grass retain the pleasant and strong aroma for a very long time even for some years, while only fresh roots of Vettiver (Coleus sp.) are scented and made use of since they become odourless as they dry up in the course of 3 or 4 days. The fresh Vettiver roots are straw-coloured but soon become dark as they dry up, while those of Khus-khus retain the straw colour even after drying.

In the Telugu Districts of this Presidency starting from the Chingleput District right up to Ganjam, Khus-khus roots are known as Vetti ver. The idols in the Telugu temples are not generally decorated with any scented roots. Since Khus-khus is known as Vetti ver, the products of Khus-khus, viz., chick-thatties, fans, etc., are also known as Vettiver thatties, fans, etc., in these parts.

It has already been shown that Khus-khus and Vettiver (also known as Kuruver) are the roots of two different kinds of plants but are recognised by different conflicting names in different localities of this Province. This misnomer in the local name has been carried so far that the local name of the Coleus species was given to a species of grass, *Vetiveria odorata* Virey., as early as 1827. Hooker, in the *Flora of British India*, puts Vetiveria as a subgenus of Andropogon and called this plant *Andropogon squarrosus* Linn. f., but Gamble, in the *Flora of the Presidency of Madras*, names this grass as *Vetiveria zizanioides* Nash. The local name of this *Coleus* has become the generic name of a group of grasses, one of which has scented roots.

The origin of the name Vettiver for Khus-khus in Telugu parts is not known. The following explanation is suggested:—

T. Abboy Naidu's specimen of this *Coleus* was collected in the year 1870, near Madras and is known as Kuruver. Telugu area begins with Madras. This *Coleus*, therefore, might have been known to Telugus as Kuruver. The Telugus who visit the famous South Indian temples might have become familiar with Vettiver roots which are used to decorate the

idols in those temples. It is likely that they might have been ignorant of the two different names Kuruver and Vettiver for the same plant. They might have hence thought that Vettiver might be the roots of the Khus-khus plant which are also scented. During the time of the East India Company, Samalkota, in Telugu country, was a centre of botanical study and the name Vettiver might have been first introduced into botanical works somewhere here.

Vettiver or Kuruver (*Coleus* sp.) is largely cultivated on the river banks in sandy loams. It is propagated by planting young shoots and plants are ready for lifting in about 4 months when the roots would have attained the maximum length and possessed with best aroma. It needs heavy manuring and constant watering.

This species of Coleus which has not so far been correctly named is designated as *Coleus vettiveroides* K. C. Jacob. The specific name *vettiveroides* is after the most popular Tamil name of the plant in places where it is largely cultivated.

Type in Madras Herbarium, Coimbatore : Madras Herbarium No. 85,676.

My thanks are due to Father A. Rapinat, S. J., Professor of Botany, St. Joseph's College, Trichinopoly, for kindly rendering the English description into Latin, to Rao Bahadur G. N. Rangaswami Ayyangar, F.N.I., I.A.S., Geneticist and Principal, Agricultural College, Coimbatore, and Dr. N. L. Bor, Forest Botanist, Dehra Dun, for their valuable suggestions.

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MARINE SHELLS OF MADRAS.

BY

M. D. CRICHTON.

(*With 4 plates*).

Melvill and Standen[1] computed the total of Madras marine mollusca at slightly over 700 of which, approximately, 470 were univalves and 230 bivalves. It should be noted, however, that the collections examined by them when compiling their catalogue included specimens from the neighbourhood of Pamban, a distance of 235 miles by sea from Madras, where coral formation predominates in marked contrast to the unrelieved sand of the southern portion of the East Coast of India. As there are many mollusca peculiar to coral-reef conditions which are not found elsewhere there would appear to be reason—if only as a matter of local interest—for keeping separate a record of species which are known to make their homes, in some cases it may be only as temporary visitors, within sound of the surf of the Coromandel Coast.

I have had opportunities of collecting at many places along the shores of this coast besides dredging down to 6 or 8 fathoms off Pondicherry, Cuddalore, Porto Novo, and Negapatam, and to a greater depth at Madras, and am satisfied that the forms found at Madras may be regarded as typical of the entire coast, say from Point Calimere (Lat. 10° 18′ N.) to Cocanada (Lat. 17° N.). The territory covered by these notes, however, will be confined to the strip of sea-board in the immediate vicinity of Madras, extending about thirty miles from Ennur towards Covelong in the south. Apart from the harbour area the coast presents an unbroken vista of yellow sand except where intersected by the channels of the backwater at Ennur and of the Cooum and Adyar, two small rivers whose egress is barred periodically by great banks of sand piled up during the dry months following each north-east monsoon.

Consequently the mollusca comprise chiefly the dwellers in sand and mud, the only rock habitations being those provided by the hand of man, such as the blocks of concrete and stone placed as breakwaters for the protection of the harbour walls and the revetment immediately north of Royapuram Bay. The total number of species known to Madras exceeds 700, approximately 500 univalves and 230 bivalves. This total is constantly being added to. The mollusca here enumerated should be taken merely as a general indication of some of the species to be found.

THE LITTORAL ZONE.

The number of living mollusca within reach of the seeker along the shore is limited, not only by the absence of such favourite molluscan haunts as reefs and rock-fringed pools but also by the

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[1] The marine mollusca of Madras and the immediate neighbourhood. *J. Conchol.*, vol. 9, pp. 30-85 (1898).

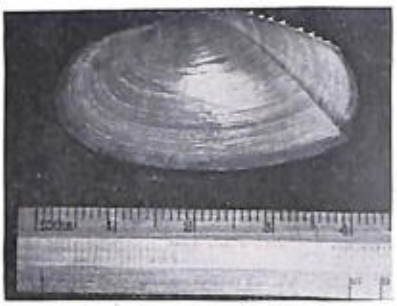
restricted collecting area available between high and low water mark, the average rise and fall of the tide being under 3 feet with a maximum of 4.5 feet. Even so, a diligent search within wading depth will bring to light a fair range of species varying more or less regularly in seasonal rotation throughout the year. The most noticeable of these visitors is the lively tapering *Bullia vittata* (L.) with large water-charged foot and narrow and inadequate operculum which, with the rarer *B. livida* Reeve, may be seen in considerable numbers on the firm wet sand at low tide, particularly at Parry's Beach to the south of the harbour. This, on occasion, feeds on the little round-backed crab (*Philyra*) whose arrival synchronizes with that of *Bullia;* after an initial 'hand off', the crab submits to being seized without any further effort at resistance and is soon drawn within the muscular folds of the mantle. So determined is the hold on its victim that the *Bullia* can be pulled almost completely out of the shell without losing its grip. This mollusc dwells with us for several months each year, during which time its family increases and grows up rapidly. The shell of *B. livida,* although resembling that of *B. vittata* both in shape and design, except that the spiral band of tubercles below the sutures of the latter consists of two or three rows whereas in *B. livida* it is usually single, will be easily recognized by a richer colouring and thickened outer lip, in addition to which the operculum is squarely oval and more or less fills the aperture. *B. tranquebarica* (Röding) is a third local representative of this genus of the family *Nassariidae,* and its triangulate operculum with serrated edge completes the three types of operculum associated with this family.

Farther south, at St. Thomé and beyond, olive-shells are to be found at all seasons, both *Oliva oliva* (L.) and *O. ispidula* (L.), the latter in an infinite variety of colours and markings. Early in February each year large colonies of *Oliva gibbosa* (Born), in mature form, are to be found for a brief season near the shore at Elliot's Beach, the raised ridges of their mole-like burrows in the sand indicating their position. This handsome shell attains a length of some 3 inches and bears a close resemblance to *O. nebulosa* Lam., both in pattern and colouring. The latter, however, is narrower with a more tapering spire. Unlike *O. gibbosa* it is very rarely taken near the shore although commonly dredged in from 6 to 10 fathoms in all stages of growth.

The Olives are also carnivorous and show a partiality for the shy little mole-crab (*Hippa asiatica* Edwards). I have more than once witnessed the unequal contest with the victim struggling valiantly but helpless in the pincers-like grip of *O. hispidula,* whilst the swift incoming waves have swept the pair several times up and along and down the gently sloping beach and finally into deeper water without being able to break them apart. One cannot help feeling a sympathy for this strange, gentle creature, known locally as 'eel-lee', which spends the entire day digging itself into the wet sand with feverish haste as each receding wave leaves the ill-protected little body exposed to the pounce of Brahminy Kites and crows ever on the look-out for the tasty morsel. Providence's only compensation would appear to be the allotment of a

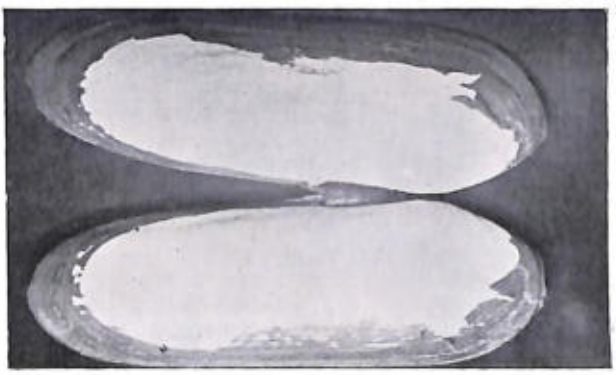
MARINE SHELLS OF MADRAS.

1. *Cardium assimile* Reeve.



2. *Tellina foliacea* Lin.

3. *Tellina angulata* Gmelin. *Tellina timorensis* Lam.



4. *Cultellus maximus* (Gmelin).

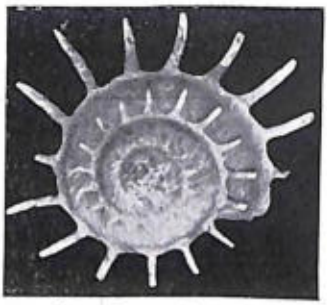
5. *Psammobia amethystus* Wood.

6. *Siliqua radiata* (Lin.).

MARINE SHELLS OF MADRAS.

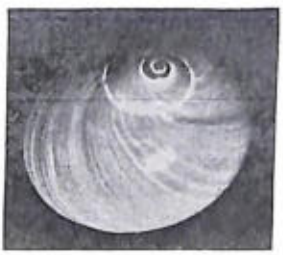
1. *Argonauta hians* (Solander).

2. *Spirula spirula* (Lin.).



3. *Xenophora solaris* (Lin.).

4. *Natica lineata* (Rod.).



5. *N. didyma* (Rod.). (normal shell).

6. *N. didyma* (Rod.). var. with scalariform whorls.

7. *Bursa spinosa* (Lam.).

8. *B. crumena* (Lam.).

9. *Gyrineum natator* (Bolten).

very brief span and its troubles, therefore, are soon over. Let us hope that under cover of darkness there may exist compensations of a more material kind!

Rapana bulbosa (Dillwyn) (Plate III, fig. 6) is sometimes swept shorewards during stormy weather and may be found clinging to an old shell or root of sea-weed, the young ones adhering to each other in clusters. *Nassarius* and *Natica* (Plate II, figs. 4, 5, 6) may also be taken.

Amongst the bivalves which feed near the shore are found four or five kinds of wedge-shell, the finest being the magnificent *Donax scortum* L., strongly fashioned with deep corrugations and rich purple interior. The tiny *D. dussumieri* Bertin may be found during brief periods about February and August each year. Large quantities of this brilliantly variegated little shell congregate an inch or so under the surface at ebb of tide; when exposed they quickly dive out of sight, sharp end first, into the wet sand. The commonest is *D. cuneatus* L. in a range of colouring, radiating from the umboes, which includes pale blue, yellow, brown, and a harsh liver-green. The young are in evidence in October in the shelter of Ennur backwater, while in February and March the half-grown and adult shells may be found together in large numbers between tide marks at St. Thomé and Ennur. In calm water the circular orifice of the upper or lower siphon may be observed just above the surface of the sand, indicating the presence of the shell buried an inch or so below. Fully grown shells measure from 40 to 43 mm. in length. Other all-the-year-round frequenters of the intertidal region include *Sunetta scripta* (L.), beautifully and variously patterned in purples, browns, mauves, gold, and ivory. These make their début about December and their growth may be followed month after month until the following autumn when they attain a full stature of some 33 mm. Several other brightly patterned species of the Venus family are also found.

Mactra cygnus Gm., whose thin but strongly formed shells, in a good range of colours, are usually to be found scattered on the beach, visits the shallows for a brief period only during the south-west monsoon, the young shells beginning to appear about April. *Mactra mera* Rv., *M. striatula* L., and young *M. turgida* Gm. are not uncommon towards the end of the north-east monsoon. The shells are seldom found complete, i.e. with both valves joined together or 'mudi' (முடி) as our young helpers concisely describe this desirable condition, unless taken alive.

Of the Garidae, *Soletellina diphos* (L.) should be looked for immediately south of the Adyar during the first violent storms of the north-east monsoon when it is dislodged from its sandy bed and flung ashore. Unless freshly collected the valves soon become separated, the thick greenish yellow periostracum cracks and peels away and the hot sun quickly bleaches the rich purple colouring of the shell. The young may be found earlier in the year in the extensive backwaters at Ennur and Covelong which are periodically open to the inflow of the sea.

The fan-oyster (*Pinna*) is another dweller in or near the channel of the Adyar river to seaward; live specimens are sometimes

uprooted from their burrows during the north-east gales. *Pinna* grows to a large size, *P. pectinata* L. (=*hanleyi* Rv.) and *P. attenuata* Rv. having both been found at Madras up to over one foot in length. A specimen of the latter, taken at Tuticorin, measures 19½ inches. A third species, *P. vexillum* Born, of dark colour and spreading shape and provided with a short, strong byssus, is occasionally delivered up during stormy weather a few miles farther south; mature shells of this species are of heavy, stout structure and are easily recognized. It may be remarked that the Madras *P. pectinata* does not, as a rule, show any external sign of the byssus, usually associated with *Pinna,* although, on close examination, two or three fine silken threads will be found issuing from the byssal opening immediately above the foot of the animal. It seems possible that these particular individuals, living in sand, without stones or other suitable anchorage available, had no use for a byssus. *Pinna* breeds about May or June to judge by a 20 mm. juvenile collected towards the end of June. *Siliqua radiata,* the sunset-shell, is very seldom taken alive or even with periostracum, but the spread-out empty valves, brilliantly rayed with blue and white, are abundant on the wet sands at ebb-tide.

Towards the end of the year, after a period of gales, large numbers of living *Pecten tranquebaricus* Gm. and *Pinctada chemnitzii* (Phil.) are sometimes washed ashore at Ennur.

Shore Collecting.

High-water mark throughout the year will reward the diligent seeker with a varying and fascinating harvest, chiefly of the smaller sort. There are many sharp little eyes at our service among the children of certain villages by the sea who have learnt to know what the *changu-dorai* wants and what he does not want. Amongst such helpers I remember with special gratitude Chinápen, Pichi-karen, Sammykins and his sister Chinnapoo. From these high-tide gatherings could be named upwards of one hundred species, but a selection must suffice.

The gastropod Aglossates are well represented. Of these the brilliant *Pyramidella terebellum* (Müller), with deep-chestnut spiral bands, grows to a full inch. The genus *Turbonilla*, of the same family, is represented by five or six species, including the white *T. coromandelica* (Melv. & St.), growing to 21 mm. With the aid of a magnifying glass may be clearly seen the peculiar development of the shell, the spiral growth of which begins in a sinistral direction thereafter twisting at right angles and finally developing in a normal dextral manner. The allied family of Eulimidae is represented by polished shells of the genera *Eulima, Balcis,* and *Niso.* The last is represented by two species, one of which, *Niso pyramidelloides* Nevill, just over half an inch in height and recognizable by its double spiral band of rich chestnut-brown, is among Madras's loveliest shells. *Balcis* is of snow-white colour, a typical feature of many species being a graceful backward bend which is very noticeable in *B. martinii* (A. Ad.). *Eulima* is usually spirally banded with brown; the local species *E. bivittata* (H. & A.

MARINE SHELLS OF MADRAS.

1. *Ficus graciis* (Sow.).

2. *F. ficus* (Lin.).

3. *Thais rudolphi* Lam.

4. *Murex tribulus* Lin.

5. *M. trapa* Rod.

6. *Rapana bulbosa* (Dill.).

7. *Xancus pyrum* (Lin.).
Height 9.2″; diameter 5.2″.

MARINE SHELLS OF MADRAS.

1. *Conus textile* Lin.

2. *C. betulinus* Lin.

3. *C. amadis* Lin.

4. *Turris indica* Rod.

5. *Turricula javana* (Lin.).

6. *Terebera commaculata* (Gmel.).

7. *T. duplicata* L.

8. *T. anilis* (Rod.).

out in order to avoid damaging the delicate edge of the inner plate. Colonies of *Crucibulum extinctorium* auct., a close relative of *Crepidula* but of a limpet or cup-like shape and with the inner plate formed into a twisted poke or cone, are also often to be found adhering to the outer surface of dead or living shells. This possesses a clearly recurved apex which, however, is usually blunted or worn away. The shell varies greatly in shape according to its environment and not infrequently bears a coloured spiral decoration; it may also show a grooved or striated pattern impressed from the sculptured surface of the shell on which it has grown.

No record of the shells of the shore should omit mention of that sapphire harvest of the monsoon when the violet sea snails (*Ianthinidae*) are cast ashore, sometimes in prodigious numbers and still alive with their efficient floats attached, the delicate shells flung from the crests of the crashing waves and seldom suffering hurt because of their lightness and buoyancy. It requires several days of strong onshore winds to bring them from their ocean base and—this is important—one must be present when the miracle takes place; by next day the wind will have scattered the shells far and wide and scarcely a trace will remain. The two commoner species of *Ianthina* which visit Madras are of very distinctive forms. *I. roseola* Rv. is squat in shape, the aperture three-quarters square and the shell of a heavier and stronger structure than *I. iricolor* Rv., whose larger aperture extends to a point at the base and has an outer lip of cupid's bow shape. The latter is seldom seen, although in March, 1939, I witnessed a large influx of them in all stages of growth from 5 mm. up to 35 mm. in height, many of the larger size having closely arranged egg-pouches, of a pale mauve colour, hanging from the underside of the float.

In spite of their enforced migration, a highly efficient organization manifests itself by the presence of small jellyfishes (*Siphonophora*) which bear them company during the long voyage and upon which they feed. Many of these are also violet in tint or else a sea-green, examples being the thin circular *Porpita*, *Velella* with sail-like projection set diagonally across its raft, and the Portuguese man-o'-war (*Physalia*), all of which are invariably found on the shore in large numbers along with *Ianthina*. Young *Ianthina* sometimes drift to the shore in the early months of the year; even the tiniest of these, barely 2 mm. in height, is provided with its float several times the size of the shell. At the time of low tide the white, frothy appearance of the float bubbles and the brilliant blue shells sparkle in the sunshine on the smooth wet sand. At similar seasons, and apparently forming a unit of the flotilla, may also be found the acrobatic little *Glaucus marinus* (Du Pont)—but this is a shell-less mollusc and therefore outside the scope of these notes.

The Fishing-Nets

It is worth while to be at hand when the great seine nets or *periyavalai*, taken a mile or so out to sea by Masula boat, are hauled in to shore. These frequently provide something new or desirable if one is quick enough, and lucky enough, not to miss

the prize as it slides elusively out of sight to be lost irremediably in the mass of soft palpitating bodies of fishes of all shapes and sizes, cuttles, medusae, crabs, and sea-snakes which are brought in with each haul. Incidentally, the collector would be well advised not to stand in the sea in the vicinity of the jellyfish which have to be cast out of the nets particularly during March and April. The slightest contact will set up a painful irritation and the affected part should immediately be rubbed down with sand and sea-water. A local cure is the application of tamarind paste. The villagers' name for jellyfish is *sori*, meaning itching. By means of these nets and particularly from a similar but smaller type of net known as *turi* which is used for ground trawling, being operated from two catamarans out to sea, many of our larger shells, usually in living condition, may be secured. I here mention some of these without adopting any particular order.

Harpa conoidalis Lam. is the sole representative of the family Harpidae. The shell is sturdy, richly decorated, and gloriously polished within. The inhabitant, at any effort to draw it forth, detaches the hinder and deeper coloured portion of its foot, which is left in one's hand in a most disconcerting way, much as the gecko with its tail. This solid fleshy attachment is fitted into a groove running along the posterior edge of the foot proper and comes away with very little pressure, leaving a clean undamaged socket which reminds one of the spring-back binding of a certain type of loose-leaf album. The amputation can be, and is, performed without adventitious aid, as occurred with a fully grown specimen which was being kept under observation in a bowl of sea-water; this individual climbed over the edge of the bowl and tumbled out leaving the lobular appendage behind. On another occasion this part detached itself and fell to the ground when a specimen was being transferred from one bucket to another, the shell being held mouth downwards and without any contact with the inmate. My largest specimen of this shell, collected at Madras, measures 95 mm. in height and 68 mm. in diameter.

The Conidae, with narrow operculum which is not always easy to locate, provide at least half-a-dozen species. *C. figulinus* L. is the common form with thick brown shell, but *Conus amadis* L. (Plate IV, fig. 3) is of outstanding beauty both in colour and brilliance of polish, varying considerably in design and fairly plentiful. *C. betulinus* L., (Plate IV, fig. 2) with thick periostracum and decorated with rows of dark brown spots, is of massive proportions and grows to above 4 inches in height, with a circumference of twice that measurement. My largest specimen measures 110 mm. in height.

The Ficidae or fig-shells number three species, all of them with delicately graved reticulate pattern and thin outer lip whose fragile edge, in the growing shell, requires the greatest care in cleaning to avoid chipping.

The Muricidae are well represented, many being provided with formidable defence works such as *Murex virgineus* (Röding), with mouth edged with coral pink and the spiny *M. tribulus* L. (Plate III, fig. 4). Some *tribulus* develop a distinctive

sculpture, the main feature of which is the number of transverse ridges between each of the major spines which varies from five to eight instead of the usual three. In addition the tubercles on the body-whorls of the former are closer set and more numerous; until young specimens of the former type have been found it must be assumed that the variation is merely a late development of the same species. *M. trapa* Roding (Plate III, fig. 5), a third variety of the type found at Madras is distinguished by its elongate spire but, particularly, by a prominent denticle in the anterior portion of the outer lip which can be traced back in the varices to the earliest whorls of the shell. The delicate *Murex pinnatus* Swainson, with feathery fin-like varices, is also worthy of special mention.

Cymatiidae, of which some half-a-dozen species may be secured, are of strangely irregular shape and furnished with fringes of strong bristle-like hairs along the crests of the varices.

The Tonnidae are represented by four species of which *Tonna dolium* (L.)=*maculata* (Lam.) comes ashore in large numbers. The protoconch is a tiny, smooth, amber-coloured spiral globe and bears no resemblance to the developed shell, but will be readily recognized by an examination of the apex of a mature specimen. A series of this shell showing the different stages of growth, the thickening and strengthening of the shell and the development and final fading away of the colour pattern as the supply of pigment becomes inadequate for the adornment of the expanded surface, can easily be formed. This method of collecting might, indeed, be applied to many of the spiral shells to add an instructive interest to the collection.

Amongst the Pectinidae is the beautiful *Amusium pleuronectes* (L.), known as the 'sun and moon shell', with the left or upper valve of livid hue and the other a dead white. This lamellibranch gets caught up in the nets a few miles south of Elliot's Beach, off Tiruavamoor, the adults arriving early in February, apparently for spawning as the spat and growing shells are in evidence from early March until June. Full-grown specimens measure up to 83 mm. both in length and height. *Amusium*, in common with other members of the Pectinidae, is active in its movements and, if placed in a large basin of sea-water may be seen to dart about with an amazing quickness of action. The animal is provided with a hundred or so eyes of different sizes, round and staring like those of a doll, which are placed at odd intervals among the waving filaments which fringe the edge of the upper mantle just inside the rim of the shell. I have counted up to 106 such eyes in one individual. *P. pyxidatus* (Born) has about 30 and *P. tranquebaricus* Gm. upwards of 50 eyes fringing both mantles to the auricle extremities.

Madras can claim about forty species of the family Veneridae among which three *Paphia*, commonly brought in from the deeper sea during the latter months of the year, deserve special mention by reason of their colouring and brilliant sheen, namely *P. alapapilionis* Röding (85 mm.), *P. textile* (Gm.) (66 mm.), and *P. gallus* (Gm.), also known as *P. malabarica* (57 mm.); the

measurements given in brackets are the lengths of the largest specimens so far collected by the writer. Several specimens of *P. undulata* (Born), distinguishable from *textile* by well marked, irregular, concentric ridges, have been found recently after a lapse of many years. Similar occurrences of the intermittent appearance of a particular species, after an apparent interval of years, are evident from time to time; a further example may be cited this year (1940) in the case of *Xenophora solaris* (L.) (Plate II, fig. 3), sixteen live specimens having been brought up in the catamaran drag nets during the month of July although no specimens had been recorded during the past five years.

Mactridae, too, are plentiful, amongst which *Mactra turgida* Gm., swollen out as its name implies and with umboes violet-tinged, is notable for its size, as is also the gaping *Cultellus maximus* (Gm.) (Plate I, fig. 4), of the Solenidae, which exceeds 5 inches in length.

Volva sowerbyana (Weink.), a small relative of the *Cypraeidae*, is rarely taken in live condition. The mantle fringe is dotted with bright spots of deep orange colour and the shell itself has an attractive sheen which, however, soon wears off.

Hydatina velum (Gm.), light as a bubble and measuring up to 46 mm. in height and 4 inches in circumference, is brought to shore in fair numbers about July and again towards the end of the year. To see the animal fully exserted and expanded, with frills and flounces most attractively fringed with purple, fills one with amazement that so much can come out of so little. To tuck itself in again requires delicate adjustment and takes time.

The true *Cassis* is not known at Madras but there are four species of the genus *Phalium*. These have brightly decorated shells, particularly *Phalium areola* (L.). *P. glaucum* (L.) has also a very handsome shell which grows to 4 inches or more in height. The animal is beautifully coloured in orange, brown, etc., the mantle being bordered with a brown edge. This is capable of expelling a purple fluid which will soon discolour a bucket of water.

Of the Strombidae, which are well represented in the Gulf of Manaar, four species have found their way as far north as Madras; *Strombus succinctus* L., whose shells, with expanding outer lip and measuring about 2 inches in height, are very occasionally brought in. These are invariably tenanted by hermit crabs, no living specimen having so far been taken. The young shells up to $\frac{3}{4}$ in. are not infrequently found on the shore. Madras's other Strombs are *S. sibbaldii* Sow., (?) *S. vittatus* L., and *Rimella cancellata* (Lam.), a most attractive little shell of about 1 inch.

A few miles south is located the local chank bed, to judge by the number of *Xancus pyrum* (L.) (Plate III, fig. 7), brought in. These are of the Tanjore tribe, fully turbinate and with flesh-tone colouring within. A large specimen, taken in a fisherman's net off Warikuppam, the village immediately south of Elliot's Beach, measures $9\frac{1}{4}$ inches in height and $15\frac{1}{2}$ inches in circumference, and weighs $2\frac{1}{2}$ lbs. This is a truly handsome shell although not so highly prized for the bangle industry as the purer white and more spindle-shaped *X. rapa* (Lam.) of Tuticorin. Young shells of both

these species are as a rule brightly decorated with closely set rows of brown spots. The egg-case of this mollusc is occasionally washed up during the early part of the year, in shape reminiscent of a goat's horn, with numerous segmental divisions stuffed with embryonic shells. The nipple-like protoconch persists in the full-grown shell as also in *Tudicla spirillus* (L.), of the same family, which is also found in this locality.

Few collectors can boast the possession of a sinistral chank. This well-known variety commands fancy prices partly on account of its scarcity but chiefly because it possesses a religious significance in Hinduism and Buddhism, which ensures a keen demand locally at all times. At long intervals one of these desiderata comes on to the market, the price realized for a medium-sized specimen being usually about Rs. 500 to Rs. 800, although much higher sums have been paid. Unfortunately there is no record of the number of sinistral chanks taken off the east coast of India, the Tanjore Chank Fishing-rights having been leased out by Government to contractors except for two or three seasons only when it was worked departmentally. During these years, out of a total catch of 57,324 shells, there is no record of a sinistral chank having been taken. The Tinnevelly Chank Fishery at Tuticorin has remained under strict Government control for many years. The records in this Department show that only two sinistral, or *valampuri* (meaning 'right twist') chanks were taken during the twenty-four years from 1914—one in 1930 and one in 1937—out of a total annual catch which, in recent years, has averaged between 300,000 and 400,000 shells. The fortunate diver who brings in a specimen receives a reward of one thousand times the price of a normal shell, which, at the present rate of one anna per shell, would amount to Rs. 62-8 as. From what I can gather it would appear that the sinistral variety of *X. rapa* of the Gulf of Manaar is much scarcer than that of *X. pyrum*, the Tanjore or Madras species.

The only other freak sinistral shell that I have seen from South Indian waters was a specimen of *Marginella angustata* Sowerby. Two species of *Triphora* in which the sinistral condition is normal may be found at Madras.

Many minor freak formations may be found such as in *Murex tribulus* L. (Plate III, fig. 4), whose normally straight canal is sometimes sinuous or twisted, and *Natica didyma* (Röding) (Plate II, fig. 5) with scalariform whorls. *Thais bufo* (Lam.) develops a remarkable thickening of the columellar lip which may even engulf the apex of the shell and was made a separate species by Lamarck under the name *callosa*. In another category are the malformations due, for the most part, to some early fracture and subsequent repair which has interrupted the orderly growth of the shell or disturbed the normal position of the varices or other processes, such as occur in *Murex* and *Volema*. From a similar cause damage to the mantle may affect the supply of pigment resulting in the colour-pattern of the shell changing or even vanishing altogether. I have examples of these in *Natica alapapilionis* (Röding) and *Tonna dolium* (L.). Albinism is of frequent occurrence amongst some of the brightly coloured bivalves such as Tellinidae as well as in

certain gastropods, for example *Drillia crenularis* (Lam.) and *Turricula tornata* (Dillwyn). I have also seen a striking example in *Conus amadis* Gm., which normally boasts a resplendent coat of brown and gold.

Our only Volute is *Cymbium*, the melon-shell, which grows to nearly a foot in height and twice this measurement in circumference. The animal wears a handsome mantle decorated with yellow and dark-brown stripes, depicted on the shell in the earlier stages of growth, while the interior of the shell has a beautiful satiny sheen. These are fairly plentiful, particularly towards the end of the year.

The best collecting period from the nets is from December to February when the mature molluscs apparently return each year to their spawning grounds in the shallower depths reached by the smaller trawling nets, say, perhaps, of 10 to 15 fathoms.

Dredging.

To explore with a dredge the sea bed of Royapuram Bay, and such depths as can be dragged by hand from a small boat yields a rich harvest of various dwellers in mud and sand.

With the first haul one is almost certain to see *Babylonia spirata* (L.), a powerfully built mollusc which, when dropped into the Kilner jar, immediately begins to throw its weight about in its endeavour to force an escape, much to the discomfiture of its fellow-captives. The aperture of the shell is usually of a highly glazed porcellanous white but a variation also exists in which the mouth and columella area are coloured a fulvous yellow. The two varieties are very distinct. Furthermore, the shell normally has a deeply excavated umbilical opening but specimens are not uncommon where the lower part of the columellar lip has folded backwards and spread over this opening until the umbilicus is completely obscured. The mature shell is generally about 2 inches in height but specimens are found exceeding 2½ inches. *B. zeylanica* (Brug.), a scarcer member of the family, is remarkable for the bright violet colouring within the umbilical opening of the shell and the two richly coloured red-brown bands which decorate the upper side of the leaf-shaped foot of the animal.

Several species of *Mitra*, including *Vexillum*, and of *Cancellaria* will be found as well as the very striking staircase-shell, *Architectonica*, with its variations in design, its brightly coloured decorations and peculiar pegged operculum.

Volema pugilina (Born), one of the largest shells of the coast, is obtainable here and, at the other extreme as regards size, *Phacoides macassari* (Prashad), a tiny spherical bivalve of extraordinarily deep sculpture, which barely fills the 5 millimeter gauge in any direction.

The Conidae and Terebridae, of the tribe Toxoglossa, whose members are provided with a poison-gland, occupy an important place amongst the Madras mollusca. In addition to the Coninae, whose sole genus *Conus* (Plate IV, figs. 1, 2, and 3) we have already noted, the Conidae family is divided into the sub-families

Brachytominae, Cytharinae, and Turrinae, the shells having a sinus or slit at the upper end of the labrum which at one time earned for them the descriptive group-name of Pleurotomatidae. Madras can claim over fifty species of these 'silt-lips', many of them obtainable by dredge.

The local Terebridae, numbering some eighteen species (Plate IV, figs. 6, 7, and 8), display considerable diversity in design and colour pattern. In size they vary from the ½ in. *Terebra tenera* Hinds, to a height of close upon 5 inches in *T. commaculata* (Gm.) (Plate IV, fig. 6). Many of these are fairly plentiful at a depth of from 15 to 20 fathoms, both out from the harbour and farther south. *T. triseriata* Gray, remarkable alike for its attenuated form and delicate sculpture, is one of the scarcest of the Madras shells whereas *T. eximia* Dh., reputedly a shell of some rarity, apparently pays seasonal visits to Madras waters a few miles south of Elliot's Beach, the empty shells, in fairly fresh condition, but generally with a hermit crab in possession, being not infrequently brought up in the fishing-nets during the north-east monsoon season. There are two varieties of *T. eximia* with three and four narrow bands respectively between the main spiral bands. No living specimen has yet been taken locally and my efforts to locate their place of settlement have resulted only in the capture of a dead specimen obtained at a depth of 15 fathoms. The shells measure up to slightly over 2½ inches in height.

Marginella ventricosa Fischer with deep olive-green shell which soon fades to a dove grey on exposure to the air, is a gem which should be preserved as long as possible in the home aquarium in order to mark the bejewelled decoration of mantle and tentacles. *M. angustata* Sowerby, of brilliant polish, is plentiful in all stages of growth.

Philine is an interesting creature, to outward appearance a lump of white, rather solid, jelly. Careful dissection is necessary here in order to expose, without fracture, the gossamer-thin shell within and the gizzard plates which are so well fitted for crunching the shells of smaller mollusca for food. It may happen that a tiny shell is actually in place for cracking at the moment of capture. *Sinum*, a relative of *Natica*, also has the shell hidden within the flesh and likewise requires delicate handling. *Ancilla* is unable to retire wholly within its smooth ivory-like shell but in this respect cannot be compared with the internal shells of *Philine* and *Sinum*.

Arcidae are in abundance and in varied forms which include the hirsute *Barbatia*, the strange twisted *Trisidos tortuosa* L. and, in the mud deposit off the East Quay, at a depth of 6 fathoms, *Cucullaea concamera* (Brug.), which is provided with a cup-like compartment in each valve for the attachment of the anterior adductor muscle. *Glycymeris*, a relative of *Arca*, is also plentiful.

The nut-shell (*Nucula*) with nacreous interior and the tiny *Nuculana*, whose shells are never to be found on the shore in fresh condition, are obtainable in Royapuram Bay in 6 to 8 fathoms. Two varieties of *Nucula* are common, one with smooth rims and the other with the interior of the margins finely serrated. *Aloidis*, better known by its synonym *Corbula*, with misfit valve, is another of

the smaller lamellibranchs, several species of which will be taken from the same fishing-ground.

Tellinidae are well represented, also cockles [*Cardium* (Plate I, fig. 1) and *Cardita*], the razor-fish (*Ensis*), *Cultellus* (Plate I, fig. 4), and *Pandora*. *Cardium asiaticum* Brug., odd valves of which are common on the beach, in live condition has the radiating ridges set with sharp-pointed spines and delicate laminae which are absent in beach specimens.

Among the sea-urchins there are two species, *Temnopleurus toreumaticus* and *Salmacis rubricincta* (?), which play host respectively to species of *Eulima* and *Stylifer*, whose minute shells may be found attached between the spines. The Holothurians or sea-cucumbers should not be thrown back without inspection. If the long-fingered starfish, *Linckia*, should make its appearance it should be searched carefully for a small Capulid of the genus *Thyca*, though I must confess that it has so far eluded me.

The Harbour.

Residents of Madras may be surprised to learn that upwards of fifty different species live in the harbour, some preferring a site to seaward although battered constantly by the waves, others choosing the tranquil waters within.

The harbour floor consists of a slimy, soft mud which is practically devoid of mollusc life with the exception of very occasional specimens of *Pandora*, *Paphia*, and *Cancellaria*, which can be obtained under pleasanter conditions out to sea. The large buoys or ships' moorings in the centre of the harbour are also disappointing, being overcrowded by *Mytilus viridis* L. to the exclusion of aught else. The collector is recommended to steer his boat to the inner quay on the northern side where good 'bags' can be secured amongst the submerged agglomeration of seaweeds, sponges, hydroids, and other sea-growths rooted to the wooden piles. The Lamellibranchia are almost exclusively of the fixed type, that is either cemented to the piles or to each other, or anchored by a byssus. Amongst the former are the massive *Chama* and *Spondylus* whose rough surfaces often bear strong outgrowing spines, the interiors being flushed with purple-rose. Of the byssus-forming mollusca a fairly representative collection can be formed, amongst which will be counted three or four species of Arcidae, of which *Arca lateralis* Rv. develops an interior plate or shelf-like septum although not so pronounced as in the case of *Cucullaea concamera*. Others are the oysters and mussels including the allied forms *Anomia*, *Septifer*, *Malleus*, and *Isognomon*, the last with a hinge reminiscent of a 'zip' fastener. *Lima lima* (L.), whose fringe of red and white filaments in constant motion is fascinating to watch, is provided with a beautiful pure white laminated shell.

The Gastropoda are about equal to the bivalves in numbers. *Euchelus asper* (Gm.) with rounded whorls, a Trochid of solid mother-o'-pearl, flourishes in large numbers throughout the year along with the flattened and sharply ridged sub-variety *tricarinata*. *Gyrineum natator* (Röding) (Plate II, fig. 9), a neatly sculptured

Cymatiid shell attaining a height of at least 2 inches, will also be found in abundance, particularly during the early months of the year. Species of *Engina*, *Pyrene*, *Drupa*, and *Thais* (Plate III, fig. 3) also live here.

Of the dozen species of cowry known to Madras, three at least make their homes here, viz. *Cypraea arabica* L., *C. pallida* Gray, and *C. ocellata* L. The last-named, decorated with brightly coloured ocelli, is a brilliant shell which it would be difficult to recognize in beach-worn specimens. Others attracted to this rich pasturage include the keyhole limpet, *Diodora lima* (Sow.) and the scarcer *Amalthea tricarinata* (Gm.). The latter challenges close scrutiny, being almost indistinguishable in its brown jacket, clinging limpet-like to a pearl oyster or gigantic mussel.

During the cold-weather months of 1938-9, large numbers of the small limpet-shaped brachiopod *Discinisca indica* Dall appeared. At low tide in the same area a Chiton should be looked for just above the sea level. This belongs to the genus *Acanthochitona* and may exceed 1 inch in length. It can be recognized by the tufts of strong bristles (eighteen in number) which decorate the margin or girdle. Numerous specimens of *Cypraea arabica*, already found on the piles, some reaching a basal measurement of 3 inches, and an occasional immature shell will also be found at low water, lurking in the deep fissures in the north wall which is also the home of *Mitra caeligena* Rv.

Higher up on the harbour wall, near and above the sea mark, are to be found *Littorina undulata* (L.), in vast quantities, of varied pattern and colour, and the local *Planaxis sulcatus* (Born) which is smaller than the Pamban and Tuticorin shell. A *Siphonaria*, that strange pulmonate of limpet form, will also be found here and the true limpet, *Patella* (*Cellana*).

The limpets, of which there are two or, possibly, three species, and several species of *Thais* thrive on the rocks outside the harbour walls where the boisterous and unexpected wave rejoices to catch the unwary mortal. Small chitons, *Plaxiphora indica* Thiele, may be taken clinging to the barnacle-roughened walls or lying closely hidden under the sea moss which covers the submerged concrete blocks of the breakwaters. This moss also provides cover for the dainty little *Pyrene terpsichore* (Sow.). *Venerupis macrophylla* Dh. should be looked for in chinks in the rocks where it lies securely wedged, although at times also found among the algae.

An opportunity should be watched for to explore the pools at the base of the blocks of concrete piled up in the fork at the northern end of the East Quay. Suitable conditions of low tide, combined with a westerly wind to check the incoming swell, will be met with during July. This exclusive site possesses a distinctive fauna which includes several mollusca not to be found elsewhere at Madras. Pride of place must be given to a large colony of *Turbo argyrostoma* L. clinging to the outer rocks at or just below sea-level; these are in such numbers that a handful of three or four at a time can be gathered. *Nerita albicilla* L. and *Nerita chamaeleon* L. will be noticed higher up on the rocks. Nerites have the nocturnal wandering habits of land-snails and are best collected

after dark, but the seeker by torchlight will find his task no easy one in this rough patch of country. It is strange that the shells of *Turbo* and *Nerita* are never found on the Madras shore, but this may be accounted for by the viscid nature of the soft mud of the harbour channel into which any old or dead shells must fall and sink deeply.

At one point occurs an unsuspected crop of coral (*Pocillopora*) within the thick stems of which will be discovered specimens of *Gastrochaena* and *Lithophaga;* in another pool a densely rooted seaweed furnishes a secluded retreat for *Arca avellana* Lam. Groups of a tiny *Arca symmetrica* Rv. will be found nested together in the hollowed undersurface of submerged stones. Numbers of the richly coloured *Thais rudolphi* Lam (Plate III, fig. 3), congregate at the head of narrow fissures in the rocks while *Thais intermedia* Kiener (=*hippocastanum* auct.) and two or three species of *Drupa*, and other rock climbers noticed elsewhere, are plentifully represented.

Cypraea arabica is particularly abundant, three distinct forms of the shell being present; two with dorsum of the flattened shape usual to Madras, one narrow and the other broad, the ratio of width to height ranging from ·54 to ·69, and a third with humped back sometimes separated as *histrio* Gm.

A straying *Bursa granularis* (Röding) or *Murex torrefactus* Sow. is indicative of other desirable things which may be clinging to the underside of the rocks deep in the sea. How to get at them is the problem! Here, if anywhere, should be the haunt of *Haliotis* if an unconfirmed report that it has actually been taken at Madras is true.

The rock-oyster (*Ostrea forskalii* Gm.) will be noticed growing thickly at about tide level both inside and outside the harbour. A hammer and chisel will be found necessary in order to obtain a complete specimen. The empty valves adhering to the walls and rocks offer a favourite resting place to the small *Nerita* already mentioned.

The end of the projecting South Wall provides a swarming ground for countless numbers of small Littorinidae, particularly *Littorina malaccana* Ph. and *Littorina ventricosa* Ph., as well as a tiny reddish-brown *Assiminea* (?) which spreads like a fine gravel over the spray-drenched areas.

The Backwaters.

In the backwaters at Ennur, as well as in the Adyar basin, will be found representatives of several genera which, although at home under brackish conditions, are so closely connected with the sea as to justify inclusion amongst their purely marine kindred.

Of such are several of the *Tellinidae*, including the blood-red *Tellina cuspis* Hanley (at times, but rarely, a shining white), *Neritina*, fluviatile forms of *Nassarius*, *Cerithidea*, and the brightly and variously coloured button shells, *Umbonium vestiarium* (L.), which are fully grown about April-May. In their turn some sea-dwellers find their way into this territory for feeding and breeding

purposes. These include several species of *Arca*, a small cockle, oysters, *Donax*, *Volema*, *Oliva*, and *Natica*; the egg-ribbon of *Natica* is in evidence from April onwards. Other marine molluscs to be taken here include *Turritella duplicata* (L.), *Conus figulinus* L., *Paphia gallus* (Gm.), and the diminutive *Nuculana mauritiana* (Sow.). The last group may be regarded as chance visitors swept in by the tide before the closing of the sea channel; nevertheless they accommodate themselves to the changed conditions in which they find themselves and appear to thrive. This is particularly the case at Ennur where the wide channel admits a free inflow of the sea during the greater part of the year. In April or May, shortly after the banking sand has closed the entrance, many imprisoned molluscs may be collected. These instinctively make their way in the direction of the sea and will be found in the shallowing end of the closed channel or stranded on the wet sand and mud exposed by the sinking water. Mature specimens of the brightly coloured *Bursa crumena* (Lam.) (Plate II, fig. 8) and *Tonna dolium* (L.) are usually in evidence. It was here that I obtained my largest *Rapana bulbosa* (Dillwyn) (Plate III, fig. 6) measuring 3½" in height. This will also be an opportunity for collecting *Pinna pectinata* L. which ordinarily is difficult to locate in the deeper and swiftly flowing waters of the open channel.

In these peaceful retreats the sea-hare pursues its quiet way. *Aplysia fimbriata* Ad. & Rv., which is the form commonly to be found at Ennur, exceeds 7 inches in length, its heavy, lumpy body being mottled with patches of grey and a dull sage-green, the darker shadings bearing a distinctive mosaic pattern. The Adyar sea-hare, probably a form of *Aplysia tigrina* Rang, with hood and mantle-folds richly ornamented in a close-set intertwining or maze-like pattern of bright olive-green on a grey background, is a gorgeous creature of leisurely movement whose general appearance conveys an impression of a prosperous and well ordered life. The internal 'shell' or shield of *Aplysia* is a transparent membranaceous affair measuring upwards of 2 inches in height and rather less across; the Ennur species has a more sloping shoulder than the other. *Bursatella*, sometimes misnamed *Notarchus*, adorned with jewel-like ocelli and variously coloured in deep brown, grey, or a bright golden-rust, is a close relative of *Aplysia* and makes its appearance in large numbers during the spawning season both in the Adyar and at Ennur. A microscopic spiral shell of nautiloid contour is present in the embryo.

At this season, in February and March, the weed-grown shallows will be found to be teeming with life in a wide variety of forms. Particularly so is this the case in the Adyar waters. The ubiquitous *Cerithidea cingulata* (Gm.) will be observed browsing in this rich feeding-ground and in the mud at the roots of the mossy weeds there may be collected a fair range of gapers, including several varieties of *Laternula*, whose paper-like, hyaline shells of a frosted whiteness require the greatest care in handling. These carry a fracture-like scar traversing both umbos but should not be discarded on this account, the condition apparently being normal. *Standella pellucida* (Gm.) is also present, its lurking-place revealed by the

attenuated siphon which protrudes 4 or 5 inches from the mud.

Periodically, with each spawning, the sea-grass and weeds will be found crowded with myriads of the small *Finella virgata* (Phil.) which reach a 'fledgling' stage in the course of two or three weeks and suddenly and mysteriously disappear. In the same way swarms of juvenile *Natica*, *Umbonium*, and *Nassarius*, may be noticed shortly after hatching, at odd times in different pools, throughout this period. These also quickly achieve a state of independence and disappear suddenly but are later easily retrieved from the river mud and sand at a depth of from 4 to 8 inches. The sea-grass harbours also the jewel-like *Smaragdia oualaniensis* (Lesson) and *Neritina siquijorensis* Récluz, both attractively adorned with variegated mosaic-like patterns. *Neritina* should also be looked for adhering to the inside of an old oyster or other shell and on stones in the Adyar above Elphinstone Bridge. On mud-covered bricks and bits of masonry lying in the edge of the water at the S.-E. corner of the Adyar pool may be found *Cyclostrema bushi* Dautzenberg and Fischer, besides two species of *Assiminea* and the small *Modiolus undulatus* (Dunker). Young oysters, both *Ostrea madrasensis* Preston and *O. forskalii* Gm., may also be noticed in large numbers astride the shells of *Cerithidea cingulata*, to which particular species they show a remarkable constancy, inevitably to become an embarrassment to both parties as the newcomer quickly outgrows its allotment. These top-heavy shells are often tenanted by hermit-crabs which soon become figures of misery as they stagger about under the increasing burdens which they have to bear until they are no longer able to join their more nimble brethren at the feast among the tender tips of the growing weeds.

At Ennur the larger Arcidae and *Telescopium telescopium* (L.), a ponderous Potamidid of 5 inches, the interior of which is smoothed over with a thick layer of plum coloured enamel, are fairly common in the soft exposed mud. The latter are particularly plentiful in the northern reaches of the backwaters at Covelong where the black mud acquires a slimy consistency to its liking.

A number of other species can be gleaned from the sand and mud with the aid of a sieve. In this manner we have secured at Ennur specimens of the lively little razor-shell, *Neosolen aquaedulcioris* Ghosh, and both at Ennur and Adyar several species of *Nassarius* and *Tellina*, which lie closely hidden a few inches below the surface of the mud, the familiar window-pane oyster (*Placenta placenta*), some of the smaller Trochidae such as *Euchelus* and *Minolia*, and the ½ in. *Odostomia attenuata* (A. Ad.) in amazing quantities considering that the empty shell is of the rarest occurrence. This last is seldom seen alive on the surface. Its method of progression is laborious, first advancing the small blood-red foot about a millimetre at a time, taking a grip on the sand and then hauling the shell along, repeating the process with a distinct pause at each stage of the completed movement in what can only be described as a furtive manner.

During the dry-weather months of March to May each year

the exposed surfaces of the sand-banks of the Adyar are scattered over with the thick shells of the popular edible 'mat-tee' (*Meretrix casta*) and other clams belonging to the Venus family. The empty valves of *Sanguinolaria* and the small slender *Solen annandalei* should also be looked for at the same time. The latter runs from barely 1 inch in length early in February to fully 3 inches in July. These bear a general resemblance to a broader and stoutly formed 4-inch shell, possibly *Solen lamarckii* Deshayes, which is brought in from the sea between August and October, young specimens in January/February.

Still later, in the months immediately preceding the south-west monsoon, a visit to Ennur will reward the collector with a very fair series of *Littorina*, both *L. scabra* (L.), whose colour-phases range over a choice of shades in yellow, brown, purple, and red, and the more attenuated *L. melanostoma* Gray, which may be gathered from the little white mangroves and marsh herbs of the muddy flats.

One should not omit to record the brachiopod *Lingula* which is to be found deep in the mud at the St. Thomé end of the Adyar basin. The brilliant colouring and sheen, the swivel-action of the hinge and the cilia in constant movement combine to make it a most fascinating creature to watch.

I should like to express my appreciation of the assistance so readily given at all times by the Museum and the Fisheries Department authorities in Madras as well as by Mr. R. Winckworth, of London, to whom I am also indebted for many identifications and the revision of the names of most of the shells enumerated in these notes. My thanks are also due to Mr. Sadasivan Chetty of Madras who kindly took the photographs illustrating this article.

196. **Schinus molle** L. Sp. Pl. 388.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38638!, 11458).
Flowers.—February-May.
Distribution.—Tropical America.

197. **Schinus dependens** Orteg. Hort. Matr. Dec. 102.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14875!).
Flowers.—April.
Distribution.—Brazil.

109. ODINA *ROXB.*

198. **Odina Woodier** Roxb. Fl. Ind. II, 293.

Locality.—Gurdaspur (Fane 4859!); Hoshiarpur (Ait. 514!).
Flowers.—June.
Distribution.—India; Ceylon.

XLI. LEGUMINOSAE.

1. *PAPILIONACEAE.*

110. ARGYROLOBIUM *ECKL. & ZEYL.*

199. **Argyrolobium flaccidum** Jaub. & Spach.

Locality.—Dalhousie (49!).
Distribution.—India.

111. CROTALARIA *L.*

200. **Crotalaria Burhia** Hamilt. in Wall. Cat. 5386.

Locality.—Lahore—Kot Lakhpat (Parker 14348!); Rawalpindi (Ait. 691!).
Flowers.—October.
Distribution.—Afghanistan, Baluchistan, N.-W. India, Gujarat, Rajputana, Sind.

201. **Crotalaria prostrata** Roxb. Hort. Beng. 54.

Locality.—Hoshiarpur (Ait. 567!).
Distribution.—India. Ceylon, Java.

202. **Crotalaria alata** Hamilt. ex. Roxb. in Don. Prodr. 241.

Locality. Kangra (Jameson 33667!, 33668!); Hoshiarpur (Ait. 532!).
Distribution.—Java; N.-W. India.

203. **Crotalaria sericea** Retz.

Locality.—Gurdaspur (Drum. 2!); Rawalpindi (Ait. 576!).
Flowers.—October-November.
Distribution.—N.-W. India.

204. **Crotalaria medicaginea** Lamk. Dict. II, 201.

Variety.—neglecta.
Locality.—Hoshiarpur (Ait. 279!).
Flowers.—August.
Distribution.—Malay isles; Afghanistan; China; Australia. India—Rajputana, Sind, N.-W. India to Ceylon and Burma.

112. TRIGONELLA *L.*

205. **Trigonella Foenum-graecum** L.

Locality.—Lahore (Stewart 2550!; 2902!); Rawalpindi (363!).
Flowers.—April.
Distribution.—S. Europe and Orient, widely cultivated. N.-W. India.

A CONTRIBUTION TO THE FLORA OF THE PUNJAB AND THE ASSOCIATED HILL REGIONS

BY

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PART II.

(*Continued from Vol. xlii, No.* 1, 149).

XL. ANACARDIACEAE.

106. RHUS *L.*

190. Rhus semialata Murray.

Locality.—Rawalpindi (Jerram 8090! alt. 4,500 ft.).
Distribution.—Temperate Himalaya; from Bahahal to Sikkim, alt. 3-6,000 ft.; Khasia Hills, alt. 3-5,000 ft.

191. Rhus rhodanthema Engl.

Locality.—Lahore (Mustoe 11706!).
Flowers.—March; Bright crimson.

192. Rhus copallina L. Sp. Pl. 266.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 6771!).
Flowers.—December.
* Introduced from Cuba.
Distribution.—N. America.

193. Rhus laevigata L. Sp. Pl. ed. II, 1672.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38633!).
Flowers.—April.
Distribution.—S. Africa.

107. PISTACIA *L.*

194. Pistacia integerrima Stewart in Brandis For. Flor. 122, t. XXII.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 31045!).
Flowers.—March.
Distribution.—Cultivated. North-Western Frontier; Peshawar valley and Salt Range; Western Himalaya; alt. 1,200-8,000 ft., from the Indus to Kumaon, usually on hot slopes.

108. SCHINUS *L.*

195. Schinus terebinthifolius Raddi, in Mem. Mod. XVIII. Fis. (1820) 399.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14364!).
Flowers.—October.
Distribution.—Brazil.

196. **Schinus molle** L. Sp. Pl. 388.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38638!, 11458).
Flowers.—February-May.
Distribution.—Tropical America.

197. **Schinus dependens** Orteg. Hort. Matr. Dec. 102.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14875!).
Flowers.—April.
Distribution.—Brazil.

109. ODINA *ROXB.*

198. **Odina Woodier** Roxb. Fl. Ind. II, 293.

Locality.—Gurdaspur (Fane 4859!); Hoshiarpur (Ait. 514!).
Flowers.—June.
Distribution.—India; Ceylon.

XLI. LEGUMINOSAE.

1. *PAPILIONACEAE.*

110. ARGYROLOBIUM *ECKL. & ZEYL.*

199. **Argyrolobium flaccidum** Jaub. & Spach.

Locality.—Dalhousie (49!).
Distribution.—India.

111. CROTALARIA *L.*

200. **Crotalaria Burhia** Hamilt. in Wall. Cat. 5386.

Locality.—Lahore—Kot Lakhpat (Parker 14348!); Rawalpindi (Ait. 691!).
Flowers.—October.
Distribution.—Afghanistan, Baluchistan, N.-W. India, Gujarat, Rajputana, Sind.

201. **Crotalaria prostrata** Roxb. Hort. Beng. 54.

Locality.—Hoshiarpur (Ait. 567!).
Distribution.—India. Ceylon, Java.

202. **Crotalaria alata** Hamilt. ex. Roxb. in Don. Prodr. 241.

Locality. Kangra (Jameson 33667!, 33668!); Hoshiarpur (Ait. 532!).
Distribution.—Java; N.-W. India.

203. **Crotalaria sericea** Retz.

Locality.—Gurdaspur (Drum. 2!); Rawalpindi (Ait. 576!).
Flowers.—October-November.
Distribution.—N.-W. India.

204. **Crotalaria medicaginea** Lamk. Dict. II, 201.

Variety.—neglecta.
Locality.—Hoshiarpur (Ait. 279!).
Flowers.—August.
Distribution.—Malay isles; Afghanistan; China; Australia. India—Rajputana, Sind, N.-W. India to Ceylon and Burma.

112. TRIGONELLA *L.*

205. **Trigonella Foenum-graecum** L.

Locality.—Lahore (Stewart 2550!; 2902!); Rawalpindi (363!).
Flowers.—April.
Distribution.—S. Europe and Orient, widely cultivated. N.-W. India.

113. Melilotus *JUSS.*

206. **Melilotus parviflora** Desf.

Locality.—Rawalpindi—Hussand (Ait. 370!, 369!, 368!); Lahore. (2933!; Stewart 2557!, 2602!).
Flowers.—March-May.
Distribution.—Orient, Europe and introduced in many other regions. India.

207. **Melilotus alba** Lamk. Dict. IV, 63.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21718!).
Flowers.—March; White.
* Grown for fodder.
Distribution.—Europe; Orient; Siberia. India.

208. **Melilotus indica** All. Fl. Pedem I (1785) 308.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21716!).
Flowers.—March; Yellow.
* Grown for fodder.
Distribution.—Europe; S. Persia; Afghanistan; Baluchistan and introduced in many other localities.

209. **Melilotus corylifolia** Linn.

Locality.—Rawalpindi (Ait. 371!).
Flowers.—April; Weed.

114. Medicago *L.*

210. **Medicago falcata** L.

Locality.—Rawalpindi (*Ait. 364!).
Flowers.—April.
* Cultivated for fodder (lucern).
Distribution.—Afghanistan; Orient; and all through Europe. N.-W. India.

211. **Medicago laciniata** All.

Locality.—Rawalpindi (Ait. 367!, 1037!).
Flowers.—March-April.
Distribution.—Abyssinia; Egypt; Baluchistan. India.

212. **Medicago denticulata** Willd.

Locality.—Lahore (* Parker 21715!, Stewart 2552!), Rawalpindi (Ait. 366!).
Flowers.—March.
* Cold weather weed in grassy places.
Distribution.—Europe; Abyssinia; Baluchistan; Orient; China; Japan; Siberia. India.

213. **Medicago Minima** Lamk.

Locality.—Rawalpindi—Barrakow (Ait. 365!).
Flowers.—April.
Distribution.—Afghanistan; Orient; Mediterranean region; Abyssinia; Europe. India.

115. Cyamopsis *DC.*

214. **Cyamopsis psoralioides** DC.

Locality.—Rawalpindi—Futtehgunj (Ait. 372!).
Flowers.—August.
Distribution.—Afghanistan. India—Rajputana, Sind.
Quite wild and not cultivated N.-W. of the Jhelum river.

116. INDIGOFERA *L.*

215. **Indigofera echinata** Willd.

Locality.—Rawalpindi—Googerkhaw (Ait. 374!).
Flowers.—June.
Distribution.—Guinea. India—Western Peninsula. Ceylon.

216. **Indigofera cordifolia** Heyne.

Locality.—Rawalpindi (Ait. 140!).
Flowers.—August.
Distribution.—Afghanistan; Baluchistan; Nubia; Malay Isles; N. Australia. India.

217. **Indigofera hirsuta** L.

Locality.—Hoshiarpur (Ait. 533!).
Distribution.—Tropical America; Java; Philippines; N. Australia. India.

218. **Indigofera tinctoria** L.

Locality.—Hoshiarpur (Ait. 295!).
Distribution.—Tropical regions, cultivated for local use.

219. **Indigofera hebepetala** Benth. Mss.

Locality.—Rawalpindi (Jerram 8274!).
Flowers.—July.
Distribution.—India—Himalayas, from Kashmir to Sikkim, alt. 6-15,000 ft.

220. **Indigofera pulchella** Roxb. Hort. Beng. 57.

Locality.—Hoshiarpur (Ait. 530!).
Distribution.—Throughout the Himalayas and hills of India proper, ascending to 5,000 ft., in Kumaon.

117. PSORALEA *L.*

221. **Psoralea plicata** Delile.

Locality.—Lahore—Chang (* Parker 13790!); Lahore 2903!; Hissar (Duthie 5234!).
Flowers.—August-September. Petals pale yellow, tipped with purple.
Distribution.—Arabia; Egypt; Tropical Africa. India—Plains of the Punjab.

118. EYSENHARDTIA *H. B. & K.*

222. **Eysenhardtia amorphoides** H. B. & K. Nov. Gen. et. Sp. VI, 489.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 38771!, 21023!).
Flowers.—March-August.
* Seed from Mexico. Petals all free. St. 9, 1, Anthers uniform. Ovary 2-ovulate. A shrub 6 ft. high. Leaves absolutely gland-dotted.
Distribution.—Mexico.

119. AMORPHA *L.*

223. **Amorpha fruticosa** L. Sp. Pl. 713.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38840!, 13639!, 13638!, 13637!, 12946!).
Flowers.—June-August.
Distribution.—N. America.

120. MILLETTIA *WT. & ARN.*

224. **Millettia ovalifolia** Kurz in Journ. Asiat. Soc. Beng. XLII, 2, 68, excl. Syn. W. & A.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11460 !, 14372 !, 12969 !, 38862 !); Ravi Park (Parker 38640 !).
Flowers.—April-August.
Distribution.—Burma.

121. TEPHROSIA *PERS.*

225. **Tephrosia tenuis** Wall. Cat. 5970.

Locality.—Rawalpindi (Ait. 145 !); Barrokow (Ait. 375 !).
Flowers.—August-September.
Distribution.—Laccadives. India—plains of Sind, Rajputana, the Punjab, Konkan.

226. **Tephrosia purpurea** Pers. Syn. Pl. II (1807) 329.

Locality.—Rawalpindi (Ait. 579 !).
Flowers.—October.
Distribution.—India—Rajputana. Ceylon. Everywhere in the tropics.

227. **Tephrosia Hamiltonii** J. R. Drum. in Gamble. Fl. Madras (1918) 320

Locality.—Pabbi Hills (Parker 24514 !, 24516 !).
Flowers.—December.
Distribution.—India.

122. SESBANIA *PERS.*

228. **Sesbania aegyptiaca** Pers.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6776 !, 6775 !).
Flowers.—December.
A small tree—20 ft. high.
Distribution.—Cosmopolitan in tropics of Old World.

229. **Sesbania aculeata** Pers.

Locality.—Multan (Holland 26316 !; 36130); Lahore—Kot Lakhpat (Parker 14327 !, 14328., 14329 !); Rawalpindi (Ait. 186 !, 575 !).
Flowers.—July-October.
Grows up to 8.9 ft. high.
Distribution.—Tropics of the Old World. India—Rajputana, Sind.

123. ASTRAGALUS *L.*

230. **Astragalus prolixus** Sieber Pl. Aegypt. Exsic.

Locality.—Lahore 2910 !; (Stewart 2528 !).
Flowers.—March.
Distribution.—Cape Verde Islands; Egypt; Arabia. India—Plains of Sind and Punjab.

231. **Astragalus Aitchisoni** Baker.

Locality.—Rawalpindi (Ait. 1040 !).
Flowers.—February.
Distribution.—India—Punjab.

232. **Astragalus tribuloides** Delile.

Locality.—Lahore (Stewart 2527 !); Rawalpindi (Ait. 379 !); Lyallpur (Inayat).
Flowers.—March-May.
Distribution.—Canaries through Egypt to Afghanistan. India—Plains of the Punjab.

233. **Astragalus pyrrhotrichus** Boiss. Diag. IX, 73.

Locality.—Near Peshawar (Collett 57 !); Rawalpindi—between Huzroo and Attsel on plains (* Ait. 1043 !).
* Not common.
Distribution.—Afghanistan. India—the Punjab.

234. **Astragalus Psilocentros** Fisch. in Bull. Soc. Nat. Mosc. (1853) II, 405=*polyacanthus.*

Locality.—Pabbi, west of Jhelum (Lambert 39880, alt. 1,100 ft.); Rawalpindi (Ait. 378 !).
Flowers.—March.
Distribution.—India—Himalayan region.

235. **Astragalus composum** Bth. ex Bunge, Astrag. II, 3.

Locality.—Rawalpindi (Ait. 376 !); Near Peshawar (Collett 57 !).
Flowers.—April.
Distribution.—Afghanistan.

124. TAVERNIERA *DC.*

236. **Taverniera nummularia** DC. Prodr. II, 339.

Locality.—Rawalpindi (23990 !, 6153 !); (Ait. 146 !, 380 !).
Flowers.—April-August-December.
Distribution.—Orient; Afghanistan; Baluchistan. India—Plains of Sind and the Punjab.

125. ONOBRYCHIS *GAERTN.*

237. **Onobrychis Stewartii** Baker.

Locality.—Rawalpindi (Ait. 377 !).
Flowers.—April.
Distribution.—India—the Punjab.

126. LESPEDEZA *MICH.*

238. **Lespedeza sericea** Miq. Ann. Mus. Lug. Bat. III, 49.

Locality.—Dalhousie (244 !, 245 !, 246 !, 247 !; Drum's collection); Rawalpindi—Barrakow and Triete (Ait. 383 !).
Flowers.—September.
Distribution.—China; Japan; N. Australia. India—the Punjab.

239. **Lespedeza eriocarpa** DC.

Locality.—Dalhousie (34 !; Drum's Herb.); Rawalpindi—Murree (Ait. 1048 ! alt. 7,000 ft.).
Flowers.—July.
Distribution.—India—the Punjab.

127. ALHAGI *DESV.*

240. **Alhagi camelorum** Fisch. Ind. Hort. Gorenk. ed. 2 (1812) 72.

Locality.—Lahore—Ag. Hort. Gdns. (Parker * 13640 !, 13135 !, 13809 !, 13808 !); Chang (Parker 13783 !).
Flowers.—April-September.
* Wild.
Distribution.—Egypt; Arabia. India—Sind, Rajputana, N. and N.-W. Provinces. Baluchistan.

128. Zornia *GMEL.*

241. **Zornia diphylla** Pers.

Locality.—Dalhousie (Drum. 33!).
Flowers.—August.
Distribution.—Everywhere in the Tropics. India—Plains from the Himalayas to Ceylon and Burma.

129. Uraria *DESV.*

242. **Uraria neglecta** Prain in Journ. As. Soc. Beng. LXVI, 382, 1897.

Locality.—Hoshiarpur (Ait. 463!).
Distribution.—India.

130. Alysicarpus *NECK.*

243. **Alysicarpus longifolius** W. & A. Prodr. 233.

Locality.—Lahore (2950).
Distribution.—Plains, scattered throughout India proper.

131. Ougeinia *BENTH.*

244. **Ougeinia dalbergioides** Benth. Pl. Jungh. 216.

Locality.—Hoshiarpur (Holland 45329!); (Mardainali 337!).
Flowers.—March.
Distribution.—Hilly tracts of Northern India and Konkan, ascending to 4,000 ft. in Kumaon.

132. Desmodium *DESV.*

245. **Desmodium laxiflorum** DC. Prodr. **II, 335.**

Locality.—Dalhousie (Drum. 4616!).
Distribution.—Java; Borneo; Philippines. India.

246. **Desmodium podocarpum** DC. Prodr. II, 336.

Locality.—Dalhousie (Drum. 59!).
Flowers.—September.
Distribution.—China; Japan. India—temperate and tropical Himalayas. alt. 2,000-7,000 ft., from Simla and Gharwal to Khasia and Sikkim.

247. **Desmodium tiliaefolium** G. Don Gen. Syst. II, 297.

Locality.—Rawalpindi—Triete (Ait. 382!).
Flowers.—September.
Distribution.—All along the Himalayas from the upper Punjab to Tavoy. Temperate and tropical zones, ascending to 9,000 ft.

248. **Desmodium gangeticum** DC. Prodr. II, 327.

Locality.—**Hoshiarpur (Ait. 471!).**
Distribution.—Tropical Africa; Malay Isles; Philippines; China, introduced in West Indies. India.

133. Abrus L.

249. **Abrus precatorius** L.

Locality.—Hoshiarpur (Ait. 519!).
Distribution.—India—Himalayas to Ceylon and Siam. Cosmopolitan in the Tropics, often planted.

134. CICER L.

250. **Cicer arietinum** L.

Locality.—Lahore (Stewart 2554 !).
Flowers.—March.
Distribution.—India—Commonly cultivated in northern provinces and Nilgiris. Cultivated in various temperate and tropical countries.

135. VICIA L.

251. **Vicia hirsuta** Koch. Synops. 191.

Locality.—Peshawar College (Quizilbash 23 !); Hoshiarpur (Ait. 575 !).
Distribution.—Europe; Orient. India—N.-W. Provinces.

252. **Vicia pallida** Turcz.

Locality.—Rawalpindi—Hussanal (Ait. 389 !).
Flowers.—March.
Distribution.—Siberia. India.

253 **Vicia Griffithii** Baker.

Locality.—Rawalpindi—Futtehgunj (Ait. 10461 !); Hussanal (Ait. 389 !, 1045 !).
Flowers.—March.
Distribution.—Afghanistan. India.

254. **Vicia sativa** L.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21705 !, 21706 !); near Peshawar (Collett); Lahore (Stewart 2529 !); Rawalpindi (Ait. 385 !, 387 !, 386 !).
Flowers.—March-April.
* Weed in wheat crop.
Distribution.—India—N.-W. Provinces, probably cultivated.

255. **Vicia bithynica** L. Syst. ed. x, 1166.

Locality.—Gurdaspur (Drum. 11 !).
Flowers.—February.
Distribution.—Mediterranean region.

136. LATHYRUS L.

256. **Lathyrus Aphaca** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 391 !); Lahore (Stewart 2915 !).
Flowers.—March-April.
Distribution.—Europe; Orient; Abyssinia. India—spread through the N. Provinces, ascending from the plains of Bengal to the temperate zone in Hazara, Kashmir and Kumaon.

257. **Lathyrus sativus** L.; DC. Prodr. II, 373.

Locality.—Rawalpindi—Hoshiarpur (Ait. 91 !); Barrakow (Ait. 393 !).
Flowers.—April.
Distribution.—Europe; Orient; Tropical Africa. India—spread through the N. Provinces, ascending from the plains of Bengal to Kumaon.

258. **Lathyrus sphaericus** Retz.; D.C. Prodr. II, 372.

Locality.—Gurdaspur (Drum. 9 !); Hoshiarpur (Ait. 1047 !).
Flowers.—February; Colour—vermilion.
Distribution.—Europe; Orient; Abyssinia. India—N.-W. Provinces, ascending from Bundelkhand and the Punjab to 5,500 ft. in Kumaon.

259. **Lathyrus inconspicuus** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 394 !).
Flowers.—April.
Distribution.—Mesopotamia; Syria; Afghanistan; Baluchistan. India—Sind, the Punjab.

128. Zornia *GMEL.*

241. **Zornia diphylla** Pers.

Locality.—Dalhousie (Drum. 33 !).
Flowers.—August.
Distribution.—Everywhere in the Tropics. India—Plains from the Himalayas to Ceylon and Burma.

129. Uraria *DESV.*

242. **Uraria neglecta** Prain in Journ. As. Soc. Beng. LXVI, 382, 1897.

Locality.—Hoshiarpur (Ait. 463 !).
Distribution.—India.

130. Alysicarpus *NECK.*

243. **Alysicarpus longifolius** W. & A. Prodr. 233.

Locality.—Lahore (2950).
Distribution.—Plains, scattered throughout India proper.

131. Ougeinia *BENTH.*

244. **Ougeinia dalbergioides** Benth. Pl. Jungh. 216.

Locality.—Hoshiarpur (Holland 45329 !); (Mardainali 337 !).
Flowers.—March.
Distribution.—Hilly tracts of Northern India and Konkan, ascending to 4,000 ft. in Kumaon.

132. Desmodium *DESV.*

245. **Desmodium laxiflorum** DC. Prodr. **II, 335.**

Locality.—Dalhousie (Drum. 4616 !).
Distribution.—Java; Borneo; Philippines. India.

246. **Desmodium podocarpum** DC. Prodr. II, 336.

Locality.—Dalhousie (Drum. 59 !).
Flowers.—September.
Distribution.—China; Japan. India—temperate and tropical Himalayas. alt. 2,000-7,000 ft., from Simla and Gharwal to Khasia and Sikkim.

247. **Desmodium tiliaefolium** G. Don Gen. Syst. II, 297.

Locality.—Rawalpindi—Triete (Ait. 382 !).
Flowers.—September.
Distribution.—All along the Himalayas from the upper Punjab to Tavoy. Temperate and tropical zones, ascending to 9,000 ft.

248. **Desmodium gangeticum** DC. Prodr. II, 327.

Locality.—**Hoshiarpur (Ait. 471 !).**
Distribution.—Tropical Africa; Malay Isles; Philippines; China, introduced in West Indies. India.

133. Abrus L.

249. **Abrus precatorius** L.

Locality.—Hoshiarpur (Ait. 519 !).
Distribution.—India—Himalayas to Ceylon and Siam. Cosmopolitan in the Tropics, often planted.

134. Cicer L.

250. **Cicer arietinum** L.

Locality.—Lahore (Stewart 2554 !).
Flowers.—March.
Distribution.—India—Commonly cultivated in northern provinces and Nilgiris. Cultivated in various temperate and tropical countries.

135. Vicia L.

251. **Vicia hirsuta** Koch. Synops. 191.

Locality.—Peshawar College (Quizilbash 23 !); Hoshiarpur (Ait. 575 !).
Distribution.—Europe; Orient. India—N.-W. Provinces.

252. **Vicia pallida** Turcz.

Locality.—Rawalpindi—Hussanal (Ait. 389 !).
Flowers.—March.
Distribution.—Siberia. India.

253 **Vicia Griffithii** Baker.

Locality.—Rawalpindi—Futtehgunj (Ait. 10461 !); Hussanal (Ait. 389 !, 1045 !).
Flowers.—March.
Distribution.—Afghanistan. India.

254. **Vicia sativa** L.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21705 !, 21706 !); near Peshawar (Collett); Lahore (Stewart 2529 !); Rawalpindi (Ait. 385 !, 387 !, 386 !).
Flowers.—March-April.
* Weed in wheat crop.
Distribution.—India—N.-W. Provinces, probably cultivated.

255. **Vicia bithynica** L. Syst. ed. x, 1166.

Locality.—Gurdaspur (Drum. 11 !).
Flowers.—February.
Distribution.—Mediterranean region.

136. Lathyrus L.

256. **Lathyrus Aphaca** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 391 !); Lahore (Stewart 2915 !).
Flowers.—March-April.
Distribution.—Europe; Orient; Abyssinia. India—spread through the N. Provinces, ascending from the plains of Bengal to the temperate zone in Hazara, Kashmir and Kumaon.

257. **Lathyrus sativus** L.; DC. Prodr. II, 373.

Locality.—Rawalpindi—Hoshiarpur (Ait. 91 !); Barrakow (Ait. 393 !).
Flowers.—April.
Distribution.—Europe; Orient; Tropical Africa. India—spread through the N. Provinces, ascending from the plains of Bengal to Kumaon.

258. **Lathyrus sphaericus** Retz.; D.C. Prodr. II, 372.

Locality.—Gurdaspur (Drum. 9 !); Hoshiarpur (Ait. 1047 !).
Flowers.—February; Colour—vermillion.
Distribution.—Europe; Orient; Abyssinia. India—N.-W. Provinces, ascending from Bundelkhand and the Punjab to 5,500 ft. in Kumaon.

259. **Lathyrus inconspicuus** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 394 !).
Flowers.—April.
Distribution.—Mesopotamia; Syria; Afghanistan; Baluchistan. India—Sind, the Punjab.

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241. **Zornia diphylla** Pers.

Locality.—Dalhousie (Drum. 33 !).
Flowers.—August.
Distribution.—Everywhere in the Tropics. India—Plains from the Himalayas to Ceylon and Burma.

129. URARIA *DESV.*

242. **Uraria neglecta** Prain in Journ. As. Soc. Beng. LXVI, 382, 1897.

Locality.—Hoshiarpur (Ait. 463 !).
Distribution.—India.

130. ALYSICARPUS *NECK.*

243. **Alysicarpus longifolius** W. & A. Prodr. 233.

Locality.—Lahore (2950).
Distribution.—Plains, scattered throughout India proper.

131. OUGEINIA *BENTH.*

244. **Ougeinia dalbergioides** Benth. Pl. Jungh. 216.

Locality.—Hoshiarpur (Holland 45329 !); (Mardainali 337 !).
Flowers.—March.
Distribution.—Hilly tracts of Northern India and Konkan, ascending to 4,000 ft. in Kumaon.

132. DESMODIUM *DESV.*

245. **Desmodium laxiflorum** DC. Prodr. **II, 335.**

Locality.—Dalhousie (Drum. 4616 !).
Distribution.—Java; Borneo; Philippines. India.

246. **Desmodium podocarpum** DC. Prodr. II, 336.

Locality.—Dalhousie (Drum. 59 !).
Flowers.—September.
Distribution.—China; Japan. India—temperate and tropical Himalayas. alt. 2,000-7,000 ft., from Simla and Gharwal to Khasia and Sikkim.

247. **Desmodium tiliaefolium** G. Don Gen. Syst. II, 297.

Locality.—Rawalpindi—Triete (Ait. 382 !).
Flowers.—September.
Distribution.—All along the Himalayas from the upper Punjab to Tavoy. Temperate and tropical zones, ascending to 9,000 ft.

248. **Desmodium gangeticum** DC. Prodr. II, 327.

Locality.—**Hoshiarpur (Ait. 471 !).**
Distribution.—Tropical Africa; Malay Isles; Philippines; China, introduced in West Indies. India.

133. ABRUS L.

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Distribution.—India—Himalayas to Ceylon and Siam. Cosmopolitan in the Tropics, often planted.

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Flowers.—March.
Distribution.—India—Commonly cultivated in northern provinces and Nilgiris. Cultivated in various temperate and tropical countries.

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Distribution.—Europe; Orient. India—N.-W. Provinces.

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Flowers.—March.
Distribution.—Afghanistan. India.

254. **Vicia sativa** L.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21705 !, 21706 !); near Peshawar (Collett); Lahore (Stewart 2529 !); Rawalpindi (Ait. 385 !, 387 !, 386 !).
Flowers.—March-April.
* Weed in wheat crop.
Distribution.—India—N.-W. Provinces, probably cultivated.

255. **Vicia bithynica** L. Syst. ed. x, 1166.

Locality.—Gurdaspur (Drum. 11 !).
Flowers.—February.
Distribution.—Mediterranean region.

136. Lathyrus L.

256. **Lathyrus Aphaca** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 391 !); Lahore (Stewart 2915 !).
Flowers.—March-April.
Distribution.—Europe; Orient; Abyssinia. India—spread through the N. Provinces, ascending from the plains of Bengal to the temperate zone in Hazara, Kashmir and Kumaon.

257. **Lathyrus sativus** L.; DC. Prodr. II, 373.

Locality.—Rawalpindi—Hoshiarpur (Ait. 91 !); Barrakow (Ait. 393 !).
Flowers.—April.
Distribution.—Europe; Orient; Tropical Africa. India—spread through the N. Provinces, ascending from the plains of Bengal to Kumaon.

258. **Lathyrus sphaericus** Retz.; D.C. Prodr. II, 372.

Locality.—Gurdaspur (Drum. 9 !); Hoshiarpur (Ait. 1047 !).
Flowers.—February; Colour—vermilion.
Distribution.—Europe; Orient; Abyssinia. India—N.-W. Provinces, ascending from Bundelkhand and the Punjab to 5,500 ft. in Kumaon.

259. **Lathyrus inconspicuus** L.; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 394 !).
Flowers.—April.
Distribution.—Mesopotamia; Syria; Afghanistan; Baluchistan. India—Sind, the Punjab.

137. MUCUNA *ADANS.*

260. **Mucuna pruriens** DC. Prodr. II, 405.

Locality.—Hoshiarpur (Ait. 470 !).
Distribution.—Cosmopolitan in the Tropics. India—from the Himalayas, in the plains to Ceylon and Burma.

138. ERYTHRINA *L.*

261. **Erythrina Crista-galli** L. Mant I, 99.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 13735 !, 13131 !).
Flowers.—May. Bright pink.
* Almost spine-less form. A small tree 20 ft. high. Bark rough corky. In winter shoots die back for 18 in. apparently naturally and not owing to frost.
Distribution.—Brazil.

262. **Erythrina Blakei** Hort.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 13666 !).
Flowers.—May.
* Grown in N. Indian gardens as *E. Blakei.* Seems to be a hybrid or form of *E. herbacea* L.

139. BUTEA *ROXB.*

263. **Butea frondosa** Roxb. Cor. Pl. 21, t. 21.

Locality.—Hoshiarpur (Ait. 124 !).
Distribution.—Plains from the Himalayas to Ceylon and Burma, ascending to 4,000 ft. in the North-west, Rajputana, Sind.

140. PHASEOLUS *L.*

264. **Phaseolus aconitifolius** Jacq. Obs. III, t. 52.

Locality.—Rawalpindi—Huzzoo (Ait. 570 !).
Flowers.—October.
Distribution.—Himalayas to Ceylon, tropical region, upto 4,000 ft. in the north-west; native of India, generally cultivated.

141. ATYLOSIA *W. & A.*

265. **Atylosia scarabaeoides** Benth. Pl. Jungh. 243.

Locality.—Hoshiarpur (Ait. 631 !).
Distribution.—China; Malaya; Mauritius; Madagascar. Universally spread in the plains throughout India.

266. **Atylosia crassa** Prain in Journ. As. Soc. Beng. 268, LXVI, 45432.

Locality.—Rawalpindi—Rajgarh (Parker 6504 !).
Flowers.—December.
Distribution.—Java; Philippines. India—N.-W. Provinces, Bengal, S. India, Assam, Burma.

142. CAJANUS *DC.*

267. **Cajanus indicus** Spreng. Syst. III, 248.

Locality.—Hoshiarpur (* Ait. 582 !).
* Seems indigenous in the low hills at Hoshiarpur with small leaves.
Distribution.—Everywhere in the tropics; probably native of the Old World.

143. RHYNCHOSIA *LOUR.*

268. **Rhynchosia minima** DC. Prodr. II, 385.

Locality.—Jullandar—* Phillaur Plantation (7712 !); Hissar (Duthie 3953 !, 2908 !); Lahore (Stewart 2618 !); Lyallpur (Inayat !); Multan !; Rawalpindi (Ait. 214 !, 135 !); Hoshiarpur (Ait. 81 !).
Flowers.—August-February.
* Abundant in the P. Plantations. Stems sometimes woody at the base.
Distribution.—Cosmopolitan in the Tropics; Cape; United States; Ceylon. India—Rajputana, Sind and everywhere in the plains.

269. **Rhynchosia sericea** Spanoghe in Linnaea, xv, 105.

Locality.—Hoshiarpur (Ait. 465 !).
Distribution.—Malaya. India.

144. FLEMINGIA *ROXB.*

270. **Flemingia fruticulosa** Wall. Cat. n. 5754 = *strobilifera.*

Locality.—Dalhousie—(4742 !; Drum.'s Herb.).
Distribution.—Malaya. India.

271. **Flemingia congesta** Roxb. Hort. Beng. 56.

Variety.—*semialata.*
Locality.—Rawalpindi (Parker 7711 !).
Flowers.—June.
Distribution.—Malay Isles; China; Philippines; India. Ceylon.

145. DALBERGIA *L. f.*

272. **Dalbergia Sissoo** Roxb. Hort. Beng. 53.

Locality.—Rawalpindi (Ait. 395 !).
Flowers.—April.
Distribution.—Afghanistan; Baluchistan. Plains throughout India ascending to 5,000 ft. in the Central Himalaya.

146. PONGAMIA *VENT.*

273. **Pongamia glabra** Vent. Jard. Malm. t. 28.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14363 !, 13806 !, 14362 !, *13732 !, * 13731 !, 13662 !, 38644 !, 13119 !); Hoshiarpur (Holland 11138 !); (Ait. 478 !).
Flowers.—April-May. *Fruits.*—January.
* Leaflets of different shape from ordinary form. Flowers much earlier at Lahore and is not easy to grow from seed. Suffers from cold and damp in winter, whereas ordinary Pongamia very hardy. Flowers more highly coloured, and petals and ovary more hairy (from Parker's notes).
Distribution.—Malaya Isles; N. Australia; Polynesia; Seychelles. India—Central and East Himalayas to Ceylon and Malacca.

147. DERRIS *LOUR.*

274. **Derris robusta** Benth. in Journ. Linn. Soc. IV, Suppl. 104.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38782 !, 38783 !, 13734 !, 13733 !)
Flowers.—April-August.
Distribution.—India— Eastern Himalayas, Western Peninsula. Ceylon.

148. SOPHORA *L.*

275. **Sophora mollis** Grah. in Wall. Cat. 5335.

Locality.—Rawalpindi (Ait. 396 !).
Flowers.—May.
Distribution.—India—Plains and low hills of the north-west; Hazara and Salt Range to Kumaon and Nepal, ascending to 4,000 ft.

276. **Sophora secundiflora** Lag. ex DC. Cat. Hort. Monsp. (1813) 148.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 18074 !, 18073 !, 13126 !).
Fruits.—April-July.
Distribution.—Mexico.

149. Castanospermum *A. CUNN.*

277. **Castanospermum australe** A. Cunn. & Fraser, in Hook. f. I, 556.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13810 !).
Flowers.—May.
Distribution.—Australia.

2. *CAESALPINEAE.*

150. Caesalpinia *L.*

278. **Caesalpinia pulcherrima** Swartz Obs. 166.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13614 !).
Flowers.—January
Distribution.—Universally cultivated throughout India and elsewhere in the Tropics; the native country is not clearly known.

279. **Caesalpinia sepiaria** Roxb. Hort. Beng. 32.

Locality.—Hoshiarpur (Ait. 601 !).
Distribution.—Malay Isles; China; Japan; and introduced in Tropical America. India.

280. **Caesalpinia Gilliesii** Wall. ex Hook. Bot. Misc. i (1830) 129.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13611 !, 13113 !).
Flowers.—April-July.
Distribution.—South America.

281. **Caesalpinia coriaria** Willd. Sp. Pl. ii.; 532.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 14861 !).
Flowers.—November.
* Suffers from frost.
Distribution.—South America.

151. Gleditschia *CLAYTON.*

282. **Gleditschia triacanthos** L. Sp. Pl. 1056.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 143671 !, 14366 !, 12977 !).
Flowers.—April.
Distribution.—North America.

152. Parkinsonia *L.*

283. **Parkinsonia aculeata** L. Sp. Pl. (1753) 375.

Locality.—Kangra (Bisram 53113 !); Lahore—Forest Office (Parker 12992 !).
Flowes.—April. *Fruits.*—May.
Distribution.—Universally cultivated and often naturalized. A native of Tropical America.

153. Cassia *L.*

284. **Cassia Fistula** L. Sp. Pl. (1753) 377.

Locality.—Rawalpindi (Ait. 397 !); Gurdaspur (Bisram 846 !).
Flowers.—July.
Distribution.—China; Malay Isles; Ceylon. India.

285. **Cassia Sophera** L. Sp. Pl. (1753) 379.

Locality.—Lahore—Changa Manga (Parker 24335 !, 24336 !, 24337 !); Ag. Hort. Gdns. (Parker 13736 !); Gurdaspur (Drum. 61 !).
Flowers.—May-December.

286. **Cassia Sophera** L. var. *purpurea* Roxb. Hort. Beng. 31.

Locality.—Lahore—Changa Manga (Parker 25743 !, 24334 !, 24333 !).
Flowers.—December.
Distribution.—As in *C. Sophera* L.

287. **Cassia Tora** L. Sp. Pl. (1753) 376.

Locality.—Hoshiarpur (* Parker 14378 !); Ait. 513 !); Rawalpindi (Ait. 1891 !).
Flowers.—August-September.
* Abundant on grazing grounds and not eaten by cattle.
Distribution.—India. Ceylon; and the Tropics generally.

288. **Cassia bicapsularis** L. Sp. Pl. (1753) 376.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37195 !, 37194 !).
Fruits.—January.
Distribution.—Tropical America.

289. **Cassia laevigata** Willd. Enum. Hort. Beng. 441.

Locality.—Lahore—Changa Manga (* Parker 19330 !, 19329 !).
Flowers.—May.
* Cultivated.
Distribution.—Cosmopolitan in the Tropics.

290. **Cassia didymobotrya** Fresen. in Flora, XXII (1839) 53.

Locality.—Lahore—Changa Manga (Parker 1933 !).
Distribution.—Abyssinia. Cultivated.

291. **Cassia corymbosa** Lam. Encyc. i, 644.

Locality.—Lahore—Changa Manga (Parker 24234 !).
Fruits.—December.
Distribution.—America. Cultivated.

292. **Cassia mimosoides** L. Sp. Pl. 379.

Locality.—Rawalpindi—Barrakow (Ait. 398 !).
Fruits.—August.
Distribution.—Cosmopolitan in the Tropics; probably native in Asia only.
Distribution.—Southern Europe, Orient.

154. Ceratonia L.

293. **Ceratonia siliqua** L. Sp. Pl. 1026.

Locality.—Ferozepore—Fazilka (Parker 14374 !, 14373 !, 14375 !).
Flowers.—October.
Distribution.—Cosmopolitan in the Tropics, Ceylon, India.

155. Bauhinia L.

294. **Bauhinia racemosa** Lam. Dict. I, 390.

Locality.—Hoshiarpur (Ait. 473 !).
Distribution.—Ceylon, China, Malay Isles, Timor. Throughout India.

295. **Bauhinia Vahlii** W. & A. Prodr., 297.

Locality.—Hoshiarpur (Ait. 517 !).
Distribution.—Throughout India in hilly districts.

296. **Bauhinia candicans** Benth. in Mart. Fl. Bras. XV. ii, 201.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38773 !).
Flowers.—August.
Distribution.—Brazil.

297. **Bauhinia corymbosa** Roxb. Hort. Beng. 31. Fl. Ind. ii, 329.

Flowers.—May.
Distribution.—China.

156. SCHOTIA *JACQ.*

298. **Schotia brachypetala** Sond. in Linnaea, XXIII (1850) 39.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13139 !).
Flowers.—April.
Distribution.—South Africa.

157. PIPTADENIA *BENTH.*

299. **Piptadenia nitida** Benth. in Journ. Bot. iv (1842) 336.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 39654 !, 39655 !, 39656 !).
Flowers.—April.
Distribution.—Brazil.

3. *MIMOSEAE.*

158. PROSOPIS *L.*

300. **Prosopis spicigera** L. Mantiss (1767) 68.

Locality.—Hissar (Duthie 3962 !).
Flowers.—October.
Distribution.—Afghanistan; Persia. India—Punjab, Rajputana, Sind. Bundelkhand and dry regions of W. Peninsula, Baluchistan.

301. **Prosopis juliflora** DC. Prodr. II, 447.

Variety.—glandulosa Sarg.
Locality.—Lahore—Forest Office (* Parker 13624 !, 13133 !, 12973 !, 12945 !): Changa Manga (7904 !).
Flowers.—April-May; *Fruits.*—May-June.
* Original seed from Mexico.
Distribution.—Tropical America.

302. **Prosopis juliflora** DC. Prod. II, 447.

Variety.—velutina Sarg.
Locality.—Lahore—Forest Office (* Parker 17188 !, 17187 !, 17186 !, 23988 !).
Flowers.—June-July.
* Evergreen, seed from Mexico.

303. **Prosopis alba** Gieseb. in Goett. Abh XIX (1874) 131.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 408 !).
Original seed from Buenos Ayres.
Distribution.—Argentine.

159. DICHROSTACHYS *DC.*

304. **Dichrostachys nutans** Benth. in Hook. Journ. Bot. IV (1842) 353.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38637 !, 37128 !, 37127 !).
Flowers.—January-May.
Distribution.—Tropical Africa.

160. DESMANTHUS *WILLD.*

305. **Desmanthus virgatus** Willd. Sp. Pl. iv, 1047.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 7776 !, 7777 !, 4460 !).
Flowers.—November.
* A naturalized weed.
Distribution.—North America. Western India.

161. MIMOSA *L.*

306. **Mimosa rubicaulis** Lam. Encyc. Menth. V. i. (1783) 20.

Locality.—Rawalpindi (Jerram 7897 ! alt. 3,000-5,000 ft., 7718 !); (Ait. 147 !); Hoshiarpur (Ait. 282 !).
Flowers.—May-June.
Distribution.—Afghanistan. Throughout India.

307. **Mimosa acerba** Benth. in Hook.—Journ. Bot. iv (1842) 378.

Locality.—Lahore—Changa Manga (Parker 21894 !).
Flowers.—August.
Cultivated: Original seed from Argentina.
Distribution.—Brazil.

308. **Mimosa hamata** Willd. Sp. Pl. v 4. (1805) 1033.

Locality.—Hissar (Duthie 396 !); Lahore—Changa Manga (Parker 20119 !).
Flowers.—October.
Cultivated.
Distribution.—India—W. Peninsula.

309. **Mimosa himalayana** Gamble. in Kew Bull. 1920, 4.

Locality.—Lahore—Changa Manga (Parker 24425 !, 24424 !, 24426 !).
Flowers.—December.
Distribution.—India.

162. LEUCAENA BENTH.

310. **Leucaena glauca** Benth. in Hook. Journ. Bot. iv. 416.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14376 !).
Flowers.—September.
Distribution.—Spread throughout India, as it is through Tropical Asia and Africa, but probably indigenous in Tropical America.

163. ACACIA *WILLD.*

311. **Acacia Farnesiana** Willd. Sp. Pl. V. 4 (1805) 1083.

Locality.—Rawalpindi (Ait. 570 !).
Flowers—December.
Distribution.—Cosmopolitan in the Tropics, often planted.

312. **Acacia arabica** Willd. Sp. Pl. V. 4 (1805) 1085.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38848 !); Changa Manga—(Parker 18077 !, 18078 !, 18079 !, 18080 !, 18032 !, 18034 !, 18035 !, 18036 !, 18037 !, 18033 !, 18038 !); Multan (Monro 35 !); Rawalpindi (Ait. 148 !).
Flowers.—April-September.
Grown from seed supplied by Vilmorin Paris as *A. Nilotica.* In Lahore it flowers at the same time as the local variety and has the same pods (Parker).
Distribution.—Ceylon, Arabia, Egypt, Tropical Africa, Natal. Throughout the greater part of India.

313. **Acacia eburnea** Willd. Sp. Pl. V. 4 (1805) 1081.

Locality.—Rawalpindi (Ait. 48!, 399!; Parker 24015!).
Flowers.—April-September.
Distribution.—Arabia, Afghanistan. Throughout India in dry districts, Ceylon.

314 **Acacia leucophloea** Willd. Sp. Pl. V. 4 (1805) 1083.

Locality.—Lahore—Changa Manga (Parker 14326!, 14325!); Hoshiarpur (Ait. 523!).
Flowers.—September.
Distribution.—Malay Isles, Timor. Throughout India in dry districts.

315. **Acacia Catechu** Willd. Sp. Pl. V. 4 (1805) 1079.

Locality.—Hoshiarpur (Ait. 524!); Rawalpindi (Ait. 188!).
Flowers.—September.
Distribution.—India (Punjab, N.-W. Himalayas, Central India, Berar, Gurgaon, Burma); often planted.

316. **Acacia modesta** Wall. Pl. As. Rar. t. 130.

Locality.—Rawalpindi (7716!; Ait. 400!).
Flowers.—April-December.
Distribution.—Afghanistan. India (Western and Central Himalayas).

317. **Acacia torta** Craib in Kew. Bull. 1915, 410 = Mimosa torta.

Locality.—Hoshiarpur (Ait. 516!).
Distribution.—Asia and Tropical Africa.

318. **Acacia aneura** F. Muell in Linnaea XXVI (1853-55) 627.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38631!).
Flowers.—May.
Distribution.—Australia.

319. **Acacia auriculaeformis** A. Cunn. ex. Benth, in Hook Lond. Journ. Bot., i (1842) 377.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37258!, 17192!).
Flowers.—October; *Fruits.*—January.
Distribution.—Australia.

320. **Acacia bonariensis** Gill. in Hook. Bot. Misc, iii (1833) 207.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38632!, 37257!, 33099!).
Flowers.—May-August.
Seed from Formosa.
Distribution.—Argentine.

321. **Acacia confusa** Merrill in Philipp. Journ. Sec. v, 27 (1910).

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38632!, 37257!, 21044!).
Flowers.—April-May; *Fruits.*—January.
Distribution.—Philippine Islands.

322. **Acacia constricta** Benth. in A. Gray. Pl. Wright i. 66.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14884!).
Flowers.—April; Sweet scented.
A struggling shrub. Introduced from Mexico.
Distribution.—North Mexico.

323. **Acacia filicina** Willd. Sp. Pl. iv. 1072.

Locality.—Lahore—Changa Manga (* Parker 24231!); Ag. Hort. Gdns. (Parker 13647!, 13646!, 13645!, 13644!, 12943!, 11444!).
Flowers.—April-June. *Fruits.*—December-February.
* Cultivated. A shrub 6 ft. high; seed from Mexico.
Distribution.—Mexico.

324. **Acacia homalophylla** A. Cunn. ex Benth. in Hook. Journ. Bot. i (1842) 365.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14885 !, 11548).
Flowers.—January.
Distribution.—Australia.

325. **Acacia sphaerocephala** Cham. Schlecht in Linnaea V (1830) 594.

Locality.—Lahore—Government House Gdns. (* Parker 15039 !).
Flowers.—May.
* Spines 2½ in. long and ½ in. broad. Extraordinarily large.
Distribution.—Mexico.

326. **Acacia spadicigera** Cham. & Schlecht in Linnaea V (1830) 594.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15041 !).
Flowers.—May.
Distribution.—Jamaica.

164. CALLIANDRA *BENTH.*

327. **Calliandra grandiflora** Benth. in Hook Journ. Bot. II (1840) 139.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38887 !, 13670 !, 11457 !).
Flowers.—May-August; *Fruits.*—February.
Distribution.—Tropical America.

165. ALBIZZIA *DURAZZ.*

328. **Albizzia Lebbeck** Benth. in Hook. Lond. Journ. Bot. V. 3 (1844) 87.

Locality.—Rawalpindi (Ait. 240 !, 401 !).
Flowers.—May.
Distribution.—Tropical and subtropical Asia and Africa. Throughout India. Usually planted.

329. **Albizzia odoratissima** Benth. in Hook. Journ. Bot. V. 3 (1844) 88.

Locality.—Rawalpindi—Saligraon (Parker 7713 !); Gurdaspur-Dhunera (Bisram 302 !).
Fruits.—February.
Distribution.—Throughout India. Ceylon.

330. **Albizzia mollis** Boiv. in Encyc. XIX. Siecle, II, 33.

Locality.—Dalhousie 3,000-5,000 ft. (Drum. 22 !).
Flowers.—August.
Distribution.—Tropical Africa.

331. **Albizzia stipulata** Boiv. in Encyc. du xix Siecle, V 2, 33.

Locality.—Dalhousie.
Distribution.—S.-E. Asia. Throughout India.

166. PITHECOLOBIUM *MART.*

332. **Pithecolobium dulce** Benth. in Hook. Journ. 1844, 199.

Locality—Lahore—Ag. Hort. Gdns.—(Parker 13125 !); Forest Office (Parker* 14882 !, ** 17185 !).
Flowers.—April-May; *Fruits.*—July.
* Grown from Mexican seed.
** Seed from Esperanza, Sonora, Mexico. A frost-hardy form.
Distribution.—A native of Tropical Africa. Ceylon; Malay Isles; Philippines. Cultivated throughout India, but not indigenous.

XLII. ROSACEAE.

167. Prunus *L.*

333. **Prunus communis** Huds.

Locality.—Rawalpindi (Ait. !).
Flowers.—February.
Distribution.—India.—W. temperate Himalaya, cultivated, or indigenous from Gharwal to Kashmir, alt. 5-7,000 ft.

168. Spiraea *L.*

334. **Spiraea prunifolia** Sieb & Zucc. Fl. Jap. I, 131.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14879 !, 11455 !).
Flowers.—February. 2-3 ft. high.
Distribution.—Japan.

169. Rubus *L.*

335. **Rubus fruticosus** L. Sp. Pl. 493.

Locality.—Rawalpindi—(Jerram 8086 !, 8085 !).
Flowers.—June.
Distribution.—Europe.

170. Rosa *L.*

336. **Rosa multiflora** Thunb. Fl. Jap. 214.

Locality.—Lahore.—Ag. Hort. Gdns. (Parker 12955 !).
Flowers.—April.
Distribution.—Japan; China.

171. Pyrus *L.*

337. **Pyrus communis** L. Sp. Pl. 479.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12991 !).
Flowers.—April.
A French variety which ripens its fruits in the plains. Most do not.
Distribution.—N. Persia westwards to S. Europe. India—Cultivated in the N.-W. Himalayas, alt., 2-8,000 ft.

172. Crataegus *L.*

338. **Crataegus saligna** Greene, Pittonia III, 99.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14845 !, 14244 !).
Distribution.—North America.

173. Cotoneaster *L.*

339. **Cotoneaster microphylla** Wall. Cat. 662 A.

Locality.—Rawalpindi (Jerram 8064 !, 6,500 ft.)
Flowers.—June.
Distribution.—India—temperate Himalaya, alt. 4-8,000 ft.

XLIII. SAXIFRAGACEAE.

174. Deutzia *THUNB.*

340. **Deutzia staminea** R. Br. in Wall. Pl. As. Rar 82, t. 191.

Locality.—Rawalpindi—alt. 5,500 ft. (Jerrum 7902 !).
Flowers.—May.
Distribution.—India—temperate W. Himalayas to Kashmir, alt. 5-9,000 ft., common.

XLIV. HAMAMELIDACEAE.

175. Parrotia *C.A. MEY.*

341. **Parrotia Jacquemontiana** Decne. in Jacq Voy. Bot. t. 82.

Locality.—Rawalpindi 8,000 ft. (Ait. 121 !).
Flowers.—May.
Distribution.—India—Kashmir, alt. 5-9,000 ft., common.

XLV. COMBRETACEAE.

176. Terminalia *L.*

342. **Terminalia belerica** Roxb. Cor. Pl. V, 2 (1798) 54, t, 198.

Locality.—Hoshiarpur (Ait. 488 !).
Distribution.—Ceylon, Malaya. Throughout India except Sind and desert region of the west.

343. **Terminalia Arjuna** Bedd. Fl. Sylv. t. 28.

Locality.—Hoshiarpur (Ait. 538 !).
Distribution.—India—sub-Himalayan tracts of the N.-W. Provinces, W. Peninsula; Ceylon.

177. Anogeissus *WALL.*

344. **Anogeissus latifolia** Wall. Cat. (1828) 4015.

Locality.—Kangra 9733 !
Flowers.—November.
Distribution.—Throughout the greater part of India; Ceylon.

178. Combretum *L.*

345. **Combretum coccineum** Lamk Encyc. I 734.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13674 !).
Flowers.—May.
Distribution.—Madagascar; Mauritius.

179. Callistemon *R.Br.*

346. **Callistemon coccineus** F. Muell Fragm. I, 13.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 137381 !).
Flowers.—April. Deep crimson.
Distribution.—Australia.

XLVI. MYRTACEAE.

180. Melaleuca *L.*

347. **Melaleuca Leucadendron** *L.*

Locality.—Lahore—Ravi Park (Parker 38643 !); Ag. Hort. Gdns. (Parker 13128 !).
Flowers.—April-May.
Distribution.—Malay Islands to Australia.

181. Eucalyptus *L' HERIT.*

348. **Eucalyptus bicolor** A. Cunn. ex Hook. in Mitch. Journ. Austral. 390.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11445 !, 11547 ! 38680 !, 38679 !, * 38678 !); Lawrence Gdns. (Parker 22420 !).
Flowers.—May.
* From French seed sown in April.
Distribution.—Australia.

349. **Eucalyptus affinis** Deane & Maiden in Proc. Linn. Soc. N. S. Wales XXIV 454.

Locality.—Lahore (Parker 22462 !).
Seedling grown in Lahore from Australian seed.
Distribution.—Australia.

350. **Eucalyptus Bosistoana** F. Muell.

Locality.—Lahore (* Parker 22459 !).
* Seedling grown in Lahore from Australian seed.
Distribution.—Australia.

351. **Eucalyptus cornuta** Labill .Voy. I, 403 t. 20.

Locality.—Lahore—Lawrence Gdns. (Parker 22481 !).
Distribution.—Australia.

352. **Eucalyptus foecunda** Schau. Lehm. Pl. Preiss I, 130.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38672 !, 38671 !, 38670 !, 14866 !).
Flowers.—May.
* Seed from W. Australian Forest Dept., sown April 1912, planted August 1912. Flowering as a shrub 3 ft. high in February 1916.
Distribution.—Australia.

353. **Eucalyptus gomphocephala** DC. Prod. III, 220.

Locality.—Lahore—Lawrence Gdns. (Parker 22482 !).
Distribution.—Australia.

354. **Eucalyptus crebra** F. Muell. in Journ. Linn. Soc. III (1859) 87.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38865 !); Lawrence Gdns. (Parker 22429 !); Changa Manga (Parker 14871 !, 14870 !); Amritsar—Ram Bagh (Parker 4479 !, 22430 !); Kangra (Parker 22438 !); Gurdaspur—Madhopur (Parker 14342 !, 14343 !, 14344 !, 14339 !, 14340 !, 14341).
Flowers.—November-May.
Distribution.—Australia.

355. **Eucalyptus Leucoxylon** F. Muell. in Trans. Vict. Inst. I (1855) 33.

Locality.—Lahore (Parker 4439 !); Lawrence Gdns. (* Parker 22470 !).
* Seedling from Vilmorin's seed.
Distribution.—Australia.

356. **Eucalyptus microcorys** F. Muell. Fragm. II, 50.

Locality.—Lahore—Lawrence Gdns. (Parker 22483 !).
Distribution.—Australia.

357. **Eucalyptus hemiphloia** F. Muell. Fragm. II, 62.

Locality.—Lahore—(Parker 22492 !); Ag. Hort. Gdns. (Parker 38668 !); Lawrence Gdns. (Parker 22491 !); Kot. Lakhpat (Parker 14338 !, 14345 !).
Distribution.—Australia.

358. **Eucalyptus siderophloia** Benth. Fl. Austral III, 220.

Locality.—Lahore—(** Parker 4454 !; Changa Manga—Parker 5956 !, 4478 !, 22477 !); Lawrence Gdns. (*Parker 22478 !).
Flowers.—April.
* Seedling from Vilmorin's seed.
** Seedling from Australian seed.
Distribution.—Australia.

359. **Eucalyptus Kirtoniana** F. Muell. Eucalyptogr. DEC. I (1879) in obs., Sub. E. resinifera.

Locality.—Lahore (* Parker 22506, 6112 !, ** 4457 !; Lawrence Gdns. * Parker 22505 !, 22504 !).
Flowers.—December.
* From sucker shoots. ** Seedling from Australian seed.
Distribution.—Australia.

360. **Eucalyptus patentinervis** R. T. Baker in Proc. Linn. Soc. N. S. Wales XXIV—602.

Locality.—Lahore (* Parker 22461 !).
* Seedlings from Australian seed.
Distribution.—Australia.

361. **Eucalyptus radis** Endl. in Enum Pl. Hueg. 49.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6377 !, 38842 !, 38841 !); (* Mustoe 580 !).
Flowers.—August.
* Sown spring 1911. Flower buds September 1913.
Distribution.—Australia.

362. **Eucalyptus rostrata** Schlecht in Linnaea XX (1847) 665.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38771 !, 38844 !, *38665 !), Lawrence Gdns. (Parker 22447 !, 22448 !).
Flowers.—May-August.
* Seed from France as 'Foeld Bay'.
Distribution.—Australia.

363. **Eucalyptus platyphylla** F. Muell in Journ. Linn. Soc. (1859) 93.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 21039 !, 38682 !); Changa Manga (Parker 19340 !).
Flowers.—April-May.
Distribution.—Australia.

364. **Eucalyptus microtheca** F. Muell in Journ. Linn. Soc. III, (1858) 87.

Locality.—Lahore—Lawrence Gdns. (Parker 22469 !); Changa Manga (Parker 17184 !, 17183 !, 17182 !, 17181 !, 17180 !).
Flowers.—July-August.
From seed supplied by the Bot. Gdns. Sydney.
Distribution.—Australia.

365. **Eucalyptus polyanthemos** Schau. in Walp. Rep. II, 924.

Locality.—Lahore—Lawrence Gdns. (* Parker 22468 !; 4438 !).
From Vilmorin's seed.
Distribution.—Australia.

366. **Eucalyptus melanophloia** F. Muell. in Journ. Linn. Soc. III (1859) 93.

Locality.—Lahore—Lawrence Gdns. (Parker 22442 !); Changa Manga (Parker 22443 !, 22444 !, 44771 !).
Flowers.—May.
Distribution.—Australia.

367. **Eucalyptus tereticornis** Sm. Bot. N. Holl. 41.

Locality.—Lahore—Lawrence Gdns. (Parker 6150 !); Ag. Hort. Gdns. (Parker 38843 !, 38693 !); Changa Manga (Parker 22456 !).
Flowers.—April-August.
Distribution.—Australia.

368. **Eucalyptus paniculata** Sm. in Trans. Linn Soc. III (1797) 287.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 3868 !); Changa Manga (Parker 22422 !, 22421 !, 5957 !); Kot Lakhpat (Parker 14868 !).
Flowers.—February-May.
Distribution.—Australia.

369. **Eucalyptus loxophleba** Benth. Fl. Austral. III, 252.

Locality.—Lahore—Lawrence Gdns. (* Parker 22485 !, 4451 !).
* Seedling from Australian seed.
Distribution.—Australia.

370. **Eucalyptus ochrophloia** F. Muell. Fragm. XI. 36.

Locality.—Lahore—(Parker 4452 !); Ag. Hort. Gdns. (Parker 38683 !, 38684 !).
Flowers.—May.
* Seedling from Australian seed.
Distribution.—Australia.

371. **Eucalyptus oleosa** F. Muell. Fragm. II, 56.

Locality.—Lahore (* Parker 4453 !); Ag. Hort. Gdns. (Parker 1544 !).
* Seedling from seed from W. Australia Forest Dept.
Flowering 4 ft. high.
Distribution.—Australia.

372. **Eucalyptus citriodora** Hook. in Mitch. Journ. Trop. Austral. 235.

Locality.—Lahore—Lawrence Gdns. (Parker 22489 !).
Flowers—May.
Distribution.—Australia.

373. **Eucalyptus platypus** Hook. Ic. Pl. t. 849.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 11546 !).
Flowers.—February; flowering 3 ft. high.
Distribution.—Australia.

374. **Eucalyptus redunca** Schau. in Lehm. Pl. Preiss I, 127.

Locality.—Lahore (* Parker 22471 !, 4442 !).
* Seedling from seed from Vilmorin.
Distribution.—Australia.

375. **Eucalyptus resinifera** Sm. in White, Journ. Voy. N.-S. Wales 231.

Locality.—Lahore—Lawrence Gdns. (* Parker 22480 !).
Distribution.—Australia.

376. **Eucalyptus salmonophloia** F. Muell. Fragm XI, 11.

Locality.—*Lahore* (* Parker 4441 !).
* Seedling from Australian seed.
Distribution.—Australia.

377. **Eucalyptus salubris** F. Fragm. XI, II.

Locality.—Lahore (Parker 22460 !, 22496 !, 4443 !).
Seedling from Australian seed.
Distribution.—Australia.

378. **Eucalyptus Trabuti** Vilm.

Locality.—Lahore—Ag. Hort. Gdns. (Gdns. Overseer 39760 !, 39761 !, 39762 !, 39763 !); (Parker 38866 !; 38772 !; 38770 !); Lawrence Gdns. (* Parker 22465 !).
Flowers.—April-August.
* Seedling from Vilmorin's seed.

379. **Eucalyptus uncinata** Turcz. in Bull. Soc. Nat. Mosc. XXII (1849) II, 23.

Locality.—Lahore (* Parker 4437 !).
* Seedling from Vilmorin's seed.
Distribution.—Australia.

380. **Eucalyptus populifolia** Hook. Ic. Pl. t. 879.

Locality.—Lahore—Lawrence Gdns. (* Parker 22487 !, 22486 !, 4449 !).
Seedling from Australian seed.
Distribution.—Australia.

381. **Eucalyptus exerta** F. Muell in Journ. Linn. Soc. III (1859) 85.

Locality.—Lahore (Parker 22463 !, 4459 !).
Seedling from Australian seed.
Distribution.—Australia.

382. **Eucalyptus melliodora** A. Cunn. ex Schau in Walp. Rep. II, 924.

Locality.—Lahore—Lawrence Gdns. (Parker 22484 !).
Distribution.—Australia.

182. PSIDIUM *L.*

383. **Psidium cattleianum** Sabine in Trans. Hort. Soc. IV, 1822, 317. t. 11.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13725 !).
Flowers.—April.
Distribution.—Brazil.

384. **Psidium pumilum** Vahl. Symb. Bot. II, 56.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13668 !, 15046 !).
Flowers.—May.
Distribution.—Tropical America.

183. MYRTUS *L.*

385. **Myrtus communis** L. Sp. Pl. (1753) 471.

Locality.—Rawalpindi (Ait. 403 !).
Flowers.—May.
Distribution.—A native of S. Europe.

184. EUGENIA *L.*

386. **Eugenia Jambolana** Lam. Encyc. III Method (1789) 198.

Locality.—Rawalpindi (Ait. 124 !).
Flowers.—August.
Distribution.—Ceylon; Malaya; Australia. Throughout India.

387. **Eugenia bracteata** Roxb. Hort. Beng. (1814) 37.

Locality.—Lahore—Ag. Hort. Gdns. (6779 !; Parker 13116 !).
Flowers.—April. *Fruits.*—December.
Distribution.—S. India. Ceylon.

388. **Eugenia uniflora** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13737 !).
Fruits.—April.
Distribution.—A native of S. America, becoming naturalized in Ceylon and parts of India.

XLVII. LYTHRACEAE.

185. Ammannia *L.*

389. **Ammannia baccifera** L. Sp. Pl. (1762) 175.

Locality.—Hoshiarpur (Ait. 611 !).
Distribution.—Tropical Africa; Afghanistan; Ceylon; China; Malaya; Australia. Throughout India in moist places.

186. Woodfordia *SALISB.*

390. **Woodfordia floribunda** Salisb. Parad. Lond. (1806) t. 42.

Locality.—Dalhousie (Drum's Hort. 296 !); Rawalpindi (Ait. 404 !).
Flowers.—March.
Distribution.—Tropical Africa; Madagascar; China; Japan; Sumatra. Throughout India. Ceylon; Baluchistan.

187. Nesaea *COMM.*

391. **Nesaea myrtifolia** Chas.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13132 !, 6778 !, 6777 !, 13788 !).
Flowers.—May.
Distribution.—Brazil.

188. Lawsonia *L.*

392. **Lawsonia alba** Lamk. Ill. t. 296, fig. 2.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13671 !); Multan (Monro 312 !).
Flowers.—April-June.
Distribution.—Kabul; Persia. Cultivated in many tropical and warm temperate regions. Throughout India, very common, cultivated; perhaps wild in W. India.

189. Lagerstroemia *L.*

393. **Lagerstroemia Flos-Reginae** Retz. Obs. V. 25.

Locality.—Gurdaspur (Fane 4857 !).
Flowers.—June.
Distribution.—Malaya, China. India—from Bombay southwards.

394. **Lagerstroemia floribunda** Jack. in Mal. Misc. I, 38.

Locality.—Lahore—Ag. Hort. Gdns. (Porder 38831 !, *14365 !).
Flowers.—August-October.
* Colour—rose fading to white.
Distribution.—Siam; Malaya; China.

395. **Lagerstroemia anisoptera** Kcehne.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38634 !, 37122 !).
Flowers.—January-May; Colour white.

XLVIII. ONAGRACEAE.

190. Epilobium L.

396. **Epilobium roseum** Schreb.

Locality.—Rawalpindi (Ait. 71 !).
Flowers.—September.
Distribution.—West Asia; Europe. India—temperate Himalaya, at 5-11,000 ft., common.

191. TRAPA *L.*

397. **Trapa bispinosa** Roxb. Cor. Pl. 234.

Variety.—*incisa* Wall.
Locality.—Hoshiarpur (Ait. 422 !).
Distribution.—S.-E. Asia, Malaya, Tropical Africa. Throughout India cultivated. Ceylon.

XLIX. SAMYDACEAE.

192. CASEARIA *JACQ.*

398. **Casearia tomentosa** Roxb. Fl. Ind. II (1832) 421.

Locality.—Hoshiarpur (Ait. 503 !).
Distribution.—Ceylon; Malaya; N. Australia. Throughout India.

L. PASSIFLORACEAE.

193. PASSIFLORA *L.*

399. **Passiflora lunata** Willd. Sp. Pl. III, 612.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15038 !).
Flowers.—October.
Distribution.—Tropical America.

400. **Passiflora caerulea-racemosa** Sab.

Locality.—Lahore—Changa Manga (Parker 19327 !).
Flowers.—May; Purple.
Cultivated.

LI. CUCURBITACEAE.

194. TRICHOSANTHES *L.*

401. **Trichosanthes cucumerina** L. Sp. Pl. (1753) 1008.

Locality.—Hoshiarpur (Ait. 509).
Distribution.—Ceylon; Malaya; N. Australia. Throughout India.

195. MOMORDICA *L.*

402. **Momordica dioica** Roxb. Fl. Ind. III, 709.

Locality.—Rawalpindi (Ait. 408 !, 196 !, 195 !, 194 !); Hissar (Duthie 4036 !).
Flowers.—July-September.
Distribution.—Ceylon; Malaya Throughout India.

196. CUCUMIS *L.*

403. **Cucumis trigonus** Roxb. Fl. Ind. II, 722.

Locality.—Rawalpindi (Ait. 192 !).
Flowers.—September.
Distribution.—Ceylon; Malaya; N. Australia; Afghanistan; Persia. Throughout India.

404. **Cucumis Melo** L. Sp. Pl. (1753) 1011.

Locality.—Rawalpindi (Ait. 4091).
Flowers.—July-September.
Distribution.—Throughout India cultivated. Cultivated in most hot countries.

197. CITRULLUS *SCHRADER.*

405. **Citrullus Colocynthis** Schrader in Linnaea V. 12 (1838) 414.

Locality.—Sandy grounds near Jaito (Duthie 4034 !).
Flowers.—August.
Distribution.—Ceylon; W. Asia; Arabia; Baluchistan. Throughout India, wild or sparingly cultivated.

406. **Citrullus vulgaris** Schrader in Linnaea 1848, 412.

Locality.—Rawalpindi (Ait. 410 !); Lahore (2943 Brandis Herb).
Flowers.—July.
Distribution.—Throughout India, cultivated. In all warm countries of the world, cultivated.

198. CEPHALANDRA *SCHRADER.*

407. **Cephalandra indica** Naud. in Ann. Sc. Ser. 5, V, 16.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38822 !).
Flowers.—August.
Naturalized in these gardens.
Distribution.—Malaya, Africa. Throughout India, common.

LII. CACTACEAE.

199. OPUNTIA *TOURN.*

408. **Opuntia Dillenii** Haw. Suppl. Pl. Succ. 79.

Locality.—Rawalpindi (Ait. 1067 !).
Flowers.—February.
Distribution.—S. America.

LIII. FICOIDEAE.

200. TRIANTHEMA *L.*

409. **Trianthema crystallina** Vahl. Symb. I, 32.

Locality.—Multan 31 !; Lahore (Cleghorn 2646 !; Stewart 2900). Rawalpindi—on salt ground (Ait. 580 !).
Flowers.—October.
On clayey hard soil. Fodder for goats.
Distribution.—Throughout Africa. India—Punjab.

410. **Trianthema pentandra** L. Mant. 79.

Locality.—Hissar (Duthie 4041 !); Lahore (2662 ! Brandis Herb); Multan (Monro 201 !). Rawalpindi (Ait. 411 !, 412 !).
Flowers.—April-August.
Distribution.—Tropical Africa. India—Punjab, N.-W. Provinces, Sind, W. Peninsula.

201. MOLLUGO *L.*

411. **Mollugo hirta** Thunb. Fl. Cap. 120.

Locality.—Lahore (Stewart 2566 !); Hoshiarpur (Ait. 605 !); Multan (Monro 233 !).
Flowers.—March.
Distribution.—Throughout India, common. Ceylon; warmer regions of the world.

412. **Mollugo nudicaulis** Lamk. Dict. IV, 234.

Locality.—Multan (Monro 31 !, 232 !); Rawalpindi—Barrakow (Ait. 413 !).
Flowers.—October.
Distribution.—Ceylon; New Caledonia; Tropical Africa and Cuba. India—Punjab and hotter and drier parts.

LIV. UMBELLIFERAE.

202. CARUM *L.*

413. **Carum Bulbocastanum** G. D. J. Koch. in Nov. Ait. Acad. Caes. Leop. (1825) 121.

Locality.—Peshawar—College (Quizilbash 55 !).
Distribution.—Baluchistan; N. Asia; Europe; N. Africa.

414. **Carum anethifolium** Benth. in gen. Pl. I, 89.

Locality.—Dalhousie (179 ! Drum's Herb.).
Distribution.—India—Almora, alt. 5,000 ft.; Nepal.

203. ANETHUM *TOURN.*

415. **Anethum graveolens** L. Sp. Pl. 263.

Locality.—Lahore (Stewart 2546 !).
Distribution.—Cultivated in S. Europe and W. Asia. Throughout tropical and subtropical India.

204. FOENICULUM *ADANS.*

416. **Foeniculum vulgare** Gaertn. Fruct. I, 105, t. 23, fig. 5.

Locality.—Rawalpindi (Ait. 417 !).
Flowers.—April.
Distribution.—Commonly cultivated throughout India, alt. 0-6,000 ft., often appearing wild.

205. OENANTHE *L.*

417. **Oenanthe stolonifera** Wall. Cat. 585.

Locality.—Rawalpindi (Ait. 118 !).
Flowers.—September.
Distribution.—Java; China and Japan. Northern India from Kashmir and the Punjab to Assam, alt. 0-5,000 ft. frequent; common in the plains of Bengal.

206. HERACLEUM *L.*

418. **Heracleum candicans** Wall. Cat. 573.

Locality.—Dalhousie (Drum 328 !); Kangra (Jamesan 3354 !).
Flowers.—February.
Distribution.—India—Kashmir to Kumaon alt. 6-12,000 ft., common.

207. CORIANDRUM *L.*

419. **Coriandrum sativum** L.

Locality.—Rawalpindi (Ait. 414 !); Lahore (Stewart 2547 !).
Flowers.—March.
Distribution.—Throughout India, cultivated.

208. CAUCALIS *L.*

420. **Caucalis leptophylla** L.

Locality.—Peshawar College (Quizilbash 18 !).
Distribution.—W. Asia; S. Europe; N. Africa. India—Punjab.

209. PSAMMOGETON *EDGW.*

421. **Psammogeton biternatum** Edgew. in Trans. Linn. Soc. XX, 57.

Locality.—Lyallpur—(Inayat !).
Distribution.—Baluchistan; Kabul; Persia. India—Punjab, Sind.

422. **Psammogeton canescens** Valke.

Locality.—Peshawar (1028!); Lahore (2904).
Flowers.—March-April.

LV. ARALIACEAE.

210. HEPTAPLEURUM *GAERTN.*

423. **Heptapleurum venulosum** Seem. Rev. Heder. 44.

Locality.—Hoshiarpur (Ait.).
Distribution.—Malaya; Tropical Australia. Throughout India.

211. HEDERA *L.*

424. **Hedera Helix** L.

Locality.—Rawalpindi (Ait. 138! alt. 5000); Patiala State (Jannujee 10!).
Distribution.—W. Europe to Japan.

LVI. CORNACEAE.

212. CORNUS *L.*

425. **Cornus oblonga** Wall. Roxb. Fl. Ind. ed. Carey & Wall. I, 432.

Locality.—Rawalpindi—Dhirkot alt. 3500-4500 (Jerram 7475! 7474!, 7473!, 7354!).
Flowers.—March.
Distribution.—India—Jhelum to Nepal, alt. 4-7,000 ft. frequent; Bhutan.

LVII. CAPRIFOLIACEAE.

213. VIBURNUM *L.*

426. **Viburnum cotinifolium** Don. Prodr. 141.

Locality.—Dalhousie (4627! Drum's Herb.).
Distribution.—India—Kashmir to Kumaon alt. 6-11,000 ft.

427. **Viburnum stellulatum** Wall. Pl. As. Rar II, 54, t. 169.

Locality.—Dalhousie (4626! Drum's Herb.); Rawalpindi alt. over 6,000 ft. (Jerram 8269!).
Flowers.—July.
Distribution.—India—Temp. Himalaya alt. 6-11,000 ft., Kashmir to Sikkim, common.

428. **Viburnum coriaceum** Blume. Bijd., 656.

Locality.—Rawalpindi—alt. 3,500-4,500 ft. (Jerram—7469!, 7470!).
Flowers.—March.
Distribution.—Java. India—Temperate Himalaya; N. Burma.

214. LONICERA *L.*

429. **Lonicera quinquelocularis** Hardwick in As. Res. VI, 351.

Locality.—Rawalpindi (Jerram 7782!).
Flowers.—April.
Distribution.—India—temperate Himalayas, Kashmir to Kumaon alt. 8-13,000 ft., frequent.

430. **Lonicera sempervirens** L. Sp. Pl. 173.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11459!).
Flowers.—February.
Distribution.—North America.

LVIII. RUBIACEAE.

215. STEPHEGYNE *KORTH.*

431. **Stephegyne parvifolia** Korth in Verh. Gesch. Nat. Bot. 161.

Locality.—Kangra (9739 !).
Flowers.—June.
Distribution.—Throughout drier parts of India. Ceylon.

216. WENDLANDIA *BARTL.*

432. **Wendlandia exerta** DC. Prodr. IV, 411.

Locality.—Rawalpindi (Lehtrar 9744 !); Kangra (9740 !).
Flowers.—May.
Distribution.—India—dry forests of tropical Himalaya, Orissa, C. India, N. Deccan, Konkan.

433. **Wendlandia puberula** DC. Prodr. IV, 412.

Locality.—Rawalpindi (Alt. 4,300 ft. Jerram, 723 !).
Distribution.—India—dry forests of tropical Himalaya, from Gharwal to Nepal, alt. 0-4,000 ft.).

217. RANDIA *L.*

434. **Randia tetrasperma** Roxb. Fl. Ind. I, 709 (Gardenia).

Locality.—Rawalpindi—Seribari 4,500 ft. (Jerram 7891 !).
Distribution.—India—Kashmir and subtropical Himalaya; Sikkim; Bhootan

218. GARDENIA *L.*

435. **Gardenia Thunbergia** L. f. Suppl. 162.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13608 !, 13623 !).
Flowers.—June.
Distribution.—South Africa.

219. PAVETTA *L.*

436. **Pavetta indica** L. Sp. Pl. (1753) 110.

Locality.—Rawalpindi—Kam Rat (Jerram 6752 !).
Distribution.—Malay Archipelago; S. China; N. Australia. Throughout India.

220. HAMILTONIA *ROXB.*

437. **Hamiltonia suaveolens** Roxb. Hort. Beng. 15.

Locality.—Rawalpindi (Ait. 1061 !).
Flowers.—March.
Distribution.—China. India—tropical and subtropical Himalayas, C. India, W. Peninsula.

221. LEPTODERMIS *WALL.*

438. **Leptodermis lanceolata** Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II, 191.

Locality.—Dalhousie (Drum's Herb. 383 !, 384 !).
Distribution.—India—Temperate Himalaya.

439. **Leptodermis parkeri** Dunn. in Kew Bull. 1920, 206.

Locality.—Dalhousie (385 ! Drum's Herb.).
Distribution.—India.

222. SERISSA *COMM.*

440. Serissa foetida Lamk. Illustr. II, 211.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12962 !).
Flowers.—April.
Distribution.—China, Japan.

223. SPERMACOCE *L.*

441. Spermacoce hispida L. Sp. Pl. (1753) 102.

Locality.—Hoshiarpur (Ait. 606 !).
Distribution.—S. China; Malay Archipelago. Throughout India.

224. GALIUM *L.*

442. Galium Aparine L.

Locality.—Hoshiarpur (Ait. 353 !); Rawalpindi (Ait. 194 !).
Flowers.—March.
Distribution.—Europe; N. Africa; N. and W. Central Asia. India—Temperate Himalaya.

443. Galium tricorne With.

Locality.—Peshawar College (Quizilbash 9 !).
Distribution.—Central and S. Europe, N. Africa; W. Asia. India—Western Himalaya.

LIX. VALERIANACEAE.

225. FEDIA *GAERTN.*

444. Fedia sclerocarpa Fisch. & Mey.

Locality.—Hoshiarpur (*Ait. 628 !).
* A common garden weed at Hoshiarpur, Jhelum and Rawalpindi.

LX. DIPSACEAE.

226. SCABIOSA *L.*

445. Scabiosa Olivieri Coult. Dips. 36 t. 2, fig. 10.

Locality.—Rawalpindi (Ait. 425 !).
Flowers.—April.
Distribution.—Afghanistan to Armania and Arabia. India—W. Punjab.

LXI. COMPOSITAE.

227. VERNONIA *SCHREB.*

446. Vernonia cinerea Less. in Linnaea IV, 291, and VI, 673.

Locality.—Rawalpindi (Ait. 203 !).
Flowers.—September.
Distribution.—Tropical Asia, Africa, Australia. Throughout India.

228. EUPATORIUM *L.*

447. Eupatorium conyzoides Vahl. Symb. Bot. III, 96.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14846 !; 13726 !).
Flowers.—May.
Seed from Mexico. Large perennial, more or less shrubby below, and grows vigorously.
Distribution.—Tropical and N. America.

229. SOLIDAGO *L.*

448. **Solidago Virga-aurea** L.

Locality.—Dalhousie (387 ! Drum's Herb.).
Distribution.—Europe; Temperate Asia and America; Hongkong. India—Temperate Himalaya.

230. CYATHOCLINE *CASS.*

449. **Cyathocline lyrata** Cass. in Ann. Sc. Nat., Ser. I, XVII. (1829) 420.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 21711); Rawalpindi (Ait. 459 !).
Flowers.—November.
* Weed in moist places.
Distribution.—India.

231. GRANGEA *FORSK.*

450. **Grangea maderaspatana** Poir. Encyc. Method. Suppl. V. (1811) 825.

Locality.—Gurdaspur (453 ! Drum's Herb).
Distribution.—Ceylon; tropical and subtropical Asia and Africa. Throughout India.

232. MYRIACTIS *LESS.*

451. **Myriactis nepalensis** Less.

Locality.—Dalhousie (411 ! Drum's Herb.).
Distribution.—Central Asia. India—Temperate Himalaya.

233. ASTER *L.*

452. **Aster Thomsoni** Clarke Comp. Ind. 48.

Locality.—Dalhousie (389 ! Drum's Herb.).
Distribution.—India—W. Himalaya.

234. ERIGERON *L.*

453. **Erigeron linifolius** Willd. Sp. Pl. III, 1955.

Locality.—Rawalpindi (Ait. 126 !).
Flowers.—June. Weed.
Distribution.—Caledonia.

454. **Erigeron canadensis** L.

Locality.—Rawalpindi (Ait. 198 !); Lahore—Changa Manga (Monro !).
Flowers.—August-September.
Distribution.—All warm countries; Assumed to be a native of N. America. India—W. Himalaya and the Punjab.

455. **Erigeron alpinus** L.

Locality.—Dalhousie (394 ! Drum's Herb.).
Distribution.—Mountains of the N. Temperate Zone. India—throughout the temperate and Alpine W. Himalaya.

235. BLUMEA *DC.*

456. **Blumea Wightiana** DC. in Wight Contrib. 14.

Locality.—Peshawar College (Quizilbash 351 !); Rawalpindi (Ait. 1073 !).
Distribution.—Malay Islands; China; Australia; tropical Africa. Throughout the plains of India.

236. LAGGERA *SCH. BIP.*

457. **Laggera aurita** Schultz-Bip. in Herb. Hohenack.

Locality.—Lahore (2936 !).
Flowers.—April.
Distribution.—Tropical Africa. Throughout the plains of India.

237. PLUCHEA *CASS.*

458. **Pluchea lanceolata** Oliv. Fl. Trop. Afr. III, 329.

Locality.—Lahore—Changa Manga (Kanji Lal 1122 !); Lahore—(Parker 9724 !; Stewart 2555 !); Rawalpindi (Ait. 427 !).
Flowers.—January-May-June.
Distribution.—Afghanistan; Baluchistan; N. Africa. India.

238. FILAGO *L.*

459. **Filago germanica** L.

Locality.—Rawalpindi (Ait. 437 !); Hoshiarpur (Ait. 346 !); Lyallpur (Inayat !); Lahore (Stewart 2564 !).
Flowers.—March-April.
Distribution.—India—Plains and Mountains of N.-W. Provinces. Westwards to Canaries.

239. IFLOGA *CASS.*

460. **Ifloga Fontanesii** Cass. in Dict. Sc. Nat. XXIII, 14.

Locality.—Rawalpindi—Hoshiarpur (Ait. 1071 !); Lahore (Stewart 2569 !).
Flowers.—March.
Distribution.—India—Upper Gangetic Plains, from Saharanpur to the Frontier. Westwards to Canaries.

240. LEONTOPODIUM *Br.*

461. **Leontopodium alpinum** Cass.

Locality.—Dalhousie (15302 Drum's Herb.).
Distribution.—Alps of Europe and Central Asia. India-Alpine Himalaya.

241. GNAPHALIUM *L.*

462. **Gnaphalium luteo-album** L.

Locality.—Rawalpindi (Ait. 43 !, 135 !).
Flowers.—February-March.
Distribution.—Most hot and warm temperate countries. Throughout India.

242. CAESULIA *ROXB.*

463. **Caesulia axillaris** Roxb. Hort. Beng. 62.

Locality.—Hoshiarpur (Ait. 609 !).
Distribution.—Throughout Northern India.

243. INULA *L.*

464. **Inula Cappa** DC. Prodr. V, 469.

Locality.—Rawalpindi (Lehtrar 9719).
Flowers.—May.
Distribution.—Java; China. India—Temperate Himalaya.

244. VICOA *CASS*

465. **Vicoa vestita** Benth. in Gen. Pl. II, 335.

Locality.—Rawalpindi (Ait. 428 !); Lahore (Stewart 2923 !, 2924 !, 2928 !, 2557 !, 2558 !, 2559 !).
Flowers.—April-May.
Distribution.—Afghanistan. Drier parts of India.

245. PULICARIA *GAERTN.*

466. **Pulicaria crispa** Benth, in Gen. Pl. II, 336.

Locality.—Lahore—Kot Lakhpat (Parker 17178!, 17179!, 17197!); Rawalpindi (Ait. 434!); Lahore (Stewart 2556!, 2609!).
Flowers.—March-May.
Distribution.—Arabia; Africa; the Canary and Cape Verde Islands. India—the Punjab, Upper Gangetic Plain and eastwards to Bihar.

246. XANTHIUM *L.*

467. **Xanthium Strumarium** L.

Locality.—Rawalpindi—Googerkh (Ait. 58!).
Flowers.—June-October.
Distribution.—Throughout the hotter parts of India and Ceylon, usually near houses; ascending in W. Himalaya to 5,000 ft.

247. SIEGESBECKIA *L.*

468. **Siegesbeckia orientalis** L.

Locality.—Dalhousie (15588! Drum's Herb.); Rawalpindi Barrakow (Ait. 431!).
Flowers.—September.
Distribution.—Cosmopolitan in warm climates. Throughout India, ascending to 5,000 ft. in the Himalaya.

248. ECLIPTA *L.*

469. **Eclipta alba** Hassk.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38817!); Dalhousie (15591! Drum's Herb.); Lahore—(3003! Brandis Herb.; Stewart 2598!; Ciegnorn 2650!).
Flowers.—August-October.
Distribution.—Cosmopolitan in warm climates. Throughout India, ascending to 6,000 ft. in the Himalaya.

249. BLAINVILLEA *CASS.*

470. **Blainvillea latifolia** DC. Wight Contrib. 17.

Locality.—Rawalpindi (Ait. 200!).
Flowers.—September.
Distribution.—Ceylon; tropical Asia; Africa and Australia. W. India and Deccan ascending to 5,000 ft. in Kumaon.

250. CENIA *JUSS.*

471. **Cenia turbinata** Pers. Syn. II, 465.

Locality.—Hoshiarpur (Ait.).
Probably an escape. An African type.
Distribution.—South Africa.

251. CENTIPEDA *LOUR.*

472. **Centipeda orbicularis** Lour. Fl. Coch.

Locality.—Hoshiarpur (Ait. 637!).
Distribution.—Ceylon; Afghanistan; E. tropical Asia; Australia and the Pacific Islands. Throughout the plains of India in moist places.

252. ARTEMISIA *L.*

473. **Artemisia scoparia** Waldst. & Kit. Pl. Rar. Hung. I, 66, t. 65.

Locality.—Rawalpindi (Ait. 582!).
Flowers.—October.
Distribution.—Japan; Afghanistan to Central Europe. India—Upper Gangetic Plain and westwards to Sind and the Punjab, W. Himalaya, 5-7,000 ft.

253. SENECIO *L.*

474. **Senecio Coronopifolius** Desf.

Locality.—Rawalpindi (Ait. 1069 !).
Flowers.—March.
Distribution.—Afghanistan and westwards to Spain. India—W. Himalaya.

254. ECHINOPS *L.*

475. **Echinops echinatus** DC. in Wight Contrib. 24.

Locality.—Lahore (2627 ! ; Stewart 2590 !).
Flowers.—March-April.
Distribution.—Afghanistan. India—Upper Gangetic Plain, N.-W. Himalaya, the Punjab, Bihar, Sind, Rajputana, the Deccan.

255. COUSINIA *CASS.*

476. **Cousinia minuta** Boiss. Fl. Orient. III, 489.

Locality.—Peshawar College (Quizilbash 41 !) ; Rawalpindi (Ait. 441 !).
Flowers.—May.
Distribution.—Afghanistan ; Baluchistan and Persia. India—the Punjab.

256. CNICUS *L.*

477. **Cnicus arvensis** Hoffm.

Locality.—Peshawar—College (Quizilbash 7 !) ; Lahore (2926 ! Brandis Herb ! ; Stewart 2608 !).
Flowers.—March-April.
Distribution.—N. Asia and westwards to the Atlantic. India—Bengal, Gangetic Plains, the Punjab, W. Himalaya.

478. **Cnicus argyracanthus** DC. Prodr. 640 (*Cirsium*).

Locality.—Gurdaspur—Seya-purkandi (Bisram 839 !).
Flowers.—May.
Distribution.—India—Temperate Himalaya.

257. SAUSSUREA *DC.*

479. **Saussurea candicans** Clarke Comp. Ind. 232.

Locality.—Hoshiarpur (Ait. 580 !).
Distribution.—Afghanistan. Subtropical and temperate W. India and the Himalaya.

480. **Saussurea albescens** Hook f. & T. in Clarke Comp. Ind. 233.

Locality.—Dalhousie (15593 ! Drum's Herb.).
Distribution.—India—W. and C. Himalaya.

258. VOLUTARELLA *CASS.*

481. **Volutarella divaricata** Benth. in Gen. Pl. II, 476, excl. some syns.

Locality.—Lahore (Stewart 2591 !, 2505 !).
Distribution.—Afghanistan ; Baluchistan. India.

259. CENTAUREA *L.*

482. **Centaurea cyanus** L.

Locality.—Rawalpindi (* Ait. 440 !).
Flowers.—April.
* May be an escape from gardens.
Distribution.—Caucasus and westwards to Atlantic. In corn fields and cultivated places of N.-W. India, sporadic.

483. Centaurea Calcitrapa L.

Locality.—Peshawar—College (Quizilbash 33 !).
Distribution.—W. Asia and Europe, introduced in most parts of the world. N.-W. India.

260. CARTHAMUS *L.*

484. Carthamus oxyacantha Bieb.

Locality.—Multan (Monro 401 !); Rawalpindi (Ait. 443 !).
Flowers.—May.
Distribution.—India—the Punjab. Westwards to Caucasus. Perhaps a wild form of the Safflower, *C. tinctorius* (Clarke).

261. GERBERA *GRONOV.*

485. Gerbera lanuginosa Benth. in Gen. Pl. II, 497.

Locality.—Rawalpindi (Ait. 134 !).
Flowers.—August.
Distribution.—India—W. Himalaya.

262. CICHORIUM *L.*

486. Cichorium Intybus L.

Locality.—Lahore (Stewart 2604 !); Peshawar College (Quizilbash 51 !).
Flowers.—April.
Distribution.—N.-W. India. Westwards to the Atlantic.

263. KOELPINIA *PALL.*

487. Koelpinia linaria Pall.

Locality.—Peshawar (Quizilbash 43 !); Rawalpindi (Ait. 1071 !, 439 !).
Flowers.—May.
Distribution.—C. and W. Asia, N. Africa, S. Russia. India—the Punjab, Kashmir.

264. CREPIS *L.*

488. Crepis foetida L.

Locality.—Rawalpindi (Ait. 429 !).
Flowers.—April.
Distribution.—India—the Punjab and W. Himalaya. Westwards to Atlantic.

489. Crepis japonica Benth. Fl. Hongk. 164.

Locality.—Hoshiarpur (Ait. 496 !).
Distribution.—Ceylon; Malay Peninsula; China; Japan; Afghanistan; Mauritius. Throughout India.

265. LACTUCA *L.*

490. Lactuca dissecta Don. Prodr. 164.

Locality.—Rawalpindi (Ait. 457 !, 450 !, 452 !).
Flowers.—March-April.
Distribution.—Afghanistan; Baluchistan. India—Temperate Himalaya.

266. PICRIDIUM *DESF.*

491. Picridium tingitatum Desf. Bois. Fl. Orient. III, 827.

Locality.—Rawalpindi (Ait. 1070 !).
Distribution.—Afghanistan; Baluchistan; Persia; Arabia; and N. Africa to the Canaries, S. Europe. India—the Punjab.

267. SONCHUS *L.*

492. **Sonchus oleraceus** L.

Locality.—Rawalpindi (Ait. 447 !).
Flowers.—April.
Distribution.—Throughout India.

493. **Sonchus arvensis** L.

Locality.—Rawalpindi (Ait. 445 !, 202 !, 149 !, 448 !); Lahore (Brandis 2608 !).
Flowers.—March-September.
Distribution.—Throughout India.

268. LAUNAEA *CASS.*

494. **Launaea asplenifolia** DC. Prodr. VII. 181 (*Microrhynchus*).

Locality.—Lahore (Stewart 2611).
Flowers.—April.
Distribution.—Plains of India.

495. **Launaea chondrilloides** DC. Prodr. VII, 183 (*Zollikoferia*).

Locality.—Rawalpindi (Ait. 455 !).
Flowers.—March-April.
Distribution.—Afghanistan; Persia; Arabia; Egypt. India—Punjab, Sind Rajputana.

496. **Launaea nudicaulis** Less. Synops. 139 (*Microrhynchus*).

Locality.—Peshawar, College (Quizilbash 31 !); Lahore (2920 ! Brandis Herb.); * Multan (281); Lahore (Stewart 2842 !, 2563 !); Phaltal (15 !); Rawalpindi (Ait. 454 !).
Flowers.—March-April.
* Grows on sandy soil. Fodder for goats only. Used here also as medicine for eyes.
Distribution.—Afghanistan and westwards to the Atlantic. Plains of India.

LXII. CAMPANULACEAE.

269. CAMPANULA *L.*

497. **Campanula canescens** Wall. Cat. 1289.

Locality.—Lahore (Stewart 2826 !); Hoshiarpur (Ait. 354 !); Rawalpindi (Ait. 460 !).
Flowers.—March.
Distribution.—Throughout India. Ceylon.

498. **Campanula colorata** Wall. Cat. 1287.

Locality.—Dalhousie (13907 !, 13908 ! Drum's Herb.).
Distribution.—Kabul. India—temperate Himalaya 3-10,000 ft. Western Ghats 5-7,000 ft.).

LXIII. ERICACEAE.

270. PIERIS *D.DON.*

499. **Pieris ovalifolia** D.Don in Edinb. Phil. Journ. XVII (1834), 159.

Locality.—Dalhousie (4701 ! Drum's Herb.).
Distribution.—Japan. India—temperate Himalaya; Burma.

LXIV. PLUMBAGINACEAE.

271. PLUMBAGO *L.*

500. **Plumbago capensis** Thunb. Prodr. Pl. Cap. 33.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13115 !).
Flowers.—April.
Distribution.—S. Africa.

LXV. PRIMULACEAE.

272. PRIMULA *L.*

500. **Primula erosa** Wall. Cat. 611.

Locality.—Dalhousie (13917!, 13916! Drum's Herb.).
Distribution.—India—temperate Himalaya, alt. 4,500-9,500 ft.

273. ANDROSACE *L.*

502. **Androsace saxifragaefolia** Bunge Enum. Pl. Chin. Bor. 53.

Locality.—Hoshiarpur (Ait. 500!).
Distribution.—N.-E. China; Japan; Loochoo Islands. India—Gangetic Plains to the Punjab and ascending the Himalayas to 4,000 ft.

503. **Androsace lanuginosa** Wall. in Roxb. Fl. Ind. ed. Wall. & Carey, II, 15.

Locality.—Dalhousie (13914! Drum's Herb.).
Distribution.—India—W. Himalaya.

274. ANAGALLIS *TOURNEF.*

504. **Anagallis arvensis** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 21019!, 20999!); Rawalpindi 8,000 ft. (Ait. 461!).
Flowers.—March-October.
Distribution.—Ceylon; Europe; W. Asia and introduced into most temperate regions. India—Bengal, N.-W. Provinces, Central India, Himalaya, Nilgiri Hills.

LXVI. MYRSINACEAE.

275. MYRSINE *L.*

505. **Myrsine semiserrata** Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II, 293.

Locality.—Rawalpindi—Charihan 6,000 ft. (Jerram 7784!, 7783!).
Flowers.—April.
Distribution.—Himalayas, Burma.

276. ARDISIA *SWARTZ.*

506. **Ardisia solanacea** Roxb. Cor. Pl. 27. t. 27.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13143!, 13144!).
Flowers.—May.
Distribution.—Ceylon, Malaya, China. Throughout India, alt. 0-5,000 ft.

507. **Ardisia Pickeringia** Terr. & Gray ex DC. Prodr. VIII, 124.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14368!, 11454!).
Flowers.—November-February.
Distribution.—Philippine Islands.

277. REPTONIA *A.DC.*

508. **Reptonia buxifolia** A. DC. Prodr. VIII, 153.

Locality.—Peshawar—Nizampur (8219!).
Distribution.—Afghanistan; Muscat.

LXVII. SAPOTACEAE.

278. MIMUSOPS *L.*

509. **Mimusops Elengi** L.

Locality.—Multan-Harani Bagh (Monro 314!).
Distribution.—Cultivated in the Tropics. India—Deccan; in N. India frequently cultivated.

510. **Mimusops hexandra** Roxb. Cor. Pl. I, 16, t. 15 and Fl. Ind. II, 238.

Locality.—Multan & Jalalpur (Monro 409 !).
Flowers.—June.
Distribution.—India—Deccan common; extending north to Gujrat, Banda and Circars; cultivated in N.-W. India. Ceylon common.

LXVIII. EBENACEAE.

279. Diospyros *L.*

511. **Diospyros cordifolia** Roxb. Cor. Pl. I, 38, t. 50 and Fl. Ind., II, 538.

Locality.—Hoshiarpur (Ait. 563 !).
Distribution.—Burma; Malay Archipelago; Tropical Australia.

512. **Diospyros tomentosa** Roxb. Hort. Beng. 40 and Fl. Ind. II, 532.

Locality.—Hoshiarpur !.
Fruits.—October.
Distribution.—India.

LXIX. OLEACEAE.

280. Jasminum *L.*

513. **Jasminum Sambac** Ait Hort. Kew I, 8.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6369 !).
Flowers.—June.
Distribution.—Much cultivated throughout India and in the Tropics of both hemispheres.

514. **Jasminum pubescens** Willd. Sp. Pl. I, 37.

Locality.—Hoshiarpur (Ait. 596 !).
Distribution.—Burma; Ceylon; China. Throughout India.

515. **Jasminum arborescens** Roxb. Hort. Beng. 3 and Fl. Ind. ed. Carey & Wall. I, 94.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6367 !).
Flowers.—May.
Distribution.—Throughout India, in the hot lower hills, alt. 500-3,000 ft., common.

516. **Jasminum rigidum** Zenker Pl. Ind. 5, t. 6.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6380 !).
Flowers.—April.
Distribution.—India—Deccan Peninsula. Ceylon.

517. **Jasminum auriculatum** Vahl. Symb. III, 1.

Locality.—Hoshiarpur (Ait. 561 !).
Distribution.—Ceylon common; Siam and Mauritius cultivated. India—Deccan Peninsula common, cultivated in Sind, N.-W. India, Bengal.

518. **Jasminum humile** L.

Locality.—Rawalpindi 4,000-6,000 ft. (Jerram 7894 !).
Flowers.—May.
Distribution.—Ceylon and Nepal common, Kabul cultivated widely. India—S. India and subtropical Himalaya common, alt. 2-5,000 ft. common.

519. **Jasminum officinale** L.

Locality.—Dalhousie (4844 ! Drum's Herb.); Rawalpindi 5,000 ft. (Jerram 8091 !).
Flowers.—June.
Distribution.—Kabul; Persia; China; Europe, etc. Often cultivated in India.

281. FRAXINUS *L.*

520. **Fraxinus oxyphylla** Bieb. Fl. Taur. Cauc. II, 450.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14247 !, 12970 !, 13811 !, 13664 !).
Flowers.—April-May.
Distribution.—Tauria.

282. OLEA *L.*

521. **Olea cuspidata** Wall. Cat. 2817.

Locality.—Rawalpindi (P. 5891 !, Ait. 205 !); Hoshiarpur (Ait. 204 !).
Flowers.—September. *Fruits.*—November.
Distribution.—Kabul; Baluchistan. India—N.-W. Himalaya and Kashmir, alt. 2-6,000 ft. frequent.

522. **Olea europaea** L. Sp. Pl. 8.

Locality.—Hoshiarpur (*Parker 14377 !); Rawalpindi (Ait. 462 !).
Flowers.—July.
* It is 5 ft. in girth near the base but, as in Lanore, gets covered with woolly blight.
Distribution.—Mediterranean region; Orient.

(To be continued)

THE MEDICINAL AND POISONOUS LABIATES OF INDIA.

BY

J. F. CAIUS, S.J., F.L.S.

The LABIATAE are herbs or under-shrubs with stems usually quadrangular bearing the leaves on the flat side. They form a large family of 3,300 species grouped in 200 genera. They are distributed over both hemispheres, especially in temperate regions, being particularly abundant in the Mediterranean area.

This important Order has but few poisonous members, and includes a number of medicinal and sub-medicinal plants of great value. In the lists of drugs supplied to herbalists the Labiates are very strongly represented. They mostly exhibit aromatic or bitter-aromatic, stimulant, and astringent properties; and they are used as tonics, emmenagogues, diaphoretics, and antispasmodics.

Many members yield *essential oils* when distilled. *Alkaloids*—betonicine, stachydrine, turicine—, and *glucosides*—hyssopin—have been isolated.

The medicinal and poisonous Labiates of the world belong to 84 genera :—ACROCEPHALUS (Malay Archipelago to tropical Africa); ACROTOME (southern and tropical Africa); AEOLANTHUS (Africa); AGASTACHE (North America); AJUGA (palaeotemperate regions); AMARACUS (eastern Mediterranean); ANISOCHILUS (Asia, Africa); ANISOMELES (Indo-Malayan region); AUDIBERTIA (North America); BALLOTA (Europe, Mediterranean region; western Asia); BETONICA (cosmopolitan); BRUNELLA (cosmopolitan); CALAMINTHA (northern temperate regions; tropical mountains); COLEBROOKEA (India); COLEUS (palaeotropical regions); CUNILA (America); DRACOCEPHALUM (northern temperate regions); DYSOPHYLLA (eastern Asia, Australia); ELSHOLTZIA (Asia, Europe, Abyssinia); ENDOSTEMON (southern and tropical Africa); EREMOSTACHYS (central and western Asia); ERYTHROCHLAMYS (tropical Africa); GALEOPSIS (northern temperate regions); GENIOSPORUM (Africa, Madagascar, Indo-Malayan region); GLECHOMA (Old World); GLECHON (Brazil, Paraguay); GOMPHOSTEMMA (Indo-Malayan region, China); HEDEOMA (America); HOSLUNDIA (warm Africa); HYMENOCRATER (western Asia); HYPTIS (warm America); HYSSOPUS (Europe, Mediterranean region, Asia); IBOZA (southern and tropical Africa); LALLEMANTIA western Asia); LAMIUM (Europe, Asia, extratropical Africa); LASIOCORYS (Africa); LAVANDULA (Mediterranean region to India); LEONOTIS (tropical and southern Africa); LEONURUS (Europe, Asia; tropical regions); LEUCAS (tropical regions; Africa, Asia); LOPHANTHUS (central Asia; China); LYCOPUS (northern temperate regions); MARRUBIUM (Europe, North Africa, temperate Asia); MARSYPIANTHES (warm America); MELISSA (Europe, western Asia); MELITTIS (Europe); MENTHA (Old World); MERIANDRA (Himalaya; Abyssinia); MICROMERIA (cosmopolitan); MONARDA (North America); MONARDELLA

(Western North America); MOSCHOSMA (palaeotropical regions); MOSLA (Himalaya to Japan); NEPETA (northern hemisphere); OCIMUM (tropical and warm temperate regions); ORIGANUM (Europe; Mediterranean region); ORTHOSIPHON (Indo-Malayan region; tropical Africa); OTOSTEGIA (western Asia; Abyssinia); PELTODON (Brazil, Paraguay); PERILLA (India to Japan); PEROWSKIA (western Asia); PHLOMIS (northern palaeotemperate regions); PHYSOSTEGIA (North America); PLATYSTOMA (tropical Asia; Africa); PLECTRANTHUS (palaeotropical regions; eastern Asia); POGOGYNE (California); POGOSTEMON (Indo-Malayan region); PYCNANTHEMUM (North America); ROSMARINUS (Mediterranean region); ROYLEA (Himalaya); SALVIA (tropical and temperate regions); SATUREIA (warm regions); SCUTELLARIA (cosmopolitan, except South Africa); SOLENOSTEMON (western Africa); SPHACELE (warm America; Hawaiian Isles); STACHYS (cosmopolitan, except Australia); SYNCOLOSTEMON (southern Africa); TETRADENIA (tropical Asia; Australia); TEUCRIUM (cosmopolitan); THYMBRA (south-eastern Europe; western Asia); THYMUS (Old World); TRICHOSTEMA (North America); ZATARIA (Persia, Afghanistan); ZIZIPHORA (Mediterranean region; central Asia).

The medicinal and poisonous Labiates of India are included in the following 49 genera:—ACROCEPHALUS, AJUGA, ANISOCHILUS, ANISOMELES, BRUNELLA, CALAMINTHA, COLEBROOKEA, COLEUS, DRACOCEPHALUM, DYSOPHYLLA, ELSHOLTZIA, EREMOSTACHYS, GALEOPSIS, GENIOSPORUM, GOMPHOSTEMMA, HYMENOCRATER, HYPTIS, HYSSOPUS, LALLEMANTIA, LAMIUM, LAVANDULA, LEONOTIS, LEONURUS, LEUCAS, LYCOPUS, MARRUBIUM, MELISSA, MENTHA, MERIANDRA, MICROMERIA, MOSCHOSMA, NEPETA, OCIMUM, ORIGANUM, ORTHOSIPHON, OTOSTEGIA, PERILLA, PEROWSKIA, PLATYSTOMA, POGOSTEMON, ROYLEA, SALVIA, SATUREIA, SCUTELLARIA, STACHYS, TEUCRIUM, THYMUS, ZATARIA, ZIZIPHORA.

I. Perfect stamens 4, rarely 2, declinate. Anther-cells confluent. Ovary 4-partite. Nutlets dry. Basal scar small.

A. Lower lip of corolla 1-lobed; stamens usually exserted; basal scar of nutlets not oblique.

1. Lower lip of corolla flat or nearly so.

a. Calyx deflexed in fruit, upper lobe recurved, margin decurrent on the tube.

i. Corolla-tube not exceeding the calyx, stigma 2-fid ... ... OCIMUM.

ii. Corolla-tube exceeding the calyx, stigma entire ... ... ORTHOSIPHON.

b. Calyx sub-erect or declinate in fruit, upper lobe not recurved, margins not decurrent.

i. Flowers in globose heads or in simple spikes or racemes.

α. Calyx narrowly tubular in fruit.

* Calyx suberect, upper lip 1-lobed, lower lip entire or 4-toothed ... ACROCEPHALUS.

** Calyx usually declinate, upper lip 1-lobed, with the lateral and lower teeth free, or the lateral teeth united with the upper lobe ... ... GENIOSPORUM.

β. Calyx widely campanulate in fruit ... PLATYSTOMA.

ii. Flowers in paniculate racemes ... ... MOSCHOSMA.

2. Lower lip of corolla conspicuously concave, or boat-shaped.
   a. Corolla distinctly 2-lipped, lower lip longer than the upper.
      i. Upper lip of calyx rounded, deflexed; or the calyx subequally 5-toothed ... COLEUS.
      ii. Upper lip of calyx beaked or truncate, curved downwards to close the mouth, or the calyx 1-lipped, the upper lip absent ... ANISOCHILUS.
   b. Corolla 5-lobed, the lowest lobe shorter or equalling the other lobes ... ... HYPTIS.

B. Lower lip of corolla 3-fid; stamens included; basal scar of nutlets oblique ... ... LAVANDULA.

II. Perfect stamens 4 with the upper pair longest or 2 straight diverging or ascending. Anthers 1- or 2-celled.

A. Stamens 2; anterior perfect, anther-cells parallel ... LYCOPUS.

B. Stamens 4.
   1. Stamens subequal not didynamous.
      a. Anthers 1-celled.
         i. Calyx 5-toothed, teeth neither feathery nor longer than the tube.
            α. Corolla sub-2-lipped, lower lip longer ... POGOSTEMON.
            β. Corolla equally 4-fid ... ... DYSOPHYLLA.
         ii. Calyx 5-partite, segments feathery, longer than the tube ... ... COLEBROOKEA.
      b. Anthers 2-celled.
         i. Fruiting calyx 2-lipped; corolla 5-lobed ... PERILLA.
         ii. Fruiting calyx 5-toothed; corolla 4-lobed ... MENTHA.
   2. Stamens didynamous.
      a. Anther-cells at length confluent, (2-celled when young ... ... ELSHOLTZIA.
      b. Anther-cells never confluent.
         i. Calyx 5-nerved ... ... ZATARIA.
         ii. Calyx 15-nerved
            α. Stamens exserted ... ... HYSSOPUS.
            β Stamens ascending under the hood ... HYMENOCRATER.
         iii. Calyx 10-13-nerved
            α. Corolla subequally 4-lobed, or obscurely 2-lipped; calyx-throat villous, mouth closed by the villi.
               * Whirls many-flowered, capitate; bracts conspicuous forming an involucre ... ... ORIGANUM.
               ** Whorls few-flowered, not capitate; bracts minute, not forming an involucre ... ... THYMUS.
            β. Corolla distinctly 2-lipped, calyx-throat glabrous or hairy, mouth not closed.
               * Corolla-tube straight.
                  ¶ Calyx sub-equally 5-toothed, or obscurely 2-lipped; corolla-tube not exceeding the calyx.
                     † Calyx usually 10-nerved (leaves linear-oblong in Indian species) ... ... SATUREIA.
                     †† Calyx usually 13-nerved (leaves broadly ovate in Indian species) ... ... MICROMERIA.
                  ¶¶ Calyx distinctly 2-lipped, corolla-tube exceeding the calyx ... CALAMINTHA.
               ** Corolla-tube recurved and ascending MELISSA.

III. Perfect stamens 2, ascending, parallel. Anther-cells linear, solitary or separated by a filiform connective.
- A. Anther-cells equal, contiguous, pendulous from a small connective ... ... PEROWSKIA.
- B. Anther-cells equal, distant, pendulous from a long connective ... ... MERIANDRA.
- C. Anther-cells very unequal or solitary on a long connective ... ... SALVIA.
- D. Anthers connate at the margin ... ... ZIZIPHORA.

IV. Perfect stamens 4 with the upper pair longest, rarely 2, ascending or diverging. Anthers 2-celled, cells at length diverging. Ovary 4-partite.
- A. Calyx tubular, 5-toothed ... ... NEPETA.
- B. Calyx 2-lipped, upper lip much the larger ... DRACOCEPHALUM
- C. Calyx 2-lipped, lateral lobes of upper lip on the face of the midlobe ... ... LALLEMANTIA.

V. Perfect stamens 4, ascending, lower pair longest. Calyx 5-10-nerved. Upper lip of corolla erect, lower spreading, trif.
- A. Calyx deeply 2-lipped; mouth of fruiting calyx closed by the lips.
  - 1. Lips of calyx entire, upper lip with a broad-plate ... ... SCUTELLARIA.
  - 2. Upper lip of calyx 3-toothed, without any plate, lower lip 2-toothed ... ... BRUNELLA.
- B. Calyx tubular or campanulate, 5-10-toothed, or obscurely 2-lipped, mouth not closed.
  - 1. Upper lip of corolla flat, not hooded.
    - a. Stamens included in the corolla-tube. ... MARRUBIUM.
    - b. Stamens exserted from the corolla-tube ... ANISOMELES.
  - 2. Upper lip of corolla hooded.
    - a. Calyx with a very widely expanded limb, with sinuate margin ... ... OTOSTEGIA.
    - b. Calyx limb not expanded, 5-lobed, or 5-10-toothed.
      - i. Anther-cells hairy.
        - α. Anther-cells transverse; nutlets compressed ... ... GALEOPSIS.
        - β. Anther-cells not transverse; nutlets triquetrous ... ... LAMIUM.
      - ii. Anther-cells glabrous.
        - α. Calyx-teeth much shorter than the tube.
          - *Calyx 8-10-toothed.
            - ¶ Upper lip of corolla shorter than the lower ... ... LEUCAS.
            - ¶¶ Upper lip of corolla longer than the lower ... ... LEONOTIS.
          - ** Calyx 5-toothed, or lobed.
            - ¶ Upper filaments not appendiculate at the base.
              - † Anther-cells not transverse, (leaves not sected) ... STACHYS.
              - †† Anther-cells transverse, (leaves much sected) ... ... LEONURUS.
            - ¶¶ Upper filaments appendiculate at the base ... ... EREMOSTACHYS.
        - β. Calyx- teeth or - lobes as long as or longer than the tube ... ... ROYLEA.

V. Stamens straight or ascending. Nutlets with a small basal scar or areola, rugose with a thick and slightly fleshy pericarp ... ... GOMPHOSTEMMA.

VI. Stamens 4, ascending; calyx 10-nerved. Ovary 4-lobed. Nutlets with a large, oblique or lateral areola.

A. Corolla 1-lipped, upper lip absent, lower 5-lobed ... TEUCRIUM.

B. Corolla 2-lipped, upper entire or 2-fid, lower 3-lobed ... ... AJUGA[1]

ACROCEPHALUS.

The genus numbers 40 species, spreading from the Malay Archipelago to Africa.

A. lilacinus Oliv. is a Gold Coast remedy for headache.

Acrocephalus indicus O. Kunz. is found all over India and ascends to 5,000 ft. in the Himalayas.

The plant is used as an expectorant in Sind.

Sindi: Ustukudus—.

AJUGA.

The genus consists of 30 palaeotemperate species.

A. Iva Schreb. is used medicinally in Europe; *A. Chamaepitys* Schreb. in Europe and the M'Zab; *A. reptans* Linn. in Europe and North America; *A. ophrydis* Burch. in South Africa.

Ajuga bracteosa Wall. is a small herb inhabiting the North-West Frontier Province, Kashmir, Punjab, Kumaon, and Nepal. It extends to Afghanistan, Tibet, China, Japan, and Abyssinia.

In the Punjab the leaves are given in the treatment of fevers as a substitute for cinchona. The plant is considered a bitter astringent and an aromatic tonic, specially useful in ague.

On the Salt Range it is used to kill lice, and is regarded as depurative.

Jhelum: Kauriboti—; *Kumaon*: Ratpatha—; *Sutlej*: Karku, Nilkantihi—; *Trans-Indus*: Khurbanri—.

ANISOCHILUS.

The genus consists of 20 species, inhabiting the tropical areas of Asia and Africa.

Anisochilus carnosus Wall. is an erect annual herb found all over the country, from Western Himalaya to Burma and South India, and Ceylon.

The fresh juice of the leaves mixed with sugar-candy is given by the Tamil doctors in cynanche; and mixed with sugar and gingelly-oil, is used as a cooling liniment for the head.

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[1] Dr. S. K. Mukerjee.—A Revision of the Labiatae of the Indian Empire. *Records Bot. Survey of India;* vol. xiv, no. 1; 1940.

The plant is a mild stimulant, expectorant, particularly useful in the cough of childhood. The juice of the leaves mixed with sugar and human milk is in Mysore a popular domestic remedy for coughs in children.

The juice of the leaves is commonly used in catarrh.

The plant yields a volatile oil which is credited with stimulant, diaphoretic, and expectorant properties.

Bombay: Choraonva, Kapurli—; *Canarese*: Doddapatri—; *Deccan*: Ajvan, Panjiri—; *Hindi*: Panjiri—; *Gujerati*: Ajama, Ajmamupatru, Ubhoratavelio—; *Malayalam*: Chomara, Kattukurkka, Kurkka, Patukurkka—; *Marathi*: Choraonva, Kapurli—; *Pondicherry*: Lavande—; *Sinhalese*: Galkapprawalliya—; *Tamil*: Karppuravalli—; *Telugu*: Kurpuravalli, Omamu-aku, Rogachettu—.

Anisomeles.

The genus consists of 6 Indo-Malayan species, spreading to Australia.

A. indica O. Ktze is used medicinally in Annam, the Philippine Islands, and La Reunion; *A. malabarica* R. Br. also is used in La Reunion.

Leaves broadly ovate. Nutlets black	*A. indica.*
Leaves oblong-lanceolate. Nutlets pale brown ...	*A. malabarica.*

1. **Anisomeles indica** O. Ktze is found throughout India, ascending to 6,000 feet in the Himalayas. It is distributed to Ceylon, the Malay Peninsula and Archipelago, the Philippine Islands, and China.

The plant has carminative, astringent, and tonic properties. It yields an essential oil which, in Ceylon, is used in uterine affections.

Bombay: Gopali—; *Cantonese*: Ts'in ts'o—; *Chinese*: Ch'ien Ts'ao—; *Malaya*: Hee chin choo—; *Sinhalese*: Yak-wanassa—; *Tagalog*: Talingharap—.

2. **Anisomeles malabarica** R. Br. is found in the Deccan peninsula, and is a well-known plant in Southern India, whence it spreads to Ceylon, Malaya, and Mauritius.

In Southern India, few plants are held in higher esteem, or are more frequently employed in native practice, than this. An infusion of the aromatic bitter leaves is in common use in affections of the stomach and bowels, catarrhal affections and intermittent fevers.

In addition to its internal use in the cure of fevers, patients are made to inhale the vapour of a hot infusion so as to induce copious diaphoresis. An infusion of the leaves is given to children in colic, dyspepsia and fever arising from teething. A decoction of the plant, or the essential oil distilled from the leaves, is used externally in rheumatism.

In La Reunion the plant is considered sudorific and antipyretic. It is given for rheumatism.

In Mauritius is credited with antispasmodic and emmenagogue properties. It is given for flatulence, and in hysteria.

An infusion of the leaves of this plant is given on the west coast to children in colic, dyspepsia and fever arising from teething.

V. Stamens straight or ascending. Nutlets with a small basal scar or areola, rugose with a thick and slightly fleshy pericarp ... ... GOMPHOSTEMMA.

VI. Stamens 4, ascending; calyx 10-nerved. Ovary 4-lobed. Nutlets with a large, oblique or lateral areola.

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In Mauritius is credited with antispasmodic and emmenagogue properties. It is given for flatulence, and in hysteria.

An infusion of the leaves of this plant is given on the west coast to children in colic, dyspepsia and fever arising from teething.

The infusion acts as a diaphoretic. An infusion (1 in 10) was tried in fever accompanying teething and was found useful (Koman).

Bombay: Chodhara—; *Canarese*: Karitumbe—; *Deccan*: Mogbirekapatta—; *English*: Malabar Catmint—; *Gujerat*: Gholochodharo, Makhmalichodharo—; *Malayalam*: Karintumpa, Pemarutti, Peruntumpa—; *Marathi*: Chodhara, Pandrachodhara, Sundara, Sundraphal—; *Mauritius*: Menthe musquée des Malabars, Boutankoushum, Pémayretti—; *Sanskrit*: Oshthaphala, Vaikuntha—; *Tamil*: Irattaippeymarutti, Peymarutti, Peyverutti, Sadumbai—; *Telugu*: Chinnaranabheri, Magabira, Mogabheri—.

Brunella.

This genus includes 5 more or less cosmopolitan species. *B. vulgaris* Linn. is used medicinally in Europe, China, and Malaya.

Brunella vulgaris Linn. occurs in the temperate Himalaya from Kashmir to Bhutan from 4,000 to 11,000 feet, in the Khasia Hills at 4,000-6,000 feet, and on the hills of South India: Nilgiris, Pulneys, and Travancore mountains. It inhabits most of the temperate regions of the Northern Hemisphere, and is to be found in Australia.

The herb is aromatic and carminative; reputed useful in the treatment of haemorrhages and diarrhoea. It is esteemed by herbalists for relaxed throats.

'The decoction of Prunell', says Gerarde, 'made with wine and water, doth join together and make whole and sound all wounds, both inward and outward . . .' 'There is not a better Wound herbe in the world . . . ' The whole herb has astringent, styptic, and tonic properties.

Self-Heal is still in use in modern herbal treatment as a useful astringent for inward and outward use.

An infusion of the herb, made from 1 oz. to a pint of boiling water, and taken in doses of a wineglassful, is considered a general strengthener. Sweetened with honey, it is good for a sore and relaxed throat or ulcerated mouth, for both of which purposes it also makes a good gargle. For internal bleeding and for piles, the infusion is also used as an injection. It is a household remedy in Germany.

The Swiss peasants use the plant as a vulnerary.

Regarded by the Punjab Himalayan hill tribes as expectorant and antispasmodic (Stewart). The green leaves smeared with castor oil and warmed over the fire are applied externally to the anus in cases of painful piles.

The plant is used for fevers and coughs in China and Malaya, and is considered there anti-rheumatic, alterative, and tonic.

The Flambeau Ojibwe Indians of North America use the root to make a tea to drink before going hunting; it is supposed to sharpen their powers of observation. They also use the root mixed with others for a female remedy.

The whites of Wisconsin use the root as a pungent and bitter tonic and antispasmodic; they credit it with vermifuge properties,

and regard it as slightly diuretic. The root has also been used for obstructions of the liver, cramps and fits.

Arabic: Anas-ul-rawah—; *Chinese*: Hsia K'u Ts'ao—; *English*: All-heal, Brown-wort, Brunel, Brunella, Bumble-bees, Carpenter-grass, Carpenter's Herb, Fly Flowers, Heart of the Earth, Herb Carpenter, Hercules' All-heal, Hercules' Wound-wort, Hook-heal, London Bottles, Pick Pocket, Pimpernel, Prince's Feather, Proud Carpenter, Prunella, Self-heal, Sickle-wort, Slough-heal—; *French*: Bonnerette, Bonnette, Brunelle, Brunellier, Brunette, Charbonnière, Herbe au charpentier, Pâquerette, Petite consoude, Petite consyre, Prunelle—; *German*: Braunelle, Braunheil—; *Hindi*: Dharu—; *Italian*: Brunella—; *Malaya*: Lo han tsao, Look ham chow—; *North America*: Blue Curls, Carpenter Weed, Heal-all, Heart of the Earth, Self-heal—; *Ojibwe*: Basi' bûgûk—; *Persian*: Ustekhadus—; *Punjab*: Austakhadus—; *Roumanian*: Busuioc de camp, Busuioc marunt—; *Sind*: Ustukhudus—; *Spanish*: Brunela, Consuelda menor—; *Urdu*: Ustekhadus—; *Yorkshire*: Black Man—.

Calamintha.

The genus numbers 60 species, scattered over the northern temperate regions and the mountains of the Tropics.

C. Acinos DC., *C. alpina* Lam., *C. Clinopodium* Benth., *C. grandiflora* Moench, *C. Nepeta* Savi., *C. officinalis* Moench are used medicinally in Europe.

The flowered plant of *C. officinalis* Moench is official in France.

Calamintha Clinopodium Benth. is found in the western temperate Himalaya, from Kashmir to Kumaon, at 4,000-12,000 feet. It is distributed to northern and western Asia, Europe, North Africa, and Canada.

The plant is cephalic, astringent, carminative, and tonic to the heart.

Arabic: Asaba-el-fatiyat—; *Catalan*: Alfábrega boscana—; *French*: Clinopode—; *Spanish*: Albahaca silvestre major, Angelotes, Clinopodio, Pie de cama, Perilla de cama—.

Colebrookea.

A Himalayan genus, comprising only one species.

Colebrookea oppositifolia Sm. is one of the commonest and most abundant plants in the lower Himalaya. It occurs all over India, in the hilly parts, from Peshawar to Burma, and Simla to Travancore.

A preparation from the root is used by the Santals in epilepsy.

The leaves are applied to wounds and bruises.

The down on the stem and leaves is used by the Paharias of Sikkim to extract worms from bad sores on their legs.

Bombay: Bahmani, Bhamini, Dasai, Dasari, Dussarica—; *Canarese*: Tuggigidda—; *Dehra-Dun*: Binde, Bindu—; *Garhwal*: Binda, Bindu—; *Hindi*: Binda, Bindu, Pansra—; *Jaunsar*: Bambher, Lulri—; *Khond*: Darigopi, Merata—; *Kumaon*: Binda, Bindu, Dulshat—; *Matheran*: Bhaman—; *Melghat*: Chotabhandara—; *Nepal*: Dosul—; *Punjab*: Barmera, Basuti, Briali, Dashane, Duss, Phishekkar, Sampru, Shakardana, Suali—; *Rammagar*: Bhuriruderi—; *Saharanpur*: Bintalakri, Kalabansa—; *Santali*: Barsakapor, Bhainsa—; *Saora*: Jolidi—; *Trans-Indus*: Shakardana—; *Uriya*: Bosiki, Darigopi—.

COLEUS.

This genus consists of 150 palaeotropical species.

C. Amboinicus Lour. is used medicinally in Cambodia, the Malay Archipelago, and the Philippine Islands; *C. atropurpureus* Benth. in the Philippine Islands; *C. Bojeri* Benth. in Madagascar; *C. dysentericus* Baker in Nyassaland, Nigeria, and Madagascar; *C. floribundus* Baker in Ubanghi-Shari.

Coleus Amboinicus Lour., a native of the Moluccas, is cultivated in gardens throughout India, and Ceylon. It occurs wild in Rajputana.

The leaves are said to have a specific action on the bladder and to be useful in urinary diseases, vaginal discharges, etc. The juice mixed with sugar is given in cases of colic in children, and acts as a powerful aromatic carminative.

In spite of its intoxicating properties the people of Bengal employ it in colic and dyspepsia.

The expressed juice of the leaves is considered an anodyne and astringent, and applied over and around the eyelids, in cases of conjunctivitis.

In Ceylon a decoction of the leaves is given for asthma, chronic coughs, etc.

In Cochin-China the juice of the leaves is considered carminative and is given to children suffering from wind colic. The decoction is given for asthma, chronic bronchitis, epilepsy, and convulsions.

The leaves are official in Holland.

Bengal: Paterchur—; *Bombay*: Owa, Pathorchur, Pathurchur—; *Cambodia*: Chi trasak damrey—; *Hindi*: Pathorchur—; *Malay Archipelago*: Daoen Koetjing, Djinten—; *Marathi*: Panacha ova, Patharchur—; *Philippines*: Oregano—; *Sanskrit*: Pashanabhedi—; *Sinhalese*: Kapprawalliya—; *Tagalog*: Suganda—.

DRACOCEPHALUM.

The genus consists of 40 species, inhabiting the temperate regions of the Northern Hemisphere.

Dracocephalum Moldavica Linn. is found in the western temperate Himalaya and Kashmir, at altitudes of 7,000 to 8,000 feet. It extends to northern Asia and Europe.

In Patna the seeds are used ground up in fevers, and as demulcent.

The seeds afford an opaque mucilage when soaked in water. The drug is esteemed in Persia as a carminative and tonic.

In Europe the plant is considered tonic, astringent, and vulnerary.

Arabic: Asaba-el-fatiyat, Baklat-el-utrujuya—; *Hindustani*: Tukhm- ferunj-mishk—; *Persian*: Badrendj-bouyih, Badrendj-buya, Karanfalihostani—; *Spanish*: Melisa de Moldavia, Torongil de Turquia—; *Tabriz*: Badirash-bu—; *Teheran*: Badranj-buya—.

DYSOPHYLLA.

The genus consists of 20 species, inhabiting eastern Asia and Australia.

Dysophylla auricularia Blume is found in Sikkim, eastern Bengal, Assam, Burma, Singbhum, Poona, and South India. It is distributed to Ceylon, the Malay peninsula and islands, the Philippine Islands, and China.

The herb is a Malayan remedy for colic. The leaves are powdered with lime and rubbed on the abdomen.

Malay: Ekor kuching, Poko awi tana—.

Elsholtzia.

The genus consists of 30 species distributed over Asia, Europe, and Abyssinia.

Elsholtzia cristata Willd. is to be found from Kashmir to Mishmi at 1,200-9,000 feet. It has been of late introduced in the Nilgiris. It spreads to Tibet, China, Japan, northern Asia, and Europe.

In China and Cochin-China the plant is used as a medicine, a pot herb, and a condiment. In Annam the flowering tops are given as a diuretic. In Japan the leaves are used for tea. In a general way, like other Labiates, the drug is regarded by the Chinese as carminative, stomachic, and astringent.

Cantonese: Heung ue—; *Chinese*: Hsiang Ju—; *Malaya*: Heong yee—.

Eremostachys.

The genus numbers 40 species, natives of Central and Western Asia.

Bracts and bracteoles spine-tipped, equalling calyx; bracteoles connate below in groups of 3 ... ... *E. acanthocalyx.*
Bracts and bracteoles not spiny, much shorter than calyx, all free ... ... *E. Vicaryi.*

1. **Eremostachys acanthocalyx** Boiss. is found in West Punjab and Baluchistan, whence it extends to Baluchistan.

The Baluchis consider the plant poisonous.

Kirani: Bishkhaf—.

2. **Eremostachys Vicaryi** Benth. occurs in Western Punjab and is common on the Salt Range, ascending to 2,500 feet. It is also found at Peshawar and in Baluchistan.

In the Punjab the seeds are given as a cooling medicine.

The plant is said to be used in the Eusufzai near Peshawar for poisoning fish.

Kila Saifulla: Khurzbin—; *Pab Hills*: Bischkhaf—; *Punjab*: Gurgunna, Khalatra, Rewandchini—.

Galeopsis.

A genus of 7 palaeotemperate species, inhabiting the Northern Hemisphere.

G. ochroleuca Lam. is official in the Pharmacopoeia of Austria.

Galeopsis Tetrahit Linn. occurs in Sikkim and Kashmir. It is distributed over Tibet, North and West Asia, Europe; and has been introduced into North America.

The plant is well spoken of as an expectorant, and in phthisical complaints. An infusion of the whole plant is used in the treatment of pulmonary troubles. It has also been employed as an anti-spasmodic resolvent, and a detergent.

English: Bastard Hemp, Bee-nettle, Blind Nettle, Dai-nettle, Day-nettle, Dea-Nettle, De-Nettles, Deye-Nettle, Dog Nettle, Donnine-thell, Female Hems, Glidewort, Hemp Nettle, Holyrope, Nettle Hemp, Stinging Nettle, Sting Nettle—; *Forest Potawatomi*: Mena' kwûskûk—; *North America*: Common Hemp Nettle—.

GENIOSPORUM.

The genus includes 15 species scattered over Africa, Madagascar, and the Indo-Malayan region.

Geniosporum prostratum Benth. is found in sandy ground from the Konkan southwards, especially near the sea, and in the warmer parts of Ceylon.

In Pondicherry this plant is credited with febrifugal properties.

Pondicherry: Nazelnagai—.

GOMPHOSTEMMA.

A genus of 25 Indo-Malayan species spreading to China.

Gomphostemma crinitum Wall. occurs in Assam, Burma, and the Malay Peninsula.

var. *Griffithii* Prain, which is found in Tenasserim and Malaya, is administered in the form of decoction after confinements.

Malay: Munjulong bukit—.

HYMENOCRATER.

The genus consists of 9 species, natives of Western Asia.

Hymenocrater sessilifolius Benth. occurs in Baluchistan and Afghanistan.

In Baluchistan the leaves are left overnight soaking in water, and the infusion is given as a morning drink to children.

Baluchistan: Sursánda—.

HYPTIS.

This large genus numbers 300 species, natives of warm America.

The following species are used medicinally in Madagascar and West Tropical Africa.—*H. pectinata* Poit., *H. spicigera* Lam.—; in Guiana—*H. verticillata* Jacq.—; in Brazil—*H. canescens* Benth., *H. fasciculata* Benth., H. *fruticosa* Salzm., *H. graveolens* Salzm., *H. pectinata* Poit., *H. spicata* Poit., *H. suaveolens* Poit., *H. umbrosa* Salzm—.

Flowers not in globose heads.

Calyx 3 mm. long in fruit	...	...	... *H. pectinata*
Calyx 8-10 mm. long in fruit	...	...	... *H. suaveolens*

1. **Hyptis pectinata** Poit. is found in Bengal, Assam, and the Madras Presidency. It is distributed over tropical Africa and Asia.

In Ashanti and South Nigeria the plant is a medicine for young children, and used in connection with childbirth. Poultices of the leaves are applied for chest complaints.

In North Nigeria the leaf is used for fever. It is boiled for horses to inhale the vapour for diseases accompanied by mucous catarrh.

In Madagascar the plant is considered aromatic, tonic, anthelmintic, antispasmodic, emmenagogue, and odontalgic. It is mostly used to expel worms in children. A decoction or infusion of the flower heads is given in fever, and for chest troubles.

Adangme: Kadokeng—; *Angola*: Quibumbo, Quimbumba, Quinbumbo, Quinbungu—; *Ashanti*: Piaa—; *Awuna*: Awusa-kadi—; *Betsileo*: Afolava—; *Dagomba*: Baeba—; *Ga*: Suruwie—; *Hausa*: Kimba-kimba, Kimbar awaki, Kimbar dawaki—; *Hova*: Rombatsahona, Sangasanganandevolahy—; *Sakalave*: Sangasanganimarina—; *Twi*: Opea, Peaba—; *Yoruba*: Jogbo—.

2. **Hyptis suaveolens** Poit. occurs in the Deccan, in Chota Nagpur, Bengal, Assam, Burma, and the Andaman and Nicobar islands. It is distributed to the Malay Archipelago, the Philippine Islands, Formosa, Indo-China, Siam, and tropical Africa.

In Orissa the plant is pounded and applied to parasitical cutaneous diseases.

In West Tropical Africa an infusion of dried leaves is taken for fever. The plant is tied round the head for headache or applied to cure boils, and the juice of the pressed leaves along with lime juice is drunk for colic and stomach-ache.

In Brazil an infusion is used as a carminative and as a sudorific in catarrhal conditions.

Colombia: Botón morado, Chavito, Mastrantillo, Mastranto de perro, Mastranto de sabana, Yerba de las muelas, Yerba de la reuma—; *Malay*: Malbar hutan, Sapulut, Selasik hutan—; *Mal Paharia*: Purudo—; *Mandingo*: Fure-jambo—; *Mexico*: Chan—; *Panama*: Purgaperro, Salvia—; *Santali*: Gangatulsi—; *Tagalog*: Pansipansiyan, Soobcabayo—; *Timne*: Bupi-bupi—; *Uriya*: Gangatulsi, Purodo—; *Venezuela*: Mastranto—; *Visayan*: Locoloco—; *Yoruba*: Jogbo—.

Hyssopus.

Hyssopus officinalis Linn., the sole representative of the genus, is found in the Western Himalaya, from Kashmir to Kumaon, at 8,000-11,000 feet. It spreads to Western Asia, and grows wild in middle and southern Europe.

Hyssop is classed by the Arabians amongst their anthelmintics, stimulants, and deobstruents. In Europe it has long been known as a tonic and stimulant, and was at one time in great repute as a remedy for nervous diseases. *Pliny* also thought it useful in chest affections, and *Celsus* regarded it as an anthelmintic.

Hyssop tea is a grateful drink, well adapted to improve the tone of a feeble stomach, being brewed with the green tops of the herb. The same parts of the plant are sometimes boiled in

soup to be given for asthma. To make Hyssop tea, one drachm of the dried herb should be infused in a pint of boiling water, and allowed to become cool. Then a wineglassful is to be given as a dose two or three times a day. It is of use in the ailments of women.

A distilled water of Hyssop is deemed a good pectoral medicine.

The essential oil, in doses of one to two drops, promotes expectoration in bronchial catarrh and asthma.

The green herb, bruised and applied, will heal cuts promptly. If it be steeped in boiling water and applied hot to the part, it will quickly remove the blackness consequent upon a bruise or blow, especially in the case of 'black' or blood-shot eyes. In America an infusion of the leaves is used externally for the relief of muscular rheumatism, as also for bruises and discoloured contusions.

The juice of the leaves made into a syrup with sugar and honey is used as a vermifuge for roundworms.

A decoction of the flowers of this plant from Persia was given in cases of asthma and chronic bronchitis and found to be a useful remedy in those complaints (Koman).

The flower-tops are official in France, Portugal, and Sweden; the leaves too are official in France.

Arabic: Zufah-e-Yabis, Zufah-ul-retih—; *Catalan*: Hisop—; *Danish*: Isop—; *Dutch*: Hysop—; *English*: Hyssop—; *French*: Herbe sacrée, Hysope—; *German*: Apothekerhysop, Eiserich, Gartenrispe, Hyssop, Isipo, Isop, Ispern, Issel, Josephskraut, Klosteruesopp, Lufftskraut, Ysop—; *Greek*: Hysopos—; *Hebrew*: Esof—; *Hindi*: Zufah yabis—; *Italian*: Isopo, Issopo—; *Languedoc*: Mariarmo—; *Persian*: Zufah-e-khuskka, Zufah-e-tar, Zufah-e-yabis—; *Polish*: Isopek—; *Portuguese*: Hissopo—; *Roumanian*: Cimbru cel brun, Isop—; *Russian*: Issop—; *Spanish*: Hisopo—; *Swedish*: Isop—; *Urdu*: Zufah yabis—.

Lallemantia.

The genus consists of 4 species, inhabiting Western Asia.

Lallemantia Royleana Benth. occurs in the North West Province, the Punjab plains and hills, and Baluchistan; extending to Afghanistan, Persia, and Turkestan.

The plant is largely grown on account of its mucilaginous seeds, which are considered cooling and sedative, and are extensively employed in the preparation of a mucilaginous beverage. In Persia they are used for cough, and as a stimulant and aphrodisiac.

In the Punjab the seeds are used as cooling and sedative remedies.

Bombay: Tukhmibalangu—; *Hamadan*: Balingan—; *Harboi Hills*: Fuchkin, Yakhtali—; *Hindi*: Ghareikashmalu, Tukhmbalangu, Tukhmlealanga—; *Kashmir*: Tukhmibalunga—; *Punjab*: Ghareikashmalu, Tukhmbalangu, Tukhmmalanga, Tukmalanga—; *Persian*: Tukhmibalangu—; *Urdu*: Balanga—.

Lamium.

The genus includes 40 species distributed over Europe, North Africa, and temperate Asia.

Lamium album Linn. occurs in Kashmir, the Punjab, Kumaon, and Hazara. It is scattered over northern and western Asia, North Africa, and Europe.

The root is used medicinally in China. In Spain it is considered astringent and is used as a resolvent and vulnerary.

Catalan: Ortiga morta—; *Chinese*: Hsu Tuan—; *English*: Archangel, Bee Nettle, Blind Nettle, Day Nettle, Dead Nettle, Deaf Nettle, Dee Nettle, Dumb Nettle, Dummy Nettle, Dunny Nettle, Nettle, Snake Flower, Stingy Nettle, Suck-bottle, Suckie Sue, White Archangel, White Deadnettle, White Nettle—; *French*: Archangélique, Galéopsis, Lamier blanc, Lamion, Marachemin, Ortie blanche, Ortie morte, Pied de poule, Suçots blancs—; *German*: Bienenhuetel, Biemensang, Dahnnessel, Dangel, Daudelblume, Eddernessel, Eisblume, Gageneier, Heddernessel, Honigsugel, Huehnernessel, Hundnessel, Loeffelblume, Sengenessel, Suegede, Taubnessel, Taunessel, Urinblume, Wasserblume, Weisse Betonie, Weisser Ganzert, Weisser Kuckuck, Weisse Suegete, Wurmnessel—; *Italian*: Lamio bianco—; *Russian*: Sadovui dyagil—; *Spanish*: Ortiga blanca, Ortiga muerta, Ortiga muerta blanca—.

LAVANDULA.

The genus consists of 20 species spreading from the Mediterranean to India.

L. dentata Linn., *L. Spica* DC., *L. Stoechas* Linn., *L. vera* DC. are used medicinally in Europe.

Lavandula bipinnata O. Ktze. occurs in Chota Nagpur, Mount Abu, Konkan, Jubbulpore, Khandesh, and the Deccan.

It is reported that the villagers and shepherds of the Barda Hills in Kathiawar use the plant as a medicine.

The plant is supposed to act as an antidote against snake poison. The roots are rubbed with water and the solution or the paste is applied over the sting or the bite of poisonous animals. The powdered leaves are given for inhalation to the person who has been bitten by a serpent in order to prevent him from falling into sleep.

Gujerati: Aasmanigalgoto, Sarpnocharo—.

LEONOTIS.

The genus consists of 15 tropical and South African species.

L. dysophylla Benth., *L. Leonitis* R. Br., *L. Leonurus* R. Br., *L. microphylla* Skan., *L. mollis* Benth. are used medicinally in South Africa; *L. africana* Brig. is used in Angola and Northern Nigeria; *L. nepetaefolia* R. Br. in Northern Nigeria, Madagascar, and Brazil.

Leonotis nepetaefolia R. Br. is found, either cultivated or naturalized, in the Punjab and all the hotter provinces of northern and southern India, whence it spreads to Ceylon. It is distributed to tropical Asia, Africa, and America.

In Chota Nagpur the ashes of the flower-heads are applied to burns and scalds; in Bombay they are mixed with curds and applied to ringworm and other itchy diseases of the skin.

The plant is used medicinally by the Mundas of Chota Nagpur. The whorl, in flower or in seed, is pounded and fried in Koronj

oil; this is rubbed on itch, also on head sores of small children. When a mother's breasts swell and milk does not pass through the nipples, the crushed root is rubbed on the breast (*Encyclopoedia Mundarica*).

In Loanda a decoction of the plant is used in diseases of the abdomen.

In Northern Nigeria the leaf pounded with natron is applied locally for swellings and ulcers supposed to be of syphilitic origin; the fresh leaves are applied for headache. A decoction is used to steam the head to relieve catarrh, fever, etc., and is taken also internally as a tonic and febrifuge, and for gastro-intestinal troubles. The plant is put amongst stored corn to keep away vermin.

In Madagascar the plant is considered emmenagogue, febrifuge, depurative, narcotic, bitter, and laxative; used in skin diseases, amenorrhoea, and fever.

In Porto Rico a decoction of the leaves is used as a tonic; the juice is also expressed and taken with limejuice and rum as a febrifuge.

The leaves are used in Brazil in the treatment of rheumatic affections.

Bengal: Hejurchei—; *Bombay*: Matijer, Matisul—; *Brazil*: Cordao do frade—; *Ceylon*: Kasitumpai—; *Efik*: Ubiom—; *Fulani*: Hore gujjo—; *Gujerati*: Matijer, Matisul—; *Hausa*: Chika saura, Jam'barawo, Kam mutum, Tutar'yan sarki—; *Hindi*: Baraguma, Hejurchei—; *Krobo*: Nyeddo—; *Lagos*: Iku ekun—; *Loanda*: Maluvo, Maluvo-iameonco, Maluvo-iamgilla, Maluvo-m'angilla—; *Mano*: Seto a yi—; *Marathi*: Dipmal, Ekri—; *Mauritius*: Dacca, Léonure—; *Mundari*: Agiajanum, Gharia, Hatuseng-gelsui, Senggelsui—; *Porto Rico*: Molonillo, Rascamoño—; *Sakalave*: Kilanjan-anahary—; *Santali*: Daredhompo, Janumdhompo, jonumdhompo—; *Sinhalese*: Mahayakwanassa—; *Telugu*: Beri, Hanumantabira, Mulugolimidi, Ranabheri—; *Uriya*: Kontosidho—; *Uruguay*: Uña del diablo—; *Yoruba*: Iku ekun—.

Leonurus.

The genus consists of 8 species inhabiting Europe, Asia, and tropical regions.

L. macranthus Maxim. and *L. sibiricus* Linn. are used medicinally in China, and *L. sibiricus* is also used in Malaya; *L. Cardiaca* Linn. is used in Europe.

Upper lip of corolla densely villous, midlobe of lower lip entire ... ... *L. Cardiaca*
Upper lip of corolla tomentose, midlobe of lower lip obcordate or 2-fid ... ... *L. sibiricus*.

1. **Leonurus Cardiaca** Linn. is found in Kumaon, Kashmir, the Punjab, Hazara, and the Kurrum Valley. It is distributed to western and northern Asia, and to Europe.

Says Culpeper: 'There is no better herb to take melancholy vapours from the heart, and to strengthen it. It may be kept in a syrup or conserve; it maketh mothers joyful, and settles the womb, therefore it is called Motherwort. It is of use for the trembling of the heart, fainting and swooning. The powder, to the quantity of a spoonful, drank in wine, helps women in sore travail, as also for the suffocating or rising of the mother. It provokes

urine and women's courses, cleanses the chest of cold phlegm, kills the worms in the belly. It is of use to digest and disperse them that settle in the veins, joints, and sinews of the body, and to help cramps and convulsions.'

The herb is diaphoretic, aromatic, and stomachic.

Contact with the plant causes a dermatitis in susceptible individuals.

Catalan: Mà de Santa Maria—; *English*: Motherwort—; *French*: Agripaume, Cardiaire, Cardiale, Cardiaque, Cheneuse, Creneuse, Herbe aux tonneliers, Léonure, Patte de sorcier—; *German*: Herzgespann, Loewenschwanz—; *Italian*: Cardiaca—; *Portuguese*: Cardiaca—; *Roumanian*: Cione, Creasta cocosulin, Iarba flocoasa, Talpa gascei—; *Russian*: Pustirnik—; *Spanish*: Agripalma, Cardiaca, Cola de león—; *United States*: Lion's Ear, Lion's Tail, Motherwort, Throwwort—.

2. **Leonurus sibiricus** Linn. is found in the plains of India from Bengal and Sylhet to Coorg. It is distributed to tropical Asia, Africa, and America.

The root and leaves are bitter and used as a febrifuge.

In Chinese medicine the seeds are considered to be constructive and aphrodisiac. The dried plant is prescribed as a tonic, alterative, vulnerary, and general remedy in puerperal and mentrual diseases.

Cantonese: Ch'ung wai—; *Chinese*: Ch'ung Wei, I Mu, K'uen Ts'ao—; *Malaya*: Choong wai, Kwan chor seranting, Tebung aga—; *Patna*: Guma—; *Tagalog*: Camariangsongsong—.

Leucas.

The genus includes about 100 Asiatic and African species.

L. aspera Spreng. is used medicinally in the Philippine Islands; *L. decurvata* Baker in Nyasaland; *R. deflexa* Hook. fil. in Gold Coast; *L. martinicensis* R. Br. in Northern Nigeria, South Africa, and Brazil.

A. Calyx-mouth oblique.
  I. Mouth of calyx much produced below ... *L. urticaefolia.*
  II. Mouth of calyx produced above
    Calyx-teeth very short
      a. Calyx-mouth not villous within.
        1. Calyx smooth below, ribbed and hispid above ... ... *L. aspera.*
        2. Calyx smooth throughout or nearly so. Calyx-mouth very oblique ... *L. linifolia.*
      b. Calyx-mouth villous within
        1. Leaves linear, less than 13 mm. broad, whorls less than 2.5 cm. diam.; bracts linear, 6 mm. long ... ... *L. zeylanica.*
        2. Leaves ovate, more than 13 mm. broad,
          i. Whorls 3.5 cm. diam.; bracts lanceolate, 1.5-2.5 cm. long ... ... *L. Cephalotes.*
          ii. Whorls 2.3 cm. diam.; bracts linear-lanceolate or subulate, 6-9 mm. long ... *L. martinicensis*

B. Calyx-teeth stellately spreading in fruit, whorls terminal and axillary.
  Hairs on the stem erect or spreading. Calyx 5-10 mm. long ... ... *L. stelligera.*

1. **Leucas aspera** Spreng. occurs more or less throughout India, in the plains. It extends to Indo-China, the Philippine Islands, Java, and Mauritius.

The leaves are said to be useful in chronic rheumatism. The juice is applied in psoriasis and other chronic skin eruptions.

In North Bengal the flowers are given warmed in a little honey for coughs and colds to children. The juice of the leaves is applied to disperse painful swellings.

In Mauritius the plant is used as an emollient and pectoral.

Caius and Mhaskar have shown experimentally that the plant is not an antidote to snake venom.

Bengal: Chotahalkusa—; *Bombay*: Tamba—; *Deccan*: Thurduribaji—; *Hindi*: Chotahalkusa—; *La Reunion*: Herbe à mouches, Herbe Tombe, Tombe—; *Mauritius*: Madame Tombé, Marrube blanc, Couma, Halkasa, Poualla toumi—; *Mundari*: Gomaara—; *Sadani*: Gumhasag—; *Tagalog*: Carucansoli, Pansipansi, Solasolasian—; *Tamil*: Tumbai—; *Telugu*: Tummachettu—; *Visayan*: Paipaisi, Pansipansi, Paypaysi—.

2. **Leucas Cephalotes** Spreng. is found throughout India from Sind to Assam, and Kashmir to Deccan; scattered over all plains districts of the Madras Presidency. It extends to Afghanistan.

The plant is considered a mild stimulant and diaphoretic, and is considerably used in fevers and coughs.

The fresh juice is used in certain localities as an external application in scabies. The flowers are administered in the form of a syrup as a domestic remedy for coughs and colds.

The seeds yield an oil, which is used medicinally in Chota Nagpur.

The leaves, in combination with other drugs, are prescribed for scorpion sting (Vagbhata); but they are not an antidote to scorpion venom (Caius and Mhaskar).

Bengal: Barahalkasa, Ghalaghase—; *Gangpur*: Nakiara, Nakingara—; *Gujerati*: Doshinokubo, Khetraukubo, Kubi, Kubo—; *Hindi*: Deldóna, Dhurpisag, Goma, Guma, Motapati—; *Khandesh*: Kedari—; *Marathi*: Devkumbha, Kumbha, Shetvad, Tumba—; *Mundari*: Bananaki, Gomanaki—; *Punjab*: Chatra, Guldoda, Maldoda, Phuman, Sisalius—; *Sanskrit*: Chatraka, Chhatrani, Chitrakshupa, Chitrapatrika, Drona, Dronapushpi, Kaundinya, Kshavapatri, Kumbhayoni, Kumbhayonika, Kurumba, Kurumbika, Palindi, Phalepushpa, Shvasanaka, Supushpi, Vrikshasaraka—; *Santali*: Andiadhuruparak, Andiadura parak—; *Telugu*: Peddatumni, Tumni—.

3. **Leucas linifolia** Spreng. is met with in the plains, more or less throughout India. It is distributed to Malaya and Mauritius.

The natives of Central India believe that the leaves, when roasted and eaten with salt, have febrifugal properties.

The fresh juice is employed as a remedy against headaches and colds.

At Lakhimpur in Assam it is used for loss of appetite. The leaves are wrapped up in a plantain leaf, heated, and then eaten. The first effect of this treatment is that the appetite decreases to such an extent that the patient is unable to take any food at all, on the second day it passes off and he takes food with avidity (Carter).

In the North West, the leaves are bruised and a teaspoonful of juice given, which is snuffed up the nostrils as a remedy against snake-bite.

The leaves are equally useless in the treatment of snake-bite whether given internally, or used as an errhine or a collyrium, or applied locally to the part bitten (Mhaskar and Caius).

Assam: Dron—; *Bengal*: Halkasa, Halkussa—; *Deccan*: Goma—; *Gond*: Gumi, Kumbha—; *Gujerati*: Jhinanpannikubo—; *Hindi*: Guma, Halkusa, Kumbha—; *Lakhimpur*: Guma—; *La Reunion*: Herbe à mouches, Herbe Tombe, Tombe—; *Marathi*: Kuva—; *Philippines*: Parnipansi—; *Sanskrit*: Dronapushpi, Kumbhi, Rudrapushpa—; *Sundribuns*: Guma, Hal-kūsa—; *Telugu*: Pulátumni—; *Urdu*: Guma—.

4. **Leucas martinicensis** R. Br. is found all over South India. It is distributed to the Malay Peninsula, tropical Africa, and tropical America.

In Gambia the whole plant is made into an infusion and used as a wash in fevers.

In Northern Nigeria the plant is burnt for the purpose of expelling mosquitoes. An infusion is used for simple gastro-intestinal troubles and for colds, and as a wash or steam for fevers.

The infusion is used in Brazil as a bath for hysterical fits and for pain in the joints.

Betsileo: Kifilanjambola—; *Brazil*: Catinga da Mulata—; *Fulani*: Erisku, Hore gujjo, Risku—; *Gambia*: Wild Tea Bush—; *Hausa*: Kam'barawo—; *Hova*: Lanjananahary—; *Katsina*: Sarakuwar sauro—; *Sokoto*: Sarakuwar sauro—; *Zaria*: 'Dai'doyar gona—.

5. **Leucas stelligera** Wall. is found in the Konkan, Canara, Mysore, and the Nilgiris.

The plant has stimulant, carminative, and emmenagogue properties.

Gujerati: Dungaraukubo—; *Laos*: Jang nog gan—; *Marathi*: Barumbi, Guma—; *Matheran*: Borambi, Guma, Matasul—.

6. **Leucas urticaefolia** R. Br. occurs from Baluchistan and the Punjab to Behar, Sind, Gujerat, Rajputana, Central and South India, mostly in the plains. It is distributed to Arabia, Nubia, and Abyssinia.

At Gomawal in Baluchistan the plant is used as a cure for fever.

Gujerat: Kubo—.

7. **Leucas zeylanica** R. Br. occurs in Assam, Chittagong, and South India, whence it spreads to Ceylon. It extends to the Malay Peninsula and Archipelago, and to China.

In Malaya the herb is used as a cure for scabies.

In Ceylon the leaves are bruised and a teaspoonful of the juice given, which is sniffed up as a remedy in snake-bite. The juice is also employed in headache and colds.

The leaves are useless as an errhine in the treatment of snake-bite (Mhaskar and Caius).

Malay: Katumbit—; *Sinhalese*: Gattatumba, Getatumba—.

LYCOPUS.

This genus includes 10 species of the northern temperate regions. *L. sinuatus* Ell. and *L. virginicus* Linn. are used medicinally in the United States of America.

Lycopus europaeus Linn. is found in Kashmir. It is distributed to Europe, West, North, and Central Asia.

The leaves are used externally as a poultice to cleanse foul wounds.

It is used in the Punjab as a cooling drug.

It has been employed in Europe as a substitute for quinine.

English: Gipsywort—; *French*: Marube aquatique—; *German*: Wolfsfuss—; *Kashmir*: Gandamgundu, Jalnim—; *Spanish*: Marrubio acuático, Pie de lobo—.

MARRUBIUM.

The genus includes 30 species, natives of Europe, North Africa, and temperate Asia.

M. Alysson Linn. is used medicinally in Spain; *M. vulgare* Linn. in Europe, California, and South Africa.

Marrubium vulgare Linn. occurs in Kashmir, the North West Frontier Province, and Baluchistan, whence it extends to Afghanistan, Europe, and North Africa.

The dried leaves and flowering tops are carminative, expectorant, laxative, aperient, diaphoretic, stimulant, and tonic.

The herb is a bitter tonic, expectorant, and diuretic. It is perhaps the most popular of herbal pectoral remedies in England. It is exceedingly valuable in coughs, cold, and pulmonary affections. In many parts it is brewed and sold as Horehound Ale, making an appetising and healthful beverage. Also a candy is prepared, and if properly made, is no doubt efficacious.

The infusion is much used in Europe as a domestic remedy for bronchitis with profuse expectoration. It is tonic, and in large doses, purgative.

The Europeans in South Africa use an infusion in febrile conditions, and especially in typhoid fever.

In America it is generally used in catarrhal states of the air passages.

The plant is especially esteemed by the Spanish-Californians as a remedy for colds and lung troubles.

In Mexico a preparation made from the leaves is used for rheumatism; it is added to mescal and applied as a liniment.

Afrikaans: Koorsbossie—; *Arabic*: Faracioûn, Farasiym, Hashishatelkalb, Sufelard—; *Brahui*: Borkash—; *Catalan*: Malroig, Malrubé, Malrubi blanch, Malrubins, Marreus—; *Danish*: Hvidmarru, Hvidrubike, Rubike—; *Dutch*: Gemeene malrove—; *English*: Common Horehound, Hoarhound, Horehound, White Hoarhound—; *French*: Blanc roubi, Blanc rubi, Bonhomme, Bon riblet, Bon rubi, Grand bonhomme, Herbe vierge, Marchemin, Marinclin, Marrochemin, Marrochen, Marrube, Marrube blanc, Marrube bonhomme, Marrube commun, Mont blanc—; *German*: Andornkraut, Berghopfen, Chinakraut, Gotteshuelfe, Gottvergess, Gutverges, Kuckskraut, Lungenkraute, Maeuseoehrchen, Marienwurzelkraut, Markobell, Nagelkraut, Siebennagelspitzer, Wasserdorn, Weisse Leuchte,

Weisser Andorn, Weisser Anton, Weisser Daurand, Weisser Dorand, Weisser Gottvergess, Weisser Winderthon, Weissleuchterkraut—; *Greek*: Prasion—; *Hindi*: Paharigandana—; *Italian*: Erba apiola, Marrobio, Marrobio bianco—; *Kurdish*: Qutainah—; *Languedoc*: Maltraste, Maribbe—; *Malta*: White Horehound, Marrobio, Robbio, Erba apiola, Marrubija, Marrubjabajda—; *Persian*: Afnanesar—; *Polish*: Szanta biala—; *Portuguese*: Marroio, Marroio branco—; *Provence*: Bouan rible, Mentastre, Marroufe, Marrubi, Moun blanc—; *Roumanian*: Catusnica, Catusnica selbatica, Iarba flocoasa, Iarba mitei, Iarba vintului—; *Russian*: Marrub, Schandra—; *South Africa*: Horehound, Marvel, White Horehound—; *Spanish*: Marrubio, Marrubio blanco—; *Swedish*: Andorn—; *Urdu*: Farasiym—; *Uruguay*: Malva rubia, Marrubio, Yuyo del sapo—.

Melissa.

A genus of 4 species, natives of Europe and Western Asia.

M. officinalis Linn. is used medicinally in Europe. Its flower-heads and leaves are official in Austria, Belgium, Brazil, Denmark, France, Germany, Hungary, Italy, Norway, Portugal, Spain, Switzerland, Turkey, and Yugoslavia.

Melissa parviflora Benth. occurs in the temperate Himalaya, from Garhwal to Sikkim and Mishmi, and in the Khasia Hills. It is distributed to Java.

The plant is a good substitute for *M. officinalis*.

Arabic: Baklatelutrujiya, Mufarehulkalab—; *Hindi*: Bililotan—; *Persian*: Badrunjboya—; *Urdu*: Baranjboya—.

Mentha.

The genus includes 25 Old World species.

The following species are used medicinally in Europe:—*M. aquatica* Linn., *M. arvensis* Linn., *M. cardiaca* J. G. Baker, *M. gentilis* Linn,, *M. piperita* Linn., *M. Pulegium* Linn., *M. rotundifolia* Huds., *M. sativa* Linn., *M. sylvestris* Linn., *M. viridis* Linn.—; in China, Indo-China, and Malaya—*M. arvensis* Linn.—; in Madagascar—*Mentha spp.*—; in South Africa—*M. aquatica* Linn., *M. capensis* Thunb., *M. crispa* Linn., *M. longifolia* Huds.—; in North America—*M. aquatica* Linn., *M. piperita* Linn., *M. sylvestris* Linn .—.

1. Leaves sessile, lanceolate to oblong, coarsely dentate, smooth above, glandular below ... ... *M. viridis.*
2. Leaves petioled, coarsely serrate, smooth above, rarely sparingly hairy on the nerves below ... ... *M. piperita.*
3. Leaves nearly sessile, sharply toothed, upper surface hoary pubescent, lower white tomentose ... ... *M. sylvestris.*
4. Leaves narrowed below, stalked, ovate, oblong, lanceolate, toothed ... ... *M. arvensis.*

1. **Mentha arvensis** Linn. is a herb of the Western Himalaya, found in Kashmir, the Punjab, Kumaon, and Garhwal. It is distributed to Afghanistan, West and North Asia, China, and Europe.

The dried plant is refrigerant, stomachic, diuretic, and stimulant. It possesses antispasmodic and emmenagogue properties. It is used in jaundice, and is frequently given to stop vomiting.

In China the leaves and stems are made into infusion, and used as carminative, sudorific, and antispasmodic.

In Annam the plant is considered an excellent diaphoretic. An infusion is given in fevers, indigestion, and cephalalgia. The juice of the leaves is applied to the sting or bite of poisonous animals. The leaves pounded with salt are applied to the whitlow.

It is said that the effect of this plant, when animals eat it, is to prevent coagulation of their milk, so that it can hardly be made to yield cheese.

Annam: Bac ha, Bac ha tay, Ke to, Kim tien bac ha, Nam ha, Thuy to, To lan—; *Arabic*: Fodanajihindi, Fotanajehindi, Habakjabuli, Habaqulhind, Naanaaehindi, Naanaaulhind—; *Bengal*: Podina—; *Bombay*: Pudinah—; *Burma*: Bhudina—; *Canarese*: Chetnimaragu, Maraga—; *Chinese*: Po Ho—; *English*: Chinese Mint, Corn Mint, Marsh Mint—; *French*: Baume des champs, Menthe des champs, Menthe du Japon, Pouliot thym—; *Guam*: Yerba buena—; *Gujerati*: Phudno, Pudina—; *Hindi*: Pudinah—; *Languedoc*: Fau pulegi—; *Malaya*: Pok ho—; *Malayalam*: Putiyina—; *Marathi*: Pudina—; *Persian*: Filfilmun, Pudinah—; *Sind*: Pfudnah—; *Sinhalese*: Odutalan—; *Spanish*: Yerba buena—; *Tamil*: Pudina, Yechakkirai—; *Telugu*: Igaenglikura, Pudina—; *Tongking*: Ba Kha—; *Urdu*: Pudinchkohi—.

2. **Mentha piperita** Linn. is cultivated in Indian gardens. It is found spontaneous and cultivated in most temperate regions of Europe, Asia, and North America.

The leaves and the tops of the flowering plant are carminative, stimulant, nervine, antispasmodic, analgesic, anodyne.

In Europe the herb is considered stimulant, stomachic, carminative; and is used for allaying nausea, flatulence, sickness, vomiting, and as an infants' cordial.

Its bruised fresh leaves, if applied, will relieve local pains and headache. A hot infusion, taken as tea, soothes stomach-ache, allays sickness, and stays colicky diarrhoea. This will also subdue menstrual colic.

This is one of the three plants used by the Menomini Indians of North America in the cure of pneumonia, the others being wild mint and catnep. The compound is drunk in the form of a tea and is also used as a poultice.

A volatile oil obtained from the plant is well-known in medicine for its antiseptic, stimulant, and carminative properties; and peppermint oil is the most extensively used of all the volatile oils, both medicinally and commercially.

The oil itself is often given on sugar and added to pills, also a spirit made from the oil, but the preparation in most general use is Peppermint Water, which is the oil and water distilled together. In flatulent colic, spirit of Peppermint in hot water is a good household remedy, also the oil given in doses of one or two drops on sugar.

The local anaesthetic action of Peppermint Oil is exceptionally strong. It is also powerfully antiseptic, the two properties making it valuable in the relief of toothache and in the treatment of cavities in the teeth.

Rats dislike Peppermint, a fact that is made use of by ratcatchers, who, when clearing a building of rats, will block up most of their

holes with rags soaked in oil of Peppermint, and drive them by ferrets through the remaining holes into bags.

Arabic: Nāna—; *Berber*: Nemdar, Timedja, Timersitin—; *Bogotá*: Yerba buena—; *Brazil*: Hortela pimenta—; *Catalan*: Menta piperita—; *Chinese*: Po Ho—; *Danish*: Pebermynte—; *Dutch*: Pepermint—; *English*: Brandy Mint, Peppermint—; *French*: Menthe, Menthe anglaise, Menthe d' Angleterré, Menthe officinale, Menthe poivrée—; *German*: Edelmindkraut, Edelminze, Hausminze, Odernunze, Pfefferminze, Pfeffermuenze—; *Hungarian*: Borsos menta—; *Italian*: Menta piperita—; *Menomini*: Dakixkomik—; *Mexico*: Menta piperita—; *North America*: Brandy Mint, Lamb Mint, Lammint, Peppermint—; *Norwegian*: Peppermynte—; *Polish*: Pepparmynta—; *Portuguese*: Hortelana pimentosa, Hortelao apimentada, Hortelao pimenta—; *Russian*: Myata perechnaya—; *Spanish*: Menta inglesa, Menta pimentada, Menta piperita, Yerba buena de sabor de pimienta—; *Swedish*: Pepparmynt—; *Turkish*: Nana—; *Uruguay*: Menta—; *Yugoslavia*: Paprena metvica, Nana—.

3. **Mentha sylvestris** Linn. is met with in the temperate Western Himalaya and Western Tibet, at altitudes of 4,000 to 12,000 feet; in Kashmir, Kumaon, Garhwal, and the Punjab. It is distributed to Afghanistan, Western and Central Asia, and temperate Europe. It is frequently cultivated in gardens in the plains of India.

The dried leaves and flower heads are carminative, and stimulant.

The leaves and a decoction of the plant are considerably used by the natives of the Himalaya as a carminative. They are also employed as an astringent, and for rheumatic pains.

The leaves soaked in water give an infusion which is drunk as a cooling medicine in Shahrig. Trans-Indus, a decoction is used in fever and heat apoplexy.

In the Konkan the plant is much used as a domestic remedy on account of its mildly stimulant and carminative properties.

The herb is used as a carminative and stimulant in Europe. The dry herb yields about 1 per cent of essential oil, endowed with the same carminative and stimulant properties.

Arabic: Fudanajhabak, Fudanajnaanna—; *Baluchi*: Purchink—; *Bombay*: Pudina, Vartalau—; *Brahui*: Purchink—; *Burma*: Boodeema—; *Catalan*: Menta borda—; *Egypt*: Habag—; *English*: Horsemint—; *French*: Mentastre, Menthe sauvage—; *Hindi*: Podina—; *Khowas*: Wealni—; *North-Western Provinces*: Padina—; *Punjab*: Baburi, Belanne, Koshu, Pudnakushna, Vien, Yura—; *Pushtu*: Shamshabai—; *Sanskrit*: Ajirnahara, Pudina, Rochani, Ruchishya, Shakashobaana, Sugandhipatra, Vantihara, Vyanjana—; *Shahrig*: Shinshobae, Velanae, Vialangi—; *Spanish*: Mastranzo nevado, Menta silvestre—; *Urdu*: Pudina—; *Uruguay*: Menta—; *Zhob*: Shinshobae—.

4. **Mentha viridis** Linn. is commonly grown in native gardens all over the plains of India.

The seeds are mucilaginous. The leaves are given in fever and bronchitis, and a decoction is used as lotion in aphthae.

In Europe the herb is considered stimulant, carminative, and antispasmodic. It is added to many compounds on account of its carminative properties and its pleasant taste. For infantile troubles generally the sweetened infusion is an excellent remedy. A distilled water is made which will relieve hiccough and flatulence as well as the giddiness of indigestion.

The oil is less used than that of Peppermint.

A homoeopathic tincture prepared from the fresh plant in flower has been found serviceable in strangury, gravel, and as a local application in painful haemorrhoids. Its principal employment is for its febrifuge and diuretic properties.

Bengal: Pundia—; *Bombay*: Pahadipudina, Pudina—; *Brazil*: Hortela commum—; *Catalan*: Herba sana, Menta comuna—; *English*: Brown Mint, Fish Mint, Garden Mint, Green Mint, Lamb Mint, Mackerel Mint, Our Lady's Mint, Sage of Bethlehem, Spearmint, Spire Mint—; *French*: Baume vert, Menthe à épis, Menthe de Notre-Dame, Menthe romaine, Menthe verte—; *German*: Frauenmuenze, Gruene Muenze, Roemische Minze—; *Gujerati*: Phudino—; *Hindi*: Paharipudina, Podina—; *Italian*: Menta romana—; *Malta*: Spearmint, Menta comune, Naghnieh—; *Marathi*: Pudina—; *Mexico*: Herbabuena—; *North-Western Provinces*: Paharipudina—; *Persian*: Nagbo, Pudneh, Shahsufiam—; *Pishin*: Nana—; *Portuguese*: Hortelao, Ortelao vulgare—; *Punjab*: Paharipodina, Pudina, Pudinakuhi, *Pudna*—; Quetta: Nana—; *Roumanian*: Izma, Minta—; *Sind*: Phudina, Pudina—; *Sinhalese*: Meenchi—; *Spanish*: Costo, Erba Santa Maria, Menta romana, Yerba buena—; *Telugu*: Pudina—.

Meriandra.

This genus consists of 2 species, one Himalayan, and one Abyssinian.

Shrub finely tomentose or hoary. Spikes with distant clusters of flowers	... *M. bengalensis.*
Shrub flocculently woolly. Spikes uninterrupted	... *M. strobilifera.*

1. **Meriandra bengalensis** Benth., a native of Abyssinia, is cultivated in most of the provinces in India.

An infusion of the leaves is a useful application to aphthae and sore throats. It diminishes or arrests the secretion of milk.

Bombay: Kafurkapatta, Sesti—; *Deccan*: Kafurkapatta—; *English*: Bengal Sage—; *Hindi*: Kafurkapat—; *Tamil*: Sayayilai—; *Telugu*: Simakarpuramu—.

2. **Meriandra strobilifera** Benth. is found in the western temperate Himalaya, from Simla to Kumaon, at altitudes of 5,000 to 6,000 feet.

The decoction, when made strong, is a good lotion for ulcers and heals raw abrasions of the skin. It dries up the breast milk.

Micromeria.

The genus includes 130 cosmopolitan species.

M. Douglasii Benth. is used popularly as an emmenagogue along the Pacific Coast.

Micromeria capitellata Benth. occurs in Kumaon and Dehra Dun, the Upper Gangetic Plain, Chota Nagpur, Bihar, the Western Ghats, the Northern Circars, and the Nilgiris.

It is a fairly good substitute for *Mentha piperita*.

Moschosma.

The genus consists of 6 palaeotropical species.

Moschosma polystachium Benth. is found in Gujerat, Konkan, Deccan, Bengal, Bihar, and Burma. It extends to Ceylon, Java, the Philippine Islands, China, Australia, and tropical Africa.

In the Gold Coast Colony the juice of the plant is squeezed into the nostrils of children to cure headache.

Ashanti: Nwansing nwansing—; *Betsileo*: Karanjamboay, Karanjanamboay—*Hausa*: Kimbar rafi—; *Tamil*: Sanakki poondu—.

Nepeta.

The genus includes 150 species, natives of temperate Europe, North Africa, and Asia.

The following species are used medicinally in Europe—*N. Cataria* Linn., *N. glechoma* Benth., *N. italica* Linn.—; in China—*N. glechoma* Benth., *N. japonica* Maxim., *N. tenuifolia* Benth.—; in Annam and Malaya—*N. tenuifolia* Benth.—; in the United States of America—*N. glechoma* Benth.—.

I. Flowers in continuous spikes or heads; basal clusters rarely distinct ... ... *N. elliptica.*

II. Flowers in distinct clusters either axillary, or forming interrupted spikes or panicles.

A. Whorls all sessile.

1. Leaves as broad as long; hoary on both sides ... *N. glomerulosa.*
2. Leaves longer than broad, upper surface not hoary ... *N. ciliaris.*

B. Whorls peduncled, the lower conspicuously so.

1. Stem and branches stout; leaf-apex acute or acuminate; corolla dotted with purple ... *N. Cataria.*
2. Stem and branches slender; leaf-apex obtuse; corolla blue-purple ... ... *N. ruderalis.*

1. **Nepeta Cataria** Linn. is found in Kashmir, the North-Western Frontier Province, the Kurrum Valley, Baluchistan, and Afghanistan. It is distributed to Western Europe.

The dried leaves and flowering tops are carminative, tonic, diaphoretic, refrigerant and slightly emmenagogue, specially antispasmodic, and mildly stimulating.

Producing free perspiration, Catnep Tea is very useful in colds. It is a valuable drink in every case of fever, because of its action in inducing sleep, and producing perspiration without increasing the heat of the system. It is good in restlessness, colic, insanity, and nervousness, and is used as a mild nervine for children, one of its chief uses being, indeed, in the treatment of children's ailments.

The infusion of 1 oz. to a pint of boiling water may be taken by adults in doses of two tablespoonfuls, by children in two or three teaspoonfuls frequently, to relieve pain and flatulence. The tea may be drunk freely, but if taken in very large doses when warm,

it frequently acts as an emetic. It has proved efficacious in nervous headaches and as an emmenagogue, though for the latter purpose, it is preferable to use Catnep, not as a warm tea, but to express the juice of the green herb and take it in tablespoonful doses, three times a day.

An injection of the tea also relieves headache, hysteria, and colicky pains.

Catmint is one of the ingredients in the Menomini Indian cure for pneumonia, the others being wild mint and peppermint. The compound is drunk in the form of a tea, and is also used as a poultice on the chest.

The Flambeau Ojibwe brew a tea of catmint leaves for a blood purifier. The mint water obtained by steeping the herb in lukewarm water is used to bathe a patient, to raise the body temperature.

Catalan: Herba gatera, Menta de gat, Nepta—; *Dutch*: Kattekruid, Nip—; *English*: Catmint, Catnep, Nep—; *Flambeau Ojibwe*: Tci'name'wûck—; *French*: Cataire, Chataire, Herbe aux chats, Menthe de chat—; *German*: Katzenminze, Katzennessel, Katzensterz, Neptenkraut, Steinminze, Steinnessel—; *Italian*: Cattaia, Cattaria, Erba gatta, Gattaria, Nepitella—; *Menomini*: Ka'saka muski'ki—; *North America*: Catmint, Catnep, Catnip—; *Roumanian*: Catusnic, Catusnica—; *Russian*: Kashachya myata—; *Spanish*: Menta gatera, Menta de gatos, Yerba gatera, Yerba de gatos—; *Swedish*: Kattmynta—.

2. **Nepeta ciliaris** Benth. is found in temperate western Himalaya, from Kashmir to Garhwal, at altitudes of 6,000 to 8,000 feet.

It is given in sherbet for fever and cough.

Punjab: Zufa yabis—; *Sind*: Jufa—.

3. **Nepeta elliptica** Royle occurs in western temperate Himalaya, from Kashmir to Kumaon, at altitudes of 5,000 to 8,000 feet.

An infusion of seeds in cold water is used in dysentery by the Punjabis.

Punjab: Tukhmmalanga—.

4. **Nepeta glomerulosa** Boiss. is found from the Punjab frontier to Baluchistan, whence it extends to Afghanistan and Persia.

It is a cure for pneumonia in Bolan, for itch in Sanjawi.

It is commonly used for indigestion.

Bolan: Simsok—; *Brahui*: Simsok—; *Chiltan*: Bhinjanbutai, Chanjanbutai—; *Quetta-Pishin*: Chinjanbutae—; *Sanjawi*: Chamjanbot—.

5. **Nepeta ruderalis** Hook. fil. occurs in the hilly parts of Bengal, Bihar, the Punjab, Kumaon, the North-West Frontier Province, Rajputana, Central India, Konkan, and Deccan. It is distributed to Afghanistan.

It is largely used in fevers, and as a cardiac tonic. The decoction is used as a gargle in sore throat.

In Nepal it is taken internally as a remedy for gonorrhoea.

Nepal: Niasbo—; *Punjab*: Badranj boya, Bebrang khatai, Billi lotan—.

Ocimum.

The genus numbers 60 species, inhabiting the tropical and warm temperate regions of the world.

The following species are used medicinally in Europe—*O. basilicum* Linn., *O. gratissimum* Linn.—; in China and Indo-China—*O. basilicum* Linn.—; in Japan and Malaya—*O. crispum* Thunb.—; in the Philippine Islands—*O. basilicum* Linn., *O. gratissimum* Linn., *O. sanctum* Linn.—; in Guiana—*O. micranthum* Willd.—; in Brazil—*O. canum* Sims., *O. gratissimum* Linn., *O. micranthum* Willd.—; in La Reunion—*O. basilicum* Linn., *O. gratissimum* Linn.—; in Ethiopia and Abyssinia—*O. gratissimum* Linn.—; in Guinea and the Gold Coast—*O. canum* Sims., *O. basilicum* Linn., *O. viride* Willd.—; in Sierra Leone and Liberia—*O. viride* Willd.—; in Ubangi-Shari: *O. canum* Sims.—.

The flower tops of *O. basilicum* Linn. are official in France.

A. Pedicels as long as or longer than the calyx; 2 lower calyx-teeth longer than the upper lip ... ... *O. sanctum.*

B. Pedicels shorter than the calyx.

I. Lower calyx-teeth longer than the upper lip.

a. Bracts stalked ... ... *O. canum.*

b. Bracts stalked. Fruiting calyx very shortly pedicelled *O. basilicum.*

II. Lower calyx-teeth shorter than the upper lip ... *O. gratissimum.*

1. **Ocimum basilicum** Linn. grows throughout India. It is cultivated throughout the greater part of India, Ceylon, and Burma. It extends to the Malay Peninsula and Archipelago, Formosa, China, and Polynesia.

Diaphoretic and expectorant properties are ascribed to this plant, which is considered digestive and pectoral in La Reunion.

The roots are used for the bowel complaints of children.

The leaves are useful in the treatment of croup, for which the juice warmed with honey is given.

The expressed juice of the leaves forms the basis of a celebrated nostrum for the cure of ringworm; and the bruised leaves are applied to parts stung by scorpions to lessen the pain. The powdered dried leaves are said to be an effectual means of dislodging maggots.

The juice of the leaves or of the whole plant is dropped into the ears for the cure of headache and dullness of hearing. Mixed with ginger and black pepper it is given in the cold stage of intermittent fever.

The flowers possess stimulant, diuretic, and demulcent properties.

The seeds are largely employed, especially by the Mohammedans of Eastern Bengal, infused in water, to form a refreshing and cooling drink. When steeped in water they become immediately coated with a semi-transparent mucilage, and then form a mucilaginous jelly.

The seeds are much used medicinally in some parts of India, especially in the treatment of gonorrhoea and nephritic affections, and are regarded also as useful for dysentery and diarrhoea, especially in children for the diarrhoea of dentition. A cold infusion is said to relieve the after-pains of parturition.

The seeds washed and pounded are used in poultices for unhealthy sores and sinuses. They are also given internally with sherbet in cases of habitual constipation, internal piles, and fevers.

An infusion of the leaves is used in fevers by the natives of Gambia, where it is a popular common cooling drink.

In Guinea the decoction of the leaves and the stems is given in fevers, neuralgia, catarrh, and renal troubles; it is also used as a lotion for sore eyes.

In Annam an infusion of the plant is considered antiemetic and antidiarrhaeic. It is given for cephalalgia and gouty joints, and used as a gargle for foul breath. An infusion of the seeds is given in fevers. The seeds are chewed in cases of snake-bite, one portion is swallowed and the other portion applied to the bitten part.

The leaf is not an antidote to snake venom. In the treatment of snake-bite it is equally useless as a collyrium, an errhine, and a local application to the part bitten (Mhaskar and Caius).

Annam: Huong nhung, Nhat thong chi, Rau e lon trong, Rau e tia, Rau e trang, Rau que—; *Arabic*: Asaba-ul-feteyat, Badarwaj, Badruj, Baklut-ul-zub, Habaq, Habbok, Hebak, Hibag, Rihan, Schogor, Shahasfaram—; *Baluchi*: Nazbu—; *Bengal*: Babuitulsi, Debunsha, Khubkalam, Pashanabeddie—; *Bombay*: Takmeria—; *Brahui*: Niazpu—; *Canarese*: Kamkusturi, Ramkasturi, Sajjebiya—; *Cantonese*: Hiang Hoa Tsao—; *Catalan*: Alfabrega de fulla ampla, Alfabrega de fulla petita—; *Chinese*: Hsan Ts'ao, Lo le—; *Culión*: Camange—; *Deccan*: Salzat, Subjah, Subze, Tirunitru—; *Dutch*: Basilienkruid, Basilikum—; *Egypt*: Rihan, Sa'atar hendy—; *English*: Basil, Common Basil, Common Sweet Basil, Garden Basil, Roman Basil, Sweet Basil—; *French*: Basilic, Basilic des cuisinières, Basilic cultivé, Basilic aux sauces, Grand basilic, Herbe royale—; *Fulani*: Soukora—; *Gambia*: Patmagi—; *German*: Basilienkraut, Basilikum, Koenigskraut—; *Greek*: Basilikos, Okimon—; *Guam*: Atbahakat—; *Gujerat*: Damaro, Damro, Nasabo, Sabje—; *Hamadan*: Tukhm-i-raihan—; *Hausa*: Deidoya, Dodoya, Doidoya—; *Hindi*: Babuitulsi, Babul, Bahari, Barbar, Kalitulsi, Niyakshbo, Rihan, Sabzah, Tukhmerihan—; *Ho*: Loba—; *Iraq*: Raihan—; *Italian*: Basilico, Bassilico, Ocimo, Ozzimo—; *Kathiawar*: Marvo—; *Kurdish*: Ruhan—; *Lagos*: Efirin wewe—; *Languedoc*: Embaimo—; *La Reunion*: Grand basilic—; *Las Bela*: Drar khatori—; *Malay*: Kemangi, Pokoh, Pokoh-pokoh hitam, Ruku, Ruku-ruku, Ruku-ruku itam, Selaseh hitam, Selaseh puteh, Selasih, Selasih antan—; *Malayalam*: Pachcha, Tirunitru—; *Malinke*: Sossoguena, Soughenfira—; *Marathi*: Marya, Sabja, Sabza, Tukhamariya—; *Mauritius*: Basilic à grandes feuilles—; *Peking*: Gai K'ang—; *Persian*: Dabanshah, Firanjmushk, Nazbu, Rehan-e-dash, Reyhane sibze, Tur-eh-korasani, Ungusht-kunizuckan—; *Polish*: Bazylik—; *Porebunder*: Marvi, Takmario—; *Porto Rico*: Albahaca—; *Portuguese*: Alfabaca, Mangericoo—; *Punjab*: Babri Baburi, Purrunj mushk, Nigand, Niyazbo, Panr, Rehan, Tulsi—; *Roumanian*: Busuioc—; *Russian*: Bazilik—; *Sanskrit*: Ajaganothika, Apetarakhsasi, Asurasa, Barba, Barbara, Barbari, Karahi, Kharapushpa, Manjariki, Munjariki, Surabhi, Surasa, Tulasidvesha, Tungi, Varvara—; *Santali*: Bharbari, Dimbubaha, Malibuha—; *Serbian*: Bosilek, Bosiliak—; *Sind*: Nazbo, Sabajhi—; *Sinhalese*: Hintala, Sawandatala, Suwandutala—; *Spanish*: Albahaca, Albahaca ñna, Albahaca de hoja ancha—; *Tagalog*: Solasi, Sulasi—; *Tamil*: Tirnutpatchi, Tirunitru—; *Telugu*: Bhutulasi, Rudrajada, Vepudupachcha, Yibudipatri—; *Tongking*: Hung gioi—; *Urdu*: Janglitulasi—; *Uriya*: Dhalatulasi—; *Visayan*: Bonac, Calooy, Canela—; *Yemen*: Hehak, Raihan—.

2. **Ocimum canum** Sims is found on the plains and lower hills of India, from Assam, Bengal, Bihar, and Central India, to the south Deccan and Ceylon. It is distributed to Java, Western Asia, tropical Africa, Madagascar; and is cultivated in America.

Among the Santals, during fever when the extremities are cold, the leaves made into a paste are applied to the finger—and toe-nails. The same preparation is used as a cure for parasitical diseases of the skin.

In Jodhpur the seeds are drunk in milk as a tonic; and a decoction of them with potash in water is used as a cooling drink in fever. A bunch of the plant hung in the corner of a room is said to attract mosquitoes and keep the rest of the room free from them.

In Persia the mucilaginous seeds are given for lung and chest complaints.

In French Guinea the herb is especially used by women before parturition, or as an emmenagogue, the leaves cooked with ground-nuts taken in small quantity.

In Ubangi Shari the decoction of the leaves is given to women after they have been delivered, as also to the newly born infant. The leaves ground in oil are applied to the temples for headache. Boiled with yam or maize flower they yield a pleasantly-flavoured soup which is eaten as a cure for cough, and bronchitis.

The plant is commonly grown in gardens in Tropical West Africa and used as 'tea leaf' for fevers, often given to children, or as a bath for febrile patients, the patient sitting and pouring it over the head, or with clothing opened out over a pot in which abundance of the plant is boiled. In Gold Coast the juice of the leaves is sometimes squeezed into the patient's eyes. At Accra a decoction is also given for dysentery, or as a mouth-wash to relieve tooth-ache.

For haemorrhage from the nose, the Sutos either inhale the smoke from burning the dried leaf or apply an ointment made with the powdered leaf.

In Madagascar the leaves and the seeds are considered aromatic, tonic, febrifuge, anticatarrhal, expectorant, sternutatory, anti-rheumatismal. For malaria the seeds are ground in an infusion of the leaves. The juice and the powder obtained by pounding together the seeds and the leaves are taken as an errhine in migraine.

Adangme: Danwe—; *Awuna*: Ahame, Defetsui—; *Bambara*: Chukula—; *Bengal*: Bharbari—; *Benin*: Ihiri—; *Bombay*: Ramtulsi—; *Canarese*: Nayi-tulasi, Ramatulasi—; *Efik*: Amana, Mfang—; *English*: American Basil, Hairy Basil, Hoary Basil, Hoary Tulsi, White Basil—; *Espiritu Santo*: Neruk—; *Ewe*: Ahame, Defetsui—; *French*: Basilic d'Amérique, Basilic commun—; *Fulani*: Katchukatchunga, Sukora, Urngol—; *Ga*: Kowe—; *Gbari*: Jemijemi—; *Gbaya*: Wélé—; *Golungo Alto*: Machericao, N-xilica—; *Guam*: Atbahakat—; *Hamadan*: Tukhm-i-sherbati—; *Hausa*: 'Da'ddoya, 'Dai'doya, 'Dai'doyar masar, 'Do'dowa, 'Do 'doya, 'Dwai'dwaiya, Sarakuwar sauro, 'Yar kan masallachi—; *Ho*: Loba—; *Jodhpur*: Bapji—; *Jukun*: Afyinu, Shinu—; *Kanuri*: Kabur—; *Kaolak*: Guguniece—; *Koranko*: Sogoi—; *Krobo*: Danwe—; *Lagos*: Efirin nla, Efirin oshu—; *Limba*: Fufurufuru—; *Madagascar*: Kiranjay—; *Malay*: Kemangi—; *Malayalam*: Katturamatulasi—; *Malinke*: Su-kola—; *Mandingo*: Sisejambo—; *Manja*: Sâhagna—; *Mbi*: Gouroulou—; *Moorish*: Gumuguei—; *Old Calabar*: Iyino—; *Oloke Meji*: Efinrin marag-bosanyan—; *Persian*: Badrudge ibieze, Reyhane kuhi, Tukhm-chirbati—; *Porto Rico*: Abahaca cimarrona—; *Sadani*: Garaighasi—; *Sango*: Tété—, *Sanskrit*: Ajaka, Arjaka, Gambhira, Gandhapamirjjaka, Jambira, Kathinjara, Kshudraparna, Kshudratulasi, Kuthera, Mukharjaka, Ugagândha—; *Santali*: Bharbhari—; *Sierra Leone*: Patnage—; *Sinhalese*: Hintalla—; *Spanish*:

Albahaca—; *Suto*: Mmavwatwane—; *Tamil*: Ganjamkorai, Kanjankorai, Naitulasi—; *Telugu*: Kukkatulasi—; *Timne*: An-soro, E-soro, Koe suru—; *Tivi*: Kungulaku—; *Togbo*: Biroulou—; *Twi*: Emeng—; *Woloff*: Ngumgume—; *Yoruba*: Aruntantan, Efinrin aja, Efinrin ata, Efinrin marugboshanyan, Efinrin wewe—.

3. **Ocimum gratissimum** Linn. is found throughout India and Ceylon, often cultivated. It is distributed to Java, tropical Africa and America.

Aromatic baths or fumigations prepared with the plant are advised in the treatment of rheumatism and paralysis. In the aphthae of children a strong decoction has been found effectual.

A decoction of the leaves is of value in cases of seminal weakness, and is an esteemed remedy in gonorrhoea.

The seeds are given in headaches and neuralgia.

In China the leaves and flowers are used as a sudorific in diseases of the lungs.

Considered digestive and pectoral in La Reunion. On the Gold Coast the leaves are mashed and used as an enema by newly delivered women. It is also used for young infants.

A very popular remedy in Madagascar. It is considered aromatic, digestive, tonic, pectoral, antiemetic, antispasmodic, antineuralgic, The Betsileo chew the leaves for toothache, and sniff the juice of the leaves or the powdered seeds in headache.

Arabic: Furanjmishk—; *Bengal*: Ramtulshi, Ramtulsi—; *Betsileo*: Romba—; *Bombay*: Ramatulasa, Rantulsi, Tulsi—; *Chinese*: Tzeu Sou—; *Deccan*: Ramtulsi—; *English*: Large Basil, Lemon Basil, Shrubby Basil—; *Ewe*: Daiblorsi—; *French*: Basilic *crépu*—; *Gujerati*: Avachibavachi, Ramtulasi—; *Hindi*: Bantulsi, Malatulsi, Ramtulsi—; *La Reunion*: Baumier, Gros braume—; *Malay*: Ruku-ruku hitam, Selaseh besar—; *Malayalam*: Kattutrittavu, Ramatulasi—; *Marathi*: Ramatulasi, Ranatulasu—; *Mauritius*: Basilic, Toulashi, Toulsi—; *Mundari*: Dimbubaha—; *Persian*: Palangmishk—; *Porebunder*: Ramtulasi—; *Punjab*: Banjere—; *Sadani*: Dimbu—; *Sanskrit*: Ajaka, Doshakleshi, Nidralu, Ramatulasi, Shophahari, Sugandhi, Sukshmapatraka, Sumukha, Suprassanaka, Suvakra, Vanabarbarika, Vishaghna, Vriddhatulasi—; *Sinhalese*: Gastala, Kiritala, Otala—; *Tamil*: Elumichantulasi, Peruntulasi, Ramtulasi—; *Tankay*: Romba—; *Telugu*: Nimmatulasi, Ramatulasi—; *Urdu*: Ramtulasi—; *Uriya*: Ramotulosi, Sondabhogohulono—; *Visayan*: Coloncogon—; *Yemen*: Hobokbok, Shajaret eszir, Vusab—.

4. **Ocimum sanctum** Linn. is found throughout India, Burma, and Ceylon, and distributed to the Malay Archipelago, Australia, the islands of the Pacific, Western Asia, and Arabia.

The root is given in decoction as a diaphoretic in malarial fevers.

The leaves have expectorant properties, and their juice is used in catarrh and bronchitis. This preparation also is applied to the skin in ring-worm and other cutaneous diseases. An infusion of the leaves is used as a stomachic in the gastric disorders of children, and in hepatic affections. The dried leaves are powdered and employed as a snuff in ozaena. They are also an effectual means of dislodging maggots. The juice dropped into the ear is said to be a good remedy for earache.

The leaves are a South Indian substitute for tea. In the Tamil country the flower-tops are ground with sesamum oil and given internally to help the expulsion of the foetus.

In Arabia the leaves are given together with pepper in tertian and quartan fevers.

The seeds are mucilaginous and demulcent, and are given in disorders of the genito-urinary system.

In Ceylon the herb is used in decoctions for cough and catarrh, sometimes chewed as a substitute for betel.

The fresh roots are ground with water and applied to the stings of wasps and bees and the bites of worms and leeches. The bruised fresh roots, stems, and leaves are applied to the bites of mosquitoes (Roberts).

Every part of the plant finds its application in the treatment of snake-bite and scorpion sting; but Caius and Mhaskar have shown experimentally that every part of it is equally useless in the antidotal and symptomatic treatment of snake-bite and scorpion sting.

The juice of the leaves or decoction of the same is considered to possess diaphoretic, antiperiodic and stimulating expectorant properties. A compound decoction of *O. sanctum, Tinospora cordifolia,* and *Evolvulus alsinoides* was given in cases of malarial fever with no benefit (Koman).

Arabic: Dohsch, Schadjant eszirr, Vusab—; *Badaga*: Kapputulasi—; *Bengal*: Kalatulsi, Kural, Tulshi, Tulsi—; *Bombay*: Tulas, Tulasa—; *Burma*: Lun—; *Canarese*: Kalatulasi, Karitulasi, Sritulasi, Tulasi—; *Deccan*: Tulsi—; *English*: Holy Basil, Monk's Basil, Rough Basil, Sacred Basil—; *Gujerati*: Talasi—; *Hindi*: Baranda, Kalatulsi, Krishnatulsi, Tulsi, Varanda—; *Ilocano*: Biday—; *Konkani*: Tulsi—; *Malay*: Oku, Ruku-ruku merah, Selaseh hitam—; *Malayalam*: Krishnatulasi, Kunnakam, Nallatrittavu, Punya, Sivatulasi, Surasam, Trittavu, Tulasi—; *Marathi*: Tulasa, Tulasichajadha—; *Pampangan*: Locoloco—; *Philippines*: Albahaca—; *Portuguese*: Mangericao—; *Punjab*: Bantulsi, Tulsi—; *Queensland*: Bulla-bulla, Mooda—; *Sanskrit*: Ajaka, Arjaka, Amrita, Apetarakshasi, Bahupatri, Bharati, Bhutaghni, Bhutaka, Bhutapatri, Brinda, Devadundubhi, Divya, Gandhaharini, Gauri, Gramya, Haripriya, Kathinjara, Kayastha, Krishnamula, Krishnatulasi, Kutheraka, Laxmi, Madhavi, Malashreshtha, Manjari, Papaghni, Parnasa, Patrapushpa, Pavani, Pavitra, Pretarakshasi, Punya, Sarasa, Shrikrishnavallabha, Shyama, Subhaga, Sugandha, Sulabha, Surabhi, Suradundubhi, Surasa, Suravallari, Suravalli, Surejya, Suvaha, Tivra, Tridashamanjari, Tulasi, Vaishnavi, Vishnupatni, Vishnuvallabha, Vrinda—; *Sinhalese*: Madurutala, Mudurutulla—; *Spanish*: Albahaca morada—; *Tagalog*: Balanoi, Locoloco—; *Tamil*: Alangai, Karuttulasi, Kulimittan, Kullai, Kumuli, Malgodai, Malmurugu, Mudi, Nediyon, Pirundam, Sirttulay, Surasa, Surasam, Suriyagarandai, Savadugundi, Suvi, Tulasi, Tulavam, Tulay—; *Telugu*: Brynda, Gaggera, Krishnatulasi, Kukkatulasi, Nallagaggera, Nallatulasi, Tellatulasi, Tulasi—.

ORIGANUM.

The genus consists of 7 species, natives of the Mediterranean region.

O. dictamnus Linn., *O. hirtum* Link., *O. Majorana* Linn., *O. virens* Hoff. and Link, *O. vulgare* Linn. are used medicinally in Europe; *O. vulgare* Linn. is also used in China and Malaya.

1. The 2 longest stamens and sometimes all 4 projecting beyond the corolla ... ... *O. Majorana.*
2. Stamens 4 in unequal pairs slightly protruding ... *O. vulgare.*

1. **Origanum Majorana** Linn., a native of Europe, North Africa and Asia Minor, is extensively cultivated in India.

The herb is carminative and stomachic; useful in measles.

The leaves and seeds are considered astringent and a remedy for colic. The essential oil from the leaves is used for hot fomentations in acute diarrhoea.

In Europe an infusion made from the fresh plant is given to relieve nervous headaches; and externally the herb is applied in bags as a hot fomentation to painful swellings and rheumatism, as likewise for colic. The volatile oil is considered an excellent external application for sprains, bruises, etc.

Arabic: Mardakusch, Merdkouche, Mizunjush—; *Bogotá*: Mejorana—; *Bengal*: Murru—; *Catalan*: Moraduix, Moradux—; *Deccan*: Murwa—; *Dutch*: Marjolein—; *Egypt*: Bardaquesh, Mardaqush—; *English*: Sweet-knotted Marjoram, Sweet Marjoram—; *French*: Marjolaine à coquille, Marjolaine des jardins, Marjolaine d'Orient, Origan marjolaine—; *German*: Badkraut, Blaudoste, Blauer Tarant, Blaudunst, Costenzkraut, Doschte, Dost, Felddoste, Frauendosten, Kostenskraut, Kunerle, Kuttelkraut, Majoran, Maraun, Margrankraut, Marieleine, Masaran, Maseran, Masoran, Meiran, Meyran, Muellerkraut, Ohrkraut, Schusterkraut, Sommermajoram, Thorant, Walddosten, Wohlgemut, Wurstkraut—; *Greek*: Amarakon, Masuran—; *Hindi*: Murwa—; *Italian*: Maggiorana, Marjorana, Persa—; *Kumaon*: Bantulsi—; *Languedoc*: Majourana, Majourena, Majurena, Mayran—; *Malta*: Sweet Marjoram, Maggiorana, Persia, Mertkux—; *North America*: Knotted Marjoram, Marjoram, Sweet Marjoram—; *Roumanian*: Maghiran—; *Russian*: Mayoran—; *Sanskrit*: Ajanmasurabhipatra, Bahuvirya, Gandhapatra, Jambira, Kharapatra, Kulasaurabha, Maricha, Maru, Marubaka, Maruta, Marutaka, Phani, Phanijjaka, Prasthakusuma, Prasthapushpa, Samirana, Shitalaka, Suravha—; *Sind*: Murwo—; *Spanish*: Almoradux, Mejorana—; *Tamil*: Marru—; *Urdu*: Marvakhusha—; *Yemen*: Mardakush—.

2. **Origanum vulgare** Linn. occurs plentifully in the Himalaya, from Kashmir to Sikkim, between altitudes of 7,000 and 12,000 feet. It is distributed to Europe, North Africa, western and northern Asia.

The herb is carminative, anodyne, stomachic, and emmenagogue. In China it is considered an excellent refrigerant.

Externally, the dried leaves and flower-tops may be applied in bags as a hot fomentation to painful swellings and rheumatism, as well as for colic. An infusion made from the fresh plant will relieve nervous headache.

The whole herb is medicinal and contains a volatile oil, which is separated by distillation. Perspiration may be produced by a warm infusion, and this is useful in the commencement of measles to bring out the eruption; it is also taken to promote the menstrual flow, when suppressed by cold; it is also valuable in spasms, colic, and to give relief from pain in dyspeptic complaints.

The oil is stimulant and rubefacient, and often used as a liniment; it is given as a stimulant and tonic in colic, diarrhoea, and hysteria. It is also applied in chronic rheumatism, tooth-ache, and ear-ache.

Arabic: Buklutulgezal, Mirzanjosha, Sutur—; *Bohemian*: Dobramyssl—; *Catalan*: Orenga—; *Chinese*: Ching Chieh, Yin Ch'en—; *Danish*: Tost, Vild merian—; *Dutch*: Orego—; *English*: Common Marjoram, Organ, Organy, Origany, Wild Marjoram—; *French*: Grande marjolaine, Grande marjolaine bâtarde, Grande marjolaine sauvage, Grand origan, Marjolaine d'Angleterre, Marjolaine bâtarde, Marjolaine sauvage, Pied de lit, Origan, Origan commun, Origan vulgaire—; *German*: Blauer Orant, Brauner Dosten, Dosten, Wilder Majoran—; *Greek*: Origanos—; *Hindi*: Mirzanjosh, Sathra—; *Italian*: Origano,

Regano—; *Malaya*: Yan chan—; *Malta*: Common Marjoram, Pot Marjoram, Regamo, Acciughero, Riegnu—; *Marathi*: Marvā, Mayarona—; *North America*: Common Marjoram, Origanum, Pot Marjoram, Wild Marjoram, Winter Marjoram, Winter-sweet—; *Norwegian*: Vild merican—; *Persian*: Mizangosch, Mirzanjosha, Oushneh—; *Polish*: Lebiotka—; *Portuguese*: Ouregao, Ouregos—; *Punjab*: Mirzanjosh—; *Russian*: Dushitsa—; *Spanish*: Oregano—; *Swedish*: Dosta—; *Telugu*: Mridumaruvamu—; *Urdu*: Mirzanjosha—.

Orthosiphon.

The genus includes 50 species, natives of Indo-Malaya and tropical Africa.

Orthosiphon stamineus Benth. occurs in Assam, Burma, the Nicobar Islands, and South India. It is distributed to the Malay Archipelago, the Philippine Islands, and Australia.

In Java the leaves are made into a tea, and used in the treatment of diseases of the kidneys and bladder. They are official in Holland.

English: Cat's Whiskers, Java Tea—; *French*: Barbiflore, Thé de Java—; *Malay Archipelago*: Koemis Koetjing, Remock djoeng—.

Otostegia.

The genus consists of 10 species, inhabitants of Western Asia and Abyssinia.

1. Leaves spine-tipped; calyx naked within ... *O. Aucheri*,
2. Leaves not spine-tipped; calyx bearded within ... *O. limbata*.

1. **Otostegia Aucheri** Boiss. occurs in Baluchistan, whence it spreads to southern Persia.

At Kohlu in Baluchistan the drug is administered in suppressed small-pox if the pox do not appear, after which the pox appear (Hughes-Buller).

Baluchi: Samar, Shinisg—; *Brahui*: Sadikh, Samar—; *Kohlu*: Suraghzai—.

2. **Otostegia limbata** Hook. fil. is found on the lower hills of the Punjab, west of the Jhelum to the Salt Range.

The juice of the leaves is applied to children's gums, and to ophthalmia in man and beast (Stewart).

Hazara: Chitiboi—; *Punjab*: Agzhan, Awanibuti, Bui, Jandi, Kandiari, Lana, Phutkanda—.

Perilla.

The genus consists of 3 species, spreading from India to Japan.

Perilla ocimoides Linn. is found from Kashmir to Bhotan at altitudes of 1,000 to 10,000 feet; also in the Khasia Mountains from 3,000 to 6,000 feet; it is cultivated in Chittagong; from Champaran it extends to Burma, and is distributed to Indo-China, China, and Japan.

In China and Indo-China the leaves, the stems and the seeds are considered resolvent, diaphoretic, and cephalic. They are

prescribed in cephalalgia, hypochondriasis and mania. The leaves are eaten raw or cooked, or administered as an infusion; the seeds are either toasted or dispensed in the form of a decoction.

The plant is a popular remedy in Annam, where it is used as a sedative, an antispasmodic, and an antidote. At Vinh the herb, without the roots, is made into a decoction and taken on an empty stomach for sunstroke. At Nghe-an the decoction is used as a uterine stimulant. At Nam-o it is combined with an equal amount of *Ocimum sp.*, and used as a fumigant.

Annam: Bach to, Rau hung, Thai am mau, Tu to, Xich to—; *Chinese*: Sou Yeh—; *Hindi*: Bhanjira—; *Kumaon*: Bhangara, Jhutela—; *Naga*: Kenia—; *Vinh*: Tia to, Tu to—.

Perowskia.

The genus consists of 4 species, natives of Central Asia.

1. Leaves linear-oblong, incised or pinnatisect. Calyx closed with long cottony wool ... ... *P. abrotanoides.*
2. Leaves oblong-ovate or lanceolate, crenate-serrate or incised. Calyx hispid ... ... *P. atriplicifolia.*

1. **Perowskia abrotanoides** Karel. is met with in the Western Himalaya at altitudes of 8,000 to 13,000 feet, and in Baluchistan; it is distributed to Afghanistan, Persia, and Turkestan.

At Ziarat the plant is used as a cooling medicine. The flowers are soaked in water; and this is very cooling when applied to the body of a patient suffering from fever.

Brahui: Gwari drani—; *Pushtu*: Shânshohai—; *Seistan*: Maur—.

2. **Perowskia atriplicifolia** Benth. occurs in Kashmir at 7,500-10,000 feet, and in Baluchistan, whence it spreads to Afghanistan.

In Baluchistan the plant is used as a cooling medicine.

Baluchistan: Gwaree dumoo, Gwaridrane, Tirk—; *Waziristan*: Sansobe—.

Platystoma.

The genus consists of 4 species, natives of tropical Asia and Africa.

Platystoma africanum Beauv. occurs in Bombay, Dharwar, North Kanara, and Mysore. It inhabits tropical Africa.

In Northern Nigeria it is used for fever, feverish chills or rheumatic symptoms. In Gold Coast the leaves and seeds are a remedy for children's coughs, and are also chewed with salt to cure sore throat. The juice is squeezed into the eyes to cure headache and fever. The leaves are used in Southern Nigeria as a local haemostatic.

Ashanti: Asiresidie, Saman meng—; *Benin*: Eborukhu—; *Ewe*: Sesebli—; *Hausa*: Kimbar-rafi—; *Nzima*: Siresireke—; *Twi*: Asirisiri—.

POGOSTEMON.

The genus consists of 36 Indomalayan species.

A. Bracts ovate, imbricating, more or less concealing the calyx.
   1. Stems and leaves nearly glabrous. Flowers purple ... *P. parviflorus.*
   2. Stems and leaves below hoary-puberalous. Flowers pink or white ... ... *P. plectranthoides.*

B. Bracts narrow, lanceolate, not imbricating, not concealing the calyx.
   1. Spikes more or less continuous, about 1 cm. broad ... *P. purpurascens.*
   2. Spikes much interrupted, 5-6 mm broad ... ... *P. Heyneanus.*

1. **Pogostemon Heyneanus** Benth. (=*P. Patchouli* Hook. fil.) occurs in Kanara, the Western Ghats, and the Nilgiris. It extends to Ceylon, and is distributed to Java and the Philippine Islands.

The plant is diuretic, carminative, and insecticide. It yields an essential oil largely employed in perfumery.

Bengal: Pachapat—; *Bombay*: Patchpan—; *Dutch*: Patchoeli—; *English*: Patchouli—; *French*: Patchouli—; *Gujerati*: Patchpanadi—; *Hindi*: Pacholi, Peholi—; *Malaya*: Bur kalif, Poko nilam—; *Marathi*: Mali, Patcha, Patchpan—; *Sind*: Panel—; *Sinhalese*: Gang-kolang-kola—; *Spanish*: Pachuli—; *Straits Settlements*: Tilam wangi—; *Visayan*: Cablan—.

2. **Pogostemon parviflorus** Benth. occurs more or less throughout India.

The fresh leaves, bruised, are applied as a cataplasm in order to clean wounds and promote healthy granulation. In Satara the juice is given in colic and fever.

The root is a reputed remedy for haemorrhage, and has been given successfully in uterine haemorrhage.

The roots are used in the Ratnagiri District as an antidote for the poison of *Echis carinata*, a common snake in that district. The plant, in combination with other drugs, is prescribed as an antidote to snake and scorpion venoms; but Caius and Mhaskar have shown experimentally that no part of the plant is an antidote to either snake or scorpion venom.

Bombay: Pangla, Phang, Phangla—; *Konkani*: Pangla—; *Marathi*: Pangli—; *Matheran*: Pangli—.

3. **Pogostemon plectranthoides** Desf. is found in the Western Himalaya, Lower Bengal and Upper Burma, Bihar, Gujerat, Konkan, and South India.

The properties are said to be the same as those of *P. parviflorus.*

Bengal: Jin—; *Deccan*: Pangla—; *Garhwal*: Lujra—; *Khond*: Ishwarjata—; *Konkani*: Pangla—; *Haldwani*: Kalabasinga—; *Ramnagar*: Rudera—; *Telugu*: Kusurijang—; *Uriya*: Dumobadotoko, Gondripulu, Poksunga—.

4. **Pogostemon purpurascens** Dalz. is found in South India, Manipur, and Burma.

It is used as a substitute for *P. parviflorus.*

ROYLEA.

Roylea elegans Wall., the only species, is found in the sub-tropical Western Himalaya from Kashmir to Kumaon, at altitudes between 2,000 and 5,000 feet.

An infusion of the leaves is drunk for contusions produced by blows, and about Kumaon the same preparation is used as a bitter tonic and febrifuge.

Garhwal: Karui, Titpati—; *Hindi*: Patkarru—; *Jaunsar*: Karanoi—; *Kumaon*: Kauri, Titpatti—; *Punjab*: Kaur, Kauri—.

SALVIA.

The genus numbers 550 species, inhabiting the tropical and temperate regions of the world.

The following species are used medicinally in Europe—*S. aethiopis* Linn., *S. canariensis* Linn., *S. glutinosa* Linn., *S. Grahami* Benth., *S. hispanica* Linn., *S. Horminum* Linn., *S. officinalis* Linn., *S. pratensis* Linn., *S. Sclarea* Linn., *S. triloba* Linn. fil., *S. Verbenaca* Linn., *S. verticillata* Linn., *S. viridis* Linn.—; in China—*S. japonica* Thunb., *S. miltiorhiza* Bunge., *S. plebeja* R. Br.—; in Malaya—*S. miltiorhiza* Bunge—; in North America—*S. lanceolata* Bruce, *S. officinalis* Linn., *S. Verbenaca* Linn.—; Mexico—*S. polystachya* Ort., *S. hispanica* Linn.—; in Colombo—*S. palaefolia* H. B. K.—; in Madagascar—*S. leucodermis* Bak.—; in La Reunion—*S. gerardiana* Benth.—; in Mauritius—*S. coccinea* Juss.—; in South Africa—*S. africana* Linn., *S. aurea* Linn., *S. coccinea* Juss., *S. paniculata* Linn., *S. repens* Burch., *S. rugosa* Thunb., *S. runcinata* Linn. fil., *S. scabra* Thunb., *S. sisymbrifolia* Skan., *S. stenophylla* Burch., *S. triangularis*. Thunb.—.

I. Small shrubs or undershrubs; leaf-blade usually .5-2 cm. long
   1. Corolla 15-25 mm. long ... ... *S. cabulica.*
   2. Corolla 5 mm. long ... ... *S. aegyptiaca.*

II. Herbs; leaf-blades usually much exceeding 2 cm.
   A. Leaves more or less thick, rugose or rugulose; calyx teeth more or less spinous.
      1. All leaves more or less sessile, oblanceolate ... *S. lanata.*
      2. All or lower leaves petiolate, ovate to oblong.
         a. Calyx 20-25 mm. long, in fruit.
            i. Leaves subentire or serrate; bracts usually whitish ... ... *S. macrosiphon.*
            ii. Leaves coarsely dentate or lobed; bracts usually green ... ... *S. spinosa.*
         b. Calyx 10-15 mm. in fruit. Perennial ... *S. Moorcroftiana.*
   B. Leaves membranous, neither rugose nor rugulose; calyx teeth not spinous.
      1. Corolla 5 mm. long, white or lilac. Annual ... *S. plebeia.*
      2. Corolla 25-30 mm. long, yellow ... ... *S. glutinosa.*

1. **Salvia aegyptiaca** Linn. occurs in the Punjab plains, Sind, and Baluchistan, whence it spreads westwards to Afghanistan. It is distributed to Persia and North Africa.

At Pab, in Jhalawan, the plant is used as a cure for eye diseases.

In Sind the seeds are used as demulcent in diarrhoea, gonorrhoea, and haemorrhoids.

Arabic: Ra 'al, Raale, Sadjaret el ghasal, Shajaret-el-ghazal—; *Baluchi*: Kohi maur—; *Bolan*: Chamimar, Chammamaor—; *Egypt*: Ra 'al, Shegeret-el-ghazal—; *Pab*: Maur—; *Punjab*: Tukhmmalanga—; *Tank*: Paska, Rangboti—.

2. **Salvia cabulica** Benth. extends from the Punjab frontier to Baluchistan and Afghanistan.

In Baluchistan the plant is considered a cure for fever, also for colds and lung diseases.

Baluchistan: Mateto—.

3. **Salvia glutinosa** Linn. occurs in the North-West Frontier Province, Kashmir. the Punjab, Kumaon, Gharwal, Sikkim, and Bhootan. It is distributed to Tibet, Western Asia, and Europe.

In some parts of Europe an infusion of the leaves and flower tops is used as a diaphoretic, stimulant, and stomachic. It is an excellent lotion for ulcers, and to heal raw abrasions of the skin.

Spanish: Cetro de Júpiter—.

4. **Salvia lanata** Roxb. is found in the Western Himalaya, from Murree to Kumaon, at altitudes of 5,000 to 8,000 feet.

'It is a good substitute for *S. Moorcroftiana*.

5. **Salvia macrosiphon** Boiss. extends from the Punjab frontier to Baluchistan, Afghanistan and Persia.

At Pre Ghal, in Waziristan, the plant is used as a poultice for gangrene.

6. **Salvia Moorcroftiana** Wall. is found in the Western Himalaya, from Kashmir to Kumaon, at altitudes of 6,000 to 9,000 feet.

The root is given in cough, and the seeds are used as an emetic. The leaves are a medicine for guinea-worm and itch, and in the form of poultice applied to wounds. At Lahore, the seeds are given in colic and dysentery, and are applied to boils. The seeds are given for haemorrhoids.

Punjab: Gurgumma, Halu, Kallijarri, Laphra, Papra, Shobri, Thut—.

7. **Salvia plebeia** R. Br. is found throughout India. It is distributed to China, the Malay Islands and Australia.

The seeds are used as demulcent in gonorrhoea, menorrhagia, diarrhoea, and haemorrhoids.

The herb is used as a diuretic, astringent, and anthelmintic in China.

Bengal: Bhutulsi, Khokaburadi—; *Bombay*: Kammarkas—; *Chinese*: Ching Chieh, Ho Shih—; *Punjab*: Samundarsok, Sathi—; *Sind*: Kiuro, Summundursok—.

8. **Salvia spinosa** Linn. occurs in Baluchistan, and is distributed to Mesopotamia, Syria, and Arabia.

At Burj, in Toba Achakzai, the seed is powdered and applied to the teeth to cure tooth-ache.

Egypt: Na'eyme, Shadjeret-el-gemal, Ta'elbe, Tha'alaba—; *Mosul*: Hamham—; *Pushtu*: Ganacha—; *Quetta-Pishin*: Ganacha—.

SATUREIA.

The genus numbers 130 species dispersed through the warm regions of the world.

S. hortensis Linn., *S. montana* Linn., and *S. Thymbra* Linn. are used medicinally in Europe.

Satureia hortensis Linn. occurs in Kashmir. It is distributed to Afghanistan, Western Asia, Europe, America, and South Africa.

The herb is aromatic and carminative. The leaves and flower-tops are used as a stimulant.

Catalan: Sajulida, Sajurida—; *Dutch*: Boonenkruid—; *English*: Summer Savory—; *French*: Herbe de Saint Julien, Sadrée, Sarriète, Sarriette, Sarriette des jardins, Sauriette, Savorée, Savourée—; *German*: Bohnenkraut—; *Italian*: Santoreggia, Satureja—; *Portuguese*: Segurelha—; *Roumanian*: Galbinare—; *Russian*: Chaber—; *Spanish*: Ajedrea, Tomillo real—.

SCUTELLARIA.

The genus includes 200 cosmopolitan species.

S. canescens Nutt., *S. cordifolia* Muehl., *S. galericulata* Linn., *S. integrifolia* Linn., *S. lateriflora* have, at some time or other, been used medicinally and also as a source of 'scutelarin'—; *S. baicalensis* Georg. is used in China.

Scutellaria galericulata Linn. is found in Kashmir. It inhabits Central and Northern Asia, Europe, North Africa, and North America.

If a decoction of the plant is made with 2 ounces of the herb to 8 ounces of water, and is taken for some weeks continuously in recent epilepsy, or when the disease has only functional causes, it will often prove very beneficial. Likewise, this decoction, in common with an extract of the herb, has been given curatively for intermittent fever and ague, as well as for some depressed and disordered states of the nervous system.

A homoeopathic tincture has been successfully given in cases of the epileptiform 'petit mal'.

The crushed plant is applied fresh to old ulcers.

The Flambeau Ojibwe, of North America, use the plant for medicine having something to do with heart trouble.

Dutch: Glidkruid—; *English*: Blue Scullcap, Greater Scullcap, Helmet Flower, Hooded Willow Herb, Hoodwort—; *Flambeau Ojibwe*: Tcatcabonû 'ksik—; *French*: Grande toque, Scutellaire en toque, Toque—; *German*: Helmkraut, Stumpfhelmkraut—; *North America*: Hooded Scullcap, Marsh Skullcap—; *Spanish*: Escutelaria—.

Stachys.

The genus consists of 200 cosmopolitan species, absent from Australia.

The following species are used medicinally in Europe—*S. annua* Linn., *S. arvensis* Linn., *S. Betonica* Linn., *S. germanica* Linn., *S. hirta* Linn., *S. maritima* Linn., *S. palustris* Linn., *S. recta* Linn., *S. sylvatica* Linn.—; in China—*S. aspera* Michx., *S. Sieboldi* Miq.—; in Colombia—*S. bogotensis* H. B. K.—.

I. Stems and leaves beneath densely white woolly ... *S. parviflora.*

II. Stems and leaves densely or sparingly hairy, but not woolly.

1. Leaves petioled; corolla-tube exserted.
   a. Petiole 2 cm. or shorter, margin crenate ... *S. Sieboldi.*
   b. Petiole 4 cm. or longer, margin serrate ... *S. sylvatica.*
2. Leaves sessile; corolla-tube included ... ... *S. palustris.*

1. **Stachys palustris** Linn. grows in Kashmir. It is found in Northern and Western Asia, Europe, and North America.

The plant has always had in Europe a great reputation as a vulnerary.

In modern herbal medicine the herb, collected when just coming into flower and dried, is employed for its antiseptic and antispasmodic properties. It relieves gout, cramp and pains in the joints, and vertigo. The bruised leaves when applied to a wound will stop bleeding and heal the wound. The fresh juice is made into a syrup and taken internally to stop haemorrhages, diarrhoea, and dysentery.

In North America the plant is used as a vulnerary, antispasmodic, emetic, and emmenagogue.

English: All-Heal, Clown's Woundwort, Downy Woundwort, Husbandman's Woundwort, March Woundwort, Marsh Woundwort, Opopanewort, Panaij—; *French*: Crapaudine, Epiaire des marais, Ortie morte, Ortie rouge, Stachys des marais—; *North America*: Clown's All-heal, Clown's Woundwort, Dead-nettle, Hedge-nettle, Marsh Woundwort, Rough-weed—.

2. **Stachys parviflora** Benth. is found in the Punjab plains and hills; it extends to Afghanistan.

In the Salt Range the bruised stems are applied to the guinea-worm.

Punjab: Baggibuti, Kirimar—; *Pushtu*: Speraghunai—.

3. **Stachys Sieboldi** Mig. occurs in Upper Burma; it extends to China.

The plant is used medicinally in China as a febrifuge, astringent, and vulnerary.

Chinese: Ts'ao Shih Ts'an—.

4. **Stachys sylvatica** Linn. is found in Kashmir; it extends to Northern Asia and Europe.

An old authority has it that this herb 'stamped with vinegar and applied in manner of a pultis, taketh away wens and hard

swellings, and inflammation of the kernels under the eares and jawes', and also that the distilled water of the flowers 'is used to make the heart merry, to make a good colour in the face, and to make the vital spirits more fresh and lively'.

The plant is credited in France with tonic, emmenagogue, and diuretic properties.

English: Hedge Woundwort—; *French*: Epinire des bois, Ortie à crapaud, Ortie morte des bois, Ortie puante, Stachys des bois—.

TEUCRIUM.

The genus includes 100 cosmopolitan species.

The following species are used medicinally in Europe—*T. Botrys* Linn., *T. Chamaedrys* Linn., *T. fruticans* Linn., *T. majorana* Pers., *T. marum* Linn., *T. montanum* Linn., *T. Polium* Linn., *T. pyrenaicum* Linn., *T. scordium* Linn., *T. scorodonia* Linn.—; in South Africa—*T. capense* Thunb., *T. riparium* Hochst.—.

1. Leaves small, subsessile, ovate or obovate, cuneate-attenuated, obtuse ... ... *T. Stocksianum.*
2. Leaves small, sessile, oblong, obtuse ... ... *T. scordium.*

1. **Teucrium scordium** Linn. is found in Kashmir; it extends to Afghanistan, Northern and Western Asia, Europe, and North Africa.

The herb is considered in Europe antiseptic, diaphoretic, and stimulant. An infusion gives excellent results in all inflammatory diseases.

In Spain the flower tops and the leaves are considered aromatic, bitter, astringent, and are mostly used as diaphoretics and vermifuges.

Arabic: Skordeon—; *Bohemian*: Wodnj czessner—; *Catalan*: Escordi—; *Danish*: Skordium—; *Dutch*: Waterlook—; *English*: Water Germander—; *French*: Germandrée aquatique, Germandrée d'eau, Scordium—; *German*: Batengel, Knoblauch gamander, Lachenknoblauch, Lachinsknopfloch, Laeuse-kraut, Moosknoblauch, Peterskraut, Rosslauch, Schlagkraut, Schorseken, Scordienkraut, Sonnenschiit, Wasserbathengel, Wasserknoblauch—; *Greek*: Scordion, Scordochorto—; *Hungarian*: Vizi foghadyma—; *Italian*: Scordio—; *Lithuanian*: Embutti—; *Polish*: Czosnkowe ziele—; *Portuguese*: Escordio—; *Russian*: Dikiy tchesnok, Scordiya, Zayatchiy tchesnok—; *Spanish*: Escordio, Escordio oficinal—.

2. **Teucrium Stocksianum** Boiss. occurs in the Western Punjab, the North-Western Frontier Province, Baluchistan, and Afghanistan.

In the Harboi Hills the herb is given in cases of pain at the heart. At Kirani, near Quetta, it is used as a cure for fever.

In Persian Baluchistan the plant is boiled and allowed to stand all night; the water is then drunk as a remedy for colds.

Baluchistan: Kalpora, Kalporag—; *Waziristan*: Kastorai—.

THYMUS.

The genus consists of 33 species, inhabiting the temperate regions of the world.

T. mastichina Linn., *T. serpyllum* Linn., and *T. vulgaris* are used medicinally in Europe.

Thymus serpyllum Linn. is found in the Western temperate Himalaya, from Kashmir to Kumaon, at altitudes between 5,000 and 13,000 feet. It is distributed to Northern and Western Asia, Europe, and North Africa.

In the Punjab the herb is given in weak vision, complaints of the stomach and the liver, suppression of urine and menstruation (Honigberger). On the Chenab the seeds are given as a vermifuge (Stewart).

The oil is sometimes applied as a remedy in toothache.

In Europe the herb is considered antispasmodic, carminative, and tonic. An infusion is given in convulsive coughs, whooping coughs, catarrh, and sore throat; it is good for nervous or hysterical headaches, for flatulence, and the headache which follows inebriation. The infusion is also profitably applied for healing skin eruptions of various characters.

In Persia the leaves are considered carminative. In Teheran they are given for 'too much water in the stomach'.

Arabic: Saatar—; *Catalan*: Farigola de montanya, Serpoll—; *Danish*: Vildtimian—; *Dutch*: Quendel, Wilde Thym—; *English*: Bank Thyme, Brotherwort, Creeping Thyme, Hill-wort, Horse Thyme, Mother of Thyme, Pella Mountain, Penny Mountain, Piliol, Puliali Mountain, Running Thyme, Serpell, Shepherd's Wild Thyme, Wild English Thyme, Wild Thyme—; *French*: Mignotise des Génevoix, Pillolet, Piolet, Poleur, Pote, Pouilleux, Pouliet, Pouliot bâtard, Serpolet, Serpoule, Thym bâtard, Thym rouge, Thym sauvage, Thym serpolet—; *German*: Ameisenkraut, Bienenkraut, Choelm, Citronenquendel, Demutkraut, Fallboll, Feldkoehm, Feldkuemmel, Feldquendel, Feldthymian, Gundelkraut, Gundling, Gunnerle, Heidequendel, Heublume, Huehnerklee, Huehnerkull, Immenkraut, Jungfernzucht, Kandelkraut, Karwendel, Kindelkraut, Kingle, Koschmes, Kostenskraut, Kudelkraut, Kuechenpolei, Kuekenkuemmel, Kuenlein, Kulkraut, Kundelkraut, Kunerle, Kutelkraut Magaro, Marienbettstroh, Mattenkolen, Neugelenk, Quandel, Quangelchen, Quendel, Quengel, Raenderpolei, Rainkuemmel, Rainpolei, Schmergel, Simio, Steinquendel, Thymchen, Thyrmann, Tuemchen, Unsererlieben-frauenbettstroh, Zymis—; *Greek*: Erpylos—; *Hindi*: Banajwain—; *Italian*: Pepolino, Sermollino, Serpillo, Serpolino, Serpollo—; *Languedoc*: Faligouleto, Ferigouleto—; *North-Western Provinces*: Banajwain—; *Persia*: Djusha, Seetere, Zatar—; *Polish*: Mauerzanka—; *Portuguese*: Serpao, Serpil, Serpilhi, Serpol—; *Punjab*: Kalandarzatar, Marizha, Masho, Rangsbur, Shakei—; *Roumanian*: Cimbru de camp, Cimbrusor, Serpun, Serpunel—; *Russian*: Bogorodskaya trava, Chaber, Chabietz—; *Spanish*: Serpol—; *Swedish*: Backtimjan, Bracktimian—; *Teheran*: Joshan shirazi—; *Turkish*: Sateriberri—; *Urdu*: Hasha—; *Yemen*: Saatar—.

Zataria.

Zataria multiflora Boiss. is found in Baluchistan, whence it spreads to Afghanistan and Persia.

In Jhalawan the plant is used as a cure for stomach-ache.

Baluchistan: Isghand, Izgun—; *Hamadan*: Zatar—; *Jhalawan*: Izghand—. *Urdu*: Saatar—.

Ziziphora.

The genus includes 12 species, natives of the Mediterranean region and Central Asia.

1. Much-branched, at the base more or less suffruticose ... *Z. clinopodioides.*
2. An annual herb ... ... *Z. tenuior.*

1. **Ziziphora clinopodioides** M. Bieb. is found in Baluchistan. It is distributed to Afghanistan, Persia, the Caucasus, Armenia, and Syria.

At Jelga in Baluchistan the whole of the plant is dried and kept, and a decoction is used to cure typhus fever; also leaves are soaked in water at night and the infusion is drunk in the morning in cases of heat. In the Harboi Hills the juice is used as a tonic after recovery from fever.

Baluchi : Purchink— ; *Harboi Hills* : Purchink— ; *Persian* : Pudina— ; *Pushtu* : Maurai— ; *Ziarat Hills* : Maurai—.

2. **Ziziphora tenuior** Linn. occurs in the North-West Frontier Province, and Baluchistan. It is distributed to Afghanistan, Persia, Asia Minor, Turkestan, Soongaria, and Siberia.

The herb is used in Baluchistan to allay fever. In Teheran it is employed as a cordial and stomachic.

The seeds powdered and mixed with butter milk are used to cure dysentery in Kila Abdulla. They are used as a cure for fevers in Kharan.

Arabic : Mishkatar-el-mashih— ; *Hindubagh* : Maurai— ; *Iraq* : Za 'tar— ; *Kalat* : Mashnapurchink— ; *Kharan* : Kohipurchink— ; *Khawas* : Tukhammelanga, Tukhumimalayan— ; *Kila Abdulla* : Kahkuti, Tukhammalangai— ; *Kurdish* : Jata, Pung— ; *Quetta-Pishin* : Kahkuti— ; *Shiriz* : Rang— ; *Tank* : Paparboti— ; *Teheran* : Kakuti—.

ON THE FOOD-PLANTS OF INDIAN AGARISTIDAE AND NOCTUIDAE (HETEROCERA).

BY

D. G. SEVASTOPULO, F.R.E.S.

The present is a companion to my paper *On the Food-plants of Indian Bombyces (Heterocera)*, (1940, *Journ. Bomb. Nat. Hist. Soc.*, xli, 817-827). The authorities consulted and abbreviations used are the same as in the previous paper, except that all references to the *Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum* apply to vol. ix, vol. vii containing no reference to any Agaristid or Noctuid larva. Hampson's *Catalogue of the Lepidoptera Phalaenae* does not include the sub-families *Noctuinae, Hypeninae* and *Hyblaeinae*, whilst Seitz' *Indo-Australian Noctuidae* comes to an end half way through the *Catocalinae*. I have followed Seitz in regard to nomenclature and the arrangement of sub-families.

AGARISTIDAE.

Eusemia Dalm.

E. vetula Geyer—Dioscorea, Smilax (Lep. Phal., Seitz).
E. bisma Moore—Dioscorea oppositifolia (Lep. Phal.), Dioscorea and Batatas (Seitz). (Possibly Bananas is meant). (non-Indian).

Scrobigera Jord.

S. proxima Wlk.—Cissus (Lep. Phal., Seitz).

Mimeusemia Btlr.

M. basalis Wlk.—Dillenia (Lep. Phal., Seitz).

Ophthalmis Hbn.

O. milete Cr.—Cissus (Lep. Phal., Seitz). (non-Indian).

Seudyra Stretch.

S. transiens Wlk.—Vitis.

A number of the Australian and American species of the family feed on Vitis, others on Loranthus, Casuarina, Clarkea, Epilobium and Aenothera.

NOCTUIDAE.

ACRONICTINAE.

Diphtherocome Warr.

D. orion Esp.—Oak, Birch, Beech, etc. (Lep. Phal.). (non-Indian).

Trisula Moore.

T. variegata Moore—Ficus religiosa (Fauna, Seitz).

Acronicta Treit.

Nothing appears to be known of the Indian species; but European species feed on Ash, Privet, Alder, Hawthorn, Polygonum, Salix, Plum, Veronica, Rose, Birch, Oak, Pear, Horse-chestnut, Sycamore, Beech, Cornus, Rubus, Poplar, Elm, Myrica, etc.

Simyra Treit.

S. nervosa Schiff.—Spurge, Sorrel (Lep. Phal.). (non-Indian).
S. albovenosa Goeze—Phragmites, Carex, Typha (Lep. Phal.). (non-Indian).

MOMINAE.

Moma Hbn.

M. ludifica L.—Sorbus aucuparia, Crataegus oxyacantha (Lep. Phal.). (non-Indian).

BRYOPHILINAE.

Bryophila Treit.

B. nilgiria Moore—Lichens (Lep. Phal., Seitz).
Other non-Indian species also on Lichens.

EUXOINAE.

Euxoa Hbn.

E. segetum Schiff.—Roots of Brassica, Rumex, Chrysanthemum (Lep. Phal.), on roots of low plants (Seitz).
E. corticea Schiff.—Chenopodium, Rumex, Trifolium, etc. (Lep. Phal.), various low plants (Seitz).
E. spinifera Hbn.—Grasses (Lep. Phal., mihi).

Rhyacia Hbn.

R. ypsilon Rott.—General feeder (Lep. Phal.), polyphagous on low plants (Seitz).
R. subsequa Schiff.—Various low plants (Seitz).
R. pronuba L.—Brassica, Taraxacum, Rumex, etc. (Lep. Phal.), all low plants (Seitz).
R. orbona Hufn.—Grasses, Ranunculus, Primula, etc. (Lep. Phal.). (non-Indian).
R. c-nigrum L.—General feeder (Lep. Phal.), low plants generally (Seitz).
R. deraiota Hamps.—Menispermum, Viola, etc. (Ill. Het., Lep. Phal.), various low plants (Seitz).
R. dahlii Hbn.—Rumex, Primula, Plantago, etc. (Lep. Phal.).
R. ravida Schiff.—Taraxacum, Stellaria, etc. (Lep. Phal.), various low plants (Seitz).
R. flammatra Schiff.—Taraxacum, Fragaria (Lep. Phal.), various low plants (Seitz).
R. saucia Hbn.—Numerous low plants (Seitz).
Other non-Indian members of the genus feed on Salix, Rubus, Betula and Calluna.

Eurois Hbn.

E. prasina Schiff.—Rumex, Birch, Rubus, etc. (Lep. Phal.). (non-Indian).

Triphaena Hbn.

Non-Indian members of the genus feed on Birch, Hawthorn, Salix, Rumex, Primula, Stellaria, Rubus and grasses.

HADENINAE.

Barathra Hbn.

B. brassicae L.—Brassica, Rumex, Chenopodium, etc. (Lep. Phal.), all low plants (Seitz).

Scotogramma Smith.

S. trifolii Rott.—Atriplex, Chenopodium (Lep. Phal., Seitz).
S. nana Hfn.—Hippocrepis comosa, Coronilla minima (Lep. Phal.). (non-Indian).

Polia Treit.

Non-Indian members of the genus of the section to which the Indian species belong feed on Chenopodium, Salsola, Mesembryanthemum, Oak, Birch, Solidago, Genista, Polygonum, Stellaria, Lonicera, Rumex, Plantago, Trifolium, Cytisus, Anthyllis, Pteris, Chrysanthemum, Sonchus, Achillea, Vaccinium, Grasses, Willow, Elm, Urtica, Brassica, Scabiosa, Taraxacum, Tussilago, Delphinium and Lactuca. The section *Harmodia*, none of which are Indian, feeds on Caryophyllaceae, mostly in the seed-pods.

Hadena Schrank.

H. reticulata Vill.—Silene, Rumex, Primula, etc. (Lep. Phal.). (non-Indian).

Tiracola Moore.

T. plagiata Wlk.—Emilia (Lep. Ceyl., Fauna; Lep. Phal., Seitz).

Xylomania Hamps.

Non-Indian species feed on Lotus, Polygonum and Wild Gooseberry.

Monima Hbn.

M. incerta Hfn.—Oak, Poplar, Hawthorn (Lep. Phal.), various trees and shrubs (Seitz).
Non-Indian species on Salix, Birch, Aspen, Rose, Elm, Carduus and Lysimachia.

Brithys Hbn.—Liliaceae (Seitz).

B. crini F.—Amaryllis (Lep. Ceyl.), Liliaceae (Lep. Phal.), Amaryllideae (mihi).

Polytela Guen.

P. cliens Fldr.—Pancratium tortuosum (Lep. Phal., Seitz).
P. gloriosae F.—Amaryllis (Lep. Ceyl., Fauna, Lep. Phal., Seitz, mihi), Gloriosa superba (Lep. Phal., mihi), Gloriosa (Seitz).

Cerapteryx Curt.

C. graminis L.—Grasses (Lep. Phal.). (non-Indian).

Hyphilare Hbn.—Grasses (Seitz).

H. l-album L.—Grasses (Lep. Phal., Seitz).

Sideridis Hbn.

S. vitellina Hbn.—Grasses (Lep. Phal., Seitz).
S. comma L.—Grasses (Lep. Phal.), various fen grasses (Seitz).
S. unipuncta Haw.—Grasses, Cereals (Lep. Phal.).
S. insularis Btlr.—Grasses (mihi).

CUCULLIANAE.

Cucullia Schrank.

Non-Indian species on Artemisia, Chamomile, Sonchus, Lactuca, Aster, Linosyris, Pyrethrum, Anthemis, Tanacetum, Campanula, Hesperis, Solidago, Scrophularia and Verbascum.

Euscotia Btlr.

E. inextricata Moore—Berberis (Lep. Phal., Seitz).

Dichoniopsis Warr.

D. obliquisigna Hamps.—Oak (Lep. Phal., Seitz).

Crino Hbn.—Low plants (Seitz).

Non-Indian species on Humulus, Lonicera, Cherry, Galium, Origanum, Achillea, Cyclamen, Valeriana, Hieraceum, Leontodon.

Amathes Hbn.

Non-Indian species on Rubus, Salix, Rumex, Primula, Birch and Poplar.

Cosmia Treit.—When young on the catkins or flowers of trees, afterwards on various low plants. (Seitz).

C. gilvago Esp.—Seeds of elm, particularly Wych-elm, not Poplar (Seitz), seeds of Elm (Lep. Phal.).
Non-Indian species on Beech, Poplar, Maple, Salix, Tilia.

AMPHIPYRINAE.

Pyrois Hbn.

Non-Indian species on Elm, Euonymus, Cytisus, Cistus and Lavatera.

Amphipyra Treit.

A. tragopoginis L.—Plantago, Hawthorn, Aquilegia, etc. (Lep. Phal.), a variety of low growing plants (Seitz).
Non-Indian species on Oak, Birch, Elm, Sallow, Dandelion, Hieracium and other low-growing plants.

Mania Treit.—Various shrubs and plants (Seitz).

Non-Indian species on Salix, Rubus, Primula, Ivy.

Dipterygia Steph.—Low plants (Seitz).

Non-Indian species on Rumex and Polygonum.

Parastichtis Hbn.—Grasses (Seitz).

P. funerea Hein.—Grasses (Lep. Phal.).
Non-Indian species on Grasses, Primula and Rumex.

Oligia Hbn.—Stems and roots of grasses (Seitz).

Trachea Treit.—Low plants (Seitz).

Non-Indian species on Atriplex, Rumex, Polygonum, Taraxacum, Grasses.

Euplexia Steph.—Various low plants (Seitz).

E. lucipara L.—Ranunculus, Ligustrum, Ash, etc. (Lep. Phal.). (non-Indian).

Conservula Grote.

C. v-brunneum Guen.—Bracken (Lep. Phal., Seitz).

Eriopus Treit.—Known species on Ferns (Seitz).

E. juventina Cr.—Pteris aquilina (Lep. Phal., Seitz).
E. latreillei Treit.—Ceterach officinarum and Notochloena marante (Lep. Phal.), Ceterach officinarum and other ferns (Seitz).

Calogramma Guen.—Liliaceae (Seitz).

C. festiva Don.—Liliaceae (Lep. Phal., Seitz, mihi).

Prodenia Guen.

P. litura F.—Lantana, etc. (Lep. Ceyl.), Lantana (Lep. Phal., Fauna, Seitz), Antirrhinum, Zinnia, Spinach, Lettuce, Castor and Caladium (mihi).

Spodoptera Guen.

S. pecten Guen.—'Bukoot' (Lep. Phal., Seitz), Grasses (mihi).
S. ciliata Guen.—Grasses (mihi).
S. mauritia Bsd.—Rice (Lep. Phal.), cereals, rice (Seitz), grasses (mihi).

Laphygma Guen.

L. apertura Wlk.—Drosera (Lep. Phal., Seitz).
L. exigua Hbn.—Plantago, low growing herbs, Lucerne, Cotton (Lep. Phal.), various low-growing plants, Lucerne, Cotton (Seitz), Lucerne, Indigo, Onions, Chillies, Gingelly, Cowpea, Brinjal, Radish, Amaranthus, Turmeric, Maize, Castor, Sesbania aculeata, S. grandiflora. Eleusine coracana, Coriander, Sorghum, Cotton, Tobacco, Gisekia pharnaceoides (1939, Cherian and Kylasam, *Journ. Bomb. Nat. Hist. Soc.*, xli, 253).

Athetis Hbn.—Low-growing herbage and grasses (Seitz).

Non-Indian species on Stellaria, Rumex, Viola, Grasses, Plantago, Taraxacum, Pulmonaria, Corn, Peas, Sedum, Salix, Rubus.

Acosmetia Steph.—Low-growing plants (Seitz).

A. caliginosa Hbn.—Serratula tinctoria, Sanguisorba, Rumex (Lep. Phal.). (non-Indian).

Proxenus Herr.—Schaff.

P. hospes Frr.—Plantago and low-growing herbs (Lep. Phal.). (non-Indian).

Prospalta Wlk.

P. dolorosa Wlk.—Conyza balsamifera (Lep. Phal., Seitz).
P. capensis Guen.—Acanthads (Lep. Ceyl., Fauna, Lep. Phal.), Acanthus (Seitz), Marigold, Cosmos (mihi).
P. pallidipennis Warr.—Coreopsis (mihi).

Gortyna Treit.—In the roots and stems of marsh plants (Seitz).

G. leucostigma Hbn.—In stems of Cladium mariscus and Iris pseudacorus, etc. (Lep. Phal.), in roots and stems of large water-plants such as Iris pseudacorus and Cladium mariscus (Seitz).

Hydroecia Guen.—In the stems of various low plants (Seitz).

Non-Indian species in the stems of Petasites, Equisetum, Rumex, Valeriana, Peucedanum, Cynara, Cardunculus.

Pyrrhia Hbn.

P. umbra Hfn.—Ononis or Geranium pratense, in Assam Siegesbeckia orientalis (Lep. Phal.), on flowers and seeds of Ononis spinosa (Seitz).
Non-Indian species on Melissa, Salvia, Dictamnus, Centaurea, and Succisa.

Calymnia Hbn.

Non-Indian species on Elm, Pear, Plum, Oak, Salix.,

Mudaria Moore.

M. cornifrons Moore.—Silk-cotton (Bombax malabaricum) (Fauna, Lep. Phal., Seitz).

Phragmatiphila Hamps.

Non-Indian species in the stems of Carex and Typha.

Dichoniopsis Warr.

D. obliquisigna Hamps.—Oak (Lep. Phal., Seitz).

Crino Hbn.—Low plants (Seitz).

Non-Indian species on Humulus, Lonicera, Cherry, Galium, Origanum, Achillea, Cyclamen, Valeriana, Hieraceum, Leontodon.

Amathes Hbn.

Non-Indian species on Rubus, Salix, Rumex, Primula, Birch and Poplar.

Cosmia Treit.—When young on the catkins or flowers of trees, afterwards on various low plants. (Seitz).

C. gilvago Esp.—Seeds of elm, particularly Wych-elm, not Poplar (Seitz), seeds of Elm (Lep. Phal.).
Non-Indian species on Beech, Poplar, Maple, Salix, Tilia.

AMPHIPYRINAE.

Pyrois Hbn.

Non-Indian species on Elm, Euonymus, Cytisus, Cistus and Lavatera.

Amphipyra Treit.

A. tragopoginis L.—Plantago, Hawthorn, Aquilegia, etc. (Lep. Phal.), a variety of low growing plants (Seitz).
Non-Indian species on Oak, Birch, Elm, Sallow, Dandelion, Hieracium and other low-growing plants.

Mania Treit.—Various shrubs and plants (Seitz).

Non-Indian species on Salix, Rubus, Primula, Ivy.

Dipterygia Steph.—Low plants (Seitz).

Non-Indian species on Rumex and Polygonum.

Parastichtis Hbn.—Grasses (Seitz).

P. funerea Hein.—Grasses (Lep. Phal.).
Non-Indian species on Grasses, Primula and Rumex.

Oligia Hbn.—Stems and roots of grasses (Seitz).

Trachea Treit.—Low plants (Seitz).

Non-Indian species on Atriplex, Rumex, Polygonum, Taraxacum, Grasses.

Euplexia Steph.—Various low plants (Seitz).

E. lucipara L.—Ranunculus, Ligustrum, Ash, etc. (Lep. Phal.). (non-Indian).

Conservula Grote.

C. v-brunneum Guen.—Bracken (Lep. Phal., Seitz).

Eriopus Treit.—Known species on Ferns (Seitz).

E. juventina Cr.—Pteris aquilina (Lep. Phal., Seitz).
E. latreillei Treit.—Ceterach officinarum and Notochloena marante (Lep. Phal.), Ceterach officinarum and other ferns (Seitz).

Calogramma Guen.—Liliaceae (Seitz).

C. festiva Don.—Liliaceae (Lep. Phal., Seitz, mihi).

Prodenia Guen.

P. litura F.—Lantana, etc. (Lep. Ceyl.), Lantana (Lep. Phal., Fauna, Seitz), Antirrhinum, Zinnia, Spinach, Lettuce, Castor and Caladium (mihi).

Spodoptera Guen.

S. pecten Guen.—'Bukoot' (Lep. Phal., Seitz), Grasses (mihi).
S. ciliium Guen.—Grasses (mihi).
S. mauritia Bsd.—Rice (Lep. Phal.), cereals, rice (Seitz), grasses (mihi).

Laphygma Guen.

L. apertura Wlk.—Drosera (Lep. Phal., Seitz).
L. exigua Hbn.—Plantago, low growing herbs, Lucerne, Cotton (Lep. Phal.), various low-growing plants, Lucerne, Cotton (Seitz), Lucerne, Indigo, Onions, Chillies, Gingelly, Cowpea, Brinjal, Radish, Amaranthus, Turmeric, Maize, Castor, Sesbania aculeata, S. grandiflora. Eleusine coracana, Coriander, Sorghum, Cotton, Tobacco, Gisekia pharnaceoides (1939, Cherian and Kylasam, *Journ. Bomb. Nat. Hist. Soc.*, xli, 253).

Athetis Hbn.—Low-growing herbage and grasses (Seitz).

Non-Indian species on Stellaria, Rumex, Viola, Grasses, Plantago, Taraxacum, Pulmonaria, Corn, Peas, Sedum, Salix, Rubus.

Acosmetia Steph.—Low-growing plants (Seitz).

A. caliginosa Hbn.—Serratula tinctoria, Sanguisorba, Rumex (Lep. Phal.). (non-Indian).

Proxenus Herr.—Schaff.

P. hospes Frr.—Plantago and low-growing herbs (Lep. Phal.). (non-Indian).

Prospalta Wlk.

P. dolorosa Wlk.—Conyza balsamifera (Lep. Phal., Seitz).
P. capensis Guen.—Acanthads (Lep. Ceyl., Fauna, Lep. Phal.), Acanthus (Seitz), Marigold, Cosmos (mihi).
P. pallidipennis Warr.—Coreopsis (mihi).

Gortyna Treit.—In the roots and stems of marsh plants (Seitz).

G. leucostigma Hbn.—In stems of Cladium mariscus and Iris pseudacorus, etc. (Lep. Phal.), in roots and stems of large water-plants such as Iris pseudacorus and Cladium mariscus (Seitz).

Hydroecia Guen.—In the stems of various low plants (Seitz).

Non-Indian species in the stems of Petasites, Equisetum, Rumex, Valeriana, Peucedanum, Cynara, Cardunculus.

Pyrrhia Hbn.

P. umbra Hfn.—Ononis or Geranium pratense, in Assam Siegesbeckia orientalis (Lep. Phal.), on flowers and seeds of Ononis spinosa (Seitz).
Non-Indian species on Melissa, Salvia, Dictamnus, Centaurea, and Succisa.

Calymnia Hbn.

Non-Indian species on Elm, Pear, Plum, Oak, Salix.,

Mudaria Moore.

M. cornifrons Moore.—Silk-cotton (Bombax malabaricum) (Fauna, Lep. Phal., Seitz).

Phragmatiphila Hamps.

Non-Indian species in the stems of Carex and Typha.

Sphetta Wlk.

S. apicalis Wlk.—Diospyros, Nephelium erectum (Lep. Ceyl.).

Sesamia Guen.—In the stems of Gramineae (Seitz).

S. inferens Wlk.—In the stems of Sugar-cane (Lep. Phal., Seitz).
S. cretica Led.—In stems of Maize (Lep. Phal., Seitz).
S. uniformis Dudg.—In stems of Sugar-cane (Lep. Phal., Seitz).

ERASTRIANAE.

Usually on low plants and grasses; a few on lichens or on coccidae (Seitz)

Penisa Warr.—Lichen (Seitz).

P. erythroglauca Hamps.—A minute lichen (Lep. Phal., Seitz).
P. oblataria Wlk.—Lichens (Lep. Ceyl., Lep. Phal., Seitz).

Eublemmoides Beth.—Baker.

E. subangulata Hamps.—The Coccid Maskellia zonata Green (Lep. Phal., Seitz).

Coccidiphaga Spul.—Coccidae on various trees (Seitz).

C. scitula Rmbr.—On the eggs of Coccidae on Fig-trees, Oleanders and Yuccas (Lep. Phal., Seitz), at the Cape on Lecanium hesperidum (Lep. Phal.).

Porphyrinia Hbn.

P. ostrina Hbn.—Carduus and Helichrysum (Lep. Phal.), Carlina and Helichrysum (Seitz).
P. parva Hbn.—In the flower shoots of Inula montana and I. viscosa, Centaurea calcitrapa, and in India in the flowers of Kukraunda (Lep. Phal., Seitz).
P. amabilis Moore—On the Lac-insect Tachardia lacca (Lep. Phal., Seitz).

Autoba Wlk.—On various low plants, some few on Coccidae (Seitz).

A. vinotincta Hamps.—Coccidiphagous, on a species of Lecanium (Lep. Phal., Seitz).
A. pulvinariae Oliff.—On the eggs, adult females and ovisacs of the salt-bush scale Pulvinaria maskelli (Lep. Phal., Seitz). (non-Indian).
A. coccidiphaga Hamps.—On various Coccids, such as Lecanium and Pulvinaria (Lep. Phal., Seitz).
A. abrupta Wlk.—Ficus parasiticus (Lep. Ceyl., Lep. Phal., Seitz), Ficus (Fauna).
A. dubia Btlr.—On the Coccids Lecanium olene, L. hesperidum and L. testudo, and Eriococcus eucalypti (Lep. Phal., Seitz). (non-Indian).

Phyllophila Guen.

Non-Indian species on Santolina and Artemisia.

Amyna Guen.

A. punctum F.—Croton riglium and C. aromaticum (Lep. Phal., Seitz).

Lithacodia Hbn.—Known species on Grasses (Seitz).

Eustrotia Hbn.—Carex and grasses (Seitz).

Tarache Hbn.—Low plants (Seitz).

T. urania Friv.—Althaea cannabina (Lep. Phal.). (non-Indian).
T. lucida Hfn.—Malva, Convolvulus (Lep. Phal., Seitz).

MELICLEPTRIINAE.

Chloridea Westw.

C. dipsacea L.—Linaria, Centaurea, Ononis, etc. (Lep. Phal.), flowers of various plants, especially Ononis and Linaria (Seitz).
C. peltigera Schiff.—Ononis, Pyrethrum, Arenaria, etc. (Lep. Phal.), flowers of various low plants (Seitz).
C. assulta Guen.—Physalis peruviana (Ill. Het., Lep. Phal., Seitz).
C. obsoleta F.—Rosebuds (Lep. Ceyl., Fauna), Corn, Cotton, Tomatoes, Rosa, Reseda, Calamintha, etc. (Lep. Phal.), flowers of many plants (Seitz), flowers of Carnation, Antirrhinum, Cosmos, Chrysanthemum (mihi).

Melicleptria Hbn.

M. scutosa Schiff.—Artemisia (Lep. Phal., Seitz).

EUTELIANAE.

They keep rather exclusively—as far as it is known—to the different Anacardiineae (Seitz).

Bombotelia Hamps.

B. jocosatrix Guen.—Terminalia belerica (Lep. Ceyl., Lep. Phal., Seitz).
B. dorsipuncta Hamps.—Semecarpus (Lep. Phal., Seitz). (non-Indian).

Eutelia Hbn.

E. tripartita Semp.—Spondias (Lep. Phal., Seitz).
E. adulatrix Hbn.—Rhus cotinus, Pistacia (Lep. Phal.).

Anuga Guen.

A. constricta Guen.—Semecarpus (Lep. Phal., Seitz).

Paectes Hbn.

P. subapicalis Wlk.—Shorea robusta (Indian Lac Research Institute Report for October 1940).

STICTOPTERINAE.

Stictoptera Guen.

S. subobliqua Wlk.—Garcinia (Lep. Ceyl., Fauna, Lep. Phal., Seitz).

Lophoptera Guen.

L. illucida Wlk.—Shorea robusta (Indian Lac Research Institute Report for October 1940).

SARROTHRIPINAE.

Sarrothripus Curt.

S. revayana Scop.—Oak, Willow (Lep. Phal.).

Plothcia Wlk.

P. decrescens Wlk.—Coffee (Lep. Ceyl., Lep. Phal., Seitz).

Risoba Moore.

R. obstructa Moore—Quisqualis (Lep. Ceyl., Fauna), Quisqualis and Sterculia (Lep. Phal.).

ACONTIANAE.

Earias Hbn.

E. fabia Stoll.—In bolls of the Cotton plant (Seitz).
E. insulana Bsd.—Ceratonia siliqua, Gossypium herbaceum (Lep. Phal.), in bolls of the Cotton plant (Seitz).
Non-Indian species on Populus and Salix.

Carea Wlk.

C. varipes Wlk.—Eugenia xanthocarpa (Lep. Ceyl.).

Beara Wlk.

B. dichromella Wlk.—Celtis orientalis (Lep. Ceyl.), Zizyphus jujuba (mihi).

Westermannia Hbn.

W. superba Hbn. Terminalia (Lep. Ceyl., Fauna, Lep. Phal., Seitz).

Acontia O.

A. malvae Esp.—Malva moschata, Lavatera olbia (Lep. Phal.).
A. graellsi Feisth.—Lavatera olbia (Lep. Phal.).

CATOCALINAE.

Catocala Schrank.

C. nupta L.—Salix, Poplar, Ash (Lep. Phal.).
Non-Indian species on Oak, Birch, Sloe in addition.

Ephesia Hbn.

E. dotata Wlk.—Quercus alba (Lep. Phal., Seitz).
Non-Indian species also on Wild Cherry, Plum, Dog-wood, Crataegus Scrub Oak, Apple, Sloe.

Cocytodes Guen.

C. coerulea Guen.—Boehmeria (Ill. Het.), Great Himalayan Nettle Boehmeria (Lep. Phal.).

Lagoptera Guen.

L. honesta Hbn.—'Baucal' (Lep. Phal., Seitz).

Anua Wlk.

A. coronata F.—Quisqualis indica (Lep. Ceyl., Fauna, Lep. Phal., mihi).
A. indiscriminata Hamps.—Eucalyptus Carea and other Myrtaceae (Ill. Het., Lep. Phal., Seitz).
A. tirhaca Cr.—Pistacia lentiscus, Cistus, Rhus coriaria (Lep. Phal.).

Ercheia Wlk.

E. diversipennis Wlk.—Grass (Lep. Phal., Seitz).

Achaea Hbn.

A. mezentia Cr.—Canthium (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
A. mercatoria F.—Ricinus communis (Lep. Ceyl., Lep. Phal., Seitz).
A. melicerta Drury.—Ricinus communis (Lep. Ceyl., Lep. Phal., Seitz, mihi).

Parallelia Hbn.

P. onelia Guen.—Phyllanthus (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
P. joviana Stoll.—Phyllanthus (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
P. algira L.—Bramble, Sloe, etc. (Lep. Phal.), Ricinus communis (mihi).
P. palumba Guen.—Citrus decumanus (Lep. Ceyl.).

Attatha Moore.

A. regalis Moore—Streblus (Lep. Phal.).
A. ino Drury.—Pipul (Lep. Phal.).

Grammodes Guen.

G. geometrica F. Polygonum persicaria, Cistus salvifolia (Lep. Phal.).
G. stolida F.—Paliurus aculeatus, Rubus fruticosus, Coriaria myrtifolia, Quercus (Lep. Phal.).

Chalciope Hbn.

C. hyppasia Cr.—Rhynchosia minima (mihi).

Hypaetra Guen.

H. discolor F.—Callicarpa maesa (Lep. Phal.).

Mocis Hbn.

M. frugalis F.—Zingiberaceae (Lep. Ceyl., Fauna, Lep. Phal.).
M. undata F.—Desmodium (Lep. Ceyl., Fauna, Lep. Phal.).

Clytie Hbn.

C. illunaris Hbn.—Tamarix gallica (Lep. Phal.) (non-Indian).

Pericyma Herr.—Schaff.

P. umbrina Guen.—A small thorny shrub (Lep. Phal.).
P. glaucinans Guen.—A leguminous tree (Lep. Phal.).
P. albidentaria Frr.—Alhagi camelorum (Lep. Phal.) (non-Indian).

PHYTOMETRINAE.

Syngrapha Hbn.

S. circumflexa L.—Potato, etc. (Lep. Phal.).
Non-Indian species on Larch, Salix, Betula, Erica, Calluna and Urtica.

Phytometra Haw.

P. ni Hbn.—Nettle, Solanum, etc. (Lep. Phal.).
P. daubei Bsd.—Sonchus maritimus (Lep. Phal.).
P. chalcytes Esp.—Urtica, Salvia, Echium, Marrubium, in India on Ficus (Lep. Phal.), Ficus (Lep. Ceyl., Fauna).
P. confusa Steph. Achillea millefolium, Matricaria chamomilla (Lep. Phal.).
P. nigriluna Wlk.—Acalypha (Lep. Ceyl., Lep. Phal.).
P. jessica Btlr.—Antirrhinum flowers (mihi).
P. peponis F.—Cucurbitaceae (Lep. Ceyl., Fauna, Lep. Phal.).
P. orichalcea F.—Coreopsis (Lep. Ceyl., Fauna, Lep. Phal.).
Non-Indian species on Brassica, Tomato, Reseda, Taraxacum, Rumex, Crepis, Chenopodium, Trifolium, Senecio, Mentha, Grasses, Carex, Typha, Sparganium, Iris, Alisma, Hollyhock, Isopyrum, Thalictrum, Lamium, Urtica, Lonicera, Sonchus, Geranium, Malva, Eupatorium, Aconitum, Pulmonaria, Lycopsis, Spiraea, Humulus, Arctium.

Abrostola Ochs.

Non-Indian species on Vaccinium, Urtica, Epilobium, Humulus, Lamium.

NOCTUINAE.

Cosmophila Bsd.

C. fulvida Guen.—Waltheria indica (Lep. Ceyl., Fauna).
C. erosa Hbn.—Hibiscus (Lep. Ceyl., Fauna), Hollyhock (mihi).

Othreis Hbn.

O. ancilla Cr.—Menispermum (Lep. Ceyl., Fauna).

Ophideres Bsd.
O. fullonica L.—Tinospora cordifolia (Menispermaceae) (mihi).

Argadesa Moore.
A. materna L.—Tinospora cordifolia (mihi).

Maenas Hbn.
M. salaminia F.—Menispermaceae (Lep. Ceyl.), Menispermum (Fauna).

Khadira Moore.
K. aurantia Moore.—Menispermaceae (Lep. Ceyl.).

Hylodes Guen.
H. carantea Cr.—Acanthads (Lep. Ceyl., Fauna).

Pandesma Guen.
P. mundata Wlk.—Albizzia (Ill. Het., Fauna).

Lacera Guen.
L. alope Cr.—Pisonia, Canthium (Lep. Ceyl., Fauna).

Ischyja Hbn.
I. manlia Cr.—Terminalia, Cinnamonia, etc. (Lep. Ceyl., Fauna).

Azazia Wlk.
A. rubricans Bsd.—Phaseolus (Lep. Ceyl.).

Hypocala Guen.
H. moorei Btlr.—Diospyros (Lep. Ceyl.).

Culasta Moore.
C. minuticornis Guen.—Cocculus macrocarpus (Lep. Ceyl., Fauna).

Plusiodonta Guen.
P. coelonota Koll.—Cocculus macrocarpus (Lep. Ceyl.).

Tinolius Wlk.
T. eburneigutta Wlk.—Thunbergia alata (Lep. Ceyl.).

Pasipeda Wlk.
P. satellitia Moore—Thunbergia alata (Lep. Ceyl.).

HYPENINAE.

Hypena Schrank.
H. proboscidalis L.—Nettle (mihi).

HYBLAEINAE.

Hyblaea F.
H. puera Cr.—Bignoniaceae (Lep. Ceyl., Fauna).

OBITUARY

FREDERICK VICTOR EVANS

1865-1940

Frederick Victor Evans was born on May 16, 1865, and died on the 3rd April, 1940, of acute myocarditis. He was buried in St. Ludnos Cemetery, situated on the top of the Great Orme Head, Llandudno. Of family history there is little to record. His father, Samuel Evans, came from an old Shropshire farming family, dating back to 1604, and died a widower in 1872, leaving a young family of five children of which Frederick was the second son; a younger brother and sister predeceased him. Owing to the death of both parents, education was limited and of a private character.

He went to India with his eldest brother in the year 1886 and after gaining some Indian commercial experience branched out for himself and, with his partner, founded the firm of Evans Fraser & Co. about the year 1892. Retiring from active work in India about the year 1908, he returned to England.

I understand that he was one of the original founders and trustees of the Commercial Gymkhana, Wodehouse Road, Bombay.

In latter years, whilst in Bombay, he found recreation in shikar about the Thana Creek and nearby districts and was fond of camp life. Fishing too took up a lot of his time, and led to his practical support to local fishing clubs and their interest in developing the Lonavla Lakes belonging to the Tata Hydro-electric Scheme into possible fishing areas. Yachting was also one of his joys and with his partner and their sailing boat the *'Piwit'* won several prizes in the Bombay Yacht Club open events.

His interest in the Bombay Natural History Society began some years later. It was about this period that he began stamp collecting, specializing in the stamps of British India and the Indian Native States and nearby countries, he left a very interesting and valuable collection.

He married a widow very late in life and had no children.

He lived a very retired life in England and if there is any meaning in the term 'a Spiritual Home' his certainly was in India, which he loved very much.

Mr. Evans showed his love for India and the city of Bombay in a very practical manner. He was elected a Vice Patron of the Bombay Natural History Society in the year 1928 in recognition of the very generous assistance and support which he gave to the Society. He made several substantial contributions amounting to well over Rs. 15,000 to the Society, which were expended on the Natural History Section of the Prince of Wales Museum, and maintained at his own expense, for over a period of 10 years, the services of a modeller for the preparation of a series of casts of local marine and fresh water fishes. As a result of this generosity

the Society was able to prepare the beautiful series of models in wax and *papier mâché* of local fishes now exhibited in the Fish Gallery of the Prince of Wales Museum, Bombay. Mr. Evans also presented to the Museum the series of beautiful and expensive models illustrating insects in relation to disease. His interest in Bombay is further revealed in the fine collection of pictures and paintings of old Bombay, now exhibited in the Art Section of the Prince of Wales Museum. The Society's *Journal* also benefited by Mr. Evans' generous offer to meet the cost of many of the coloured and black and white plates produced with the serial on Wild Animals of the Indian Empire. His generosity also made it possible for us to publish the very large number of fine illustrations issued with Mr. Mosley's serial on Caddis Flies. Mr. Evans presented the Society with a fine collection of books on Bombay and Western India—many of them rare and valuable editions. His name lives in the good he has done for the city he loved so well.

At the request of Mr. C. McCann, in appreciation of the generous help and encouragement extended to him in pursuit of his natural history studies by Mr. Evans, the late Fr. E. Blatter named a new species of plant as *Kaunpfera Evansii* in his honour. Likewise Mr. H. N. Dixon named a new moss obtained by Mr. McCann from the Naga Hills, Assam, as *Isopterygium Evansii*.

REVIEW

THE FAUNA OF BRITISH INDIA INCLUDING THE REMAINDER OF THE ORIENTAL REGION. Diptera. Vol. VI—Family Calliphoridae. By R. Senior White, Daphne Aubertin and John Smart. (London, March 28, 1940.) Price 18 shillings.

As is detailed in the preface, the history of this volume has been one of delays due to the changes in official posts of the original authors. The major part of the work was carried out by Mr. R. Senior White, partly in collaboration with Major W. S. Patton, I.M.S., who, it was hoped, would have been able to collaborate in completing a volume on the Muscidae. Unfortunately Major Patton's other engagements made it impossible for him to undertake the work, and the senior author of the present volume with the collaboration of the second author and later with the help of the third author has managed to complete only the account of the family Calliphoridae.

The work deals with the subfamilies Calliphorinae, Chrysomyiinae, Rhiniinae and Sarcophaginae of the family Calliphoridae of Calyptrate Flies. 214 species of 37 genera are dealt with in the work, and a departure is made from the other volumes of the series, in that species described from the entire Oriental Region are dealt with in the work. This is due to two reasons, firstly because species of this family are very widely distributed, and secondly 'compared with the more attractive groups of insects, so little collecting has been done, that the Editor agreed to the above extension of plan'. The authors hope that when Assam and Burma are adequately worked out, many of the species now known from farther Eastern areas alone and included in this volume will prove to be Indian in the 'Fauna' sense.

The descriptions of the various species are very detailed, and keys to the subfamilies, genera and species should enable most workers to identify Indian insects of the family without much difficulty. The large number of figures of the various species will also greatly facilitate the task of identification.

As an introduction to the systematic part, the external anatomy of these flies is dealt with in fair detail (pp. 1-16), while a short account of the internal anatomy, particularly the alimentary and reproductive systems, is also given (pp. 16-18). Pages 18-25 of the introductory chapter are devoted to the early stages, bionomics, and connection of these flies with diseases. Collecting and mounting are also dealt with at the end of the same chapter.

The volume contains detailed accounts of the species described up to 1936 and included in the *Zoological Record* for the year, but six species described during 1937, 1938 and 1939 are also listed in an appendix on p. 282.

The publication of this volume will be welcomed by Dipterists in the country, and the senior author of the volume deserves the thanks of all workers for having completed a difficult task under rather trying conditions.

B. P.

MISCELLANEOUS NOTES

I.—RIVERS AS BARRIERS TO THE DISTRIBUTION OF GIBBONS.

There is a curious fact about the Gibbon (*Hylobates hoolock*) which I do not think has been placed on record. It is their apparent aversion to water in any large quantities. My observation shows that they seem to dislike having to swim in order to cross a river of any size, or, of course, it may be that it is a dislike of coming to earth from the trees.

In four years experience in an area of the Sadiya Frontier Tract in Assam, bounded on the south by the Lohit River and by the Brahmaputra after the latter's confluence with the Lohit, on the west by the Subansini River, and on the east by the Dibang River, I never came across a single one of these animals. This area is quite suitable for Gibbons to inhabit, as it consists mostly of thick rain forest and, if they had been present, I feel certain I would either have seen or heard them, for I toured there very extensively every year. Immediately south of this area, i.e. on the south bank of the Lohit-Brahmaputra it is possible to see and hear them almost every day in the jungle at Rangdoi and Kenua and particularly on the Rongdoi-Laikoaghat road. Hence this Gibbon is present on the south bank of the Lohit-Brahmaputra System; but not on the north bank! It is apparent that these rivers form a complete barrier to the spread of this animal into the area mentioned.

It is possible that it is also absent east of the Dibang; but I am not sure of this and cannot say anything about the area west of the Subansiri. The tract of country where I found them absent is very large. It extends for over a hundred miles along the Himalayan (Abor) foothills and has an average width of about twelve miles or more. These foothills to the north of this tract are also quite suitable; but here again the animal is absent. The ordinary common reddish-brown monkey is common both inside this area and also on the south of the Lohit-Brahmaputra outside it.

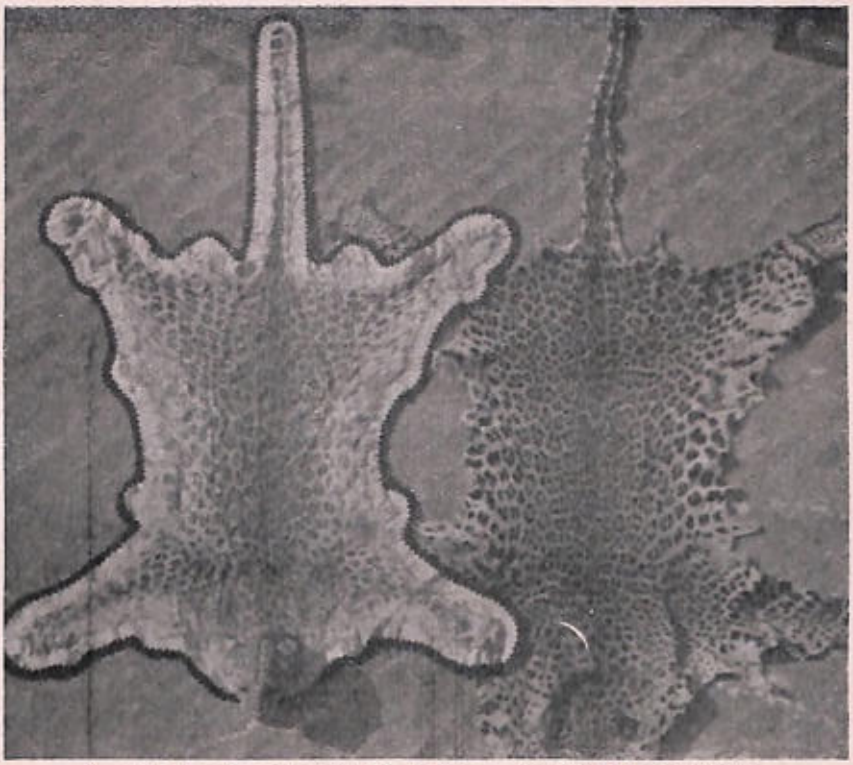
DIBRUGARH,
LAKHIMPUR DISTRICT,
ASSAM, *January* 9, 1941.

R. E. PARSONS,
Indian Police,
F.R.E.S.

[Rivers when they are wide enough definitely form natural barriers to certain groups of monkeys. Macaques readily take to water, but gibbons and leaf monkeys (*Semnopithecus*) appear to have an aversion to water and are usually baulked by a river. Nevertheless both gibbons and leaf monkeys can swim. Mr. McCann tells us that when on the Chindwin Expedition, he put a baby gibbon on a raft to prevent it becoming a nuisance, but it deliberately jumped into the river and swam ashore.—EDS.]

II.—A PALE COLOUR FORM OF THE PANTHER.

(With a photo).



A normally coloured panther is shown on the right for comparison.

I enclose a snap of a leopard shot in Dumraon State at the beginning of last year by a Mr. Lessanovitch of Calcutta. The animal is a female, and measured 6′ 2″ between pegs. The eyes were a bright sky blue with no signs of pink, and the only black hairs were at the very tip of the tail.

These latter are not to be found now; so I presume that they must have fallen out during the process of curing. The ground colour of the skin is a pale rich buff, and the spots a dull orange.

There appears to be only one other instance of a leopard of this colour from the Hazaribagh district which is not very far from the State in which the present animal was shot.

CALCUTTA, H. A. FOOKS.
January 16, 1941.

[The most usual form of colour variation in panthers is a tendency to melanism; black panthers are fairly common. More

rarely the opposite phenomenon—albinism, partial or complete, is seen. The instance recorded above is such a case of semi-albinism. It is interesting to note that this is the second record of its kind from Behar. A specimen from Hazaribagh, presented to the British Museum by Mr. R. F. S. Thomas, is described by Pocock (*Journ. Bombay Nat. Hist. Soc.*, vol. xxxiv, p. 69) as having the ground colour paler than usual with tan spots.—Eds.]

III.—A BROWN FORM OF THE HIMALAYAN BLACK BEAR (*SELENARCTOS THIBETANUS*).

A brown example of the Himalayan Black Bear (*Selenarctos thibetanus*), the property of General Sri Rudra Shum Shere Jung Bahadur Rana of Nepal, was secured in the jungles of a Himalayan valley in Nepal territory.

The general coloration of this bear was a rich brown resembling the Russian Brown Bear (*Ursus arctos*), muzzle a light brown, and a pale chest mark. From the characters of the dentition there is no mistaking this bear skin for the Himalayan Red or Isabelline Bear (*U. arctos isabellinus*).

We have had several specimens of the cinamon-coloured variety of the Sloth Bear, which are not uncommon. H. H. The Maharaja of Dewas Senior has a large male of this colour alive in his Zoo.

Van Ingen and Van Ingen, BOTHA VAN INGEN.
Mysore, S. India,
January 23, 1941.

[Pocock in his monograph on the Black and Brown Bears of Europe and Asia (*Journ. Bombay Nat. Hist. Soc.*, vol. xxxvi, p. 110) gives two records of brown specimens of the Black Bear: one of these was an example of the Baluchistan race (*S. t. gedrosianus*), which came from Mekran, and which Blanford, on account of its colouring, originally mistook for a Brown Bear. The second was a specimen shot by Major Stockley in the Kashmir Valley, which again was mistaken for a 'red' bear. Messrs. Van Ingen sent the skull of the Black Bear referred to in his note to the Society and we have verified the correctness of the identification.—Eds.]

IV.—THE INDIAN WILD DOG.

Under the head 'Fluctuating Population' in the article on the Indian Wild Dog, at page 713 of Volume xli, the possibility of rabies being a contributing cause is mentioned; and it is remarked that record of only one case of rabies could be found.

I have now come across an instance in a book *Mauled by a Tiger* by Arthur W. Strachan (1933). The Author writes:—

> 'I know of no instance of these beasts having made a concerted attack upon human beings, or even cattle, but on rare occasions single individuals affected with rabies have endeavoured to bite natives, and I once shot one in the last stages of this dread disease. It had 'treed' a coolie, but it could not possibly have bitten him as its lower jaw was completely paralysed and hung open.'

5, BENSON CROSS ROAD,
BANGALORE,

R. W. BURTON,
Lt.-Col.

April 5, 1941.

V. VILLAGE DOGS HUNTING.

In the fascinating article by Burton—'The Indian Wild Dog'—in your latest *Journal*, I was interested to read the portion dealing with 'red colour pariah dogs' mentioned by Forsyth in his *Highlands of Central India*. I have never been so fortunate as to shoot in the C. P., so cannot add anything to the subject of wild dogs of those parts, and even the *Cuon* of these parts, the Terai, and Siwalik hills have never obligingly revealed themselves to me.

The mention, however of the 'red colour pariah dogs'—which presumably means 'domesticated' or 'semi-domesticated' *village dogs*, calls to mind a most interesting sight which I witnessed in the Timli (East) Reserved Forest (Dehra Dun Divn:), one evening last November. I had done a prowl through a bit of the Timli village zemindari forest, on the off chance for shot at jungle fowl, but had had no luck, and I had emerged on to the 100' fire line separating the reserved forest from the village land when I saw four village 'pie' dogs walking up a stony 'rao' or dry nullah from the village. They stopped when they reached the edge of the reserve forest. Here they stood with their heads close together, it seemed, and appeared to confer for some time. At this moment, a slight movement on my part made them aware of me, and the sudden change in the attitude of these four dogs (two were black with an odd white 'sock' or so, each, one was black-and-white pied, while the last was raffia-coloured—all smooth-coated), was remarkable—each pretending to be unaware of the others, one cocking his leg against a handy root, while another had a sudden urge to do a spot of 'fleaing' but all had their eyes on me, a hostile and unwinking stare!! I now emerged into the open, and as my way to the waiting car lay past where the dogs were, I calmly approached, slipping I'll confess, the cartridges back into my gun, as I did so. None made any effort to efface him/herself and as I came opposite them, one, the largest 'black' growled in no friendly manner, but made no advance and I passed them (the dogs), by noting that all had their 'hackles' raised and all still eyed me narrowly. As soon as I was out of sight of the dogs, I quietly slipped behind the tall grass and sal scrub and silently observed

the dogs. They remained as I'd just seen them, for a minute or so and then without hurry they separated, the 'raffia' and one 'black' together carrying on up the nullah, while the 'piebald' and the other 'black' turned off the nullah at right angles and disappeared into the forest. The former two went off at a steady lollop up the ravine, but the latter remained unhurried, and moved very silently.

I've heard since that these village dogs hunt in similar—and larger—parties and like Cuon—but possibly to a smaller extent—do damage to the herds of chital, and also pull down an occasional sambhar hind. The young of peafowl, jungle fowl and partridge must also suffer from these village dogs.

I wonder whether any of the other members have seen anything similar. There are, of course the dogs which hunt with the Kamjars or gipsies, but those are trained (?) and hunt *with* their owners. It couldn't have been a case of a bitch 'in season' with three *beaux*—this spirit of easy harmony and understanding and conferring together would *not* have been apparent—to say the least! and the family *Canis* is not so bashful as to retire into forest fastness for his courtship. Any way, I will appreciate your own views and those of any member who may have seen a similar event.

W. P. KEELAN.

ARCADIA T.E.,
DEHRA DUN, U.P.,
October 15, 1940.

VI.—VITALITY OF A HYAENA (*HYAENA STRIATA*)

While out on a Gasht today a striped hyaena got up in front of the forward platoon who shot it. I don't know how rare these are up here, but I have never heard of one before, though some of the men say they are very common. But on the other hand some of them thought it was a panther, and others said it was in the habit of killing camels. It seemed in good condition except that one of its hind feet was missing from some previous injury; but I cannot think what they live on here as the hills are bare and barren. All flocks are driven in at night, and though a dead camel would do it well, dead camels are not as common as all that. The vitality of this animal was amazing. It was hit by a '303 bullet at close range and apparently the bullet broke up, because there was a huge hole in the belly out of which the liver and stomach (?) were protruding when found. In addition a piece of intestine ten feet long had come out where the hyaena was first hit and this it had apparently bitten off for it was found on the ground. After biting it off the hyaena had gone down a very steep nullah about two hundred feet, and a hundred feet up the other side where it was finished off. There was a very broad blood trail all the way, and it is astonishing that an animal could lose so much blood and still continue to run. We took the head and neck and the tail, but had to leave the rest owing to lack of time. While skinning the head we found a leech about 1½" long in one of the nostrils.

T. J. PHILLIPS,
Tochi Scouts.

MIRANSHAH,
N. WAZIRISTAN, N.W.F.P.,
December, 1940.

VII.—ON THE OCCURRENCE OF THE CHAFFINCH (*FRINGILLA COELEBS* [LINN.]) IN WAZIRISTAN.

These are far commoner visitors to India than is generally supposed. On the 16th February this year (1940), there were two or three cock birds here, and early in March there were about half a dozen of each sex; but I had not then a copy of the *Fauna* and consequently took little notice of them, except that they seemed duller than the English bird. For the same reason I cannot be sure, but I think they were then singing, rather a weak little song. I have been unable to get dust shot so I am afraid this specimen also is a bit battered. He was sitting on a branch calling, which was what drew my attention to him though I had seen him a few days before.

MIRANSHAH,
N. WAZIRISTAN, N.W.F.P.,
December, 1940.

T. J. PHILLIPS,
Tochi Scouts.

[The specimen of the Chaffinch was sent to us by Mr. Phillips. We have been able to verify the identification. It was obtained by him at Datta Khel 4,000 ft. in the Miranshah District, North Waziristan. In the New *Fauna* one previous record is given. This is a specimen obtained by Capt. C. H. T. Whitehead at Hangu, 25 miles north of Kohat.—EDS.]

VIII.—VULTURES AND PALMS.

Going to and fro by train to work and home again, I often wonder how many people have given a thought to, or observed the gradual, but sure disappearance of palm trees, particularly of the Brab Palms (*Borassus flabellifer* L.) on either side of the railway track, and beyond. This gradual disappearance of the palms is most noticeable after leaving Bandra station (going north), and is not entirely due to the development of the suburbs, but also to the presence of large numbers of white-backed vultures (*Pseudogyps bengalensis*) in attendance on the Bandra slaughter house. The crowns of the palms afford most convenient roost for the vultures, which naturally use them. Though vultures 'shoot' out their excrements to a considerable distance, they do not always fall clear of the palms. In course of time the crowns of the palms are smeared white with the acrid excreta. The leaves gradually get 'burnt' and dry up, and it is not long before the crown dies, leaving a bare 'pole' standing. Rot soon lays the stem low. The vultures are now forced to find a fresh roost. Thus, one by one the palms are gradually disappearing. It is only the tallest palms that are thus affected. As vultures generally do not roost for the night below a certain height, the young palms escape till they become tall enough.

It is surprising to find in what a short time the vultures kill the palms. A few random observations showed that certain palms succumbed after two and three years of use, while others dragged on for a couple of years or so more. Palms with slanting stems

seemed to survive a little longer than those with vertical stems. Palms, which had been abandoned as roosts, sometimes recovered after a while.

Coconut palms (*Cocos nucifera* L.) are also used as roosts, but on the whole are less affected, as they do not usually reach the same height as 'brabs', and the fronds are less adaptable to carrying a number of these large birds.

This is not a plea to destroy the vultures, they are by far too useful as scavengers, in spite of their ugly appearance and habits, but is merely intended as a record to show how trees may be destroyed by the excreta of some birds.

Incidentally the life and distribution of two insectivorous birds, the Palm Swift [*Tachornis bat. batasiensis* (Gray)] and the Swallow Shrike (*Artamus fuscus* Vieillot.) are bound together with the distribution of the Brab Palm, which both these birds use as roosts and nesting sites. The disappearance of the palms from Salsette may result in the disappearance of these birds, but I do not think there is any immediate danger of this taking place—Nature will, I think, take care of that.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
December 2, 1940.

IX.—SANDGROUSE COMING TO WATER AT MIDDAY.

It may be of interest to your readers to know that whilst in British Somaliland recently I noticed the Pin-tailed Sandgrouse (*Pterocles alchata*) flighting in and watering at 1-30 p.m. This struck me as very unusual for a species which normally waters in the early morning and occasionally in the evening. I would mention that the place where these birds were bathing was the only water hole for several miles.

R. C. NICHOLAS,
ADEN, *Major.*
September 30, 1940.

X.—SCARCITY OF SANDGROUSE DURING THE COLD WEATHER 1939-1940.

Have any of your members remarked on the scarcity of the Common Sandgrouse (*Pterocles exustus*) this year? During the cold weather of 1939-40 I was at Ramdurg, S. M. Country, and shot about 100 sandgrouse. I spent last Christmas there and had previously warned my old *shikari* to look out for good places for sandgrouse, but on my arrival he reported that he could not find any. I went to an old haunt of these birds, but there was not one to be seen. The uplands round Mudhol are typical places for sandgrouse, but I have seen very few. It is not a matter of scarcity of water as there are rivers here and at Ramdurg where the birds drink.

MUDHOL, E. O'BRIEN,
S. M. COUNTRY, *Lt.-Colonel.*
January 16, 1941.

XI.—HABITS OF THE SEESEE PARTRIDGE (*AMMOPERDIX GRISEOGULARIS GRISEOGULARIS*).

With reference to the habits of the Seesee Partridge, as noted in the *Fauna*, I think that Stuart Baker is mistaken about the double whistle call. They are the commonest game birds here by a long way, and I have never heard it, nor have any of our men whom I have asked. The only noise I have heard them utter is a soft *chuck chuck* from one to another in the covey, and the noise from which they get their names is the *see see* noise they make with their wings as they take off—a high pitched squeak like a badly oiled bearing. Another habit of theirs is not mentioned. In the heat of the day they seem to leave the plains and go to rocky outcrops where they hide in deep cracks and crevices, always preferring these cracks to even the shadiest stones. Also when wounded they always run to the nearest hole or crack in a rock, if there is one anywhere near by. They do not hide up in the middle of the day to the same extent in the cold weather, but even unwounded birds, when frightened, will fly into a hole in a cliff, and under these circumstances I have put out seven or eight birds in the cold weather out of one rock. Protective colouration is very highly developed in these birds, and I have had ten men searching an area of bare stony sand for three or four minutes before finding a dead bird lying there back upwards. So without a dog a wounded bird out of sight is as good as lost.

Big coveys of twenty birds or so are difficult to approach, because when they disappear over a ridge they almost invariably leave a sentry; but two or three birds together practically never do this, and if one runs forward they can usually be found just below the crest of the ridge or in the nullah below.

MIRANSHAH,
N. WAZIRISTAN,
N.-W.F.P., *December* 1940.

T. J. PHILLIPS,
Tochi Scouts.

XII.—CURIOUS NESTING SITE OF THE RED-WATTLED LAPWING (*LOBIVANELLUS INDICUS INDICUS* BODD.)

(*With a photo*)

Mr. K. Bocker sent me a couple of photographs of a Red-wattled Lapwing's nest which had been placed 'on a heap of ballast between two railway tracks in Ghosrana Station yard (Alwar State)'. The nest contained three eggs. Mr. Bocker commenting on the behaviour of the bird wrote, 'Every time a train came in the bird flew up, only to return to its domestic duties immediately the train left.' The photographs were taken early in September.

The position of the nest between two frequently used railway tracks, and in a station yard, is certainly rather unusual for a bird which is generally very careful to hide its nesting position. Another point of interest is that this lapwing generally has its nest

near water, on the banks of lakes or in the beds of rivers. According to the *Fauna* this species usually lays in April and May, but

eggs have been found in June and July. In this instance the bird laid in September, several weeks later than usual.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY,
November 13, 1940.

C. McCANN.

XIII.—RECORDS OF SWINHOE'S SNIPE IN ASSAM.

Swinhoe's snipe (*Capella megala*) are not the rarity that they were some years ago, but they are still comparatively uncommon. It may be of interest to record that three have been shot in the neighbourhood of Shillong recently. I killed the first in a valley some three miles west of the station on September 15. Major W. L. Neal, I.M.S., shot the second, 13 miles west of Shillong on September 28. I shot the third on the high plateau south of Shillong on October 30.

The first and last were solitary birds. The second was lying close to another snipe which we failed to bag.

BRIGHTWELL,
SHILLONG, ASSAM,
November 8, 1940.

J. C. HIGGINS.

XIV.—OCCURRENCE OF SWINHOE'S SNIPE IN BENGAL.

In view of the paucity of published records of the occurrence of Swinhoe's Snipe (*Capella megala*) in North India, it may be of interest to record that a specimen, sent to you herewith, turned up in a bag of 33 couple, consisting of 56 pintail snipe, 9 fantail snipe

and the Swinhoe, made by me on September 29 last, a few miles from Naihati, which is some 24 miles north of Calcutta.

The ground consisted of young paddy with swampy grassy patches here and there, which had not been cultivated, and the birds were also found sheltering from the sun in the shade of bushes and patches of jungle dotted about in and around the paddy.

The Swinhoe which, in the preliminary separation of the bag by looking at the undersides of the wings, had been placed amongst the pintails, attracted attention on account of its large size; a closer examination and a look at the tail disclosed its identity. Besides the quite distinctive tail, this particular specimen seemed to me to differ from most pintail snipe in the following respects :—

1. It was definitely large, even for a pintail; so much so that it attracted special attention.
2. The legs seemed to be rather longer.
3. The bill appears to me to be longer and more slender than is the case with most pintails, while the knob at the extremity of the upper mandible, although present, does not seem to be quite so pronounced.

These are personal impressions only, however, and the differences mentioned are certainly not sufficiently pronounced to enable identification without an examination of the tail, except for which, the bird is extraordinarily like a pintail snipe.

This is the first Swinhoe's snipe to turn up in a total of over 16,600 snipe representing an aggregate of bags made since season 1926-27, practically all within a radius of about 40 miles from Calcutta, in which I have been personally interested and all of which have definitely ben carefully examined for unusual species and varieties.

CALCUTTA, R. J. CLOUGH.
November 23, 1940.

XV.—MOULTING OF COMMON TEAL SUBSEQUENT TO MIGRATION TO INDIA.

(*With a photo*).

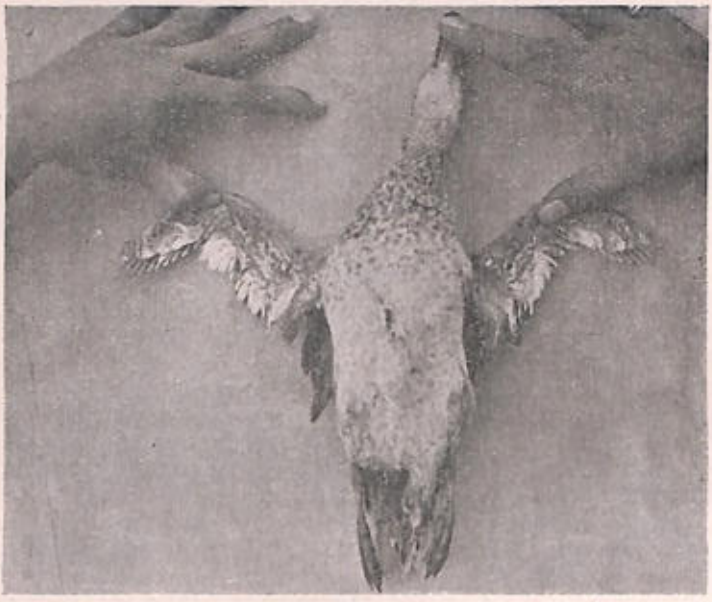
I am sending you by this evening's train a teal shot yesterday in Bikaner, i.e., on October 4, this year.

2. It is not certain, but in all probability, it was not shot flying on account of its wing condition, but must have been shot on the water when picking up wounded birds.

3. I send some photographs which have been taken, in case the bird does not arrive in good enough condition. However, I think, you will be able to see the condition of its wings at any rate. There is no doubt that the bird could not have migrated with its wings in their present condition. Such a long flight would have been impossible, in this condition, it was really quite unable to fly. Last year the lake was completely dry, so it could not have been a wounded bird left behind from the previous year.

4. The only feasible explanation is that it migrated and arrived at the end of August or early in September in the lake, and for

some unnatural and extraordinary reason, moulted after arriving here. A lot of feathers on both wings are in a growing state and still bluish in colour and soft.



5. I should be much obliged by your kindly letting me know what you think is really the case. Particularly, whether the teal, which appears to be a young bird, could have migrated in its present wing condition, or whether it could fly, even slowly, in this condition.

BIKANIR, SECRETARY TO
October 3, 1940. HEIR APPARENT OF BIKANIR.

[We have examined the teal (*Nettion creca*) which was in complete moult. The *Anatidae* (Ducks and Geese), unlike most birds—moult all their wing quills simultaneously and not pair by pair. They thus become completely flightless for a period.

Mr. Sálim Ali who was concerned with the carrying out of scientific bird surveys on behalf of the Society writes as follows :—

'Till I caught several such flightless teals and shovellers for ringing on the Ghana Jheel in Bharatpur last October (1939), I did not know that some of our migrant ducks underwent the complete post-nuptial or autumn moult after flying thousands of miles to their winter quarters on their old remiges (wing quills). This condition is not recorded anywhere in Indian bird books, as far as I know.

'Most of our winter visitors have already finished moulting their wing and tail quills before they arrive in our midst. This is, as one would expect, considering the long and hazardous journey over the Himalayan barrier that must be accomplished, to reach their winter quarters in India.

'Some individuals among the ducks, however, seem to be in such a hurry to get back to their winter quarters—(they often arrive as early as August or September) that they forsake their breeding grounds before the autumn moult has begun and go through this process at this end. Such birds, presumably, are yearlings that will not breed till the second season. They cannot be, at least the ones I examined were not—juveniles of the same season.'—EDS.]

XVI.—OCCURRENCE OF THE STIFF-TAILED DUCK AT NOWSHERA, N.-W.F.P.

As an old member of your Society, I thought you would like to know that we shot a Stiff-tailed Duck (*Erismatura leucocephala*) on the Kabul River on November 31, 1940. We were going down-stream in a boat when we suddenly came on the bird below a rapid. It refused to fly off the water although we passed it quite close, but as the boat was going very fast, and we thought we should not get a further chance we shot it on the water. It appeared to be on examination either a female or young male. The tail was very scraggy but very distinctive, also was the beak. I compared it with Stuart Baker's book, and it undoubtedly was a Stiff-tailed Duck.

I thought it might be of interest to you. It was a lone bird.

THE MALL,
NOWSHERA,
December 3, 1940.

F. F. FIELD,
Lt.-Colonel.

XVII.—INJURY TO A CROCODILE.

(With a photo).

The accompanying photo of a Marsh crocodile (*C. palustris*) is of interest. Having shot the crocodile, I found the mouth parts completely disfigured by a former bullet wound. The injuries involved both the upper and lower jaw which, as will be seen from the photo, were partly shot away. How the animal fed under these

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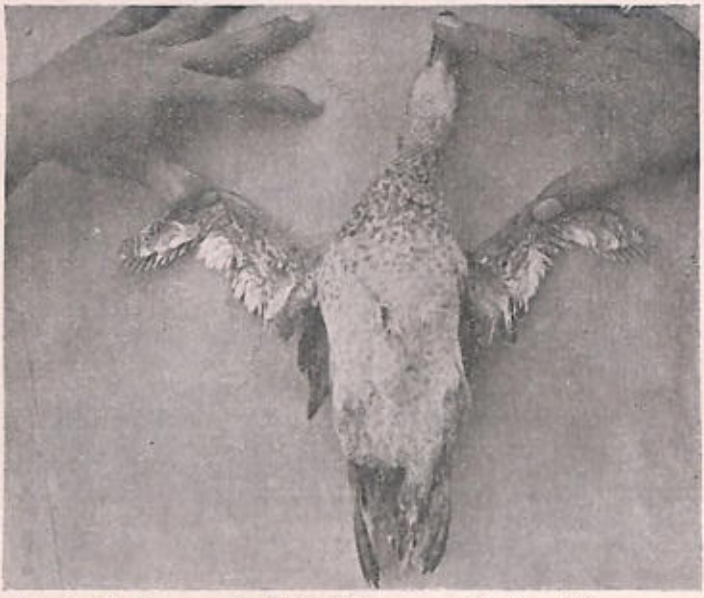

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circumstances is a mystery. The wounds had healed perfectly and the reptile was in good condition.

NILAMBAG PALACE, R. K. DHARMAKUMARSINHJI.
BHAVNAGAR,
September 27, 1940.

XVIII.—FOOD OF LIZARDS.

I was very interested to see the record (*Journ. Bomb. Nat. Hist. Soc.*, vol. xlii, p. 49) of three larvae of *Parasa lepida* Cr. (not 'Gam.') being taken from a *Calotes*. I recorded the eating of this larva by *Hemidactylus* sp. in 1936 (*Proc. R. Ent. Soc. Lond.* (A) 11: 91-2). Lizards seem to pay little attention to the colouring of the larvae they eat and I have fed *Hemidactylus* sp. on the larvae of *Polytela gloriosae* F. and *Chilasa clytia* L., both typically aposematic in appearance, the one being purple-black in colour blotched and spotted with orange and white, the other black and cream with large rose pink spots. Hairiness seems to afford protection as neither the larva of *Pericalli ricini* F. nor of *Trabala vishnu* Lef. were eaten. (1939, mihi, *Proc. R. Ent. Soc. Lond.* (A) 14: 33-4).

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XIX.—A NEW FAMILY OF FISHES.[1]

The discovery of a new vertebrate, so distinct from all previously known species as to warrant the erection of a new family for its reception, remains a zoological event of outstanding importance. Double significance is attached to the find, when, as in the discovery under review, the new species may rightly be claimed to be one of the most highly specialized and bizarrely modified members of its class.

Early in 1937, while studying fish life in brackish waters of the Bombay Province, C. V. Kulkarni encountered small, surface-swimming specimens which he first took to be the young of some goby or cyprinid fish, but which later turned out to be mature adults of an unknown species. When submitted to ichthyologists in India and America, the novelty was pronounced a new type, referable to the Order of small fishes known as Cyprinodontes. It was interpreted as a distant relative of the common Indian species, *Oryzias melastigma*, and was presumed to have been evolved from some such fish. It has gone so far on its own special line of evolution, however, that it seemed unwise to classify the new type in the same family (*Cyprinodontidae*).

Dr. George S. Myers and the reviewer were both struck by the extreme likeness of the Indian novelty to the tropical American genus *Tomeurus*. Even in the features of extreme specialization, the resemblance appeared so close that at first examination the two fish seemed to be close relatives. It seemed impossible that Nature

[1] On the Systematic Position, Structural Modifications, Bionomics and Development of a Remarkable New Family of Cyprinodont Fishes from the Bombay Province, India. By C. V. Kulkarni. *Rec. Ind. Mus.*, vol. xlii, pp. 379-423, figs. 1-20, 1940.

could have twice molded a fish into such an extreme form. On more penetrating scrutiny, however, some fundamental, hidden differences came to view, so that both of us concluded that *Tomeurus* and the then-unnamed Indian genus arose independently from the cyprinodont groups that are respectively characteristic of the two regions.

In designating the new fish *Horaichthys setnai,* Mr. Kulkarni has jointly commemorated the names of Dr. Sunder Lal Hora, India's distinguished ichthyologist, and Dr. S. B. Setna, Fisheries Officer of Bombay. Though not unduly long as scientific cognomens go, this name is slightly longer than the fish. One wonders how this thin, translucent wisp-like inch of fish can be so packed with specializations.

Horaichthys is peculiar in many ways. The small dorsal fin is set far back, almost against the caudal fin. The anal fin is much elongated. The anterior anal rays make a lobe on the females, and in the male are set apart to fabricate a marvellously complex structure, with special hooks and appendages and skeletal supports,—all of which are described in admirable detail. This structure is termed a gonopodium, from its resemblance to the similar though less extreme structure which serves as an intromittent organ in the *Poeciliidae,* a family of viviparous American cyprinodonts. The organs in the two groups are said to be homologous, as they are comprised essentially of rays 3, 4 and 5 of the anal fin, but this view can hardly be accepted by those who interpret unity of descent as a criterion of homology. In *Horaichthys* the gonopodium is utilized to transfer spermatophores (sperm-filled bundles) from male to female. These, the first true spermatophores to be recorded in fishes, are provided with a complex head of spines by which the sperm bundle is attached to the skin of the female, in the region of the genital opening. After attachment the wall of the bundle swells at a point near the spines and discharges its contents of male germ cells. The spermatozoa swim into the oviduct and there fertilize the eggs for some days. Dermal folds and ridges on the female ('genital pads') seem to aid in the attachment of the spermatophores. The usual lack of a right pelvic fin (a wholly unique feature) might be thought to serve the same function, though the author, in a Lamarckian view that seems rather strange today, states that 'it may be presumed that by such constant striking [of the gonopodium], the right fin has in the course of time been reduced and ultimately lost.'

Following wise suggestions from Dr. Hora, the author withheld the description of this marvellous little fish until it was possible to study its structural modifications, habitat, feeding and mating habits, deposition of eggs, and the structure and development of the egg and 'larva' (postlarva). All these observations were made in detail, with an eye that sees below the surface. For the completion of this outstanding contribution to their science, the ichthyologists of the world owe thanks to Mr. Kulkarni and his Indian associates.

ANN ARBOR, MICHIGAN, U.S.A.,
October 4, 1940.

CARL L. HUBBS,
University of Michigan.

XX.—ADDENDA TO THE LIST OF SIMLA BUTTERFLIES.

(*Journal, Bombay Nat. Hist. Soc.*, *vol.* xli, *p.* 716)

Parnassius simo simo, Gray.
Eight ♂ from the Shipki La, 14,000′, in July 1940.
Baltia butleri butleri, Moore.
♀ ♂ from the Shipki La, 14,000′, in July 1940.
Euploea mulciber mulciber, Cramer.
♂ caught in Chota Simla at 7,000′, on August 8, 1940.
Hesperia alpina alpina, Ersch.
Several specimens from the Shipki La, 1,400′, in July, 1940.

BISHOP COTTON PREPARATORY SCHOOL, SIMLA, E.
November 8, 1940.

M. A. WYNTER-BLYTH, M.A.

XXI.—BUTTERFLIES ATTRACTED BY MOIST EARTH.

(*Miscellaneous Note No.* xx, *Journal, vol.* xlii, *p.* 206).

Collenette, in a paper which I have not got with me, suggested that perspiration was a potent source of attraction in South America. He also remarked that most patches of damp earth or sand would attract butterflies if one or two dead ones were placed on it as decoys. In Shillong I found *Terias* spp. very common on patches of damp earth.

CALCUTTA,
December 30, 1940.

D. G. SEVASTOPULO.

XXII.—SUPPLEMENTARY NOTES ON THE LIFE HISTORY OF THE MOTH (*BRAHMEA WALLICHII*

I have a few notes to add to the admirable life histories of the large moth *Brahmea wallichii*, Gray which have been published during the last few years; viz., *Journ. Bombay Nat. Hist. Society*, vol. xxviii, page 593 by Graham, and *Journ. Darjeeling Nat. Hist. Soc.* No. 1 June 1938 by Scott.

I obtained a female of this species, a rather battered and deformed specimen, on the trunk of a fir tree at Laitlyngkot in the Khasia and Jaintia Hills on May 25, 1940. It had laid seven eggs on the bark of the tree singly, and it looked as if an attempt had been made to insert the eggs into cracks in the bark. It laid a further five eggs in the box in which it was put. The colour of these particular eggs were quite a deep yellow and had no other markings that I could see. I was on my way to Darjeeling at the time so the eggs were not observed very closely until some ten days later when it was noticed that they had turned a deep mauve colour. Shortly after the larvae emerged. It is noted by Lt.-Col. Scott that in Shillong the food plant is *Ligustrum robustum* Blume and by Major Graham as *Fraxinus macracantha*. I could find neither of these in Darjeeling. I did however find *Ligustrum confusum* Dene and made vain attempts to make the larvae eat it;

but they resolutely refused and most of them died. *Fraxinus floribunda* Wall is a fairly common tree in Darjeeling and this was tried with success. They fed well after this. The point of interest is that although the larvae will eat two species of the genus *Fraxinus* they will not eat a second species of *Ligustrum*.

I also observed that sometimes the empty egg shells were entirely eaten, but were only partially eaten in other instances. I did not however note that the cast skins were eaten. I found that they were left untouched in all cases.

I was unfortunate with the surviving larvae however. I managed to rear them to the penultimate instar when they all died as a result of being unable to cast the last skin. From my observations it is apparent that where the humidity is very high, as it is in Darjeeling during the monsoon, the larvae are very delicate, especially if they are not kept well ventilated—in the open air if possible. I was unable to do this not being in my own home. The high humidity seemed to prevent the old skin from drying sufficiently for it to be shed. It appeared to stick to the spiracles. I had a good deal of difficulty with each instar except the first, when the skins were in the process of being changed, as a matter of fact; but the last was the worst. The larvae were inclined to be lethargic and did not eat well when it was cold. The height of Laitlyngkot is 6,000 feet. It is apparent that to rear the larvae of this species successfully it is necessary to keep them as dry as possible when in captivity and very well ventilated.

ASSAM,
November 3, 1940.

R. E. PARSONS,
Indian Police,
F.R.E.S.

XXIII.—LARVA OF *THERETRA LYCETUS* CR. PARASITIZED BY TACHINID FLIES.

With reference to Mr. McCann's note on the same subject in the last issue of the *Journal*, I have several times had a similar experience with larvae of *Rhyncholaba acteus* Cr. The very noticeable caking of the underlying soil is, presumably due to the amount of fluid contained in the body of these large larvae.

CALCUTTA,
December 30, 1940.

D. G. SEVASTOPULO.

XXIV.—*LAGERSTROEMIA INDICA* AS A FOOD-PLANT OF *ACTIAS SELENE*.

(*Miscellaneous Note No.* xxii, *Journal, vol.* xlii, *p.* 208)

I have found this shrub most useful in rearing many species of larvae whose proper food-plant I did not know. The Saturniid *Philosamia cynthia* Drury eats it readily, and in Shillong I found cocoons of *Dictyoploca simla* Westw. on it in numbers. Probably most Saturniids would eat it. Of the other families, almost all Lymantriids will eat it, as will many Limacodids.

CALCUTTA,
December 30, 1940.

D. G. SEVASTOPULO.

XXV.—THE DEATH EXPEDITION OF HIBISCUS CATERPILLARS.

(*A Correction*).

There seems to be a mistake in the identification of the species referred to in this article (*Journ. Bomb. Nat. Hist. Soc.*, vol. xlii, p. 164). *Crocallis* (presumably Treit.) is the name of a genus of Geometrine moths with smooth, looper caterpillars very different from the hairy larvae shewn in the plate. It is difficult to make an identification from the information given in the note, but I feel fairly confident that the larva in question is *Eupterote geminata* Wlk. This is a common species in Calcutta and the larvae are often to be found abundantly on various trees and shrubs, the branches of which they cover with a coating of silk.

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XXVI.—ABNORMAL SEEDLING OF *MANGIFERA INDICA*, LINN. N. O. ANACARDIACEAE.

(*With a text figure*).

Mango seedlings were raised for the class work. Among these an abnormal seedling was noticed.

A normal seedling consists of a main tap-root with its branches, two cotyledons, and a shoot (epicotyl) bearing young immature leaves.

In the abnormal seedling (Fig. 1) abnormalities were present in the root and the shoot region, while the cotyledons only remained normal. Instead of a single tap-root with its branches, it was noticed that several roots were given out. In all there were eighteen roots of various lengths. The shoot system consisted of a main primary normal shoot and five axillary secondary shoots. The main primary shoot was stout and it remained enclosed inside the endocarp. At the base of this shoot, in the axils of the cotyledons, five secondary shoots were present—one in one axil and four in the other. Of these four axillary secondary shoots, one showed fasciation of three axes. The union of the axes was unequal. At the base, all the three axes were united. Higher up the outer axis got separated while the inner one was composed of two united axes. The latter also was separated again at the apex. Of these four secondary axillary shoots, two were longer than the rest. On the longer shoots, young tender leaves were present, while on the two short shoots, only rudimentary leaves resembling scales were present.

When this seedling was uprooted the only part that was above ground consisted of the two longer shoots, one with normal axis and the other with the fasciated axis. The remaining shoots and cotyledons remained inside the endocarp.

Abnormalities in the seedlings of Mango have been recorded by Masters (3), Khanna (1) and Sen and Mallik (5).

The abnormal seedling described in this note differs from the

one cited by Masters (3) in the following respects: (i) Adventitious roots are not manifested on the cotyledons. (ii) There is absence of an increased number of embryos. According to Khanna (1) embryonic shoots were given off from the part just near the endocarp as well as from the extreme part of the cotyledons. Such is not the case with this seedling. It also differs from one described by Sen and Mallik (5) in that there is absence of a single tap-root.

These axillary secondary shoots were the result of the occurrence of buds in the axils of the cotyledons. The presence of the buds in the axils of cotyledons and the development of shoots from them is of rare occurrence. Similar type of instances are recorded

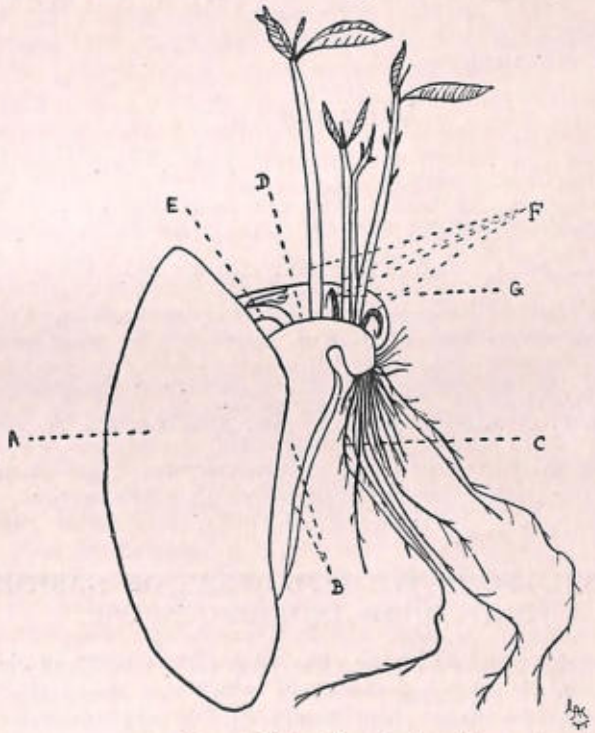

Fig. 1. Abnormal Seedling of *Mangifera indica* Linn. showing:—

(*a*) endocarp: (*b*) cotyledons: (*c*) roots: (*d*) main primary normal shoot: (*e*) single axillary secondary shoot: (*f*) four axillary secondary shoot No. 1-4: (*g*) fasciation of three axes of shoot No. 2.

in *Cassia Tora, Impatiens Balsamina, Vicia faba, Tropaeolum majus, Ricinus communis,* and some others by Tiwary (7) and in *Cicer arietinum* by Singh (6). The present case differs from that of Tiwary (7) in that there is absence of fasciated shoot. According to Singh (6) if the plant is decapitated close to the cotyledons, either in the seedling stage or a little later, axillary shoots are invariably developed in due course. There is nothing like decapitation in this case.

Sachs (4) and Lopriore (2) produced at will fasciated shoots in the axils of the cotyledons of the Scarlet Runner (*Phaseolus multiflorus*) by excising the main axis of the plumule at an early stage; if this mutilation is performed at a later stage, no fasciation results. Worsdell (8) repeated these experiments with marked success. He produced fasciated shoots in the axils of the cotyledons of majority of seedlings. In every case the shoot was only affected at the base. The rest of the shoot showed the normal growth. The present case agrees with those of Sachs in having fasciated shoots; but this is a natural phenomenon and not the result of mutilation.

BHAUDDIN COLLEGE,
AHMEDABAD,
December 1940.

G. A. KAPADIA, M.SC.

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XXVII.—SOME WILD FLOWERS OF KASHMIR AND THEIR INDIGENOUS USE.

One of the beauties of the charming valleys of Kashmir is their wild flowers. I mean those valleys which are above the tree-belt where shepherds make their homes during the summer months. Where there is less grazing, the flowers thrive and we see beds of floral vegetation in diverse colours. Sometimes we see islets right in the middle of a torrent, covered with pink, yellow or orange flowers.

Almost all the flowers of these high altitudes have medicinal qualities. There is a great scope for a scientist or a medical man to analyse these herbs. There are some men who know the uses of certain herbs, but they are loath to impart this knowledge to others. When they die this knowledge also dies with them.

The most esteemed of all these herbs is *Saussurea sacra*. This is commonly known as Jog-Pádsháh. It grows above 14,000 ft. in crevices between rocks and slabs with very little earth in them. The herb is like a fleecy ball, exactly like a cat's head without ears.

The flowers are tiny, of purple colour in pappus. The leaves are lower down and are in large numbers. It appears shining like a star. It grows on the Harmukh, in the Sonasar pass, and from Romesh Thong (the Sunset Peak) to Tatakoti. It grows in large quantities. We saw a large bed of these flowers round Makor Nág, when, in 1937, the C. M. S. School masters climbed the last-mentioned peak. There are many who have never seen this flower. I met a Sadhu last year in the Nishát Bágh and he told me that he had spent months round about Khrew and Tár-Sar trying to find the herb. He said that he wanted to collect plants enough to give him juice weighing two seers! (almost an impossibility).

It is believed that the head of the herb when powdered and drunk with boiled milk, abates fever and cures internal disorders. It is also used for snake-bites, and as a poultice for boils.

Two other plants found at almost the same height are *Allardia glabra* and *Pleurospermum*. The former grows on sandy soil among rocks, and creeps along the ground. The flower is like a daisy. The flowers of the disk are yellow, while those of the ray are purple or pink. The latter flower resembles hemlock (Mohora Kach) more or less. The plant is about 7" high. Both those specimens were found near the Kila peak (Harmoukh) and the Sonasar Nág peak. The drug which the physicians esteem most is *Macrotomia Benthami*, known as Kahzabán. There is no decoction prescribed by native physicians in which this drug is not used. An infusion of the leaves is believed to be good for heart trouble. A jam is prepared from the flowers of this plant. The flowers are pounded and mixed with double the weight of sugar and exposed for forty days in a jar in the sun. It is said that the root burnt and mixed with ghee cures burns.

Mertensia tibitica is a small plant with dark blue flowers having a long corolla tube. It grows at a height of about 13,000 ft. It has been found on Aphorwat, Yechini Pass (Kunsar Nág) Mahádive, and Hamsadwar.

Sedum wersii grows among rocks. The flowers are pink. The leaves are sessile opposite, broad and thick. It is called 'Dandas' and the chewing of the stem is believed to cure toothache. It grows on Aphorwat, Mahadive, Gangabal and Harmoukh. *Rheum webbianum* is commonly known as Pambá hák. The leaves are boiled and cooked with fish or without. The root is pounded and mixed with oil to cure wounds. It is then called Pamba tsálan. The petiole of the leaf and young shoots are generally red and the former is boiled in sugar for eating purposes. It grows on Mahadive and high margs.

Polygonum amplexicaule bears red flowers on the top of the plant. The leaves lower down are long and narrow. The root is called montsaran and is used to stop bleeding.

Jurinea macrocephala. This plant is found at a height of about 12,000 ft. The leaves are radical, ashy-coloured, long and deeply lobed. The flower is like that of a thistle surrounded by leaves. The root is used as incense when mixed with other scented drugs, such as camphor etc. It is called *Dhup*.

Saussurea Lappa. This is the famous plant known as Koṭh.

The leaves are long and broad resembling those of pumpkin leaves. The petioles have small wings attached to them. A group of 3 or more thistle-like flowers grow at the top of the stem. They are of a dark colour. Here and there we found the plant at Erin Nallah, Kanital, and Kishen Ganga valley. There are many places where the forest department is cultivating this useful plant. In 1927 we saw a large tract at Gossai in Grurais valley where this drug was being cultivated.

The root of the plant is supposed to be very useful. Its mention in *Yagupavit* ceremony shows that its use was known from the earliest times. When a new well is dug a piece of the root is put into the water to clean it. One part Koth and two parts cane sugar is supposed to cure ulcer of the stomach. The dose is as large as half a pea.

It is also powdered and in sesamum oil rubbed on a rheumatic limb. Its uses in China are manifold. It also serves the purpose of naphthalin. *Aconitum heterophyllum* (Monkshood) is a flower of high margs. The leaf is more or less Cordate with toothed edges. The plant is known by pattis. The root contains two tubers one big and the other small. Hence the other name for it is nar mada (male and female). The tuber is ground and used as medicine for fever. It is as good as Quinine. It grows in Gurais, Gosai and Purmandal.

Aconitum Chasmanthum is called 'Mohand'. The flowers are collected and made into a kind of 'Khamir' jam. Double the weight of sugar is pounded with the flowers and kept in a jar in the sun for 40 days. It is a tonic and good for rheumatism. A large dose is poisonous. It is generally taken in winter months. It grows in Tosa Maidan, Purmandal and Dánzeh. The root is ground, mixed with oil and rubbed on a rheumatic limb.

Fritillaria Roylei is known by the name of Shithkár (cures 80 diseases). The root is bulbous. I saw a shepherd boy roasting the bulb in ashes and eating it. It cures stomach trouble. The bulb when dry is mixed with curds and applied to burns. It grows in Gulmarg and Mahadive.

NATURAL HISTORY DEPARTMENT, SAMSAR CHAND KOUL.
C. M. S. HIGH SCHOOL,
SRINAGAR, KASHMIR,
December 30, 1940.

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IXORA COCCINEA R. Br.

($\frac{9}{10}$ nat. size.)

JOURNAL
OF THE
Bombay Natural History Society.

1941. VOL. XLII. No. 3.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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AND

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PART VII.

(*Continued from Vol.* xlii, No. 2 (1941), p. 241).

(*With 2 coloured and 8 black and white plates and 11 text-figures*).

Rubiaceae, PART II.

4. **Ixora** Linn.

(Van Rheede states in Hortus Malabaricus that the flowers of this genus are offered to the God, *Ixora*, a fact which has obviously given rise to the generic name).

A genus of small shrubs or trees which are great favourites in Indian gardens on account of their brilliantly coloured flowers and dark green handsome foliage. The leaves are opposite, glabrous, coriaceous, and reticulately nerved. The stipules are interpetiolar, simple, subpersistent. The inflorescence is terminal, paniculate or contracted, the branchlets being subtended by linear or subulate, free bracts and each pedicel provided with 2 bracteoles. Individual flowers bisexual, tetramerous. Calyx campanulate, adnate to the ovary, shortly 4-lobed. Corolla hypocrateriform (tube-like with spreading lobes); tube slender; lobes 4, twisted in the

bud. Stamens as many as the lobes and alternate with them; filaments short, inserted in the throat. Ovary inferior with 2 cells; ovule 1 in each cell, attached to the centre of the septum. Disk annular. Style glabrous, shortly exserted and ending in two recurved stigmatic lobes. Fruit a globose drupe. Seed semi-globose, with a deep and wide excavation on the flat side.

Key to the Species.

Flowers coloured.

Flowers yellow.

Corolla-tube 1.5 in. long; lobes broadly ovate, acute ... *I. lutea.*
Corolla-tube 1 in. long; lobes rotundate, obtuse ... *I. chinensis.*

Flowers red or reddish.

Flowers scarlet.

Corolla-tube up to 1 in. long.

Corolla-lobes rotundate, obtuse; corolla at first yellow then red ... ... *I. chinensis.*
Corolla-lobes ovate acute; corolla always scarlet. *I. coccinea.*
Corolla-tube up to 1.75 in. long ... ... *I. fulgens.*
Flowers pink ... ... *I. rosea.*

Flowers white.

Flowers less than .5 in. long.

Leaves undulate on the margin; calyx-lobes as long as the calyx-tube ... ... *I. undulata.*
Leaves not undulate; calyx-lobes much shorter than the calyx-tube ... ... *I. parviflora.*
Flowers over .5 in. long; throat of corolla woolly; corolla tube up to 1.5 in. long ... ... *I. barbata.*

Ixora coccinea Linn.

Scarlet Ixora.

(*coccinea* is a Latin word meaning scarlet-coloured, and refers to the brilliant scarlet flowers of the commonly cultivated race of this species).

Description.—A compact shrub or small tree, glabrous all over. Leaves sessile, opposite, elliptic, ovate or obovate in shape, apiculate, obtuse or mucronate at the tip, somewhat cordate at the base, thickly coriaceous in texture, 1.5-3.5 in. long, dark glossy green in colour, with 6-8 nerves on either side of the midrib. Stipules triangular, awned.

Inflorescence terminal, supported by two small, leaf-like bracts, strongly contracted, forming a compact corymb. Individual flowers with two bracteoles at the base. Calyx urceolate, .1 in. long, green, with 4 triangular acute lobes reddish or purplish at the tips. Corolla hypocrateriform, with a slender tube 1.25 in. long, surrounded by four spreading ovate acute lobes .3 in. long, which eventually become reflexed, brilliant crimson in colour. In the bud the lobes are twisted to the left. Stamens 4, on short

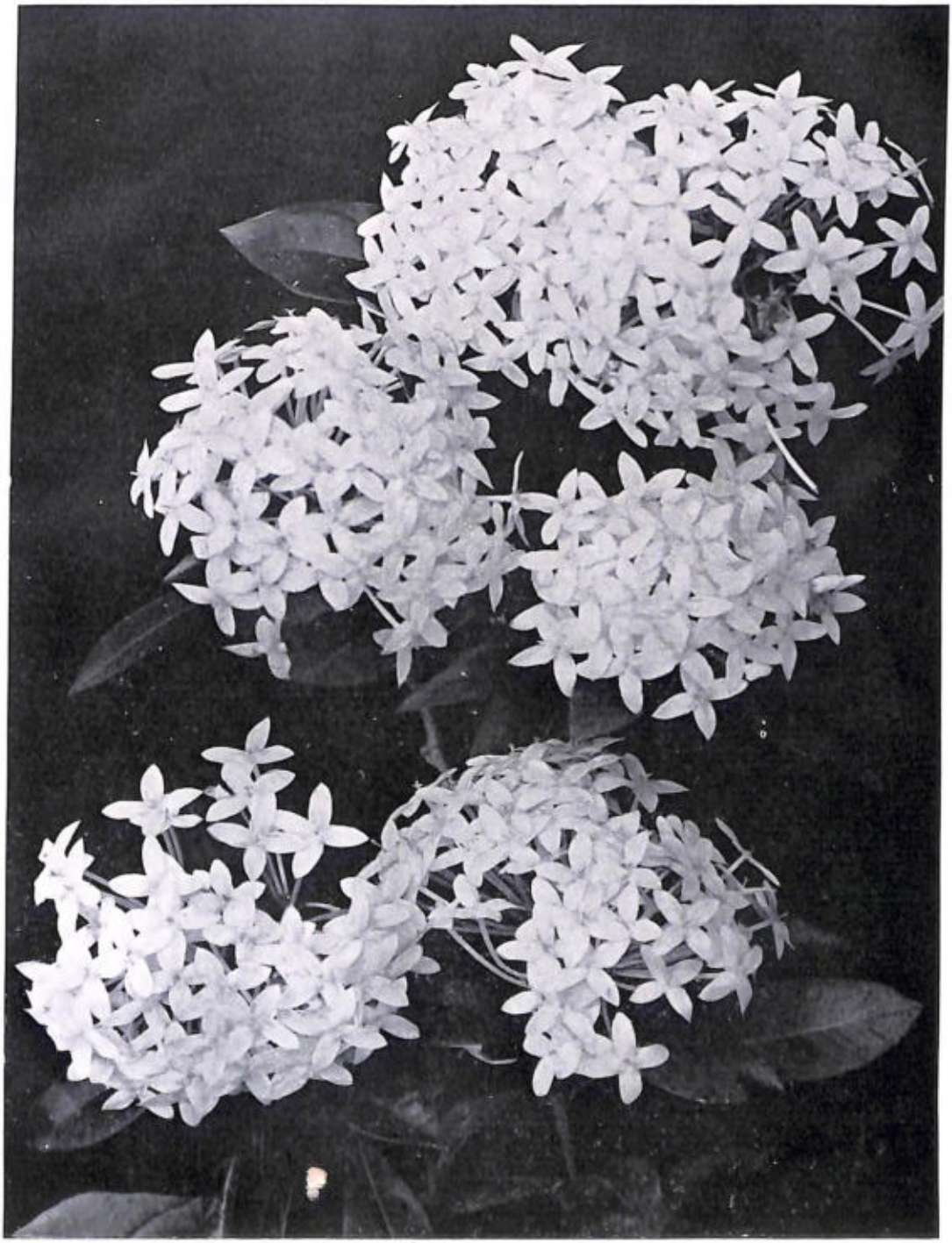

Photo by *M. N. Bakshi*

Scarlet Ixora (*Ixora coccinea*, Linn.)
New Forest, Dehra Dun.

filaments attached to the throat, alternate with the corolla lobes. The stamens dehisce in the bud which, when just open, displays the top of the style drenched with pollen. At this time the stigmas are immature and insects alighting on the style carry away pollen to an older flower.

Flowers.—Practically throughout the year, but is at its best during the rains. *Fruits.*—Cold season.

Distribution.—Native of the Western Peninsula; now widely cultivated throughout the tropics.

Gardening.—A shrub usually 3-4 ft. high, one of the commonest in cultivation, and certainly one of the most beautiful of the genus. It is practically in flower throughout the year, but in perfection during the rains when it is a truly glorious object to behold and few shrubs surpass the splendour of this Ixora when it is in full bloom. The bright scarlet flowers are arranged in large, compact corymbs. During flowering time an occasional application of liquid manure will be found beneficial, and it is advisable to prune rather closely after flowering. Easily raised from seed or layers or cuttings during the rains. Like all other species of this genus it prefers full sunshine. Where frost is severe some damage may be expected.

Medicinal use.—This plant has been known in India since ancient times and the root has some repute in native medicine. It is said to act as a cholagogue and to give relief from pain to those suffering from dysentery.

Ixora rosea Wall.

Pink Ixora.

(The specific name refers to the colour of the flowers).

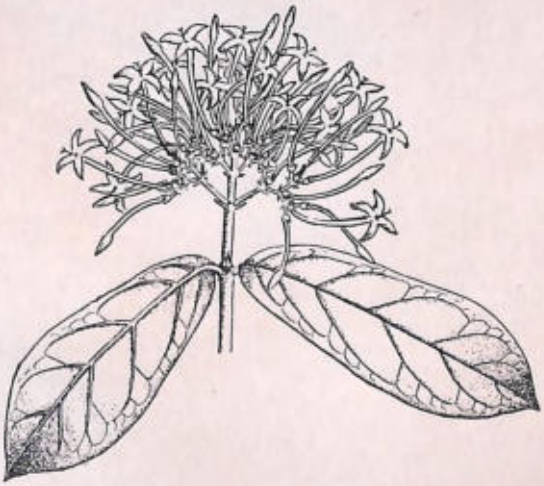

Fig. 1.—*Ixora rosea* Wall. × ½.

Description.—An untidy straggling shrub scarcely reaching 4 ft. in height at Dehra. Older stems covered with a slate-grey brown

filaments attached to the throat, alternate with the corolla lobes. The stamens dehisce in the bud which, when just open, displays the top of the style drenched with pollen. At this time the stigmas are immature and insects alighting on the style carry away pollen to an older flower.

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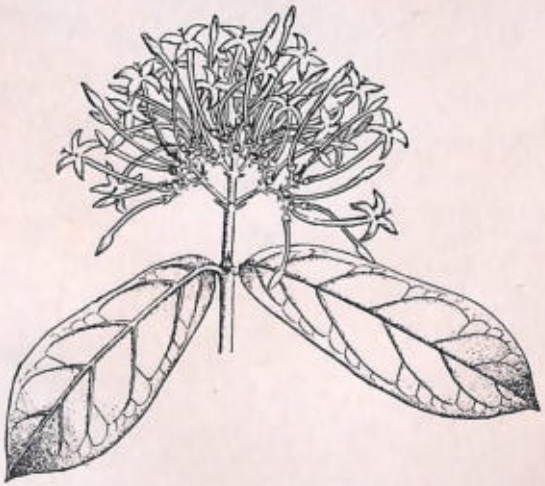

Fig. 1.—*Ixora rosea* Wall. × ½.

Description.—An untidy straggling shrub scarcely reaching 4 ft. in height at Dehra. Older stems covered with a slate-grey brown

glabrous bark, younger plants dark green, covered with a fine downy pubescence. Leaves subsessile, oblong, elliptic, elliptic-obovate in shape, obtuse or somewhat acute at the tip, rounded or slightly cordate at the base, coriaceous in texture, glossy green above, pale below, glabrous; stipules triangular, awned, pubescent.

Inflorescence peduncled; peduncles supported at the base by small bracts. Flowers shortly pedicelled, each with a pair of bracteoles below the calyx. Calyx about .1 in. long, urn-shaped, minutely pubescent, lobes .05 in. long, obtuse, tinted with red. Corolla hypocrateriform; tube 1.25, rose-coloured, minutely hairy, ending above in four elliptic-obtuse lobes, .3 in. long. Stamens 4; filaments .05 in. long, attached to the throat, alternate with the lobes; anthers .15 in. long, closely appressed to the style in the bud, reflexed in the fully opened flower. Ovary inferior, 2-celled; ovule 1 in each cell.

Flowers.—August-September. The shrub seldom fruits in Dehra.

Distribution.—According to Roxburgh it is a native of the Moluccas and China. Now widely cultivated in various parts of India.

Gardening.—An untidy straggling shrub with pink flowers in large round corymbs. It is hardly attractive when in flower, and far from being so at any other time of the year. Propagated by layers or cuttings during the rains.

Ixora parviflora Vahl.

Small-flowered Ixora.

(*parviflora* means small-flowered in Latin).

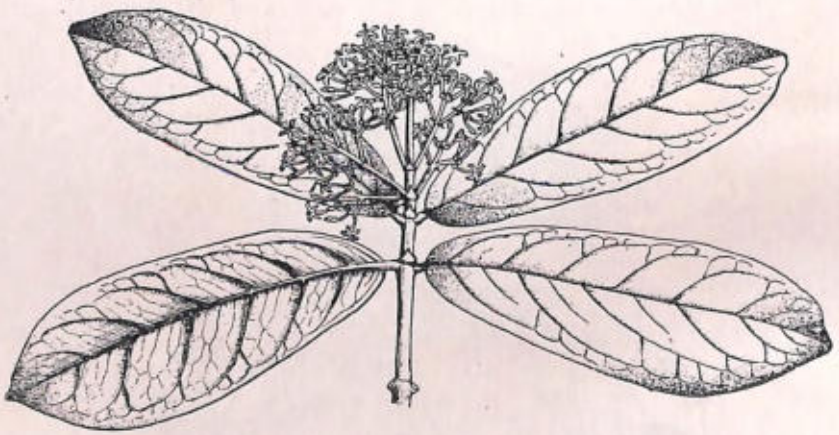

Fig. 2.—*Ixora parviflora* Vahl. × 3/8.

Description.—A small, much-branched tree; bark thick, reddish brown, exfoliating in irregular patches; branchlets slightly compressed, glabrous. Leaves opposite, stipulate, ovate-oblong or slightly obovate, 3-4 in. long, by 1.5-2 in. wide, coriaceous, glabrous,

Photo by *B. N. Bakshi*

Small-flowered Ixora (*Ixora parviflora*, Vahl.)
New Forest, Dehra Dun.

dark green and shining above, pale when dry, rounded at the base, suddenly and shortly acuminate; venation pellucid, reticulate; petioles short and stout; stipules short, cuspidate, persistent.

Flowers white, sweet scented, in sub-globose clusters, arranged in sessile, brachiate, pubescent or glabrous cymes with 3-5 pairs of opposite short branches; bracts and bracteoles subulate. Calyx minute, cup-shaped; lobes 4, very small, much shorter than the tube, subacute. Corolla tube short, glabrous .3-.4 in. long, 4-lobed; lobes linear-oblong, obtuse, ellipsoid in the bud, reflexed in the open flower. Stamens 4, alternate with the corolla lobes; filaments absent; anthers sessile, nearly as long as the lobes of the corolla. Style densely pubescent ending above in two exserted stigmatic lobes. Fruit globose, .25 in. long.

Flowers.—March-April. *Fruits.*—Cold season.

Distribution.—Native of the Western Peninsula, extending north to the Satpura range, Behar, Chota Nagpur, Orissa, Sunderbans, Chittagong, Burma and Nicobars.

Gardening.—A small much-branched tree which bears in March-April, dirty-white strongly sweet scented flowers in profusion. It can hardly be said to be attractive at any period of the year. Easily raised from seed or layers or cuttings.

Economic uses.—Wood very heavy, hard, fine grained, yellow. It is used for turney and furniture in Madras, but, as it never reaches any size, its use is restricted. The green branches are said to make excellent torches.

Ixora barbata Roxb.

Bearded Ixora.

(*barbata* means 'bearded' in Latin and refers to the woolly mouth of the corolla).

Description.—A large glabrous shrub. Trunk hardly any; branches numerous, opposite. Leaves opposite, short-petioled, elliptic or oblong in shape, somewhat acute, entire, shining on both surfaces, smooth, 6-9 in. long. The upper pairs of leaves are much smaller and are sessile and cordate. Stipules sheathing.

Inflorescence of terminal panicled corymbs, decompound, large, diffuse, often 1 ft. across. Bracts and bracteoles decreasing in size upwards, ovate, acute. Calyx globose or ovoid, reddish green, adherent to the ovary, 5 lobed; lobes small, erect, acute. Corolla tube 1.5 in. long, slender, somewhat curved, greenish white, encircled at the mouth with a delicate fringe of hairs, 5-lobed; lobes obovate, pure white in colour, obtuse, reflexed when the flower is fully open. Stamens 5, alternate with the lobes; filaments short, recurved, so that the linear anthers hang down between the lobes. Style long slender, exserted, glabrous. Stigma club-shaped, divided into two short stigmatic arms. Berry red, smooth, the size of a pea, 2-seeded.

Flowers.—April-May. *Fruits.*—Cold season.

Distribution.—Native of the Andamans and Nicobars. Commonly cultivated at Calcutta and elsewhere in India.

Fig. 3.—*Ixora barbata* Roxb. × 3/8.

Gardening.—A large glabrous shrub with rich deep green leaves. It produces during the hot season large, lax corymbs of long-tubed, white, fragrant flowers. Easily raised by layers or cuttings.

Ixora chinensis Lam.

Chinese Ixora.

(*chinensis* refers to the country of origin of this plant).

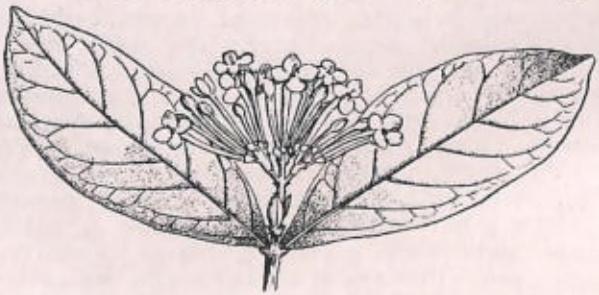

Fig. 4.—*Ixora chinensis* Lam. × ½.

Description.—A small shrub 3-4 ft. tall, with straight branches covered with smooth dark-brown bark. Leaves opposite, stipulate,

subsessile, obovate or obovate-oblong, entire, smooth on both surfaces, 5-6 in. long. Stipules interpetiolar, tapering, acute.

The inflorescence is terminal and consists of dense corymbs; branches of the inflorescence trichotomous, smooth, glabrous, reddish. Calyx tube adnate to the ovary, globose or ovoid, small, 4-lobed; lobes short, obtuse, reddish. Corolla tube cylindrical, slender, .75-1 in. long, 4-lobed; lobes almost orbicular. Stamens 4, alternate with the lobes; filaments short, inserted at the mouth of the corolla; anthers linear-acute, reflexed. The colour of the flowers is at first orange, becoming a deeper and deeper salmon-red as the flowers become fully open. Style exserted; stigma 2-cleft; lobes reflexed. Berry smooth succulent, red, 2-celled, with a single rugose seed in each cell.

Flowers.—July-September. Does not set fruit in this country.

Distribution.—Indigenous to the Malay Archipelago and China, now commonly grown in gardens in all tropical countries.

Gardening.—A shrub closely allied to *I. coccinea* and commonly cultivated in gardens for its showy rose-red flowers. Propagated by cuttings during the rains.

Economic uses.—According to Burkill a decoction of the roots of this plant is used after child birth by the Malays.

Ixora undulata Roxb.

Wavy-leafed Ixora.

(*undulata* means wavy in Latin and refers to the margins of the leaves).

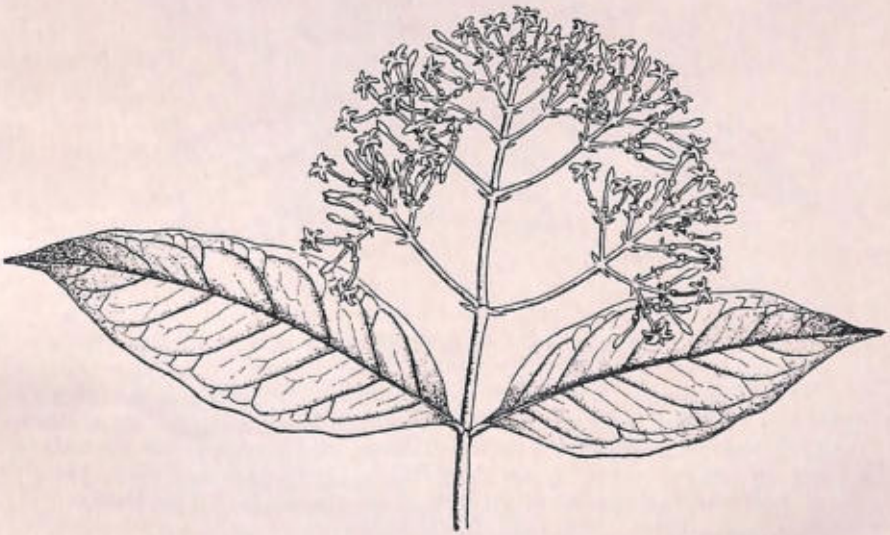

Fig. 5.—*Ixora undulata* Roxb. × ½.

Description.—A large evergreen shrub. Leaves opposite, subsessile or distinctly petioled, stipulate, oblong or lanceolate in

Distribution.—Native of the Andamans and Nicobars. Commonly cultivated at Calcutta and elsewhere in India.

Fig. 3.—*Ixora barbata* Roxb. × 3/8.

Gardening.—A large glabrous shrub with rich deep green leaves. It produces during the hot season large, lax corymbs of long-tubed, white, fragrant flowers. Easily raised by layers or cuttings.

Ixora chinensis Lam.

Chinese Ixora.

(*chinensis* refers to the country of origin of this plant).

Fig. 4.—*Ixora chinensis* Lam. × ½.

Description.—A small shrub 3-4 ft. tall, with straight branches covered with smooth dark-brown bark. Leaves opposite, stipulate,

subsessile, obovate or obovate-oblong, entire, smooth on both surfaces, 5-6 in. long. Stipules interpetiolar, tapering, acute.

The inflorescence is terminal and consists of dense corymbs; branches of the inflorescence trichotomous, smooth, glabrous, reddish. Calyx tube adnate to the ovary, globose or ovoid, small, 4-lobed; lobes short, obtuse, reddish. Corolla tube cylindrical, slender, .75-1 in. long, 4-lobed; lobes almost orbicular. Stamens 4, alternate with the lobes; filaments short, inserted at the mouth of the corolla; anthers linear-acute, reflexed. The colour of the flowers is at first orange, becoming a deeper and deeper salmon-red as the flowers become fully open. Style exserted; stigma 2-cleft; lobes reflexed. Berry smooth succulent, red, 2-celled, with a single rugose seed in each cell.

Flowers.—July-September. Does not set fruit in this country.

Distribution.—Indigenous to the Malay Archipelago and China, now commonly grown in gardens in all tropical countries.

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Economic uses.—According to Burkill a decoction of the roots of this plant is used after child birth by the Malays.

Ixora undulata Roxb.

Wavy-leafed Ixora.

(*undulata* means wavy in Latin and refers to the margins of the leaves).

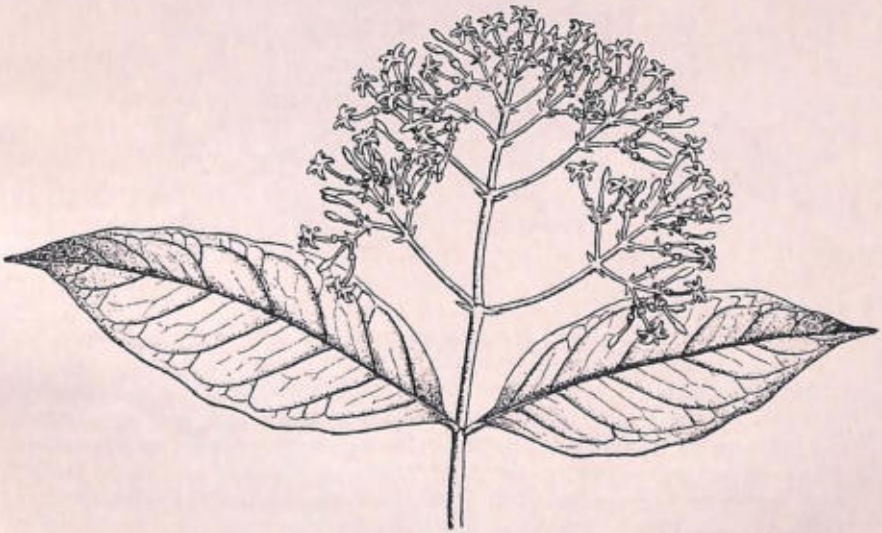


Fig. 5.—*Ixora undulata* Roxb. × ⅓.

Description.—A large evergreen shrub. Leaves opposite, subsessile or distinctly petioled, stipulate, oblong or lanceolate in

shape, 5-9 in. long by 1.5-3.3 in. wide, glabrous, usually tapering at both ends, acute or acuminate at the tip; margins undulate. Stipules interpetiolar, broad and rounded, but with a slender cusp.

Flowers white, sweet-scented, corymbs on the slender branches of long-penduncled brachiate panicles which are up to 8 in. long. Calyx tube very short, 4-toothed; lobes acute as long as the tube. Corolla tube .28-.32 in. long, white, 4-lobed; lobes .16-1.8 in. long, reflexed. Stamens 4; filaments short; anthers 2-cleft at the base. Style exserted from the tube, ending in two recurved stigmatic arms. Fruit succulent, .3 in. diameter, dull purple or slate-coloured with two plano-convex seeds.

Flowers.—March-April. *Fruits.*—Cold season.

Distribution.—Sikkim Terai and lower hills of Bhutan, Assam, Khasi hills and upper Burma.

Gardening.—A large evergreen shrub which produces in March-April, numerous small white flowers having a powerful fragrance of jasmine. Easily propagated by seed or cuttings or layers.

Ixora fulgens Roxb.

(*fulgens* is a Latin word meaning gleaming or shining and refers to the scarlet flowers).

Fig. 6.—*Ixora fulgens* Roxb. × ⅔.

Description.—A short-trunked shrub dividing into many branches covered with dark brown bark. Leaves opposite, short-petioled, entire, smooth on both surfaces, linear oblong to obovate-oblong in shape, acute at the tip, 6-8 in. long, 1-3 in. wide, with 20-30 pairs of nerves sunk in the upper surface. Stipules interpetiolar, awned.

Flowers in large terminal cymose corymbs, composed of short decussate, highly-coloured slender branches and branchlets, ending in numerous short-pedicelled, long-tubed, orange-scarlet or scarlet flowers. Calyx tube adnate to the ovary, very short, 4-lobed;

lobes obtuse. Corolla tube very slender, up to 1.75 in. long, cylindrical, glabrous, 4-lobed; lobes obovate, obtuse, .25 in. long, reflexed. Stamens 4, alternate with the lobes; filaments short. Style slender exserted; stigmas 2. Berry 2-lobed, the size of a pea, deep purple when ripe, 2-celled.

Flowers.—Most of the year. Does not fruit in this country (?).

Distribution.—Native of Tenasserim. Widely cultivated throughout the tropics.

Gardening.—A highly ornamental and elegant shrub which bears corymbs of numerous long-tubed, pretty, large, scarlet flowers. Easily multiplied by cuttings.

Ixora lutea Hutch.

Yellow Ixora.

(*lutea* means yellow in Latin).

Fig. 7.—*Ixora lutea* Hutch. × ¾.

Description.—An erect shrub reaching 3 ft. in height; branchlets covered with a fine pubescence, finally glabrous. Leaves opposite, stipulate, oblong-elliptic in shape, acute at the tip, unequally cordate at the base, 3-4 in. long by 1.5-2 in. wide, papyraceous in texture with a slightly recurved margin, pale green in colour; petiole stout, .75 in. long, minutely pubescent. Stipules up to .5 in. long, awned.

Inflorescence a terminal, lax corymbose cyme of sessile flowers; branches puberulous; bracts triangular-subulate, acute. Calyx-tube short, 4-lobed; lobes broadly ovate, about .1 in. long, finely puberulous outside. Corolla ochre-coloured; tube cylindric, 1.5 in. long, very slender, glabrous outside, 4-lobed, lobes ovate-rhomboid, acute, up to .75 in. long, toothed, glabrous. Stamens 4, almost sessile,

dark orange in colour; anthers acutely acuminate. Ovary 2-celled; style slender, glabrous, shortly exserted, arms about .1 in. long, slightly recurved and flattened on the inner surface.

Flowers.—Practically throughout the year. Does not set seed in this country.

Distribution.—Widely cultivated throughout the tropical and subtropical parts of the world. A plant of garden origin.

Gardening.—This beautiful Ixora, which in habit and foliage bears a close general resemblance to *I. coccinea*, can readily be distinguished from it not only by the colour of its flowers, but also by its laxer inflorescence and by the large ovate-rhomboid corolla lobes. It was introduced into the Royal Botanic Garden, Kew, from Peradeniya. It is an exceedingly attractive plant when in flower, and will flourish under moist tropical conditions. Raised by layers or cuttings.

5. **Coffea** Linn.

The generic name is derived from the Arabic name, 'Kahwa', for the drink, itself supposed to be from Caffa, a district in southern Abyssinia.

Small bushy shrubs with opposite stipulate leaves. Flowers yellowish or white, in axillary or terminal fascicles or in solitary or axillary dense cymes. Hypanthium short, calyx tube short or absent, often glandular and persistent; sepals minute or absent. Corolla tube short or long with 4-7 spreading lobes twisted in the bud. Anthers 4-7 sessile, often recurved or twisted. Ovary 2-celled, style filiform with 2 linear or subulate branches. Ovules 1 in each cell attached to a peltate placenta on the septum. Fruit a drupe with 2 plano-convex or vertically concave coriaceous or cartilaginous seeds.

Coffea bengalensis Roxb.

(The specific name refers to the home of the plant).

Description.—A slender deciduous shrub with spreading branches. Young shoots compressed, grey-pubescent, soon glabrous and covered with a greyish bark. Leaves opposite 1.5-4.5 in. long, by .5-2.5 in. wide, broadly ovate or elliptic in shape, obtuse at the tip, acuminate or subcaudate, rounded or acute at the base, dark green above, pale below, membranous; petiole up to .16 in. long.

Flowers appearing with the leaves, axillary in groups of 1-3, white, sessile, fragrant, 1-1.5 in. across. Calyx tube short, many-toothed, pubescent; teeth rapidly deciduous. Corolla funnel-shaped. .5-.7 in. long, 5-lobed; lobes ovate-oblong, slightly shorter than the tube, spreading or recurved, twisted in the bud. Stamens 5, alternate with the lobes, inserted in the mouth of the corolla tube, subsessile. Ovary 2-celled; ovules solitary in each cell. Style filiform, bifid. Fruit oblong, black when ripe, containing 2 planoconvex seeds.

Sweet Smelling Rondeletia
RONDELETIA ODORATA Jacq.
($\frac{9}{10}$ nat. size.)

The seed contains the alkaloids found in the true coffee plant, *C. arabica* L.

Fig. 8.—*Coffea bengalensis* Roxb. × ¾.

Flowers.—Feb.-April. *Fruits.*—Cold season.

Distribution.—Tropical Himalaya from Garhwal eastwards to Sikkim and Assam; also in Chittagong, central and south India, and Burma extending to Siam and Java.

Gardening.—A small shrub, exceedingly beautiful when in full bloom during February, with its snow-white flowers produced in great profusion. Propagated by seed.

6. **Rondeletia** Linn.

(A genus erected by Linnaeus in honour of Guillaume Rondelet, a French naturalist, who died in 1566).

This genus contains evergreen shrubs or trees. Leaves opposite, sessile or petiolate, stipulate, sometimes ternately whorled, coriaceous, chartaceous or membranous. Inflorescence of terminal or axillary corymbose cymes. Flowers coloured, white, red or yellow.

Calyx adnate to ovary, shortly lobed. Corolla hypocrateriform; tube slender, usually short, glabrous or bearded in the throat; limb 5-lobed; lobes rounded. Style slender; stigmas exserted or included. Ovary 2-celled. Fruit a capsule.

Rondeletia odorata Jacq.

Sweet-smelling Rondeletia.

(*odorata* means sweet-smelling in Latin and refers to the fragrance of the flowers).

Description.—A shrub reaching 6 ft. in height; young parts covered with a setose pubescence. Leaves opposite, stipulate, ovate or elliptic-ovate in shape, subacutely acuminate, cordate or rounded at the base, 3-7 in. long, 1-3.5 in. wide, entire, chartaceous, the younger sparsely pilose on the nerves, at length glabrous, ciliate; petiole about .12 in. long, setosely pilose. Stipules persistent, interpetiolar, ovate-lanceolate, obtuse or acute, coriaceous, up to .5 in. long, covered with appressed pubescence.

Inflorescence of many-flowered, terminal, corymbose cymes up to 5 in. diameter; bracts ovate-lanceolate, obtuse or subacute, up to .5 in. long, coriaceous, densely appressed pilose on the outer surface; bracteoles small. Calyx campanulate, .05 in. long, puberulous outside, with short obtuse lobes. Corolla with a cylindric tube .3 in. long, reddish-orange in colour, puberulous outside, pilose within, 5-6-lobed; lobes .25-.3 in. long, oblong with rounded tip, rose-coloured. Stamens as many as the corolla lobes and alternate with them; filaments short attached in the corolla throat about the centre of the tube; anthers .05 in. long. Style shorter or longer than the tube, 2-lobed, glabrous. Capsule subglobose, slightly 2-lobed, hairy.

Flowers.—Hot and rainy season. *Fruits.*—Cold season.

Distribution.—A native of the West Indies and Mexico, now commonly cultivated in the tropics of the whole world.

Gardening.—A handsome, small, hardwooded shrub about 3 ft. high. It bears beautiful orange-scarlet flowers in constant succession, through the hot and dry seasons. The faded flowers remain on the plant for a long time giving it an unsightly appearance and should, therefore, be removed quickly. Propagated by layers during the rains, but it usually takes 3-4 months before they are ready for removal.

7. **Hamelia** Jacq.

(This genus was named in honour of H. L. du Hamel de Monceau, 1700-1782, a French botanist).

Shrubs with slender, glabrous or pubescent branches. Leaves opposite or in whorls of 3 or 4, petiolate, membranous. Stipules lanceolate, subulate, deciduous. Inflorescence in di- or tri-chotomous branched terminal cymes. Flowers shortly pedicellate. Calyx ovoid

Photo by *M. N. Bakshi*

Sweet-smelling Rondeletia (*Rondeletia odorata*, Jacq.)
New Forest, Dehra Dun.

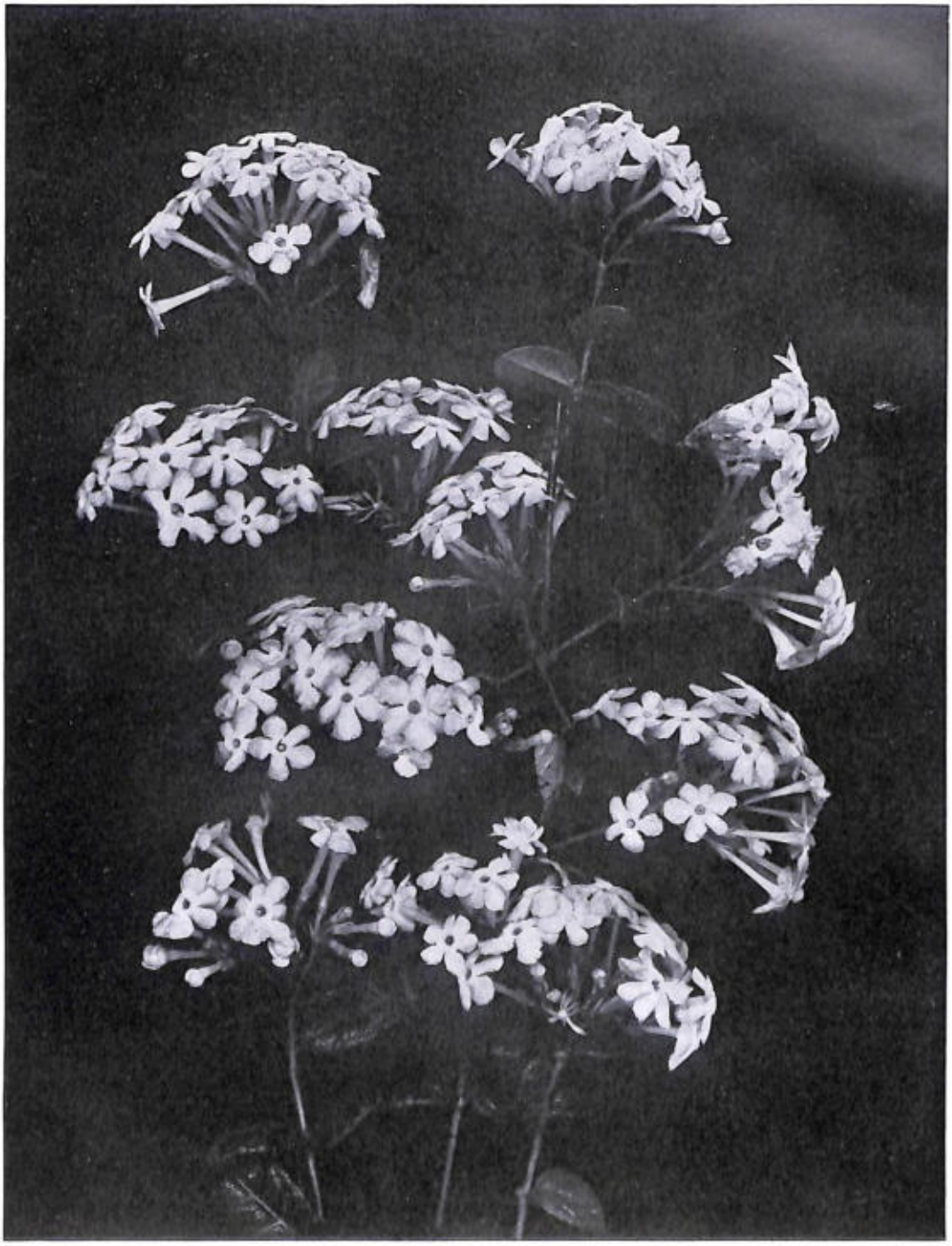


Photo by *M. N. Bakshi*

Sweet-smelling Rondeletia (*Rondeletia odorata*, Jacq.)
New Forest, Dehra Dun.

Photo by *M. N. Bakshi*

Hamelia patens, Jacq.
New Forest, Dehra Dun

Photo by *M. N. Bakshi*

Hamelia patens, Jacq.
New Forest, Dehra Dun.

or top-shaped, 5-lobed. Corolla tube cylindrical, 5-lobed; lobes imbricate in the bud. Stamens 5, inserted at the base of the tube; filaments very short; anthers fixed by the base, narrowly linear, appendaged at the apex. Ovary 5-celled; style filiform; stigma narrowly fusiform, grooved, somewhat twisted. Ovules numerous. Fruit a berry crowned by the remains of the disk.

Hamelia patens Jacq.

(*patens* means spreading in Latin and refers to the habit of the species).

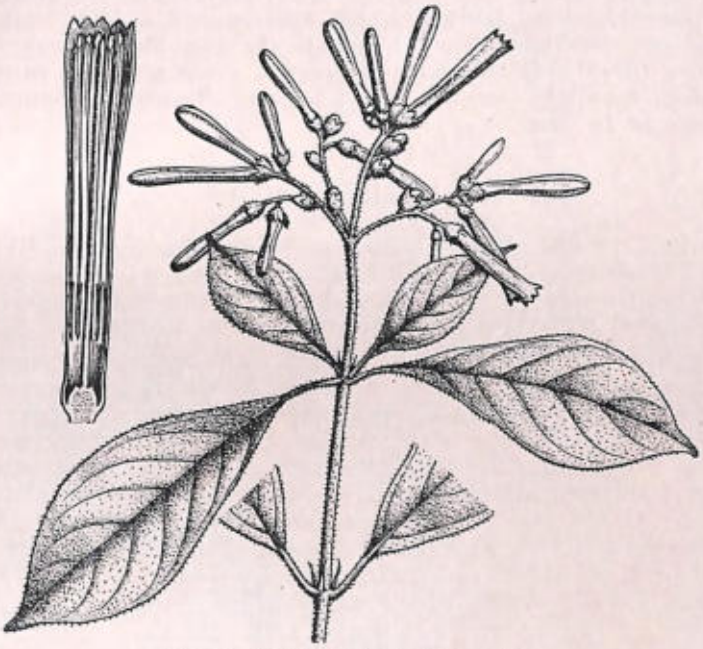


Fig. 9.—*Hamelia patens* Jacq. × ¾.

Description.—A shrub or small tree; branches reddish, covered with a short crisped pubescence, quadrangular when young, afterwards rounded. Leaves stipulate, petiolate, up to 5 in. long by 2.5 in. wide, elliptic or oblong in shape, narrowed at both ends, olive green above, paler beneath, hairy on both surfaces, membranous, opposite or in threes; nerves 6-9 pairs, prominent and often tinged with red beneath; petiole .5 in. long, reddish, hairy; stipules broad at the base, produced into a stout linear awn.

Inflorescence terminal, in cymes up to 3 in. long; principal axis short; secondary axis up to 1 in. long bearing 3-5 flowers arranged in a bostryx or scorpioid cyme. Pedicels very short. Bracteoles minute. Calyx tube adnate to the ovary, campanulate, reddish in

colour, produced above into 5 minute lobes, covered with very short hairs. Corolla tube cylindrical, .8 in. long, slightly attenuate just above the base, cylindrical, ridged (the ridges corresponding to the 5 lobes) shortly pubescent all over, 5-lobed; lobes very short, valvate in the bud. Stamens 5; filaments attached near the base of the tube, short; anthers about .5 in. long, linear, acute at the tip, bifid at the base, included in the corolla tube. Ovary 5-celled, surmounted by a thick conical disk; style 1 in. long. Berry ellipsoid, .25 in. long, surmounted by the fleshy disk.

Flowers.—Hot and rainy seasons. *Fruits.*—Cold season.

Distribution.—Indigenous to tropical America; now commonly cultivated throughout the tropics.

Gardening.—A large evergreen shrub, prized for the profusion of sprays of orange-red flowers. The flowers are succeeded by handsome blood-red berries, which are retained a long while on the plant. Numerous sun-birds visit the pipe-like flowers from morning till evening to extract the nectar. It is advisable to prune the plant heavily to keep it within bounds. Easily propagated by cuttings or by seed.

8. **Hamiltonia** Roxb.

(This genus was erected in honour of William Hamilton of Woodland, Philadelphia, an eminent American botanist of the nineteenth century. He was the first to build a conservatory in America so that tropical plants could be grown in a cold climate.)

Erect shrubs, foetid when bruised, with prominently nerved leaves and interpetiolar acute persistent stipules. Flowers small, sweet scented, arranged in terminal panicles or sub-umbellate cymes. Calyx ovoid, 4-5 lobed; lobes subulate, often glandular, persistent. Corolla funnel-shaped with a long tube, 4-5-lobed; lobes valvate. Stamens inserted in the throat, filaments short, anthers obovate-oblong. Ovary 5-furrowed, almost free from the calyx, 5-celled, finally 1-celled by absorption of the septa. Style filiform; stigmatic lobes 5, linear. Ovules 1 in each cell, basal. Fruit a capsule, 1-celled, 5-valved. Seeds triquetrous.

Hamiltonia suaveolens Roxb.

(*suaveolens* means sweet-smelling in Latin).

Description.—Stem stout, shrubby, with ash-coloured bark covered with purple specks, reaching a height of 10 ft. Leaves opposite, 3-6 in. long, broad-lanceolate in shape, smooth, entire short petioled. Stipules interpetiolar, ensiform.

Flowers sessile in terminal corymbiform heads, on short trichotomous branches, pure white or mauve, delightfully scented, supported by linear glandular-villous bracts and bracteoles. Calyx tube ovoid; lobes 4-5, subulate, .1 in. long, covered with gland-tipped hairs. Corolla tube slender, .5-.6 in. long, 4-5-lobed; lobes 4-5, oblong-obtuse, valvate in bud. Stamens 4-5; filaments very

Photo by *M. N. Bakshi*

Hamiltonia suaveolens Roxb. (cultivated form)
New Forest, Dehra Dun.

Photo by *M. N. Bakshi*

Hamiltonia suaveolens Roxb. (cultivated form)
New Forest, Dehra Dun.

short, inserted in the throat of the corolla and alternate with the lobes. Ovary 5-furrowed, almost free from the calyx, 5-celled, but becoming 1-celled from absorbtion of the septa; ovules 1 in each cell, basal. Fruit a 1-celled capsule, 5-valved at the apex, 5-1-seeded.

Fig. 10.—*Hamiltonia suaveolens* Roxb. × ⅔.

Flowers.—Cold season. *Fruits.*—May-June.

Distribution.—Sub-Himalayan tract and outer hills from the Punjab to Bhutan, ascending to 6,500 ft., Behar, and Western Peninsula.

Gardening.—A large, stout shrub with lavender blue or whitish, sweet-scented flowers which are freely produced during the cold weather. It prefers a sheltered situation, and is greatly improved by being well cut in after flowering. Propagated by cuttings. The fragrant flowers are much frequented by Hummingbird Hawk-moths.

Medicinal uses.—A decoction of the root is said to be valuable in dysentery and cholera.

9. **Catesbaea** Linn.

(A genus erected by Linnaeus in honour of an English Botanist, Mark Catesby, 1679-1749, traveller and naturalist).

Spinescent shrubs or small trees, with terete twigs and small, glabrous, often fascicled leaves. Stipules small, deciduous. Flowers

white, solitary and short-pedicelled in the axils. Calyx subcampanulate with 4 narrow subpersistent lobes. Corolla funnelform or campanulate, 4-lobed; lobes valvate. Stamens 4, attached near the base of the corolla. Ovary 2-celled; ovules few or many. Stigma 2-lobed. Fruit a berry.

A small genus of about 8 species.

Catesbaea spinosa Linn.

Prickly-apple; Spanish Guava.

(*spinosa* means spiny in Latin).

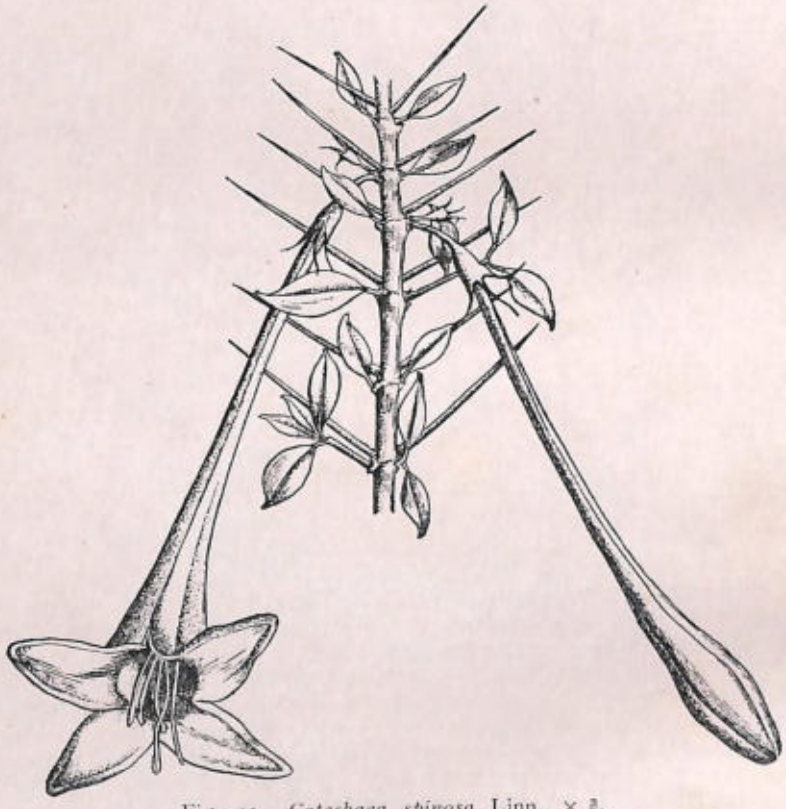


Fig. 11.—*Catesbaea spinosa* Linn. × ¾.

Description.—A spinescent shrub reaching 4 ft. in height at Dehra. Old branches covered with corky bark, younger terete, green, minutely pubescent; spines axillary, opposite, stout, sharp, .5-1 in. long, pubescent, becoming glabrous. Leaves opposite, shortly petioled, stipulate, thin or somewhat fleshy, entirely glabrous and smooth, attenuate at the base into the short petiole, apiculate at the tip, ovate-elliptic, elliptic or orbicular in shape, entire,

glossy or dull green, .25-.5 in. long; nerves inconspicuous; petiole very short; stipules interpetiolar, membranous, pubescent, rapidly deciduous.

Flowers solitary in the axils, pedicelled; pedicel .1 in. long, tinged with red. Calyx adnate to the ovary, green, sometimes reddish, oblong-campanulate, 4-lobed; lobes subulate. Corolla tube-funnel shaped, white turning yellow with age, 4-angled at the base, 3-4 in. long, pendulous, sparsely hairy outside, hairy and glandular inside, 4-lobed; lobes triangular, acute, valvate in the bud, .75 in. long. Stamens 4-5; filaments very long, attached at the very base of the corolla, rather stout, stiff, glabrous, attenuate at the tip; anthers linear somewhat less than .5 in. long, divided at the base, apiculate at the tip. Ovary 2-celled. Style slender, long, 2-lobed. Fruit up to 2 in. long.

Flowers.—May-July. It seldom fruits in this country.

Distribution.—Indigenous to the West Indies, now commonly grown in gardens throughout the plains of India.

Gardening.—A rather slow-growing, hardy, armed shrub about 4-5 ft. high. The creamy-white pendent flowers which are 3-4 in. long are outsize in proportion to the rest of the plant. Propagated by cuttings during the rains.

NEW LEPIDOPTERA FROM S. W. IRAN.

BY

E. P. WILTSHIRE, F.R.E.S.

(*With a plate*).

There were over 25% species new to science in the list of lepidoptera collected by Fred Brandt in March-September 1937 in Fars, S. W. Iran, and described by W. Brandt in the Ent. Rundschau (1938-9), many of the new species being peculiar to the southern end of the Zagros range. A similar proportion was therefore to be expected in species taken by myself in October-November 1940 in the same district, and a study of my material shews that this expectation was not disappointed. New species were also found earlier in 1940, which had escaped the vigilance of the Baltic entomologist. Some of the new species belong to difficult genera and will require the attention of a specialist before they can be published; but the following can be introduced now. They are all figured in the accompanying plate. One or two new races from the same region are also hereunder described.

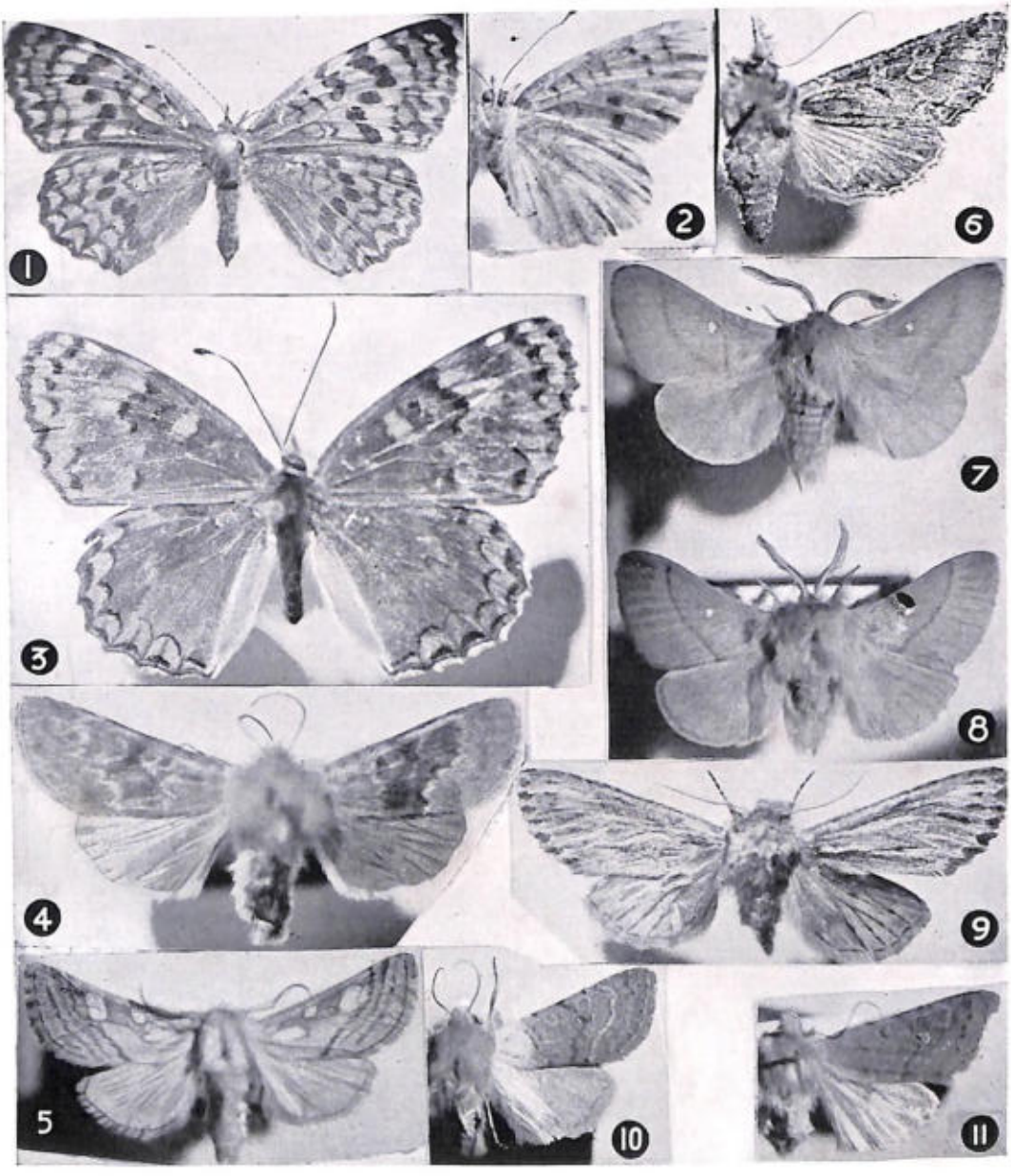
These results cannot be attributed merely to the improved communications and security of contemporary Iran which enable systematic collecting in hitherto inaccessible or insecure districts; they are due also to the peculiarity of the Southern Zagros fauna. This fauna is dual: partly it is typically Iranian; but partly it is a replica, with variations, of the Mediterranean fauna. The region is isolated on both sides by low desert tracts, and only linked faunistically by the long Zagros chain to better-known regions. The Fars mountains in fact share with the N.-W. frontier and the Teneriffe-Atlas formation the distinction of being the southernmost promontories of Palearctic woodland west of the Himalayas; and each of the three 'promontories' is isolated faunistically from the other. If, as some assert, the mountains of the interior of Iran (now quite bare) were wooded during the Pleistocene Pluvial Periods, the Fars woodlands provide a southern refuge for the relics of this woodland-fauna, perhaps more accessible than that provided in the north by the forest still clothing the north side of the Elburz range.

The following is a brief table shewing the characteristic vegetation at various altitudes along the Bushire-Shiraz-Isfahan road which makes a convenient cross-section of the southern end of the Zagros chain:

Sea-level to c. 3000 *ft.*: *Zizyphus spina-christi.*

750 *ft. upwards*: *Amygdalus*, a small spiny species.

2000 *ft. upwards*: *Pistacia* sp. & *Amygdalus spartioides*. These are the two hardiest trees and the most widely distributed. They begin in the desert hills bordering the Bushire plain and end at Qadrabad (near the site of Pasargadae). I have also been informed that a zone of scanty 'bann' (*Pistacia*) is to be found on the southern watershed of the Iranian plateau



1. *Melitaea consulis* sp. n. ♀. 2. *Melitaea consulis* sp. n. ♂ underside. 3. *Melitaea phoebe sarvistana* subsp. n. 4. *Monima mithras* sp. n. ♀. 5. *Margelana achaemenica* sp. n. ♂. 6. *Meganephria renalis* sp. n. ♀. 7, 8. *Eriogaster amygdali* sp. n. ♂♂. 9. *Brachionycha atossa* sp. n. ♀. 10. *Amathes oropotamica thermopotamica* subsp. n. ♂. 11. *Amathes oropotamica* sp. n. ♀.

The figures of the above lepidoptera are not all on exactly the same scale. Readers should consult the text for the comparative size.

south of Kerman and extends into Baluchistan. It seems doubtful whether many other of the Fars trees accompany this tree so far east.

Local at 3000 *ft. upwards*: *Quercus persicus, Prunus* sp. *Local at* 3000-4000 *ft.*: carob (*Ceratonia*). The oak is not found above 9000 ft., and has suffered heavily from deforestation, which still proceeds apace. Its thickest growth is at 4000-8000 ft., as at Mian Kotal, Pir-i-Zan. A secondary growth at Shul shows that an oak forest once grew there which probably extended formerly as far as Shiraz at least.

4000 *ft. upwards*: Wild fig, *Rhamnus* sp.

Local at 6000-8000 *ft.*: *Fraxinus* sp.

6000 *ft. upwards*: *Amygdalus*, a robuster spiny species; *Crataegus* sp., *Berberis* sp., *Lonicera persica, Colutea* sp., *Acer* sp., etc. This fauna is widespread at the requisite height, extending inland as far as Qadrabad, together with the *Amygdalus* mentioned as '750 ft. upwards'.

7000-9000 *ft.*: a few large junipers, barely surviving.

The above are forest-trees, entirely dependent on local precipitation, which only occurs in winter.

The oasis trees are as follows:

Sea-level to 3000 *ft.*: palm, tamarisk, willow, *Populus euphratica*, and various cultivated trees.

4000-6000 *ft., river beds*: willow, oleaster (*Elaeagnus*), tamarisk. *In gardens*: oriental plane, ash (*Fraxinus sp. al.*), sycamore, elm, poplar, cypress, citrus and other fruits.

Descriptions of New Species and Races

Melitaea consulis sp. n. (figures 1, 2).

An interesting new species in the *collina*-group, coming close to but distinct from *turcomanica* Higg., according to Higgins who has examined a para-type.

♂, fore-wing, same size and colour as *cinxia amardaea* Gr. Gsh. from Elburz, with white-chequered fringe, black margin, and two parallel chevrons as in *cinxia*. The median band consists of seven heavy black spots, the four nearest the costa being joined, the lower three almost or quite separate, the lowest of all being crescent-shaped, its convex side outward. Spots nos. 5 & 6 are conspicuous and oval-oblong, not (as in *phoebe*) more lightly indicated than the others. Rest of forewing, not unlike that of an ordinary form of *phoebe*. The basal fuscous suffusion extends somewhat along the inner margin. Hind-wing, like an ordinary *phoebe*, except that in all but one example the median band consists of a complete series of heavy black spots. The fuscous basal suffusion extends along the whole anal margin, leaving no pale patch as in *phoebe*. There are no dots between the nervures as in *cinxia*.

Underside, most peculiar: fore-wing: fringes and marginal area outside the proximal of the two chevrons, suffused with olive sulphur; the proximal, not the submarginal, chevron is usually the heavier. Median band, corresponding to upper side. Hind-wing: markings obsolescent, the whole wing being suffused with olive sulphur. In the few examples where the markings are traceable, there are no black marks at all on the pale median band, though other black markings do appear.

Besides the underside differences just described, the following points separate it from *collina* Led.: the median spots on the upper forewing are heavier, and the nervures are black outwards only from the proximal of the two chevrons on the hindwing, the two parallel chevrons are closer together in *consulis*.

♀, slightly larger than the ♂, with a paler ground-colour between the median band and the proximal chevron. *Holo-type*: ♂, *Allo-type*, ♀, *Para-types*, 4♂, 3♀.

All were taken on 3-v-40, at 8000-9000 ft. on a mountain close to Shiraz, and are in coll. mea. One other para-type has been sent to the British Museum, London.

Melitaea phoebe Knoch. **sarvistana** subsp. n. (figure 3)

A more normal form of this well-known species flies in Fars northwards and westwards from Shiraz, but this more southerly race seems to be an extreme development of *dorae* Graves, described from Transjordan.

Upper side, coloured like *Polygonia egea*. All black markings on the forewing have disappeared except 1/terminal line and lunules, 2/submarginal chevron, which is interrupted so that its apical part encloses 5 fulvous lunules, the lower part, three. 3/costa and nearest nervure, 4/median band, which however is obsolescent, 5/cell-markings, very light. on the hind-wing the black markings are reduced to 1/terminal line and lunules, 2/complete submarginal chevron, 3/(sometimes) a few black spots representing the median band, 4/the nervure nearest the costa; the interspace, which is suffused with fuscous, also contains traces of the normal chevrons and bands which in other forms of *phoebe* traverse the whole wing. Base, fuscous-suffused.

Underside, as in *phoebe*, except that the forewing's black median spots are obsolete, while the hindwing's black-markings are, on the other hand, intensified. Expanse, 45 mm.

Holo-type and allo-type, ♂, ♀, both on 26-iv-40 near Sarvistan, south-east of the Shiraz Salt Lake. In coll. m.

N.B. Besides the two species mentioned above, six other members of the genus *Melitaea* fly in the Shiraz district.

Eriogaster amygdali sp. n. (figures 7, 8)

♂, Antenna, bipectinated.

Head, and thorax, light brown, slightly darker on the head and collar.

Forewing, light-brown, with a small white cell-spot, and a curving brown line running from 5mm. from apex to 6mm. from the inner angle, i.e. more obliquely than in *pfeifferi* Dan. Submarginal area sometimes dusted with chocolate-brown scales, with nervures paler.

Hindwing, light brown, sometimes dusted all over with chocolate-brown scales, sometimes only near the base: in the former case, a pale median line shows.

Fringes, on both wings, pale brown.

Underside, both wings, darker brown inside the median line. In the darker form, the nervures are pale and contrast more than on the upper side. Discal spot, invisible on both wings.

Expanse, 36-38 mm.

Holo-type, ♂, bred from larvae found on wild almond and *Crataegus* at 7000-8000 ft. on various mountains in Fars: hatched, 28-x-40. In coll. mea.

Para-type, ♂, to light, Sineh Sefid, 27-x-40. (c. 6500 ft.)

The ova may be found in winter on wild almond twigs, covered densely with silver-grey fur.

The larvæ may be found in April and May, but those found in the latter month are usually ichneumoned. The larvae when full-grown, are velvety-black, with white and pale brown hairs growing transversely across the back, leaving the somital joints showing black, and blackish vertical hairs. The lateral area is blue and contains a pure white, black-edged irregular line, below which a downward-growing fringe of straw-hued hairs half conceals the black-rimmed spiracles. Head, glossy black. Feet, brown-grey. The lateral area is black in the earlier instars, and the dorsal hairs, which are clearly red-brown in the earlier instars, reappear when the mature larva begins running about before pupation. The large webs are a common sight on the beautiful wild almond bushes of the Fars mountains, but healthy larvae are hard to come by. The exposed larva has a twitching habit. The cocoon is frail, and brown, and is hidden in the ground.

Monima mithras sp. n. (Figure 4)

This striking new species resembles no previously known congener, except perhaps the Kashmirian species *castaneipennis* Hamps., but comes in section I of the genus. (*Castaneipennis* itself may prove to belong to this section when its female is discovered.)

♀, Eye, large, bristly; antenna, strongly bipectinated.

Thorax, pale buff on the shoulders, infused with light brown and grey elsewhere. Head, pale buff. Forewing, buff, heavily sprinkled with grey. All markings, rather indefinite in outline. The lines are paler, brown-edged on either side. Basal line, very faint. Antemedian line, running at right-angles to the costa, with two inward angles, on vein 1 and on the cell. Median field, darker brown, the stig-

mata shewing paler. The warm brown clouding of the median field is darkest between the stigmata and close to the antemedian line. Postmedian line, dentate on the nervures. Submarginal line, running somewhat as in *incerta*, but very faint, and edged inwardly with light brown. Stigmata, with pale but not sharp edges, and darker centres, of average size: orbicular, round; reniform, somewhat square, convex proximally, rather vague distally. Termen, pale buff. Fringes, brown basad. Hindwing, dark grey, with termen and fringes as on forewing.

Underside, forewing, whitish buff, dusted with brownish grey. Postmedian line indicated shadowily. Hindwing whitish buff, dusted with brownish grey inside a shadowy median line.

Expanse, 42 mm.

Holo-type, ♀, 7-iv-40, Pir-i-Zan woods, attracted to wild almond flowers at night; in coll. mea.

Brachionycha atossa sp. n. (Figure 9).

The absence of black streaks between the nervures in the marginal area at once distinguishes this new species from both *sphinx* Hufn., and *syriaca* Warr., close to which it must be placed.

♀, Forewing, silver grey, sprinkled with black, with a lilac tinge towards the costa, and a pinkish infusion in the centre of the wing. Basal streak, black, slightly shorter than in *sphinx*. Orbicular stigma, represented by a short black streak, paler-edged; other stigmata, invisible. First line, absent; post-median line, fine, black, more heavily black between veins 1 & 2, and sharply zigzagging inwards between the nervures which are dark grey. Submarginal area, clouded irregularly with dark grey, nervures 2, 3, 4, 7 & 8 being white edged as they pass through it. Terminal line, sharply white, wavy, with points at each nervure. Fringes, dark grey. Hindwing, grey, darker basally and anally, with darker nervures and terminal line, and a paler wavy median band. Fringes, grey, with white interruptions at the nervures.

Underside, forewing, grey, darker inside the zigzagging postmedian line; margin and fringes as on upper side. Cell-spot, large and dark. Hindwing, as upperside, but cell-spot more clearly marked.

Expanse, 44 mm.

Holo-type, ♀, Khan-i-Zinian, Fars, 8-xi-40 (c. 6000 ft.) in coll. mea.

Meganephria renalis sp.n. (Figure 6)

A striking new species between *tancrei* Graes. and *oxyacanthae* L. and distinguished from the latter by its stigmata which form the figures 80 on the left forewing, and also by the female antennae, which put it in the ***tancrei* section** of the genus.

♀, Antenna, bipectinated throughout.

Head and thorax, grey, speckled with black.

Forewing, light brown, heavily suffused with grey and speckled with black scales, especially on the nervures; the median fold is less grey-suffused than the adjacent costal and dorsal areas. Basal streak, black, as in ***oxyacanthae***. Orbicular and reniform stigmata, pale silver-grey, darker-centred, with blackish edge, forming respectively an oval and a kidney-shaped figure 8. Submarginal line, as in *oxyacanthae*; other lines, absent. Termen, white, with black proximal crescents between the nervures. Fringes, grey, interrupted by white prolongations of the nervures. Hindwing, dark grey, paler basally; terminal line, white. Fringes, as on forewing.

Underside, both wings, whitish, freckled with grey, especially the forewing. Cell-spots indicated on hindwing.

Span, 43 mm.

Holo-type, ♀, 30-xi-40, Sineh Safid (c. 6500 ft.) in coll. m.

Amathes oropotamica sp. n. (Figure 11)

A new species near *lychnidis* F., from which its pale hindwing and different reniform stigma distinguish it.

♀, Antenna, slightly cetose-ciliate.

Head and thorax slightly less brown than forewing. Abdomen, pale grey with a few dark scales.

Forewing, grey brown, of similar shape to that of *lychnidis*, or if anything a trifle more pointed and narrow. Costa, paler, with three vague purple-grey smudges above the cell. First line, not reaching the costa, faintly indicated by the fine brown edging on either side; wavy, but less so than in *lychnidis*. Outer line, paler, edged with faint brown crescents between the nervures on each side. Submarginal line, pale, interrupted, marked proximally with small black smudges between veins 4 to 8; the black costal mark near the apex, typical of *lychnidis*, is absent. Terminal line, pale brown with black dots on the proximal edge. Fringes, brown, with a yellow post-terminal line. Orbicular stigma, yellow-outlined, with a grey centre, and a blue-black spot in the upper proximal corner. Reniform stigma, more truely reniform, i. e., more rounded than in *lychnidis*, yellow-outlined, centre as in orbicular, but intensified to blue-black in lower lobe. Hindwing, pale dirty grey, the nervures, termen, and cell-dot darker.

Underside, forewing much paler and less coloured than *lychnidis*, the only clear markings being the reniform stigma on the forewing, and the cell-spot on the hindwing.

Span, 39 mm.

(3000 ft.) in coll. m.

(N.B. *Amathes lychnidis* F. occurs commonly in Shiraz gardens.)

Amathes oropotamica thermopotamica subsp. n. and sp. dist. (Figure 10)

This appears to be a dwarf, desertic race of the preceding, but might prove to be specifically distinct. It occurs in a locality intermediate between the highlands of Fars and the desert coast of the Persian Gulf. Both *oropotamica* and *thermopotamica* were taken in river beds or gorges.

♂, Antenna, strongly ciliate.

Head, thorax and forewing, lilac or brownish grey, less reddish tinted than *oropotamica*. The blackish marks along the submarginal line of that species' type are here absent or obsolescent; so are the black terminal dots. The stigmata are less conspicuous though similar in form and colouring, but the orbicular is of variable intensity.

Span, 32 mm.

Holo-type, ♂, 20-xi-40, Shapur Gorge (Tang-i-Chugan), at carob-bloom, (3000 ft.) in coll. m.

Para-type, ♂, ditto..

Amathes maciIenta Hbn. subsp. **plumbea** subsp. n.

An unusual colour-form of a well-known species which is yellowish in its typical form (Europe) and chestnut-red (subsp. *rubescens* Wilts.) in Syria and parts of Persia such as Kermanshah.

Head, thorax, and forewing, of a buff ground colour, more or less completely obscured with a lilac-grey suffusion. In the less heavily infused specimen, the thorax and basal part of the forewing are clearer buff. Postmedian and antemedian lines, very indistinct. Orbicular and reniform stigmata, not conspicuous, the latter being grey-filled and darker blue-grey in its lower part. Submarginal line, whitish, the brownish proximal edging not always clearly indicated. Marginal area, paler in one example. Fringes, pale brown, more or less suffused with lilac. Hindwing, dull grey, with paler buff fringes.

Holo-type, ♂, 20-xi-40, Shapur Gorge (Tang-i-Chugan), Fars, (c. 3000 ft.) (To carob-bloom.) in coll. m.

Para-types, ♂♂, ditto.

Crymodes bischoffii H. S. **zagrobia** subsp. n.

A distinctive, smaller race, characteristic of the southern, hotter part of the Zagros, of an autumnal species whose type-form occurs in the hills, from Turkey to Palestine and Kurdistan.

The forewing is more heavily suffused with dark grey, especially in the postmedian area, thereby causing the marginal area to appear strikingly paler, and emphasising the angularity of the submarginal line.

The distinctive underside (similar in both races) has not yet been described: the wavy postmedian line is neatly defined on both wings in grey, and stands out especially on the hindwing, the veins being darkened where they pass through

it. The cell-spot is always indicated on the hindwing, and often also on the forewing.

Span of *zagrobia*, 40-41 mm.

Holo-type, ♂, Khorramabad, Luristan, 29-x-38. In coll. mea.

Allo-type, ♀, Shapur Gorge (Tang-i-Chugan) Fars (3000 ft.) (To carob-bloom) In coll. mea.

Para-types, ♀♀, Khorramabad, 29-x-38. (To light). In coll. m.

Margelana achaemenica sp. n. (Figure 5)

Similar in size and colour to *flavidior* Wagn., but more elaborately marked.

♂, Antenna, canary-yellow, strongly bipectinate.

Head and thorax, canary-yellow.

Forewing, canary-yellow, suffused with light brown on the cell. Stigmata, clear canary-yellow, with brown outlines: orbicular, variable in size and shape, assuming a parallelogram-form when large; reniform, large, its inner edge being straight. A brown line along the cell joins these two stigmata. First line, absent. Second line, brown, meeting the inner margin about halfway, touching the lower edge of the reniform stigma, and running on an almost straight course across the wing, but curved slightly based between the nervures. Submarginal line, less straight than in *flavidior*, but straighter than in *versicolor*, brown, reaching neither costa nor inner margin. A brown costal shade, not reaching further than vein 3 even in the most strongly marked forms, runs between the second and the submarginal lines. There are also traces of a fine brown shade in the marginal area in some specimens. Termen, brown. Fringes, yellow. Hindwing, yellowish, plain, with brown termen.

Underside, yellow, with second line indicated on both wings by a brown suffusion, especially strong near the costa of the forewing.

♀, Antenna, simple.

Thorax, paler.

Forewing, paler and less marked usually than male.

Expanse, 35-40 mm.

Holo-type, ♂, 20-x-40, Pir-i-Zan woods, (c. 7000 ft.) Fars, in coll. m.

Allo-type, ♀, ditto.

Para-types, ♂♂♂♂♂♂♀♀, same date and place, also at Sineh Safid (nearer Shiraz) 27-x-40. In coll. mea.

(N.B. *Margelana flavidior* Wagn. & *versicolor* Stgr. also occur with the above species).

FISHES COLLECTED BY THE VERNAY-HOPWOOD UPPER CHINDWIN EXPEDITION, 1935[1].

BY

SUNDER LAL HORA, D.SC., F.R.S.E., F.N.I., AND K. S. MISRA, M.SC.,

Zoological Survey of India, Calcutta.

(With one plate).

The collection dealt with in this paper was received from two sources, but originally it had formed part of a much larger collection made by the Vernay-Hopwood Upper Chindwin Expedition. In June 1938, Mr. S. H. Prater sent to the Zoological Survey of India 42 specimens of fish which the Bombay Natural History Society had received as a presentation from the American Museum of Natural History. In August, 1938, Mr. J. T. Nichols of the American Museum of Natural History, on his own initiative, sent a small consignment of 50 fishes collected by Mr. H. C. Raven of the Vernay-Hopwood Chindwin Expedition. The latter lot comprised only such forms about the identification of which there were some doubts. The major part of the collection had, however, already been named and distributed on the shelves in the Museum. Of the specimens received from the Bombay Natural History Society there were some that had been collected by the Expedition in the Malay Peninsula, but we propose to deal here only with the specimens collected from the Chindwin drainage in Upper Burma. For precise data about the various localities from which the fish were obtained reference may be made to Morris's article in the *Journal of the Bombay Natural History Society* (vol. xxxviii, pp. 647-671, 1936) in which a general account of the Expedition is given.

We are given to understand that owing to unusual field difficulties of packing and transportation, the fish material could not be looked after properly and it is not surprising, therefore, that quite a number of specimens are in a poor state of preservation. However, it has been possible to identify all of them specifically.

In the following list species represented in the collection examined by us from the Upper Chindwin area are given; the localities in which the respective species were collected and their general distribution are also included.

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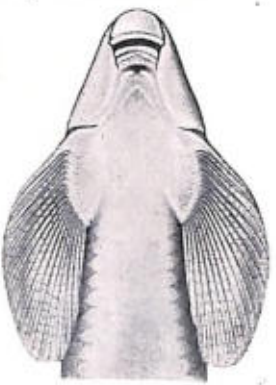
[1] Published with permission of the Director, Zoological Survey of India.



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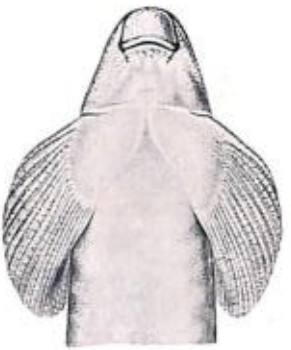

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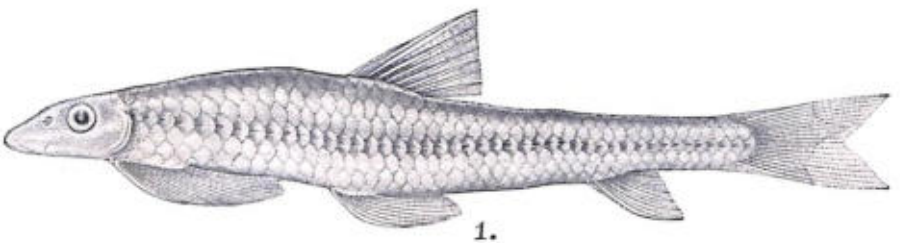

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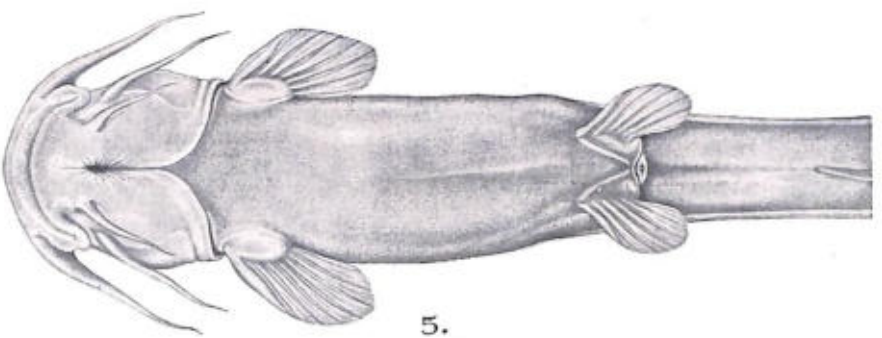

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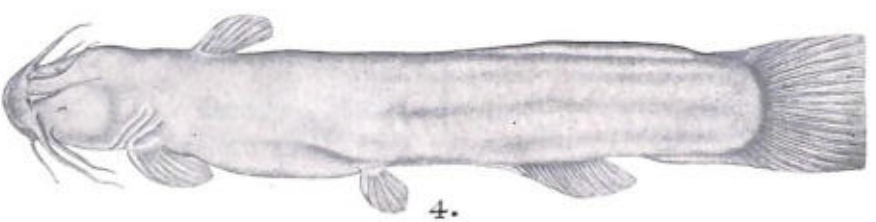

4.

Fishes collected by the Vernay-Hopwood Upper Chindwin Expedition, 1935.

For explanation see end of article.

List of Species.

Specific Name	Locality and number of specimens	Further Distribution
Family Flutidæ		
1. **Fluta alba** (Ziew).	Lonkhin : 5 specimens ...	Manipur, Assam ; Burma; Malay Peninsula and Archipelago, Siam to Northern China; Chinese islands; Formosa and Japan.
Family Mastacembelidæ		
2. **Mastacembelus unicolor** (K. & V. Hass.).	Mawlaik : 1 specimen ...	Burma to Java.
Family Cyprinidæ		
Subfamily *Rasborinæ*		
3. **Danio aequipinnatus** (McClelland).	Kora : 14 specimens ...	India, Burma and Siam.
4. **Rasbora rasbora** (Hamilton).	Dalu : 6 specimens ...	India, Burma and Pihang.
5. **Barilius barna** Hamilton	Upper Burma : 2 specimens ...	India and Burma.
Subfamily *Cyprininæ*		
6. **Barbus (Tor) mosal** (Hamilton).	Lonkhin : 1 specimen ...	India and Burma.
7. **Barbus (Puntius) sewelli** Prashad and Mukerji.	Dalu : 2 specimens ...	Myitkyina District, Upper Burma.
8. **Barbus (Puntius) ticto** Hamilton.	Dalu : 3 specimens ...	India, Burma, Ceylon and Siam.
9. **Labeo devdevi** Hora.	Dalu : 22 specimens ...	Chindwin Drainage, Assam ; Burma and Siam.
10. **Psilorhynchus homaloptera** var. **rowleyi**, nov.	Kora : 3 specimens ...	...
11. **Rohtee cotio** var **cunma** Day.	Kaunghein : 1 specimen.	Chindwin Drainage in Assam, Peninsular India and Burma.
12. **Rohtee feae** (Vinciguerra).	Kalawa : 3 specimens ...	Burma.
Family Cobitidæ		
13. **Acanthopsis choirorhynchus** (Blkr.).	Kaunghein : 2 specimens.	Sumatra, Java, Borneo, Malay Peninsula, Burma, Siam and Annam.
14. **Lepidocephalus berdmorei** (Blyth).	Dalu : 1 specimen ...	Chindwin Drainage in Assam, and Burma.
Family Ariidæ		
15. **Arius jatius** (Hamilton).	Kalewa : 1 specimen ...	Estuaries and rivers of Bengal and Burma.

Specific Name	Locality and number of specimens	Further Distribution
Family SILURIDÆ		
16. **Silurus cochinchinensis** Cuv. and Val.	Kaunghein : 1 specimen...	India, Burma, Malay Peninsula and Cochin China.
Family AMBLYCIPITIDÆ		
17. **Amblyceps mangois** (Hamilton).	Kora : 2 specimens ; Hai Bum : 4 specimens ...	India, Burma, Siam and Malay Peninsula.
Family SISORIDÆ		
18. **Exostoma vinciguerre** Regan.	Kora : 1 specimen ...	Upper Burma.
Family OPHICEPHALIDÆ		
19 **Ophicephalus gachua** Hamilton.	Kora : 3 specimens ...	Throughout the Oriental Region.
Family NANDIDÆ		
20. **Badis badis** (Hamilton).	Burma : 4 specimens ...	India and Burma.
Family AMBASSIDÆ		
21. **Ambassis baculis** (Hamilton).	Kaunghein : 2 specimens.	India, Burma and Siam.

Most of the species are widely distributed in parts of the Oriental Region and do not require any further comments. Some of the species, such as *Barbus (Tor) mosal* (Hamilton)[1], *Barbus (Puntius) ticto* Hamilton[2], *Barbus (Puntius) sewelli* Prashad and Mukerji[3] *Labeo devdevi* Hora[4], *Rohtee cotio* var. *cunma* Day[5], *Rohtee feae* (Vinciguerra)[5], *Silurus cochinchinensis* Cuvier &

[1] Hora, S. L.—'The Game Fishes of India. X. The Mahseers or the Large-scaled Barbels of India. 3. The Mosal Mahseer, *Barbus (Tor) mosal* (Hamilton)'. *Journ. Bombay Nat. Hist. Soc.*, vol. xli, pp. 784-794 (1940). The measurements of the specimen from Lonkhin are given on page 789.

[2] Hora, S. L., Misra, K. S. and Malik, G. M.—'A Study of Variations in *Barbus (Puntius) ticto* (Hamilton)'. *Rec. Ind. Mus.*, vol. xli, pp. 263-279 (1939). The measurements, scale-counts and position of colour spots of the specimens from Dalu are given on page 274.

[3] Prashad, B. and Mukerji, D. D.—'The Fish of the Indawgyi Lake and the streams of the Myitkyina District (Upper Burma)'. *Rec. Ind. Mus.* vol. xxxi, p. 197, pl. ix, figs. 1, 1*a*, 1*b* (1939). *B. sewelli* is represented in the collection by juvenile specimens.

[4] Hora, S. L.—'On a Further Collection of Fish from the Naga Hills'. *Rec. Ind. Mus.*, vol. xxxviii, pp. 323, 324 (1936) ; 'Notes on Fishes in the Indian Museum. xxxii. On a Small Collection of Fish from the Upper Chindwin Drainage'. *ibid.*, vol. xxxix, p. 333 (1937). In the collection under report, *Labeo devdevi* is represented by juvenile specimens.

[5] Hora, S. L. and Misra, K. S.—'Notes on Fishes in the Indian Museum. XL. On Fishes of the genus *Rohtee* Sykes'. *Rec. Ind. Mus.*, vol. xlii, pp. 155-172 (1940). Measurements, number of anal rays, and scale-counts of the Kaunghein specimen of *Rohtee cotio* var. *cunma* are given on page 170, while those of the two specimens of *R. feae* from Kalawa are given on page 158.

Valenciennes[1] and *Exostoma vinciguerra* Regan[2] have already been dealt with in recent years, while notes on *Psilorhynchus homaloptera* var. *rowleyi*, nov. and *Amblyceps mangois* (Hamilton) are given below. The occurrence of *Arius jatius* (Hamilton) in the Upper Chindwin Drainage is of special significance, for though the species is known to ascend far above tidal reach its record from such great distance from the sea is rather unusual. As pointed out by Hamilton[3] the palatine teeth are entirely absent.

Psilorhynchus homaloptera var. **rowleyi,** nov.

Plate I, figs. 1 and 2.

In 1935, Hora and Mukerji[4] described a new species of *Psilorhynchus, P. homaloptera,* from the Brahmaputra Drainage of the Naga Hills, Assam. Next year, Hora[5] recorded two more specimens of the same species from this region. In the collection under report, there are three specimens from Kora which are generally similar to *P. homaloptera* (Plate I, fig. 3), but the body is only slightly depressed, the caudal peduncle is more slender and narrow, the head is somewhat more pointed, the interorbital space is narrower and the eyes are proportionately larger. We believe that these specimens represent a distinct Burmese variety of the species which we have named after Major Rowley, a member of the Expedition.

The differences noted above between the typical form from India and the Burmese variety are of the same nature as pointed out by Hora[6] between *Balitora brucei* Gray from India and its variety *burmanica* Hora from Burma.

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[1] Hora, S. L.—'Siluroid Fishes of India, Burma and Ceylon. VII. Fishes of the genus *Silurus* Linnaeus'. *Rec. Ind. Mus.*, vol. xxxviii, pp. 351-56 (1936).

[2] Hora, S. L.—'Notes on Fishes in the Indian Museum. V. On the composite Genus *Glyptosternum* McClelland' *Rec. Ind. Mus.*, vol. xxv, p. 41, pl. iii, figs. 1-3 (1923).

Now that the generic limits of *Glyptosternum* McClelland have become sufficiently defined, we recognise the divisions into which this composite genus has been divided by Regan, Norman and Smith (*Journ. Siam Soc. Nat. Hist. Suppl.*, ix, p. 71, 1933). The generic appellation *Exostoma* Blyth is, however, inappropriate, for, as shown by Hora (*loc. cit.*, p. 3), its type-species belongs to *Glyptothorax* Blyth. Till fresh specimens of *E. berdmorei* Blyth become available, we do not wish to disturb the present nomenclatorial arrangement and have accordingly adopted the generic name *Exostoma* for *E. labiatus* Blyth and allied forms.

[3] Hamilton, F.—'*An Account of the Fishes found in the River Ganges and its tributary branches,*' pp. 171, 376 (Edinburgh, 1822).

[4] Hora, S. L. and Mukerji, D. D.—'Fish of the Naga Hills, Assam'. *Rec. Ind. Mus.*, vol. xxxvii, pp. 391-397, pl. vii, figs. 1-6 (1935).

[5] Hora, S. L.—'On a Further Collection of Fish from the Naga Hills'. *Rec. Ind. Mus.*, vol. xxxviii, p. 318 (1936).

[6] Hora, S. L.—'Classification, Bionomics and Evolution of Homalopterid Fishes'. *Mem. Ind. Mus.*, vol. xii, p. 291, pl. xi, fig. 6 (1932).

Measurements in millimetres.

Standard length	61·5	75·0
Length of head	12·0	14·0
Height of head	7·0	9·0
Width of head	10·0	11·0
Diameter of eye	4·0	4·5
Length of snout	5·0	6·3
Interorbital distance	4·9	5·6
Depth of body	9·5	12·0
Width of body	9·5	12·0
Length of caudal peduncle .	10·5	11·0
Least height of caudal peduncle ...	4·5	5·5

Amblyceps mangois (Hamilton).

Plate I, figs. 4 and 5.

1933. *Amblyceps mangois*, Hora, *Rec. Ind. Mus.*, xxxv, pp. 607-621.

The specimens of *Amblyceps mangois* from Hai Bum are the largest yet recorded, the largest specimen being 163 mm. in total length. In these examples the head and the body are covered with a felt-like growth of papillae. The lips are also thickly papillated. The eyes are very minute, almost indistinguishable, and the caudal fin is truncate. The adipose fin is thick and low, and just forms a ridge.

Owing to their strong build, these specimens are liable to be confused with *Liobagrus* Hilgendorf, but can be readily distinguished on account of the respiratory structures associated with the gill-openings (*vide* Hora, *loc. cit.*, p. 612). The larger examples are superficially not dissimilar to *Glyptosternum* McClelland (=*Parexostoma* Regan), but the extent of the gill-openings, and the position and form of the various fins are sufficient to distinguish the two types of fishes.

The pelvic fins are close together on the ventral surface and are provided with muscular bases. Some of the specimens are heavily parasitised by worms which are encysted in the body wall and on the fins.

In recent years the range of distribution of *A. mangois* has been greatly extended. It is found in the Malay Peninsula, Burma, Siam, Assam Hills, Himalayas, Rajmahal Hills, Santal Parganas and the headwaters of the Mahanadi River.

EXPLANATION OF PLATE

Fig. 1.—Lateral view of the type-specimen of *Psilorhynchus homaloptera* var. *rowleyi*, nov. × 1⅜.

Fig. 2.—Ventral surface of head and anterior part of body of the same. × 1⅜.

Fig. 3.—Ventral surface of head and anterior part of body of *Psilorhynchus homaloptera* Hora & Mukerji. × 1⅜.

Fig. 4.—Dorso-lateral view of a specimen of *Amblyceps mangois* (Hamilton) from Hai Bum. × 5/6.

Fig. 5.—Ventral surface of head and part of body of the same. × *ca* 1½.

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THE MALAYAN ELEPHANT.

(ELEPHAS MAXIMUS INDICUS).

BY

THEODORE HUBBACK.

(With 8 plates).

INTRODUCTION.

In the Abstr. Proceedings of the Zoological Society of London (No. 130, 1914, page 20), Richard Lydekker designated the Malayan Elephant as a sub-species of *Elephas maximus*, giving it the name of *Elephas maximus hirsutus*.

On page 285 of the Proceedings of the Zoological Society, 1914, there is an amplification of this dictum.

The sub-species was made on the following grounds :—

". . . characterized by the square instead of triangular ear, the early date at which its upper margin is bent over, and the presence in the young condition, at least in some cases, of a thick coat of black and in part bristly hair . . . "

There is, I think, little doubt that the above description does not apply to the normal wild Malayan elephant and it seems that the sub-species was made on insufficient data.

I have seen many young wild Malayan elephants from babies still in the pink stage to those of four or five feet in height, but I have never noticed a thick coat of hair on any of them.

I have handled several baby elephants and I must have noticed had they been covered with thick hair. All Malayan elephants have a certain amount of hair or bristles on parts of their bodies but not in sufficient quantities to differentiate them from other Asiatic sub-species.

Also the description of the shape of the ear does not agree with the shapes of the ears of mature or semi-mature wild elephants that I have seen. The photographs illustrating this article show the usual triangular ear which we associate with *Elephas maximus*, and although it is possible that some abnormality presented itself to Lydekker which led him to believe that a square ear was typical of the Malayan elephant, it is not a normal characteristic in those I have seen. It is true that in the Malayan elephant the upper margin of the ear is bent over at an early age. I have a photograph of a young wild elephant, not more than six feet high, showing the fold on the upper margin of the ear.

In a recent publication entitled *Handlist of Malayasian Mammals*, compiled by Mr. F. N. Chasen, Director of the Raffles Museum, Singapore, Straits Settlements, he disagrees with the deductions of Lydekker and suggests *Elephas maximus indicus* as the nomenclature for the Malayan sub-species.

I think that Lydekker's premises were wrong. I agree with Mr. Chasen that as a sub-species has been created for the Malayan elephant it should be called *indicus* and not *hirsutus*. Chasen himself writes—

'It has not yet been demonstrated that the elephants of Siam and the Malay Peninsula differ from the Indian form . . .'

It seems therefore that *indicus* is the more suitable name if *hirsutus* can be shown to be inappropriate. In remote ages wild elephants came down the Malay Peninsula from the north, and until it is shown that the elephants in Malaya have some more or less general characteristics which distinguish them from the Indian variety I think we should be content to call them *Elephas maximus indicus*.

I cannot agree to the claim put forward that the Malayan elephant is of a smaller size than the Indian elephant. I have known of several elephants which have been shot in Malaya which measured over 9' 6" at the shoulder. I shot one myself measuring 9' 6½", and Mr. E. Frederiksen shot one measuring 9' 8½". Although elephants in India have been recorded as having measured over ten feet such occurrences have been rare and may well be considered abnormal. Blanford in *Fauna of British India* states that the height of adult males does not as a rule exceed 9' 0" at the shoulder and I should say that this is correct for the Malayan form.

In Malaya tusks weighing over 70 pounds the pair are not uncommon and, as I have shown later on, tusks up to over 140 pounds the pair have been obtained. Such a weight however should be considered very exceptional.

During the last few decades the numbers of firearms has increased so much in Malaya that many elephants have been shot under the mistaken idea that allowing such indiscriminating slaughter benefits the cultivator by saving his crops; a fallacy which is very apparent to anyone who has lived in Malaya for many years. Many elephants are wounded and injured by this method and I think it is fair to say that few male elephants in Malaya reach a ripe old age. This might account for the comparatively small ivory that is generally obtained in Malaya.

Before passing on to the main theme of this article I should like to mention the fact that the origin of the wild elephants in Borneo is somewhat obscure. They are found only in the northern portion of the island; in that part of the territory known as British North Borneo.

I am informed that the earliest mention made of elephants in Borneo is by Pigafetti, Chronicler of Magellan, who records that during a visit to Brunei in 1521 they were conveyed to the palace on caparisoned elephants. But this does not prove that they were indigenous to Borneo.

There is a persistent story that a Prince from the West presented the Rajah of Solo with some tame elephants, but the Raja found that these elephants were rather a nuisance so he had them shipped to the east coast of Borneo and there let loose.

If this is true it may account for the wild elephants in North Borneo, but we are still left without knowledge of their exact origin.

The only clue, and a very slender one, is the fact that many, possibly most, of the mature male elephants in Borneo have very straight tusks and do not conform with the usual curved tusks of *Elephas maximus*.

It is possible that the Borneo elephants came originally from Sumatra. Dutch records will show whether straight tusks are common or not amongst the wild herds in Sumatra. I have seen photographs of elephants shot in Sumatra and their tusks appeared to be straighter than those I have generally seen in Malaya.

Distribution of the Malayan Elephant.

Wild elephants, not so many decades ago, were widely distributed throughout Peninsular Malaya, but owing to the opening up of the country for commercial purposes there is now probably not a tenth of the number of elephants that once roamed the Malayan jungle.

The elephant has not been wisely conserved; it has been looked upon as a menace to progress and quite unnecessary loopholes have been permitted in the Game Laws to enable *Elephas maximus* to be destroyed on the weakest grounds. This is not the place to go into the harm which has resulted from the wounding of many elephants by irresponsible persons, who are allowed to shoot at an elephant in alleged defence of crops with any weapon, however inadequate: but such actions have resulted in large numbers of elephants being wounded and becoming rogues, thus establishing a vicious circle difficult to deal with.

At the present time on the West Coast of Malaya there are few elephants left, and those left are by no means left in peace. In many places untidy native cultivation is an attraction to elephants, and as many of these clearings are allowed to take care of themselves for weeks at a time much damage is sometimes done to what is called 'cultivation'. There is then a clamour for more executions, so the Malayan elephant's hopes for the future are very uncertain. Perhaps due to the persecution that they have been subject to, elephants in the higher country in Malaya have taken to travelling long distances right up to the tops of the mountains. I have seen the tracks of elephants as high as 5,000 feet altitude, but they have been seen even on the tops of the highest mountains which reach to 7,000 feet. Generally these wanderers are solitary bulls, but not necessarily old animals, and disturbance may have something to do with their long treks. I have seen herd elephants between the 2,000 feet and 3,000 feet contour, but they were feeding on bamboo at the time, which was no doubt the attraction, and their presence may be considered as a normal migration during the bamboo season.

The elephant is not used to any extent in Malaya for transport and very little for show. There are no tribes here, as in India, who have made a living for generations by tending elephants, and there is not the same desire to conserve the elephant for purposes of utility.

In Burma and Siam they are extensively used in the teak forests, but here there is nothing to correspond to that class of labour.

There are no reserves on the West Coast which are of any use to elephants, except possibly a sanctuary in Johore near Segamat. With that one exception I think we must recognize that the Malayan elephant on the west side of the Peninsula is doomed to extinction, although for many years an occasional animal or two may be found in the mountainous country.

On the East Coast, the position is better because the country is less opened up and there are at least two reserves which should prove the saving of the Malayan elephant as a species. The King George V National Park, an area of nearly 1,800 square miles, extending over portions of the three States of Pahang, Trengganu and Kelantan, is mostly mountainous terrain, but still is favourable in many parts for elephant.

The danger lies in the defective and inadequate legislation which has been passed to guard this sanctuary. Unless great care is taken, the Park will become a refuge for wildlife, including elephants, in name only.

I do not think that wild elephants have been recorded as having been found on Singapore Island, but they have reached the southernmost portion of the Peninsula and have roamed the jungles from coast to coast. The whole of the Malay Peninsula was their domain in days not so far past, and there is still sufficient of their natural environment left to make it possible, with wise conservation, to save them from extermination.

The Malayan Elephant and His Jungle.

Malayan elephants spend most of their time in primeval forest and it is, I think, only after their true habitat has become too restricted for their needs that they have to forage for food in secondary jungle, and so tend to become a nuisance to cultivators and contract the habit of going on to cultivated or semi-cultivated land.

The Forest Reserves in the low country of Malaya are no permanent refuges for elephant because they are at times much disturbed, and elephants like all other wild animals hate disturbance.

The Malayan elephant is compelled to travel great distances in search of food. It is a discriminative eater and does not take just whatever comes to hand. G. P. Sanderson in his well-known book *Thirteen Years Among the Wild Beasts of India* writes:

> 'An elephant in captivity should be supplied with 800 pounds of good fodder every day, of which it will eat about 650 pounds and waste about 150 pounds.'

It is unlikely that a wild elephant eats less than an elephant in captivity, so it does not require any great stretch of the

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imagination to appreciate that a mature wild elephant has to do a good deal of foraging to satisfy its appetite. Anyone, who has tracked wild elephants in virgin jungle, knows that they cover many miles through the forest during the day, picking up a little food here and there, but doing most of their feeding during the night.

Although a herd of elephants probably has more or less defined parts of the country in which it feeds, and although this terrain covers a big area, when elephants have been much disturbed and their domain restricted by the opening up of the country, then damage to cultivation is likely to occur.

For many years in the Plus Valley in Perak, a district well patronized by rubber planters, considerable damage was done to para rubber cultivation. When giving evidence before the Wild Life Commission of Malaya in 1930, European witnesses stated that during twenty years of endeavour to deal with the elephants that raided their estates in that area, 30 elephants had been shot; the value of rubber trees destroyed by elephants was estimated at £20,000; and there were more elephants than ever.

However a scheme was inaugurated on the recommendation of the Commission that overcame the difficulties, which as records show was a complete success. The useless killing of elephants ceased. By a system of patrols, the cost of which was met half by the government and half by the estates, elephants were prevented from reaching the planted area. The result of this action shows that indiscriminate shooting of elephants, as in this case, was not only unnecessary but useless as a complete defence to the menace from marauding elephants. The Plus Valley scheme can well be considered as an example to others who wish to protect cultivation and at the same time preserve wildlife.

Since those days the electric fence has come into use and I have no doubt will prove, where properly erected and looked after, a very efficient check against wandering elephants.

Where land is given out in isolated blocks in elephant country for, what will most certainly result, in 'fugitive cultivation', where the main game trails are cut up, and where temporary crops are planted in, what might be described as favourite stamping grounds for the larger fauna, there is bound to be trouble from elephants.

Under such conditions they will sometimes be driven away, sometimes wounded, sometimes even killed, so, in such country, they move on and on in search of that solitude and tranquillity which must be part of their normal life. Thus they get forced back and back into unopened mountainous country which is not a congenial environment, nor can it be a permanent part of their true habitat, and is not, I believe, suitable country for normal breeding.

When with a herd, a newly born elephant is a fascinating little animal; fussing around amongst the legs of its mother; waving about a much undeveloped trunk; very important; and with its pinkish skin making a striking note in the picture. This pinkish colour is probably retained for some weeks, but it is difficult to

make accurate observations on colour because the wild elephant is so often covered with mud.

I recollect on one occasion, when hunting elephants, trying to locate a tusker which I knew was with the herd. While doing this some of the herd moved uphill away from me and ran across the trail we had made a few minutes before when making our approach. Immediately a shrill trumpet gave the alarm and an avalanche of elephants came down the hill towards our position. I slipped behind a tree, a big comfortable tree, expecting the elephants to sweep past me. None of them came unpleasantly close; but an old cow, another female and a tiny calf seemed to deliberately change their direction and stopped a few yards on the other side of my tree. I had a good view of the calf. Its little trunk, still much undeveloped, waved about aimlessly from under its mother. There was no mistaking that the calf had flesh-coloured skin which certainly had no long hair on it. Presently these elephants moved off down the hill to join the rest of the herd; not altogether to my disappointment! I never caught up to the herd again and so did not see the tusker.

I do not know how long the calves suckle their mothers. Plate No. 1 shows a young calf with its mother and clearly shows the female's left breast full of milk. This calf was not very small but I could not estimate its age.

So soon as the calves get a little bigger they become independent, and although they do not wander far from their mother or from the other female, which is generally in attendance, and about which I have something to say later on, they act exactly like children and frequently become a nuisance to their elders. It is no uncommon thing, when in the vicinity of a herd of elephants, to hear a shrill squeal from a baby elephant, which is in protest to some correction by its mother generally a whack from her trunk. As Plate No. 1 shows a small elephant, even when suckling, will take its place at a salt lick amongst the big elephants, and try to get its share of the sulphur water with the best of them.

In that particular case I think the baby was not very successful because it wandered away from the lick after a minute or so and seemed uncertain what to do with itself. The playfulness of elephants even when mature is well shown in Plates Nos. 3 and 4 where a young tusker climbs up on to a log just for fun. Plate No. 4 shows by the expression on his face how pleased he was with himself, and well he might be, because he balanced himself on a log split down the middle and not more that twelve inches wide in the broadest part. Having done that he proceeded to walk along the log, turned round, retraced his steps, got down from the log more or less where he had got up, and then as Plate No. 5 shows disappeared out of the picture. The elephant shown in the illustration was one of a herd of seven, three of which were tuskers, but all young ones. There was a calf in the herd about four feet high. The log which attracted the attention of the young tusker has been used many times by elephants doing the same trick. It is a live log and the abrasions on the bark

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Copyright] SOMETHING DONE. *[T. Hubback*

Copyright] "GOOD NIGHT." [*T. Hubback*

caused by the elephants' feet or toe nails grow into little knobs with which the top of the log is covered. These knobs are shiny and polished by the action of numerous elephants amusing themselves on the log.

This herd of elephants was in the same lick as the one shown in Plate No. 1, and had a great time. But not until the leading cow accompanied by a young tusker, probably her son, had had their fill, would any of the others go near the lick.

I have seen this happen more than once. Twice have I seen two tuskers come into the lick when the bigger one would have his fill first, the smaller one patiently waiting his turn. In one case the smaller one got fed up and after circling around for some time left the lick witnout getting his medicine at all.

I am sure elephants show great respect for their elders and the younger ones would never think of disputing their rights to the first place in a lick. I have seen the same thing happen with seladang (*Bibos gaurus*), and I think we might well take a lesson in these matters from wild animals whose behaviour under normal conditions is exemplary.

One very striking habit of wild elephants, which I have often seen, is that when an elephant is very small another female elephant will attach itself to the mother appearing to act as a 'nurse' or protector. Those Malays, who are well-versed in jungle lore, recognize this phenomenon and call the second elephant the *pengasoh*, meaning 'nurse' or 'foster-mother'. The incident I have related of the little pink calf coming so close to me was enhanced in interest by the presence of a second cow. I have often seen two cows and one calf and I believe that it is by design and not just accident. Malay jungle gossip says that the *pengasoh* is the one to watch if approaching a herd wherein there is a small calf. The nurse, they state, will take the offensive while the mother bustles away with the calf. I have never seen this happen. Malays cannot be considered reliable witnesses, because they generally mistake quick movements of wild animals as presaging an attack, and do not wait to observe what really happens.

Cow elephants always, I believe, remain all their lives with their herd or with one or two companions. They are generally separated from the herd when calving but not always. I remember an extraordinary incident that happened on a rubber plantation in Negri Sembilan many years ago. An elephant had a calf sometime during the night on the estate amongst the rubber trees. She was with a herd, and after having heard tremendous trumpetings during the night, some of the labourers went to investigate the next morning. They found no elephants but discovered an enormous after-birth, which alarmed them so much that they reported to the manager they had found the remains of some extraordinary thing amongst the rubber, which they believed had been left there by the elephants! The manager had it well and truly buried. That is the story I had from the manager whom I knew well. He told me that the elephants had left the estate immediately and were not in the vicinity for some time. It appears that, in this case

anyway, the baby elephant was able to get away or be moved away a few hours after it was born.

In the dense jungle of Malaya it is not easy to observe the habits of wild animals even elephants, and one's knowledge of their lives is bound to be meagre. When hunting them one has plenty of opportunity of learning how they react when frightened and occasionally, if you hunt enough, when they are angry; but except to know what they are likely to do under certain circumstances, for instance after heavy feeding or when anxious to catch up a herd, one really learns very little about the elephant that lives in a forest.

But, if one takes to the art of photography and tries to get pictures of elephants one then has a chance of learning something about them when undisturbed, when unafraid, and when going about their ordinary occasions. I hunted elephants over a period of thirty-five years, until about five years ago, when age precluded me from further strenuous hunting. So I took up wildlife photography in the Malayan jungle and during the last five years I have learnt more about the normal behaviour of elephants and other large game than I learnt in all the previous years.

However, before I go on to tell you about the observations I have made of elephants going about their daily rounds and of their visits to salt licks, I should like to give you a few instances of what I gleaned when I was still a hunter.

I often noticed, when following solitary elephants, that, when they fed extensively on a certain creeper known to Malays as *akar beluru* and to Science as *Entada schefferi,* they invariably travelled far after such a meal. Possibly that particular creeper has some sustaining effect on the elephant which acts as an incentive to greater and unusual effort; and although this may seem a rather far-fetched theory, I have noticed this stimulating effect on an elephant's activities too often to be mistaken about it. On the other hand, when elephants have been feeding on a palm called *bayas* in Malay and *Oncosperma horrida* in the text books, they are lethargic and unwilling to travel very far. In fact I have known occasions when an elephant, having fed well but possibly not too wisely on this palm, would not travel more than a few hundred yards from where there was a stand of this plant before he would lie down for a nap; only to return again on waking up to have another gorge. Possibly the cabbage of this palm may contain something which acts as a soporific on the elephant? The cabbage is excellent eating for human beings.

The elephant's method for getting at the pith of the palm is interesting. *Bayas* is covered with an extremely tough, long and nasty thorn which points downwards, so the elephant presses his forehead against the palm which, if not too old, is pushed over. He avoids getting the thorns into his forehead because he presses with the grain so to speak. Having got his tree down he proceeds to stamp along the upper half of the trunk from the leaves at the top, and when it is well and truly reduced to a pulp he eats as much of the pith as he thinks he can digest. He eats all the cabbage! This takes a long time because the *bayas* palm is never

very big, probably never more than two feet round, and not much pith can be picked out at one time. I have often thought when looking at a *bayas* that had been pushed over, stamped almost flat with all the pith removed, how extraordinarily patient and persistent the animal must have been to pick out the centre of the tree and leave everything else.

I have never known elephants eat the leaves or roots of wild ginger. Malays call these plants *tepus* or *pua*. There are so many varieties of wild ginger in Malaya that it is quite possible elephants may eat some of those I have never come across. I have often seen where they have stamped about and even pulled up some wild ginger roots but I could never find signs of any of it having been eaten.

Elephants are fond of many palms and will feed extensively off the roots and shoots of *bertam* (*Eugeissona triste*). This palm is considered by Forest Officials to be a pest because it grows very rapidly and extensively, preventing the regeneration of the useful forest. *Bertam* is a valuable thatch for houses and as such the leaves are much used by the peasants. It is only found in primeval forest not in secondary jungle. I have noticed where elephants were once fairly numerous and where now they are not to be found that the *bertam* had increased very much and I could only suppose that so long as there were elephants in that part of the jungle they kept the *bertam* in check? That at least can go to their credit account.

Elephants are fond of most of the varieties of bamboo of which some large varieties, such as *Dendrocalmus flagellifer*, are common in Malaya in the higher country. When bamboos throw out fresh shoots elephants are particularly attracted to the vicinity, but they are liable to feed on bamboos at any time.

Bamboos in the Malayan jungle produce shoots almost every month in the year, and although in the hill country there is no real bamboo jungle, that is to say no great extent of bamboo except where it is a secondary growth on old Sakai (aborigines) clearings, there is no shortage of bamboo for elephants throughout most of the undeveloped country.

I have mentioned how mischievous young elephants can be, and when a herd raids cultivation or solitary elephants visit houses or shacks they often behave in a peculiar way and eat things which normally would not come within the scope of their diet.

I call to mind a case of a young solitary elephant which had taken a fancy to visit certain dilapidated huts around which there was a neglected grove of bananas. The people who lived near by, Sumatra Malays, left their houses to take care of themselves and the elephant no doubt emboldened by the lack of human occupation went farther afield than the shacks and started to investigate the inside of a house recently abandoned. He pulled down the rear side of the house and feeling about with his trunk found a sack of padi (unhusked rice) which he scattered all over the place. He also upset other things in the house and pulled down a lot of clothes which were hanging on a line outside.

I visited the place the following day and could see that the elephant had thoroughly enjoyed himself!

I followed the elephant, and after tracking him for about three miles, found where he had stopped to feed and rest. Presently still following his tracks I saw an enormous heap of droppings out of which protruded a piece of cloth. I thought this rather unusual so investigated. We discovered a complete and uninjured Malay sarong—the cotton skirt worn by Malays. This had probably come off the clothes line. I told one of my men to take it to a stream which was close by and wash it. This he did. We then proceeded after the elephant. Two days afterwards I returned to the road, hunted up the owner of the house which had been raided by the elephant and asked him if the sarong was his. He said it belonged to his daughter. I explained to him that such a sarong would now have magical properties because it had been carried through the jungle inside an elephant and had been recovered. Why I told him this was because Malays attach great value to an entire *durian* fruit that is supposed to have passed through an elephant and been deposited in its droppings.

The *durian* (*Durio zibethinus*) is the fruit most valued by Malays one reason being that it is credited with being an aphrodisiac. The potency of the fruit is greatly enhanced if it has been eaten or swallowed by an elephant but not digested!

An elephant is reputed to wrap the *durian*, which is covered with formidable spikes, in some leaves and swallow it whole. I need scarcely say that I have never seen anything of the sort. But elephants are fond of *durians* and will stamp on a fruit which has fallen from the tree and pick out the pulp covered seeds from the flattened mess of spikes. I have often seen where that has been done. It is inconceivable that an elephant can swallow a *durian* whole, but I relate the fable as illustrating the credulity of Malays. So perhaps the Malay got my meaning about the sarong!

I remember an incident where some Chinese arrived at a remote spot near a newly constructed road where they wanted to undertake some mineral prospecting work. They had already had a community house erected by Malays and they turned up one afternoon with two bullock carts—it was in pre-motor days—loaded with provisions, mostly rice, which they proceeded to store in the new house.

That night a small herd of elephants turned up and investigating this alteration to the landscape proceeded to pull the walls of the house down. The walls were only palm leaves. The Chinese had heard the elephants before they reached the house, and instead of blowing up their fires and beating some of the kerosene oil tins that they had with them and generally making their presence known, which would have scared the elephants, they climbed up into the rafters of the roof! Quite the worst place they could have gone to, especially with the elephants playing about below them and quite capable in their elephantine way of pushing the house over. The elephants played about with the provisions and scattered the rice everywhere. I happened to be on the spot a

day or two afterwards—the elephants had banned the prospecting and the Chinese had gone—and found rice scattered all over the road in front of the house. I examined the tracks of these elephants and followed the trail they had made when they left the vicinity. I noticed that rice was distributed along the trail and wondered how it had got there. I followed this rice trail for a mile and then came across the remains of a sack which had contained the rice and which an elephant had obviously brought to the spot from the house. It was not much torn and I can only suppose that it had got attached to an elephant's tusk and that he was unable to shake it off. His tracks did not show signs of panic so I suppose he did not object to the sack very much. He may have carried it with his trunk. Wild elephants often carry about in their trunks bunches of palm leaves with which to beat off flies and possibly this elephant thought the sack might serve such a purpose!

I was once after an elephant which had been causing some trouble, and had killed one or two people and created a reign of terror in the district he frequented.

We had a long trek after him. He took us up to the top of a hill, which at sometime or other had been cleared by Sakai, and was now covered with an oldish secondary growth of jungle. We knew we were close to the elephant; we could smell him. Presently, when peering about through the heavy undergrowth—his tracks criss-crossed all over the hill top showing that he had been there for some time—I saw what looked like a mound of earth but of a peculiar colour. Going a little closer I saw something waving about in the air and realized that what I had mistaken for a mound of earth was the stomach of the recumbent elephant and that what was waving about was a bunch of palm leaves held in his trunk. The leaves were being used as a fly switch.

I could then make out a little more of the elephant but the ground was unfavourable and there was a large ant-hill between myself and the beast which masked my view. An approach from another direction was ruled out on account of wind. I was close to the elephant, twenty yards at the outside, and I felt sure that when he stood up, as he was bound to do presently, I must bag him. Presently the fly switch stopped waving about and I saw the elephant very slowly bending one of his hind legs. I could not see his forelegs. I realized that he had our wind and was about to jump up. Perhaps an elephant cannot jump but his extraordinarily quick movements can only be described by that word. He bent his hind leg inch by inch until he had bent it pretty well as far as it would go, and then was on his feet and had swung round away from me so quickly that I had no chance of getting a bead either on his head or behind his shoulder. He was gone. I followed him for some time and came up to him in thick jungle, when he heard me, turned round towards me, and then swung away down a steepish hill side. He was gone again. The very rapid movements of this elephant on both occasions were really astonishing and I had no sort of a chance of killing

him. Perhaps he had a guilty conscience? I did get him the next day however. I slept on his tracks and followed him up into the foothills of the main range.

I have often seen letters in sporting papers discussing the habits of elephants and in some cases disputing the fact that elephants lie down to rest or sleep except very occasionally. I do not pretend to any first-hand knowledge of the African elephant but the Malayan elephant most certainly does lie down when he wants to rest. It is one of their regular habits to lie down during the heat of the day and I have often seen them or disturbed them when sleeping. One of the chances of getting a clue to the size of a bull's tusks is to examine a place where he has been lying down to find the impression of a tusk. They favour sloping ground, the side of a low ant-hill being a common selection for the mid-day nap.

That they also doze, I would not say sleep, leaning against a tree is true but this is no substitute for their regular sleep. In following a herd I have almost invariably found the spot where they have been sleeping during the daytime—sometimes lying almost in a heap! They often lie down in the vicinity of a favourite salt-lick especially if there is a youngster with the herd.

Elephants like tapioca (*Manihot utilissima*) which is grown in some quantities throughout the Peninsula. Sakai especially favour its planting it being an easy crop to look after as it wants no attention! Elephants pull up the shrubs and eat the tubers. Complaints are sometimes made that elephants are doing damage to tapioca plantations, which generally belong to Chinese; but there is usually some contributory cause.

I recollect one case where much damage was alleged to have been done to a Chinese-owned tapioca plantation. This place was inter-planted with rubber which was more valuable than the tapioca, and both products were suffering. There were two elephants accused of this marauding but when I visited the estate only one was in residence. I shot this elephant which practically lived on the plantation. The reason was not far to seek. The unfortunate animal had been wounded by a piece of a mild steel rod two inches long, sharpened at one end, which had been fired from a twelve bore gun. This 'bullet' was embedded in the muscles of the left hind foot, the elephant having been shot from behind. He had not only a badly swollen foot but was unable to walk except quite slowly. The other elephant was shot not long afterwards by a friend of mine who found that it had a terrible drop-spear wound in its back and was no doubt badly incapacitated. These two unfortunate elephants, unable to go their usual jungle rounds, found easily obtained food on this plantation and so practically lived there. They resented being driven away. Who can blame them? Try taking a bone away from a well-fed dog and see what he thinks about it? These poor wounded animals were unable owing to the action of man to go about their lawful occasions and had to get food as best they could.

I traced the steel rod to a Malay on the plantation who was employed by the Chinese manager as a 'hunter'—poacher would be a more correct term—and it was due to his action that one of the elephants lived on the estate. The fact that the elephant had been fired at was never disclosed to me at the time I went to the plantation to look for it.

This is a playful habit Malays have after having fired at an elephant; complain of damage to crops but never disclose the fact that the elephant has been wounded.

On one occasion I might easily have got into trouble. I was asked to deal with an elephant which was alleged to have caused a lot of trouble in a small Malay settlement.

I was very busy at the time and could only spare a day. So I left my house in the early morning, while it was still dark, and motoring about twenty miles arrived at the place where a track went into the jungle, taking me to the usual conglomeration of tumble down Malay huts and poor cultivation. An elephant had certainly been in amongst the bananas and weeds and I found that he had visited this place during the previous night, so I had a good chance of getting up to him. I had to get back home that evening and my tactics in dealing with the elephant had to be based on that fact.

I made careful inquiries, and I think I must have been suspicious, because I asked if the elephant had been fired at and was assured that it had not. The truth was that it had been fired at several times and only two days before had been followed up and once more wounded. These wounds merely annoyed it because it came back almost at once to have a few more of the banana plants.

When following it up I was, of course, unaware that it had been recently wounded, but was again I think suspicious when I found that it had travelled for miles and miles from this 'cultivation', and it was not until about mid-day that we came close to it. In those days I had a Malay tracker named Mat Yasin who had been with me for some years and who understood the habits of both elephants and myself. The elephant had followed the bed of a river for a long distance and had then turned up a steep hill which he steadily climbed. We were not far behind him but he was travelling as quickly as we were. Presently he stopped, and I said to Yasin that so soon as he started to feed we must come up to him. Sure enough in a few minutes we heard him feeding on *bertam* palms on a steep hill side along which his tracks had taken us. I could see him but only got a stern view. He was feeding and slowly moving along the hill side. The wind was wrong for an approach from above him; from down hill, I could see nothing. While manoeuvring for an approach—we were within twenty-five yards of him—I saw his trunk go up and wave about in the air. I knew he had scented us and turning to Yasin made a gesture of disappointment because I presumed that he would make off and it was too late to follow him farther because I had to get back.

While my head was turned towards Yasin I was startled to hear a shrill scream from the elephant who swung round and came

straight for us. He bobbed along through the thick *bertam* following his own trail where the palms were broken down and tangled up. I was so taken by surprise that I threw up my rifle without releasing the safety catch, took it down from my shoulder to see what was the matter, then pushed up the catch. The elephant was within ten yards of me when I fired. I almost missed him merely hitting him on the side of the face. Fortunately, that was not to his liking. He threw out both of his forefeet and slid along towards me doing his best to put the break on and pull up. I also was anxious to prevent him running into me so jumped down the hill side. As I turned, when clear of the track, I saw his stern disappearing up the hill. But he did not go far. I heard him stop, and no doubt he intended to fight, having got over the shock of the pain on the side of his face and the flash of the powder just in front of him. I reloaded, scrambled up the bank and almost at once saw him standing sideways on somewhat above me and about twenty yards away. I gave him both barrels behind the shoulder which finished the hunt. But it was quite close enough to be exciting.

Later on I measured where he had stopped and turned up the hill and found that he had slid along about five yards and actually came within six yards of where I had been standing. There were great furrows where he had tried to dig his toes in to stop himself.

This elephant was another victim of the indiscriminate shooting of Malays. He had only one tusk, the other had been broken off owing to a wound in the base of the tusk sheath; a nasty mess of suppuration and diseased tusk being in the socket.

His good tusk had been hit quite recently by a bullet and chipped near the gum. He had several fresh body wounds, mostly flesh wounds. What these unfortunate animals must suffer from these ill attempts to kill them is beyond estimation. No wonder they become rogues. The marvel is that one does not hear of more people being killed.

This is merely one instance amongst many that have been experienced by hunters who have gone after elephants wounded by Malays. A friend of mine was very nearly killed under similar circumstances.

I have in my house a collection of skulls of mature bull elephants and nearly all show signs of old bullet wounds. It is by no means uncommon to hear of elephants being killed with only one tusk, the other damaged or broken off short due to suffering from old wounds.

Elephants when unwounded are not difficult to drive away from cultivation; but when wounded become a very different proposition. The entire question of damage to crops by elephants is intimately connected with the large distribution of guns to Malays and the encouragement given to them to fire at elephants if in the vicinity of 'cultivation'. Elephants undoubtedly become a nuisance and a danger under such circumstances, but the ball is started rolling by irresponsible persons who will cheerfully fire at elephants and then leave them to their fate. Very few Malays would think of following up a wounded elephant, and when firing

at one will generally aim anywhere. Although there is a legal obligation on the person who wounds an elephant to report the fact, in actual practice they seldom if ever do so, with results similar to what I have related.

On one occasion I had a few uncomfortable moments when an elephant which I had fired at for the temple shot, but had failed to kill, came back on his tracks—running away, not charging—and got far too close to me to be comfortable. As he came back on his own track I fired at him again and then with an empty rifle nipped behind a big tree. He came as far as the tree, where I had been standing for some time, and stopped. At this exact spot he got my wind for the first time. Here was I with an empty rifle crouching behind this tree, with the elephant on the other side of the tree swishing his trunk about in the dead leaves trying to locate where the nasty smell came from. Fortunately his trunk did not come round the tree. He presently moved away and shortly collapsed. My second bullet had taken him through the trunk, down his throat, and finished up in his liver.

When one has hunted elephants as long as I have, especially in the dense jungles of Malaya, adventures are bound to come along at times. The man who always kills an elephant with one shot is not a hunter but a liar. It is the adventures that are the real attraction of the chase, besides one can always fight one's battles over again. As Sir Richard told Una in Kipling's story of 'Old Men at Pevensey'—'We talked together of times past. That is all men can do when they grow old, little maid'.

Just one more hunting incident. I was hunting in the mountains and came across the tracks of a sizeable elephant which I followed. He was an old beast with rounded front toe nails, but shortened by much hill climbing. An old elephant in the low country will have long toe nails because the older he gets the more he puts his weight on his heels.

It took me six days to get this elephant. He crossed the main range of the Peninsula three times. Twice he got our wind. That appears to have given him a fright and he travelled a long way. On one occasion we were climbing up a rocky gully which by some conjuring trick the elephant had scrambled up, feeding on wild bananas on the way. He was someway up the mountain and we were not very close to him, but the wind blowing up the gully must have given him a concentrated dose of human scent, well accentuated by our exertions. When we arrived at the head of the gully we found that he had rushed off, followed a ridge for a short distance and then hurled himself down a hill side almost as steep as the gully we had just come up. In his blind rush he went straight through a grove of the deadly *buloh semilian*, (*Dendrocalamus giganteus*), a bamboo which fractures with an edge as sharp as a razor, and normally avoided by elephants except when throwing out new shoots. He got a very nasty cut on his trunk for his panic, and bled freely. The wound, about three inches long, was still wide and gaping when I bagged him a day or two afterwards.

On the last day but one he left the mountains and following one of his old trails came to a place where we had, two or three days before, stored some rice to be picked up if we required it on the homeward journey. We had also stopped there to cook some food. He came to the tree where the rice was kept but was more interested in the ashes of our fire than the rice which he did not touch. Had he destroyed the rice we could not have followed him for the full six days because my carriers would have been out of food; he missed his chance and lost his life. After rummaging about amongst the ashes of our fire he turned off the track and went straight up the mountain again. When we did get up to him he was right on the watershed of the main range in rough country, where manoeuvring was out of the question; one could not follow his trail until close to him. About mid-day on the sixth day, we were climbing up the mountain side following an old elephant path which wound about trying to avoid the steepest places, when we heard him far above us. The only thing to do was to carry on along his tracks, but the broken nature of the ground with many wind eddies following the gorges gave him a good chance of getting our wind before we could get near him.

But our luck was good and gradually after some stiff climbing we were close to him. His trail followed a steep hill side round the head of a gully and following this we saw his enormous hind quarters across the gully. His head was hidden and any approach seemed impossible. He was right on the end of a little spur.

For once, when hunting, the wind did me a good turn. He got our scent; he could not go over the spur so slowly turned round no doubt intending to return by the trail we were on. As he turned he stopped for a brief second and gave me a perfect shot which I was not slow to avail myself of. He slowly sank to his knees and settled down into a sitting posture. He had a good pair of tusks weighing 75 pounds the pair. It was a long trek back to my main camp but nothing mattered now that the elephant was bagged and it had been a hunt never to be forgotten. That sixth day must have been the last day I could have followed him; our provisions were too low to allow me to go farther from my base. I may consider that I had great luck in bagging him at all, and he had had bad luck in not finding my caché of rice.

At times during periods of sexual desire elephants must come to trials of strength; but in all my years following elephants in the jungle I have never come across elephants fighting nor have I seen places where such fights have taken place.

The nearest I ever came to it was on an occasion when I was following a herd of elephants and became aware that overlaying the tracks of the herd was that of a fair-sized bull. There was a bull in the herd I knew, and it looked to me as if this second bull had either been told to keep his distance or was anxious to force his way into the herd. As we came nearer to the elephants we heard trumpet after trumpet and I hoped to have the thrill of seeing an elephant fight. But I think the trumpeting was solely from the following bull screaming in impotent frustration. He

hadn't the guts to force an issue perhaps? But he felt he had to take it out of something and presently he had his revenge on a tree!

He rushed at a soft wood tree of about 12" in diameter and by a mighty thrust split it in two. He drove so hard that he cut his gum on the fracture of the tree leaving a large blood smear where his tusk had entered. Well, I hope he felt better after that; we all know the benefit that accrues from letting off a little steam at times.

But elephants use their tusks in more useful ways than as safety valves. I remember seeing a coconut tree which had been pierced by an elephant's tusk and actually uprooted. This was done, I think, by accident, because the elephant having driven his tusk into the tree could not get it out again and in his struggles pulled the tree up. I felt sure that was what happened because he carried the coconut tree, presumably still stuck on his tusk, a distance of about thirty yards, where he got rid of it. This little diversion had shaken him so much that he did not wait to eat the coconut cabbage, the whole object of his attack on the tree, but left the place where the coconut tree had hit back, and cleared into the jungle.

Animals do sometimes attach any difficulty they get into to the place or locality that they are in and leave it as quickly as they can. I had a *siamang* gibbon (*Hylobates syndactylus*) for many years as a pet and this was a strong trait in his character.

Elephants sometimes uproot trees or push them over when suffering pain from wounds. At one salt lick where I went sometimes to search for tracks I picked up, on one occasion, the tracks of a big elephant which had been venting his rage or searching for relief from pain by knocking over trees in all directions. Although this elephant's tracks were only 24 hours old I never got up to him despite the fact that I followed him for six days. No doubt his abnormal restlessness was due to pain. He finally after leading me over a great extent of country came back to the lick, and as I was no nearer to him then than I was when I started, I went home.

I got this elephant the following year and as one of his tusks had been broken off short and there were recent lesions in the skull in the vicinity of the base of the tusk I connected his behaviour the previous year with these wounds.

It is not a very uncommon thing to bag a bull elephant that has lost its tail or part thereof, I have shot three whose tails have been so mutilated. Malays believe that the bull elephant loses part of his tail by the action of a jealous female which taking him at a disadvantage pulls his tail until it breaks!

It seems to me more likely that these mutilated tails are due to the attacks of tiger when the animals are still young. Tigers do attack young elephants even when nearing maturity. I was hunting at one time up a river where seladang were often to be found. I had made camp and as it was only five o'clock on a fine afternoon I thought, as I had been in a boat all day, that a little exercise would do me good. So I went up the river to a

large abandoned clearing where seladang sometimes fed in the evening. When coming round a bend in the river I saw an animal moving along a sand bar coming towards me. I could only see the top of its back from where we stopped. I climbed up the bank and sure enough there was a young female elephant coming along slowly on the edge of the river. Presently the elephant entered the river and started throwing water all over her, then reaching the opposite bank found a mud hole and squirted the mud all over her back. She looked rather peculiar and examining her with my glasses—she was fifty yards away—I discovered that her right ear was half torn off and her flank was badly scored. These wounds must have been the work of a tiger. She looked pretty woebegone as she passed into the jungle and went on down stream. We had come about half a mile from camp and if she continued the way she was going she would bump right into my camp.

There were three men in my camp and this is what they told me when we got back. One of them had gone down to the river to get water, when looking up stream he saw an elephant only a few yards from him. He did not bother about the water but made best time up the bank, told the others what he had seen and shinned up a tree which was just in front of my tent. The others wasted no time and did the same thing. They were hardly well settled in the branches of this tree, well out of the way of all elephants, when the elephant appeared directly opposite them, crossed to a sand spit where my boat was fastened up, passed the camp and came to a clothes line on which there were some clothes. Here she stopped and the men up the tree in the valour of their ignorance shouted at her. They were quite safe but they never thought of the camp. That shout was too much for her nerves; she gave a little squeal and ran up the bank using the steps I had had cut and arrived actually at my tent door and directly below the tree which sheltered the three brave men

She stopped there a moment and then slowly walked into the forest. She touched nothing, and I was extremely lucky.

Next day I went down the river. During the night the elephant had followed the river for about ten miles, no doubt frequently bathing her sore body. At one place she had lain down on the wet sand. Finally she joined up with the fresh tracks of a herd, which had come from up-river but had not followed it. I expect that this was her herd from which she had been 'cut out' by a tiger.

In addition to the danger to cultivation from wounded elephants travellers in the jungle are also liable to suffer from their depredations.

A river which I sometimes travel up to visit salt licks is frequented by a small herd of elephants that undoubtedly had for sometime a wounded or seriously incapacitated elephant amongst their number. I noticed more than once a peculiar track mixed up with the normal tracks of the herd, and came to the conclusion that one of the elephants had a damaged hind leg, or was hurt

in some way so that it had not proper control over one of its hind legs.

Subsequent to noticing this I was camped on the river bank, on a site often used by me, and having occasion to go farther up the river left some canned provisions and three drums of benzine, well hidden as we thought, in the jungle near the camp site. I was thinking of human marauders, not elephants.

When we came back some five or six days afterwards we found that some elephants had visited the site, had carefully hunted out our 'well hidden' benzine tins, stamped them flat, and finding the provisions proceeded to scatter them about with a malicious thoroughness worthy of a better cause.

The frame of my camp was smashed to pieces and to complete the insult an elephant had tried to make a wallow just in front of where my tent was usually erected.

I had frequently used that camp site and elephants had often been around but, with one exception which I will presently relate, no elephant had ever come close to my camp. Not long afterwards a dead elephant was found on the river bank within a few miles of this spot. It was one of the herd that had raided my camp site and I believe it is permissible to suggest that the herd, normally of good behaviour, were incited by the presence of a wounded elephant to forget their usual good manners.

The other incident was more exciting because we were in camp at the time. At about 2 a.m. I was awakened from a sound sleep by my tent coming down on top of me. I thought that the branch of a tree had fallen on my ridge pole and broken it, and jumping up with a shout I struggled from under the canvas.

A couple of tapir had been round the camp the previous night and one of my men who slept close by, hearing a noise, got up with his electric torch and came towards my tent thinking that he was going to see a tapir or possibly two.

But he got a severe shock when he heard a crack, saw one end of my tent collapse, and the hind quarters of a smallish elephant disappearing into the jungle.

Investigations next morning showed that this elephant, a small tusker still in the playful stage, had come out of the jungle, walked along beside the wall of my tent, then investigated my cook shed which he did not seem to appreciate, turned back following the same route and passed behind my tent the back of which he proceeded to examine. I still slept! While doing this he knocked over a tin dipper which clattered to the ground. This scared him, and turning round hit my tent pole with that part of his anatomy which should never be used as a weapon, and broke it in two. Down came my tent but by that time he was well and truly frightened so made tracks for the jungle. The herd was not far away but the little bull had wandered off by himself as they so often do.

This happened before there was a wounded elephant in the herd, so far as I know.

The Malayan Elephant and his Salt-licks.

I believe that in the Malayan jungles the salt-licks, so widely distributed, are an important factor in the life story of the elephant. But although they have no doubt contributed to the contentment and good health of many species of large game, they have also caused them much suffering and loss through the agency of poachers. A salt-lick is an easy place for a man, with no great desire to work, to sit up and hope for a chance shot at something that may come into the lick, seeking the sulphur water which most of these licks contain.

So for many years some of those Malays who possessed guns took advantage of this habit of wild animals, and hoping to have pot shots either from the safe vantage of a tree, if a large animal such as an elephant, a rhinoceros, or a seladang was the desired object; or from a shelter on the ground if after sambhur or barking deer. An enormous number of animals have been fired at, some killed, but many more wounded, and animals gradually developed a technique which kept them away from salt licks except at night. Then the electric torch appeared on the scene and night shooting in salt licks came into fashion. This would be designated by certain types of mind as 'progress', and it may be from one point of view, but it meant annihilation for the wild animals.

The law in Malaya prohibits these acts but it is weakly administered and these tricks are not altogether checked so far as deer are concerned. Elephants have suffered from being shot at out of trees, as the testimony of skulls that I have give proof, and I think that the large number of elephants with one or even two tusks damaged that have been shot in Malaya, shows that there have been attempts to kill many more elephants than is generally supposed. But other means are used besides sitting up in trees over salt licks. I shot an elephant on one occasion which had five scars on its stomach which had healed up but which must have caused it endless pain and inconvenience when freshly inflicted. These five scars, more or less evenly spaced, were where five bamboo spikes had penetrated its body when going down a steep bank on an elephant trail to cross a river. The excuse for doing these acts is generally that they have been set to keep elephants away from 'cultivation', although there might be no cultivation within miles that counted for anything. I have seen these infernal things set on trails and can imagine how easily an elephant can be injured by them. The trails leading to salt-licks were favourite places for setting traps of various sorts, and it was, I think, on the approaches to the salt-licks or in the licks themselves that most of the harm was done.

I have inspected many remote salt-licks in my time and in all the larger ones I found tracks of elephants. But although I know from such observations that elephants frequently used these licks, I have only been able to get photographs of elephants in one lick, in fact have only seen elephants in this one lick.

So my remarks regarding the actual behaviour of elephants in a salt-lick, as seen with my own eyes, refer to one lick, although I have of course been able to read from their tracks in other licks something of what they have been doing during the hours of darkness. The one lick where I have gleaned much from watching elephants is situated in the remote jungles of Pahang, not very far from the main range and is known as *Jenut Lanau*. *Jenut* is one of the words used by Pahang Malays for salt-lick; other words being *Taram* and *Sesap* or *Sesapan*, although the latter word is never so far as I know used for a sulphur-spring lick. In Perak the word used is *Sira*.

Jenut Lanau was a very favourite haunt for poachers a few years ago; it has a great attraction for sambhur and no doubt many have given up their lives in the vicinity of the lick.

Although elephants have been fired at in this lick, I think that owing to it being an exceptionally good sulphur lick, that is to say it has a potent sulphur spring which never seems to run dry, elephants still risk visiting it in the daytime. Also the lick has been pretty well guarded during the last few years. It is within a day's journey of my house!

The reason for so many of the licks being avoided by elephants during the day time is, I think, because their traditions warn them of the danger during the daylight hours. Even at *Jenut Lanau* elephants are often in the vicinity of the lick, but only visit it during the night; in fact most of their visits are at night. There is a very old elephant which sometimes comes to *Jenut Lanau*, but I have never been able to catch him there during the day-time although on several of my visits I have found his tracks and learnt that he had been there during the night. Now there is a story attached to this elephant, which although mostly in the realms of conjecture, is worth relating.

One of the main game trails taking one to or from *Jenut Lanau* follows for a short distance a steepish hill side, the other boundary to the path being a small river that at this point is a short but not very steep waterfall.

I noticed on more than one occasion that when this elephant had visited the lick and had followed this particular game trail, either coming or going, on reaching the steep hill side he left the trail and used the waterfall as his trail. Although it is not steep the rocks are very slippery and I should want to hold on to something if I walked down it. But this old elephant, with its peculiarly careful tread, stepping with great care from flatish rock to flatish rock made his way up or down this small waterfall and then turned to join the game trail again. A very old elephant has a characteristic gait. He walks with great circumspection placing his feet down carefully and cautiously so that if the ground is at all favourable he leaves a very clear and even impress of the sole of his foot. The natives in parts of East Africa have noticed this peculiar trait in old African elephants and the Swahili refer to this way of walking as '*uvendo wa kimgonge*' which means 'the gait of a chameleon', which also walks with a very deliberate tread.

The Asiatic elephant does the same thing and in the low

country, a very distinctly marked track usually showing long toe nails, almost invariably denotes an old beast.

This was the reason why I thought that the track I had seen in *Jenut Lanau* was that of a very old elephant. I was unable to find a single place where I could with any exactness measure the track of his forefoot. He had, wherever there was a piece of level ground, placed with great precision his hindfoot over the impression of his forefoot. I took several measurements of the impression of his hindfoot which taped 18" in length and 13" in breadth.

I do not think that this elephant comes very often to *Jenut Lanau*, in fact it is probably merely a visitor not a regular habitué like my friend shown in Plates Nos. 6 and 7.

On one occasion Wan Teh, my assistant camera-man, was sent by me to visit *Jenut Lanau* and I gave him a cine camera to take with him. He had the extraordinary good luck to find two elephants in the lick when he arrived there one afternoon.

Unfortunately there was no hide—the old hide had been knocked down by the young elephants in the herd that frequently comes into the lick—and a Malay is not good at improvising especially in the presence of a wild elephant!

But Wan Teh went to the place where the hide is always built and made a sort of shelter from which he proceeded to photograph the two elephants in the lick. They were both big elephants, but the bigger of the two, who was in possession of the lick, was facing the wrong way round so all Wan Teh got was a good piece of film of his stern. The other one, waiting his turn, wandered about on the outside of the lick but mostly behind trees or masked by the elephant in the lick. He appears in the cine film in one part emerging from the background with a bunch of palm leaves which he is using vigorously to keep off the flies. He had a fine pair of very curved tusks.

The head of the one in the lick was only very occasionally visible when he shifted his position a little. On the right side he had a very long straightish tusk, on the left the tusk had been broken and there was merely a stump in the socket.

Unfortunately the opportunity of examining the tracks was not taken by Wan Teh so I got no measurements of the foot prints. From the cine photograph I have no hesitation in saying that I have never seen either of those elephants in that lick before, but from the pictures it is clear that the one with the broken tusk was an old animal.

When I first noticed the 'elephant's way' I wondered why the tracks went down the waterfall and examined the proper game trail thinking that perhaps there was a big tree or some other obstruction that he wanted to avoid. But there was nothing of the sort, in fact the trail had been followed by a small elephant only a day or so before. This set me thinking; because an old elephant does not go down a slippery waterfall for fun.

I thought of poachers and the convenient contour of the ground which provided a waterfall on one side of the game trail and a steep hill side on the other. In fact the trail was situated in an ideal spot

Copyright] "YES, THIS IS MY SALT-LICK." [*T. Hubback*

for the fixing of a drop-spear, or *penurun* as the Malays call it. The *penurun* is generally made by fixing the blade of a spear or a piece of wood hardened in the fire, into a log of wood which may be anything up to ten or twelve feet long. This log of wood with the spike attached is then suspended over a game trail and a trip rattan is fixed across the trail about the estimated height of an elephant's back. The rattan when pushed by the elephant releases the drop-spear which is connected by an ordinary trigger as used in bird traps, and the spear descends and probably hits the elephant somewhere. The uncertainty of inflicting a mortal wound is great but that did not trouble the poacher; if he got one in ten what did he care for the sufferings of the other nine?

I thought that it was quite possible that this elephant had been hit by a *penurun* when following the trail, had been wounded by it somewhere in the head so as to damage one of his tusk cavities, and had avoided the trail ever since. But as I knew that no *penurun* had been set near that salt-lick for many years, I felt doubtful about ever finding a solution to the reason why the elephant disliked that part of the trail. But after Wan Teh had got a photograph of what I believe must have been the waterfall elephant, I started to think again.

I could see from the projection of the cine film that this elephant had only the stump of a tusk on the left side, and as so many elephants in Malaya break off tusks because of wounds in the head, I thought that perhaps here was the solution to the 'elephant's way' down the waterfall. So the next time I went to *Jenut Lanau* I hunted about to try to get any clue towards the idea of a *penurun*. I could see nothing on any of the big trees which overshadowed the game trail to lead me to believe that they had been cut for the attachment of a drop-spear, but then probably if there had been anything of the sort it would have eliminated years ago. But sometimes one stumbles across evidence quite by accident and I did here. There was a large old fallen tree, many years fallen, right at the commencement of where the trail started to follow the hill side. In fact, when the elephant went down to the waterfall he stepped off the trail and across this tree to reach the stony river bed. I thought I would remove this tree because it obstructed the path and there was a nasty slippery rock directly on the downstream side of it. But I found that this old tree was anything but rotten and it took some work to get it out of the way. While doing this I discovered that far up the tree,—I could not estimate how far—a branch had been cut off and it would have been quite high enough for the attachment for a *penurun*. The *penurun* attachment would have to have a tree on the other side of the track, but I could see no signs of this; it may have rotted away long ago. The only reason why the tree I removed was still there was because it was a hardwood tree which would last for years.

Of course this story is mostly speculation and may not have any relation to the real facts, or have any connection with the elephant and the waterfall; nor may the loss of one tusk have had anything to do with the agency of man. But no man would climb up a big tree to cut off a big branch without some reason

for doing so, so I may not be so far wrong. At any rate it is always instructive to try to reconstruct some happening in the jungle the complete solution of which is bound to defeat one.

But the elephant which has given me more enjoyment in this salt lick than any wild animal I have become intimate with is the bull shown in Plates Nos. 6, 7, 8. I have seen him twice by himself and once with another bull. But his most dramatic entrance and exit was the last time I photographed him.

I was by myself in the hide; Wan Teh having overeaten himself remained in camp with the punishment of a severe stomach ache. I had just got everything ready and had sent the man away who had come with me from camp with the apparatus, when in front of my hide I saw a large bull elephant walking sedately and slowly out of the jungle towards the pool where the lick was. This was at 9 o'clock in the morning, the light was none too good but came from a better direction than the afternoon light which I had always had to utilize on previous occasions.

As this great tusker came into the lick—I saw him almost directly he left the jungle because I happened to be looking in that direction—moving slowly across the grass (maidan), my mind saw in the apparition a great cardboard figure moving with the regularity of a clockwork elephant. It seemed to me for an instant so unreal, so unbelievable, so bizarre, that I had to take hold of myself to get down to earth and action. This is very crudely put but the psychological effect on me was something of that sort.

Had there been the slightest noise the incident could not have affected me in that way, noise means realism, but this great elephant came through the jungle without a sound; as is their wont.

I had a cine camera and two still cameras to look after, rather a handful. They were of course all on stands.

I used the cine as the elephant was coming into the lick but when he was well down to it in the pool I locked the mechanism and left the camera to run. I knew he would not go out of the picture; he was much too busy to leave the sulphur spring or materially alter his position.

When he arrived at the pool, a pool which gets fouled by elephants' droppings, he started to stir up the muck to get it out of the way I suppose, and then felt about with his trunk for the spring which was about two feet below the mud and water. Presently I saw his trunk quivering and then with a mighty blast from his trunk he blew all the dirty water away from the mouth of the spring and got busy. He blew water over his head and his back and between his legs and then started to drink a most astonishing number of times. He was actually in the pool for a quarter of an hour and most of the time he was squirting water down his throat. He was very careful when he put his trunk down to get the exact place where the sulphur water issued from the rocks at the bottom of the pool and I could see quite plainly that sometimes he had difficulty in satisfying himself that he really had got to the right spot. He evidently liked his medicine undiluted.

Copyright] GETTING DOWN TO IT. [*T. Hubback*

I had put down some salt and phosphate someway from the pool as an attraction for deer. The elephant smelt this as I saw him reach out once or twice with his trunk towards where this mixture was; but he made no attempt to investigate.

When he had satisfied his wants he slowly turned round and retraced his steps along the same trail he had entered by and disappeared into the jungle. What so impressed me at the time was that when he came in and also when he went out there was not a sound, and even in the pool it was only when he blew the mud up and once or twice when he bathed himself that there was any noise at all.

This elephant is, as I know from his tracks, a frequent visitor to this lick, as I have already written I have photographed him three times. He is easily identifiable by a bad scar on his trunk between the gums of his tusks, which is shown in the photograph reproduced here. (Plate No. 8.)

I think it is a great privilege to be able to watch any large animal going about its lawful occasions quite unalarmed, and no wild animal is more impressive or gives one a greater thrill than an elephant. It is only possible to appreciate their position and their prestige in the animal kingdom when one sees them, as I have often seen them, in their true habitat, in their natural environment, living as they were intended to live, and filling that function in nature that they have been created to fill.

An Elephant's Salt-lick Party.

Perhaps the most interesting incident that I observed and photographed in this salt-lick in Pahang was when a small herd of elephants came in late one afternoon, the star turn being a small calf and the comic turn being a well-grown bull.

I had two friends with me who had come from Singapore and I took them up to *Jenut Lanau*. They had only three days to spend with me and, unless lucky, three days is too short a time to be at all sure of seeing anything even in that salt-lick.

When we visited the lick we found that a big solitary elephant had been in during the night, so our hopes ran high. But he did not come in again while we were there. As so often happens a small herd followed the big bull and the night before my friends had to get back we were awakened by elephants trumpeting from the direction of the lick. It was bad luck on my friends that the elephants were a day or two too late. Before they left in the early morning I took them down to the lick but the elephants had gone. However they were able to see how they had enjoyed themselves in the lick. Obviously this small herd had been in the lick most of the night.

Later in the day I went to the hide and set up my apparatus. At four o'clock in the afternoon I heard the elephants trumpet and again at half past four, but nothing happened until five o'clock when, with a little scuffling noise to my right as the elephants crossed the small stream which runs in front of my hide, three

elephants walked quickly across my front and plunged into the pool. Plate No. 1 shows them as they started to drink in the lick. The small calf, as it came into the open between the two cows, had all its time cut out to keep up but they arrived together and as can be seen by the photograph all drank together. I was busy with my cine camera when my assistant touched me on the arm and said, 'Here comes the bull', and sure enough on the trail which the cows had followed was a good sized bull with poor tusks.

He did not attempt to enter the lick where the cows were but turned short right, went all round the fallen log a portion of which can be seen in the photographs of the lick, and came in from the far side. But the cows had the front seats and I presume, from watching the proceedings of the big bull as shown on Plate No. 7 where he is trying to find the exact place where the sulphur exudes from the rocks, that they were disinclined to give up their good places to any intruder.

Now the bull could have pushed the big cow out of the way very easily if he had wanted to do so, but perhaps elephants are like human beings and very often the lady wears the trousers so he made no attempt to use his great strength to get at the right spot in the lick. But he gently pushed and pushed at the cow, sometimes with his forehead and sometimes, very gently, with his tusks. But although as can be seen in Plate No. 2 he pushed the cow slightly out of the perpendicular he achieved nothing. In the meantime the other cow, the *pengasoh*, was stirring up the mud and making as much mess as she could. The calf did not like this so backed out from between the two cows and went off to explore for himself. He was still quite small and as can be seen from the photograph was still suckling. His little undeveloped trunk waved about, he touched the tree which was directly in front of him several times with the tip of his trunk not quite certain perhaps whether it was something good to eat or not. In fact he did not know what to do with himself.

Presently two other elephants came to the edge of the jungle, but not within clear view, and turned away to one side, not coming into the lick. Perhaps they saw that the house was full; anyway so long as I was there they did not appear again. The bull in the lick seemed very uncertain what to do: the cows ignored him and carried on. I do not think he appreciated this because he started stirring up the mud, occasionally throwing water over himself and incidentally the cows, in fact generally making a nuisance of himself. Then he started to wave one of his forefeet in the air just above the water with a circular motion of his foot. Sometimes he just touched the water skimming the surface. He did this for some time but what he was trying to do was beyond me. Any scum that may have been on the water had been mixed up long ago by the cows; I think it was just annoyance and indecision as to what to do about it. Soon my films were used up and as it was getting late and the light almost gone we packed up and left the elephants to it. Just as we were leaving I turned back to bid the elephants a pleasant evening when I noticed that they

Copyright] "YOU WAIT YOUR TURN." [*T. Hubback*

had all turned round and were now facing the hide. But the bull was still an 'also ran' the cows sticking to the best places.

Next morning one of my men went down to the lick and found an old cow in possession. I went down a little later and the indications in the lick showed that the elephants had been there most of the night. But we had to go down river that morning because I had to pick up my other boat on another river about noon, so we left the elephants to enjoy their salt-lick party. I expect the bull got there finally—its a way they have—but he certainly was exceptionally polite and was a good example to *Homo sapiens*.

Conclusion.

Well, we will leave the Malayan elephant for the present and hope for the best.

They can well look after themselves in Malaya's luxuriant jungles if they are given a fair chance to do so, and so long as there are properly guarded sanctuaries of sufficient area to accommodate them, they will survive.

But 'progress' in Malaya, which means commercialism *in excelsis*, is no friend to wildlife.

Unless public spirited and independent persons, who know and appreciate the value of wildlife from educative, recreative, and aesthetic standards, will fight for the proper preservation and intelligent conservation of the elephant, and the seladang, the rhinoceros and the sambhur deer, Malaya, with its polluted rivers, its mining wastes, its ever increasing erosion, its uneconomic forest exploitation, will become in a few decades a zoological wilderness, and the larger types of the fauna will become memories only.

Appendix.

The following particulars of weights and measurements of tusks of the Malayan Elephant are given to support the contention in my introduction that the Malayan Elephant is not inferior to the Indian Elephant regarding the tusks it carries.

The tusks recorded under No. 1 are very exceptional for Malaya; the others may be considered as typical of mature tusks although No. 2 is rather above the average.

No. 1 was obtained in Johore during the last four or five years, the others in Pahang, twenty to thirty years ago.

Generally speaking the elephants near the coasts carried the heaviest ivory, but No. 3 was a mountain elephant and is mentioned in my narrative.

Schedule.

	Length outside curve		*Circumference at gum*		*Weight in lbs.*	
	Right	*Left*	*Right*	*Left*	*Right*	*Left*
No. 1	7′ .5¼″	6′.10½″	17⅜″	18″	75¾	70
No. 2	5′.10″	5′.9½″	15″	16″	44¾	46
No. 3	4′.10½″	4′.10″	15½″	15½″	38	37
No. 4	5′.6″	5′.2″	15⅛″	15″	36	32

THE EARLY STAGES OF INDIAN *LEPIDOPTERA*.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART VII.

(*Continued from page 294 of this volume*).

GRYPOCERA.

HESPERIINAE.

Syrichtus galba F.

Head round, rusty black, and sparsely clothed with longish coarse black hair. 1st somite slender, orange, edged posteriorly with black and with a median yellowish-white stripe. Rest of the body bluish-green, with a slightly darker dorsal stripe, and covered with white granules. Body clothed with moderately long white pubescence, the 1st somite in addition with black hairs similar to those on the head. 1st pair of legs blackish, 2nd and 3rd pairs and prolegs bluish-green. Lives in a folded leaf.

Pupa in a folded leaf lined with white silk. Of the usual Hesperid shape. Thorax bluish-green, wing cases green and abdomen pale pinkish with a subdorsal series of greyish spots. The whole body subsequently develops a dense white bloom giving it a general pale lilac appearance. The following markings are not obscured by the bloom—a large black spot on the thoracic spiracle, two small black spots on the vertex of the head and a blackish streak across the eye. Except for the wing cases, fairly thickly covered with moderately long white hairs. Anal end enclosed in the cast larval skin, which is attached to the silk lining of the leaf.

Food-plant—*Sida rhombifolia* Linn. (Malvaceae).

Described from a full-fed larva found in Calcutta 15-xi-40, pupated 18-xi-40, and a male emerged 25-xi-40.

HETEROCERA.

THYRIDIDAE.

Striglina scitaria Wlk.

Moore, *Lep. Ceyl.*, iii, 206, pl. 175, fig. 1a. 1884-87.

Hamps. *Fauna Brit. Ind.*, Moths, i, 354. 1892.

Head large, very dark brown. Ground colour of body greenish-yellow, with a darker green dorsal line due to the contents of the intestine shewing through the skin. 1st somite posteriorly with a raised black transverse line, divided centrally. 1st to 3rd somites

each with a raised black sublateral dot. 2nd and 3rd somites each with a double raised black spiracular dot, a larger subdorsal dot and a still larger one between it and the spiracular dots. 4th to 10th somites each with a double raised black spiracular dot, a subdorsal dot and another slightly above and anterior to it. 11th somite with four raised black dorsal dots and a spiracular one. 12th somite with a transverse row of four rather larger raised black dots. Anal flap edged with a raised black line. A few white hairs. Legs, prolegs and venter yellowish. Lives in a silk-lined cell in a folded leaf. Before pupation the ground colour turns bright canary-yellow.

Pupa in a spun together leaf lined with white silk. Dark reddish chestnut. A slight projection between the eyes. Slightly waisted between the thorax and abdomen. Spiracles set in very large, deep cavities. Cremaster, consisting of a bunch of hooked spines, fixed in the silk lining of the leaf.

Food-plant—*Phaseolus* sp. (Leguminosae).

Described from a full fed larva found in Calcutta 6-i-41, pupated 9-i-41, and a male emerged 19-i-41.

Moore's description is 'Larva with 16 legs; cylindrical; with a few fine short dorsal hairs; olivaceous, with a few transverse series of black dots on third to last segment; second segment ochreous; head blackish. Pupa dark purplish brown.' Hampson's description follows this very closely, except that it is the first segment which is described as ochreous and the spots are said to be on the second to terminal segments.

LYMANTRIIDAE.

Leucoma submarginata Wlk.

Moore, *Lep. E. I. Co.*, 336, pl. 14, fig. 11a.
Hamps., *Fauna Brit. Ind.*, Moths, i, 487. 1892.
Strand Seitz, *Indo-Austr. Bombyces*, x, 311.

Ovum round, rather flattened, the micropylar area depressed. Unsculptured. Bright translucent green when laid, after twenty-four hours the green becomes duller and a dark red-brown ring develops round the upper edge under the chorion. Turns brown shortly before hatching. Laid singly or in twos and threes. Hatched on the sixth day.

Newly hatched larva with the head and body greyish white, a subdorsal dark grey stripe broken on the 1st, 8th and anal somite by a transverse band of the ground colour. Hairs white. Does not eat the eggshell.

Final instar—Head velvety black, the clypeus filled in with white. Body velvety black, a series of lateral white spots, varying considerably in size, and a white transverse dorsal line between the 1st-2nd and 2nd-3rd somites. A second form is similar except that the lateral white spots are obsolete and there is a double greyish white dorsal stripe between the 4th and 11th somites, interrupted on the 7th. A third form has the head brick red, the clypeus outlined with black and filled in with white. Ground colour black with a series of numerous transverse pale greenish yellow

lines. A sublateral series of slightly oblique, pale greenish yellow lines, the whole forming a broken sublateral line. In all forms, 1st somite with a black subdorsal tubercle tufted with greyish hair. A double dorsal and a subdorsal series of rosettes of short greyish hair, a single dorsal tuft of longer black hair on the 3rd, 7th and 12th somites. A sublateral series of rosettes of medium length grey hair. Thoracic and anal somites with single long greyish hairs. Legs and prolegs brownish. Dorsal glands greyish. Venter dark grey.

Pupa in a slight net of white silk. Typical Lymantriid pupa in shape. Colour pale frosted green, the spiracles black. Cremaster a pale brown blunt spike, armed with minute hooks, and fixed in the silk of the web.

Food-plant—*Lagerstroemia indica* Linn., but this is probably not natural as only three larvae reached maturity and these were very undersized. The newly hatched larvae were offered *Terminalia catappa* and Mango, said to be foodplants of other species of the genus, also *Quisqualis indica* and Peepul, but refused to feed.

Described from larvae bred from ova from a Calcutta caught female, one of which pupated 11-i-41, and a male emerged 16-i-41.

Hampson's description is as follows:—'Larva pale fuscous, with long, scattered, simple, and spatulate hairs; a dorsal tuft of long black hair from the second somite; subdorsal and sublateral black lines; the first and second somites banded with black in front; the second somite with a yellow band also.' Seitz gives an almost identical description and adds 'Pupa green with black spots on each side of the thorax, somewhat flattened and curved, suspended in some netted threads.'

Noctuidae.

Spodoptera pecten Guen.

Ovum pale bluish-green, spherical with the base flattened, and with numerous ribs running from the micropyle to base. Laid in large batches, sometimes two or three layers thick, and covered with hairs from the anal tuft of the female. Hatched on the fourth day.

Newly hatched larva with a honey-coloured head, body greyish with minute black specks and sparse black hairs. After feeding the ground colour becomes green.

Half grown larva with a honey-coloured head, body smooth, green with a dorsal and subdorsal white line and sublateral white stripe. In some examples the sublateral stripe is edged above with dark reddish brown, and in a very few there is a reddish brown dorsal stripe in place of the white line.

Larva in penultimate instar very variable. Head honey colour with an inverted dark V-shaped mark. Body greyish-brown with a paler dorsal and subdorsal stripe, a paler sublateral stripe edged above with darker. *Or* with a broken black line above the subdorsal stripe. *Or* with a broad yellowish-green stripe below the subdorsal stripe, which may or may not be edged above with a

broken black line. Venter greenish-brown in the brown forms, green in the forms with the green stripe.

Full grown larva—Head olive-brown with an inverted whitish Y-shaped mark, the area between the arms honey colour. Ground colour of body pale brownish-grey or greenish-grey. A paler dorsal and subdorsal stripe, the latter edged above with a series of black lunules, and a pale spiracular stripe edged above with a purple stripe. 1st somite with a dorsal plate with a white dorsal and subdorsal line. Legs pale brown. Venter and prolegs greenish-grey. Spiracles black.

The larva is very similar to that of *S. mauritia* Bsd. (mihi, *Journ. Bomb. Nat. Hist. Soc.*, xl, 687) but is slightly smaller.

Pupa subterranean in a slight earthen cocoon. Bright red brown, a dorsal stripe on the abdomen and the intersegmental rings darker. Cremaster a double spine.

Food-plant—Grasses.

Described from a number of larvae bred from ova from a Calcutta caught female, one of which pupated 27-xi-40, and a female emerged 5-xii-40.

Spodoptera cilium Guen.

Ovum greyish-green, spherical with the base flattened and with numerous ribs running from the micropyle to base. Laid in fairly large batches and covered with hairs from the anal tuft of the female. Hatched on the fifth day.

Newly hatched larva grey, the head black. Hairs dark. Turns greenish after feeding.

2nd instar—Similar, but the head very pale honey-brown.

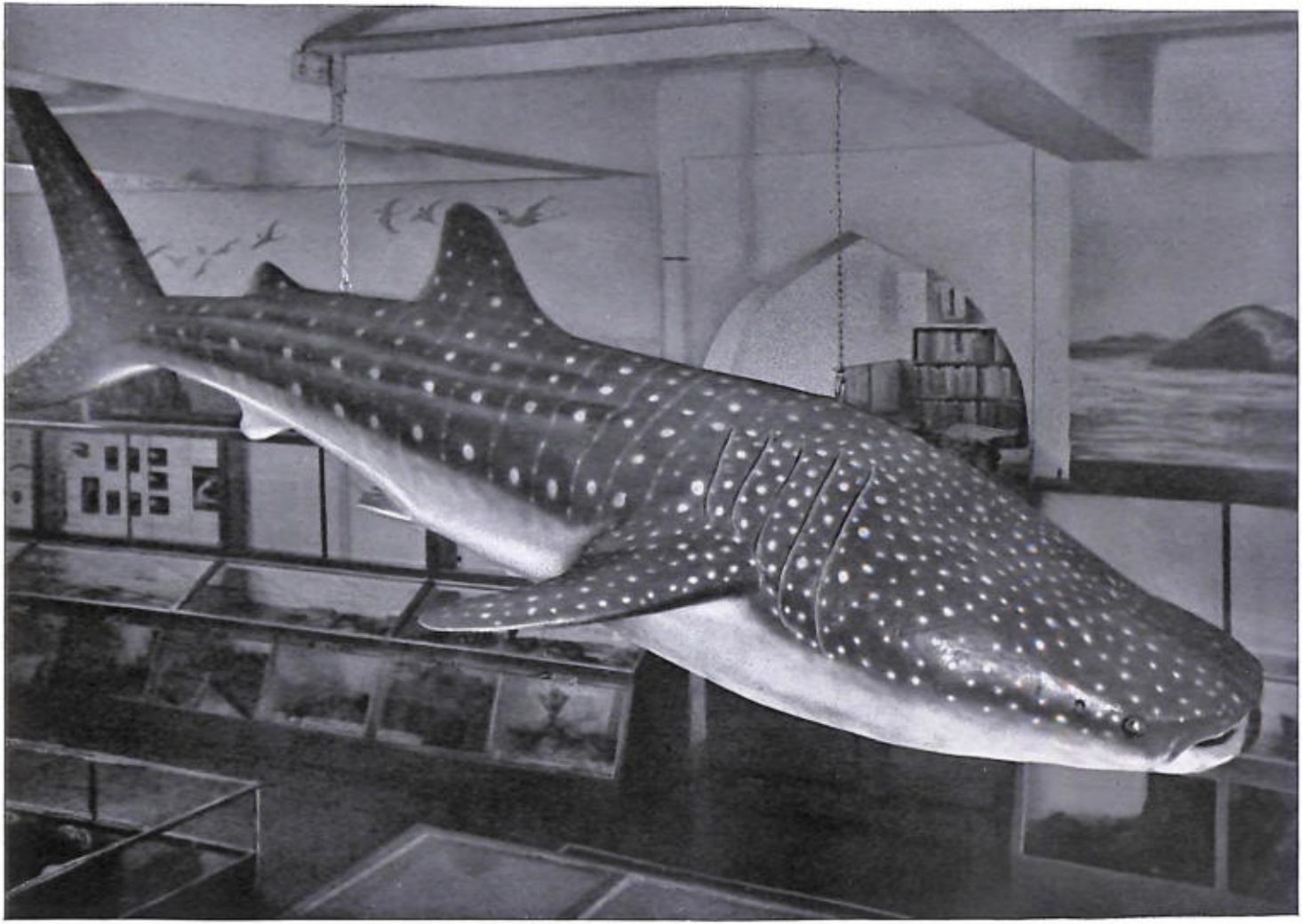
3rd instar—Similar. A faint white subdorsal and lateral line, a whitish subspiracular stripe. A number of minute black dots.

4th instar—Similar.

5th instar—Similar, the subspiracular stripe, in most examples, edged above with dark brown. Some with the dorsum tinged with reddish brown, extending in a few examples all over the body. Later a subdorsal series of black lunules usually develops.

Final instar—Head dark olive-brown, a pale inverted V-shaped mark, the arms filled in with paler olive-brown. Body dull drab, a narrow paler dorsal and subdorsal stripe, the latter edged above with a series of black lunules almost obsolete on the 1st-3rd and 11th-13th somites, and a narrow dark purplish spiracular stripe edged below with paler. Venter greenish. Legs and prolegs greenish. Spiracles black. A second form is similar except that the subdorsal stripe is tinged with green, and the area between it and the spiracular stripe is pale green. The black lunules are sometimes obsolescent, or even obsolete, those at the ends disappearing first.

It is, perhaps, interesting to note the sequence of colour changes in the larvae of this species, *S. pecten* and *S. mauritia*. The first instar larvae of all three species are alike, except that the head is black in *cilium* and *mauritia* and brown in *pecten*. After the first ecdysis the head is brown in all three species



Whale Shark (21′ 6″) caught in fishing nets 15 miles from Bombay, 7th February 1938.

Photo of a cast in the Prince of Wales Museum, Bombay.

lines. A sublateral series of slightly oblique, pale greenish yellow lines, the whole forming a broken sublateral line. In all forms, 1st somite with a black subdorsal tubercle tufted with greyish hair. A double dorsal and a subdorsal series of rosettes of short greyish hair, a single dorsal tuft of longer black hair on the 3rd, 7th and 12th somites. A sublateral series of rosettes of medium length grey hair. Thoracic and anal somites with single long greyish hairs. Legs and prolegs brownish. Dorsal glands greyish. Venter dark grey.

Pupa in a slight net of white silk. Typical Lymantriid pupa in shape. Colour pale frosted green, the spiracles black. Cremaster a pale brown blunt spike, armed with minute hooks, and fixed in the silk of the web.

Food-plant—*Lagerstroemia indica* Linn., but this is probably not natural as only three larvae reached maturity and these were very undersized. The newly hatched larvae were offered *Terminalia catappa* and Mango, said to be foodplants of other species of the genus, also *Quisqualis indica* and Peepul, but refused to feed.

Described from larvae bred from ova from a Calcutta caught female, one of which pupated 11-i-41, and a male emerged 16-i-41.

Hampson's description is as follows:—'Larva pale fuscous, with long, scattered, simple, and spatulate hairs; a dorsal tuft of long black hair from the second somite; subdorsal and sublateral black lines; the first and second somites banded with black in front; the second somite with a yellow band also.' Seitz gives an almost identical description and adds 'Pupa green with black spots on each side of the thorax, somewhat flattened and curved, suspended in some netted threads.'

Noctuidae.

Spodoptera pecten Guen.

Ovum pale bluish-green, spherical with the base flattened, and with numerous ribs running from the micropyle to base. Laid in large batches, sometimes two or three layers thick, and covered with hairs from the anal tuft of the female. Hatched on the fourth day.

Newly hatched larva with a honey-coloured head, body greyish with minute black specks and sparse black hairs. After feeding the ground colour becomes green.

Half grown larva with a honey-coloured head, body smooth, green with a dorsal and subdorsal white line and sublateral white stripe. In some examples the sublateral stripe is edged above with dark reddish brown, and in a very few there is a reddish brown dorsal stripe in place of the white line.

Larva in penultimate instar very variable. Head honey colour with an inverted dark V-shaped mark. Body greyish-brown with a paler dorsal and subdorsal stripe, a paler sublateral stripe edged above with darker. *Or* with a broken black line above the subdorsal stripe. *Or* with a broad yellowish-green stripe below the subdorsal stripe, which may or may not be edged above with a

broken black line. Venter greenish-brown in the brown forms, green in the forms with the green stripe.

Full grown larva—Head olive-brown with an inverted whitish Y-shaped mark, the area between the arms honey colour. Ground colour of body pale brownish-grey or greenish-grey. A paler dorsal and subdorsal stripe, the latter edged above with a series of black lunules, and a pale spiracular stripe edged above with a purple stripe. 1st somite with a dorsal plate with a white dorsal and subdorsal line. Legs pale brown. Venter and prolegs greenish-grey. Spiracles black.

The larva is very similar to that of *S. mauritia* Bsd. (mihi, *Journ. Bomb. Nat. Hist. Soc.*, xl, 687) but is slightly smaller.

Pupa subterranean in a slight earthen cocoon. Bright red brown, a dorsal stripe on the abdomen and the intersegmental rings darker. Cremaster a double spine.

Food-plant—Grasses.

Described from a number of larvae bred from ova from a Calcutta caught female, one of which pupated 27-xi-40, and a female emerged 5-xii-40.

Spodoptera cilium Guen.

Ovum greyish-green, spherical with the base flattened and with numerous ribs running from the micropyle to base. Laid in fairly large batches and covered with hairs from the anal tuft of the female. Hatched on the fifth day.

Newly hatched larva grey, the head black. Hairs dark. Turns greenish after feeding.

2nd instar—Similar, but the head very pale honey-brown.

3rd instar—Similar. A faint white subdorsal and lateral line, a whitish subspiracular stripe. A number of minute black dots.

4th instar—Similar.

5th instar—Similar, the subspiracular stripe, in most examples, edged above with dark brown. Some with the dorsum tinged with reddish brown, extending in a few examples all over the body. Later a subdorsal series of black lunules usually develops.

Final instar—Head dark olive-brown, a pale inverted V-shaped mark, the arms filled in with paler olive-brown. Body dull drab, a narrow paler dorsal and subdorsal stripe, the latter edged above with a series of black lunules almost obsolete on the 1st-3rd and 11th-13th somites, and a narrow dark purplish spiracular stripe edged below with paler. Venter greenish. Legs and prolegs greenish. Spiracles black. A second form is similar except that the subdorsal stripe is tinged with green, and the area between it and the spiracular stripe is pale green. The black lunules are sometimes obsolescent, or even obsolete, those at the ends disappearing first.

It is, perhaps, interesting to note the sequence of colour changes in the larvae of this species, *S. pecten* and *S. mauritia*. The first instar larvae of all three species are alike, except that the head is black in *cilium* and *mauritia* and brown in *pecten*. After the first ecdysis the head is brown in all three species

and there is little change in appearance up to the 4th instar in *cilium*, the 3rd in *pecten* and the 2nd in *mauritia*. The following instar brings the beginning of the brown colouration and this is intensified in the next, the green colour disappearing in the 5th instar in *mauritia* and in the 6th (final) instar in *pecten*, but persisting in the 6th (final) instar in *cilium*.

Pupa subterranean in an earthen cocoon. Yellowish brown, the wing cases tinged slightly with greenish. A trace of a dark dorsal line along the abdomen and with the intersegmental areas darker. Cremaster a pair of diverging stoutish spines.

Food-plant—Grasses.

Described from larvae bred from ova from a Calcutta caught female, one of which pupated 16-i-41, and a male emerged 28-i-41.

Both Hampson (*Cat. Lep. Phalaenae*, viii, 254. 1909) and Warren (Seitz, *Indo-Austr. Noctuidae*, xi, 321.) treat *cilium* as a synonym of *S. abyssinia* Guen. and give the following description of a Natal larva under this name:—'Ochreous with numerous pale points defined by pale brown; dorsal line orange; subdorsal line represented by a series of orange marks defined by irregular black lunules above; lateral line represented by orange marks; the stigmata black with brown patches above them; head and thoracic plate red-brown.'

Sideridis insularis Btlr.

Ovum pale yellow with slight mother-of-pearl reflections. Round, unsculptured. In captivity laid in the angles of the box, in a state of nature presumably, as other members of the genus, in the axils of grass. The position results in the shape being badly distorted and the ova appear to shrivel before hatching. The colour slowly darkens to deep yellow and finally turns a dull leaden grey a few hours before hatching. Hatched the fifth day.

Newly hatched larva grey with a honey-coloured head, the body turning green after feeding. A few short white hairs.

2nd and 3rd instar larvae—Head honey-brown. Body greenish-grey with ten longitudinal dark lines and a white subspiracular stripe.

4th instar—Head olive brown, the clypeus with a central black streak and with a black line on either side. Body with a greenish white dorsal line edged with dark green, a subdorsal dark green line with a narrow whitish stripe below it, below this a broader purplish-brown stripe, a pale green line and then a black-edged dark green stripe. A whitish spiracular stripe containing a brownish central stripe. Venter greyish green. Legs blackish. Prolegs greyish green with an apical dark mark. Before ecdysis the colour fades and the larva is dull drab with dark lines.

5th instar—Head as in previous instar. Ground colour dark green tinged with purple. A white dorsal and subdorsal line, the dorsal edged with darker green, the subdorsal with a purplish stripe below it. A greenish white lateral line with a very dark green stripe below it. A spiracular white stripe with a rust coloured stripe inside it. Venter greyish green. Legs and prolegs greyish green, the latter with an apical dark mark.

Final instar—Head honey-brown, a black line on either side of the clypeus and the sides with a honey-comb pattern in black. Body with a broad grey dorsal stripe, within which is a central white line edged with blackish. A white subdorsal line edging the dorsal stripe, above which is an interrupted black line. Beneath the white subdorsal line, a pink stripe, a grey stripe and then a paler pink stripe, all separated by white lines, and a white line below the paler pink stripe. Venter pale greenish. Legs and prolegs pale greenish, the latter with an apical dark mark. Spiracles black. The greys, black and pinks are not pure colours but composed of streaks and specks on a whitish ground. When completely full fed, the greys and black strongly tinged with green.

Pupa subterranean in an earthen cell. Bright reddish chestnut, the venter and wing cases slightly paler, the thorax, a stripe down the dorsum and the intersegmental rings slightly darker. Cremaster a pair of stout spines with a finer hooked spine on either side and a pair of fine hooked spines immediately behind on the dorsum.

Food-plant—Grasses.

Described from larvae bred from ova from a Calcutta caught female, one of which pupated 31-xii-40, and a male emerged 12-i-41.

Prospalta pallidipennis Warr.

Head pale green, the sides tinged with crimson and speckled with white. Ground colour pale yellowish green. 2nd and 3rd somites each with a transverse series of eight minute white dots. 4th to 10th somites each with a subdorsal triangle of three crimson-ringed white dots. A white spiracular stripe, speckled minutely with crimson and edged above by a crimson line. A white dot, with or without a crimson ring, over each spiracle above the spiracular stripe. 11th somite slightly conical with a whitish dorsal and subdorsal blotch, the area between whitish speckled with crimson. 12th and 13th somites marked with crimson dorsally. Spiracles black. Legs brown. Abdominal prolegs with a blackish spot at base, the apex speckled with crimson. Anal claspers marked with white in continuation of the spiracular stripe and slightly crimson speckled. Venter and area below the spiracular stripe rather bluer green. Before pupation the dorsum becomes suffused with purplish.

The above is the form found wild. When reared in captivity, however, this form does not appear, the following two forms taking its place.

Head brown, the sides dark purple brown speckled with white. Body with the ground colour above the spiracular stripe a rich bronzy brown (turning to deep crimson in blown specimens) with markings similar to the first form. In addition there is a series of oblique dark lines forming a dorsal and subdorsal series of diamond shaped marks. The crimson round the white dots and above the spiracular stripe somewhat obscured by the ground colour. The spiracular stripe whitish speckled slightly with crimson, the area below and venter pinkish grey.

The third form is pale yellowish green with the usual crimson markings very pronounced and, in addition, a broad, irregular,

diffused crimson dorsal stripe formed of conjoined blotches, the legs springing from crimson patches and the prolegs crimson.

The larva is very similar to that of *P. capensis* Guen. (mihi, *Journ. Bomb. Nat. Hist. Soc.*, xlii, 43) but can be distinguished by the white speckled side of the head and the subdorsal blotches on the 11th somite, *capensis* having a plain black stripe on the side of the head and no subdorsal blotch on the 11th somite.

Pupa subterranean in an earthen cell. Head, thorax, wing, leg and antenna cases olive green. Abdomen brownish yellow with an olive green dorsal stripe and an olive green line on the posterior edge of each somite, the intersegmental area purplish brown. Cremaster two short spines.

Food-plant—*Coreopsis*.

Described from a full fed larva found in Calcutta 10-xi-40; buried itself 11-xi-40, and a male emerged 19-xi-40.

GEOMETRIDAE.

Hyposidra talaca Wlk.

Moore, *Lep. Ceyl.*, iii, 392, pl. 185, fig. 1b. 1884-87.
Hamps., *Fauna Brit. Ind.*, Moths, iii, 213. 1895.

Immature larva—Head round, black. Ground colour of body blackish purple, a paler dorsal stripe from the 9th somite backwards. A transverse row of white dots between the 4th-5th, 5th-6th, 6th-7th and 7th-8th somites, the first row extending right across the body from the sublateral area, the lower portion somewhat oblique, the other three rows on the dorsum only. Legs black. Shape rather short and stout.

Full grown larva—Head round, pale brown speckled with darker. Ground colour pale brown speckled with darker and with orange. 1st to 4th somites each with a small subdorsal orange patch, that on the 4th largest. 11th somite also with a small subdorsal orange patch. Legs purplish-red banded with paler. Venter coloured as dorsum with a double median line of orange specks. The area between the legs and claspers whitish.

Pupa subterranean in an earthen cell. Colour reddish-brown, the wing cases more yellow. Cuticle polished, the abdomen minutely punctate. Cremaster a stout spine.

Food-plant—Castor (*Ricinus communis* Linn.).

Described from a larva found in Calcutta, pupated 19-xii-40, and a male emerged 4-i-41.

Moore's description is:—'Larva with ten legs; pinkish olivaceous-green, minutely black speckled; with a blackish lateral spot on the fifth and seventh segments. Pupa olivaceous-green and reddish. Feeds on *Jambona*, *Combretum*, and *Ficus parasiticus*.' His figure shews a pale coloured larva with an indistinct black ring on the 4th somite and a black figure-of-eight on the 6th. The pupa is depicted as brownish with green wing cases. Hampson's description is:—'Larva pinkish olive-green, irrorated with black, and with dark patches on 4th and 6th somites.'

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Thalassodes quadraria Guen.

Head green, bifid. Ground colour of body green, in some cases with a diffused dull crimson dorsal stripe, which may sometimes only be apparent between the somites. Legs and prolegs green. Anal flap triangular and ending in a sharp point.

Pupa between two leaves spun together with thick strands of white silk and attached by the cremaster to a few threads of silk. Shape slender, the head square across. Colour a uniform pale green. Cremaster a stout spike armed with hooked reddish spines.

Food-plant—*Polyalthea longifolia* Wall. (Anonaceae).

Described from a full fed larva found in Calcutta 17-xi-40, pupated 19-xi-40, and a male emerged 24-xi-40.

Moore (*Lep. Ceyl.*, iii, 426, pl. 194, fig. 2a. 1884-87) figures and describes the larva of *T. dissita* Wlk., which Hampson considered as conspecific with the present species. This description is as follows:—'Larva with 10 legs; looped; slender; head bifid; a pointed prominence on 12th segment; colour reddish above, greenish beneath; legs red. Pupa pinkish, greenish in front; thorax and abdomen minutely black-speckled. Feeds on Barringtonia.'

(*To be continued.*)

SALT-LICKS.

Their Vital Importance to the Conservation of Wildlife in Malaya.

BY

Theodore Hubback.

The successful preservation of Wildlife is intimately connected with ecological study.

Salt-licks are embraced by such study. To provide a congenial environment for the successful and normal production of the various species of large Wildlife found in a Malayan Jungle the environment must include some type of soil, or exudations from the soil, which form salt-licks for such animals as elephant, seladang, rhinoceros, tapir, sambhur, and barking deer.

The term salt-lick may be considered as a generic one. It is used to indicate any soil in which some natural substance is found which is attractive to wildlife and which they eat or drink. It is probably taken as a medicine, and undoubtedly acts as an aperient.

In Northern Pahang, there have been many places where from time immemorial wild animals and even birds have been accustomed to utilize certain exudations from the soil. The extent to which some of these places have been used, is clearly indicated by the trails leading thereto, they show how important they have been to the life and well being of generations of jungle inhabitants.

The most popular licks are those which have been centered round sulphur springs. Some licks are mud-licks. They do not appear to contain sulphur, but are impregnated with some saline which for want of analysis I am unable to identify.

In Pahang the important salt-licks near the main range are all sulphur springs. In one place, well in the foot-hills of the mountains, there is a hot sulphur spring, much too hot for the animals to drink from, so they have made a lick somewhat below the spring where the sulphur water has cooled down.

Many of these licks in Northern Pahang—I will describe some of them—are still being used, but in most cases, owing to circumstances that I will indicate, they have fallen from the position that they occupied a few decades ago.

The first and most important reason why they have become less used is because of the alarming decrease in the incidence of the larger wildlife. In addition to a cumulative decrease going back for some years, there has been, during the last five years or so, much disturbance throughout nearly all the river valleys by gold stealers and jelutong tappers—in many cases the same people—that a congenial environment has been denied to the larger wildlife and normal breeding has not taken place. The extraordinary decrease in the numbers of sambhur deer which cannot be accounted

for by hunting, legitimate and illegitimate, can only be due to the failure to breed in the usual sequences because of continual disturbance.

All this has affected the salt-licks; still, if our larger wild animals are to be saved from extinction—wildlife is supposed to be preserved now—it must be part of the ecological studies of those whose duty it is to enforce the preservation laws, to devote time to the question of the salt-licks and to appreciate their great importance in the life cycle of our larger fauna.

It is my earnest hope that by describing some of these licks I may stimulate those whose responsibility it is to save our decreasing wildlife to devote more time to these most important phenomena. Such study will help them to realize their real importance to the cause of preservation and the contentment of the wild creatures of the jungle.

The Telom Valley

Probably at the present time the most important salt-lick in Ulu Pahang is Jenut Lanau in the Sungei Telom Valley. This lick consists chiefly of a sulphur spring amongst some rocks at the bottom of a pool, some two feet deep. This spring never runs dry and is a permanent attraction to elephant and sambhur deer. Seladang some years ago used this lick regularly, coming over generally from the direction of the Jelai Ketchil Valley. Now only one old bull ever visits the lick, and even then only for a day or two during the year. **Jenut Lanau**

But elephants and sambhur deer use it continuously, especially elephants. I have identified eight tuskers in that lick, but possibly I may have counted one twice over. But I have certainly not seen every male elephant that visits the lick. Female elephants look so much alike that I should not like to say how many I think I have seen.

This lick is an ideal one to visit for the purpose of photographing wild elephants and sambhur. But when elephants are about, sambhur do not like the lick, and generally keep away. Elephants make such a mess of the pool, and sambhur being unable to get their mouths right down to the springs—they do their best at times, putting their muzzles into the water right up to their eyes—object to a mixture of diluted sulphur water and elephants' excrement.

I have seen as many as five sambhur in the lick together, an unusual sight in this country. I have never seen a big stag in Jenut Lanau. This is due to the considerable amount of poaching that has gone on in this lick up to a few years ago.

The landing place for Jenut Lanau can be reached from the railway station at Bukit Betong by motor-boat in a day unless the Jelai River is in flood.

Another important lick in the Telom Valley is Jenut Misong, a day's journey up river from Jenut Lanau. The last six or seven miles from Kuala Sungei Perahu, the end of navigation, is made **Jenut Misong**

by jungle path. The Jenut is about a mile from the left bank of the Telom River.

Jenut Batu

This lick, some thirty years ago, was a great place for deer shooting from hides; on the ground and up trees. It was so good that now few deer can be found there. But elephant utilize it a great deal, as well as another small lick known as Jenut Batu, about a mile further up the Misong Valley.

The principal attraction at Jenut Misong is sulphur impregnated sand on the left side of the river, which the elephants dig up to get at a more concentrated solution of sulphur deeper down.

Seladang used to occasionally visit this lick, but those days have passed. It is doubtful if any seladang herd can now be found in the Upper Telom Valley. It must be remembered however that with the continual disturbance that is going on in all these valleys, solitary seladang are liable to travel long distances from their regular beats and the discovery of a seladang in Jenut Misong must not be taken as indicating the return of a herd to its old haunts.

The Serau Valley.

The Serau River together with the Telom and Jelai Ketchil are the confluents of the Jelai River.

In the Valley of the Serau there are, what were a few decades ago, several important salt-licks. They are now mere derelicts of their former pristine value; not because the localities where they are situated have been developed, they are still in their virgin jungle; but because the chief frequenter of these licks, the Sumatran rhinoceros, has been poached almost out of existence. I will give a brief description of each lick.

Jenut Batu Dada

In the Serau itself there is one lick, Jenut Batu Dada, which is still very occasionally visited by an old male rhinoceros. This is veritably 'the last of his race' so far as that lick is concerned. From the indications in the vicinity of the lick, this place must have been used by dozens of rhinoceroses before they were destroyed by poachers and their infernal pits. Deep unused trails, abandoned wallows, banks cut into by innumerable rhinoceroses' horns and feet, all testify to the glories of this recreation ground of animals long since passed away.

There is a large pool in the centre of the clearing which constitutes the surroundings of this lick. This pool contains several sulphur springs. It is almost completely surrounded by well-polished rocks, polished by the action of generations of wild animals. I have seen rhinoceros, sambhur, kijang, and wild dogs in this lick, as well as a Malay serpent eagle, which seemed to enjoy the sulphur water with the best of them. Elephants very occasionally visit the lick. Tapir also use the lick but not seladang.

Jenut Lyong

The Sungei Besay, a large tributary on the right bank of the Serau, had three good salt-licks at one time. Jenut Lyong, not very far from Kuala Besay, is still visited by elephants.

Jenut Patchat, is a small lick on the left bank of the Besay above Jeram Limau. This lick used to be visited by rhinoceros; but they go there no longer for the excellent reason that there is none to go. **Jenut Patchat**

The most important lick in the Besay was Jenut Bliong; far up in the foot hills of Gunong Bedong. There were two very active sulphur springs in that lick. **Jenut Bliong**

From the indications still in evidence, this lick must have been used by rhinoceroses in some numbers but is seldom if ever visited by them now. I advisedly write 'seldom' because there is no reason why the old rhinoceros who visits the Jenut Batu Dada should not visit Jenut Bliong—they are not more than twenty miles apart in a straight line—although I have no evidence to support such an idea.

Elephants still use this lick. The Besay rises in Gunong Bedong and extensive pitting for rhinoceros was done in the foot hills some years ago. I have seen pits well up the mountain. No doubt the breeding stock was so depleted that rhinoceroses were not left in sufficient numbers to maintain a normal breeding rate. That means extinction.

Above Kuala Besay there is on the left bank of the Serau a large tributary known as the Briang. About three miles from Kuala Briang, situated on both sides of the river Briang, there is a large salt-lick, the Jenut Briang. **Jenut Briang**

On one side of the river there is sulphur impregnated sand, and on the right bank a rampart of limestone outcrop in which there are sulphur springs.

Around this lick I found no less than 18 old rhinoceros pits, which alone show that many rhinos must have used this lick. This lick has not been visited by rhinoceroses for very many years, but the lick is used by elephants and sambhur, and very occasionally, seladang. It is an extensive lick with many old game trails, deeply worn, leading into it. The rocks on the right bank of the river have been polished almost to perfection by the action of elephants and rhinoceroses using this lick in years long gone by.

Above the confluence of the Chadu and the Serambun, which form the Serau, there are two sulphur licks. One known as Jenut Batu Karam, on the left bank of the Chadu, has been entirely ruined by mining, mostly unlawful. **Jenut Batu Karam**

The second, known as Jenut Batu Papan, is far away up the Serambun within a couple of miles of the Kelantan Border. This lick was once a very favourite haunt of rhinoceros, but here again poachers did their deadly pitting in the early part of this century and the Serambun Valley now holds few rhinoceros. **Jenut Batu Papan**

I found no less that 14 old rhino pits round this lick, but no doubt neither here nor round Jenut Briang did I find anything like all the pits that had been made. Within the last ten years poachers have come over to this lick from Kelantan. I have myself seen the

remains of a platform built in Jenut Batu Papan, which the local Sakai informed me had been built by Chinese poachers from Pulai.

Jenut Batu Papan consists of a sulphur spring amongst some rocks, alongside the small stream that runs through the lick. But what was undoubtedly an attraction as well was a 'battery' of mud wallows close to the lick situated under the toe of a steep hill side. There were eight of these wallows quite close together. Two of them are still used, but only very occasionally. It is possible that there is a small modicum of sulphur in these wallows which made them so attractive to rhinoceroses.

An old male rhinoceros sometimes uses the wallows but does not patronize the lick very often. Tapir are fond of this lick and I have seen the tracks of serow (*kambing grun*) in the sand near the sulphur spring. I have seen rhinoceros, tapir, and also a serpent eagle in this lick.

The entire jungle for miles and miles in Pahang and Kelantan is unoccupied by any human inhabitants and the environment of the Serambun Valley is exceptionally suitable for rhinoceroses. But for years, when intensive poaching was going on, there must have been no normal breeding and the seriously depleted stock now shows the results.

Still, in the Serambun Valley, an area of about 30,000 acres, there is a very small stock of rhinoceros which might be saved with careful conservation. I have identified, a few years ago, five head which included one calf. I applied for this entirely unopened and unoccupied area as a rhinoceros reserve, but someone whispered the magic word gold, and when there is any mention of possible gold exploitation no other subject is considered for a moment!

The Serau and its tributaries are the only hope for the rhino in Ulu Pahang, with the one exception of that portion of the upper waters of the Tanum River, which lie within the King George V National Park area. But the environment there is not so suitable as that in the Serau. In the Telom and Jelai Ketchil Valleys there are no rhinoceros at all.

The Jelai Ketchil River.

Jenut Stein

In the Jelai Ketchil River the Jenut Stein is a well known and important salt-lick. It is much favoured by sambhur deer and until a few years ago by seladang. The seladang in the Jelai Ketchil have been so much disturbed by jelutong tappers that they have broken up into small groups and undoubtedly have not been breeding normally. It must be recognized that seladang are often attacked by tiger if they are found in small groups accompanied by a calf, and undoubtedly disturbance, which helps to break up the herds, is of assistance to the tiger who is able to take a greater toll of calves than he can under conditions more favourable for the seladang.

A few years ago a hut was built by two Chinese between Jenut Stein and Jenut Kahamang, a small lick about a mile away up stream from Jenut Stein. The hut was built right alongside the main game trail. **Jenut Kahamang**

These Chinese were supposed to be jelutong tappers which trade they no doubt exercised spasmodically, but they also ran an illicit still and sponged on the Sakai. To serve their illegal ends they distributed some of the liquor to the Sakai.

The lick was entirely deserted by seladang for over two years because of the continual use of their trails, the smell of human occupation which tainted the approaches to the lick, and the disturbance caused by trails which these Chinese made round the lick.

Jenut Stein consists of sulphur impregnated sand over an area of several hundred square feet, with a small stream meandering through it. Elephants were very fond of the lick until the locality was tainted by the activities of these Chinese, but during the period of the Chinese occupation they also deserted the lick. This is a good argument for proper protection of these licks. The elephants are back again now and occasionally visit the locality. They dig deep holes in the sand to try to find the best places.

Jenut Tebarau, a small lick near the end of navigation up the Jelai Ketchil River, is badly situated between two steep hill sides. It is rich in sulphur springs and at times is much used by seladang. **Jenut Tebarau**

Beyond Jenut Tebarau, far above the series of cascades that constitute the upper waters of the Jelai Ketchil, there are two hot sulphur springs which are used as Jenut. One known as Jenut Gatak—I have mentioned this lick on page 2—is used by elephants and very occasionally seladang. **Jenut Gatak**

The other spring, known as Jenut Mesai, is near Jenut Gatak but is seldom used by wildlife. **Jenut Mesai**

The Telang Valley.

There is one important salt-lick in the Ulu Telang area known as Jenut Blimbing, situated in the Ulu of the Sungei Sergi, a small tributary of the Sungei Tengalan which joins the parent river near Kuala Tengalan. **Jenut Blimbing**

This lick is a mud-lick, there being no apparent indication of sulphur. It has been much used by elephant and seladang, the deeply worn trails going down the river banks to the lick being sufficient testimony to the popularity of the lick.

But owing to a large influx of gold-stealing Chinese, and jelutong tappers, disturbance has done its deadly work to the larger fauna which frequented the valleys of the Telang and the Tengalan. This lick is no longer used as it was a few years ago.

In this area, that is to say between the Jelai River above Kuala Lipis, the Kuala Lipis—Raub Road, and the track from Raub to Kuala Medang, there is one old rhino which sometimes goes to

Jenut Blimbing. I believe that it is the sole survivor of the rhino in that area. I do not know its sex, but that is immaterial because rhinoceroses have not yet reached the Martian stage where they can propagate their species by budding-off. Rhino there, are doomed, because there is no hope of others coming into that terrain.

Conclusion.

That completes the list of important salt-licks in Ulu Pahang, but does not include those in the King George V National Park. I wish to state what I think should be done to save these licks from destruction.

Perhaps I should have given, earlier in this article, an explanation of the word 'Jenut'.

'Jenut' is the commonest word used by Malays in Pahang for salt-lick. A less common word is 'Taram'. The word 'Sesap' or 'Sesapan' is the word generally used in Negri Sembilan but is very occasionally used in Pahang.

None of the licks mentioned are in territory that has been opened up or developed; but Jenut Lanau, Jenut Stein and Jenut Tebarau are in country where there are Sakai.

The chief safe-guard for the preservation of these salt-licks must be by legal provision in the laws for the preservation of wildlife.

There is a ruling, agreed to by the Residents many years ago, that no land within two miles of a recognized salt-lick shall be given out until the Game Warden has been consulted on the matter. This ruling has not been invariably respected, and the present position is unsatisfactory.

In the Tersang Valley, in the Raub District, a buffalo farm was established almost on the top of Jenut Tersang, a valuable salt-lick used by seladang and elephants, and the only large lick in the neighbourhood. There was only one Jenut Tersang but dozens of places where a buffalo farm could have been established.

Some years ago a prospecting licence was given out without in any way consulting the Game Warden over an area embracing Jenut Misong and Jenut Batu.

Quite recently a prospecting licence was very nearly given out to cover an area embracing Jenut Lanau, the most important lick in the tributaries of the Jelai River.

These mistakes have been made due to slipshod record work in Land Offices, and can only be avoided or prevented by legislation.

An amendment to the law should be made to reserve from alienation, for any purpose whatsoever, except that of wildlife conservation, any land within a radius of two miles from all the active and valuable salt-licks, a list of which should be drawn up as a schedule to Wild Animals and Birds Protection Enactment. (Cap.: 193.).

Reservation of such areas should prohibit any action within such a cas so reserved, which would cause disturbance to those

areas, and no permission should be given to any person to take any jungle produce or to undertake any prospecting of any kind within such areas.

Some of the licks I have mentioned are marked on the topographical map sheets, and the identification of their exact positions should be simple. Those not marked should be marked.

The following salt-licks in Ulu Pahang should be scheduled as coming within the scope of special legislation.

Jenut Lanau. Jenut Misong.	Telom Valley.
Jenut Bliong. Jenut Batu Dada. Jenut Batu Papan. Jenut Briang.	Serau Valley.
Jenut Stein. Jenut Gatak.	Jelai Ketchil Valley.
Jenut Blimbing.	... Telang Valley.

In other parts of Pahang there are salt-licks important to the welfare of the wildlife, and similar steps should be taken to guard them also.

It must be a part of any vigorous policy of Wildlife Conservation to preserve salt-licks, and if they are recognized, as they should be recognized, as important adjuncts to a congenial environment for many species, then laws to preserve them, and machinery to enforce those laws, become imperative.

THE GAME FISHES OF INDIA.[1]

BY

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(With one plate and three text-figures).

(Continued from page 319 of Vol. xlii, No. 2).

XIII. THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

6. THE JUNGHA OF THE ASSAMESE, *Barbus (Tor) progeneius* McClelland.

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INTRODUCTION.

In one of the earlier articles of this series (**7**, pp. 78-79),[2] attention was directed to the species of Large-scaled Barbels described by McClelland from Assam and the hope was expressed that 'some specimens of *Jungha* from Assam would reach the author's hands by February, 1941, so as to enable him to deal with this species in a subsequent article.' Unfortunately the hope has remained unfulfilled, and I have so far not received any specimen authentically named as the *Jungha* of the Assamese. In consequence, I have to rely on what is already known concerning this species. The material in the collection of the Zoological Survey of India referred by me (**3**, pp. 328-330), to *Barbus (Tor) progeneius* is inadequate, and is not sufficient for the determination of the precise specific limits of the species. It is hoped that the members of the Society stationed in Assam will kindly send specimens of the true *Jungha* and other Mahseers of Assam, such as *Lobura*, *Burapetea* and *Bokar* to me in salt, formalin or spirits of wine.

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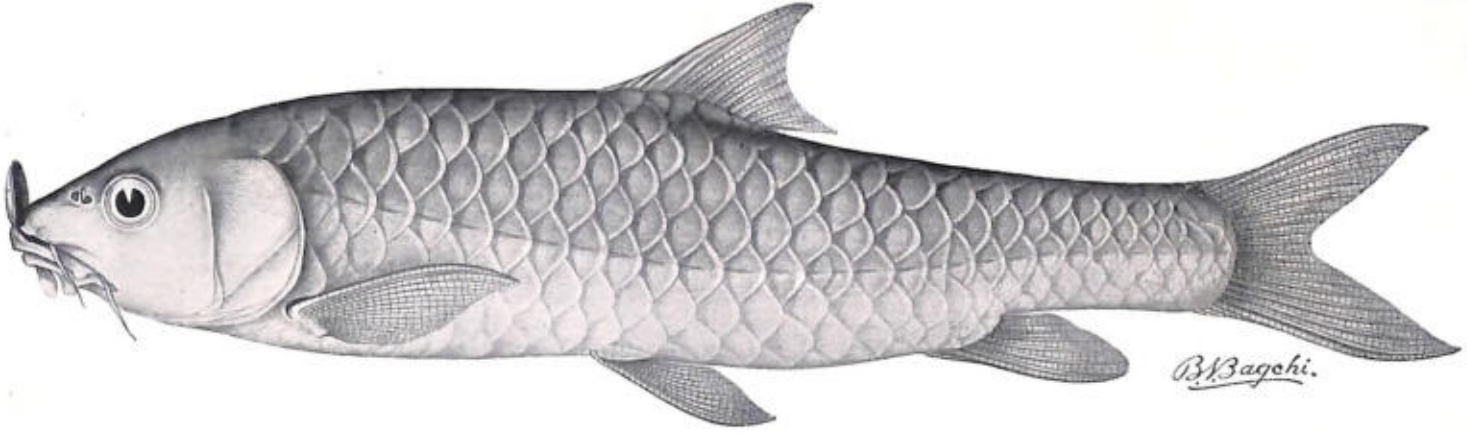
1 Published with permission of the Director, Zoological Survey of India.

2 Numerals in thick type within brackets refer to the serial numbers of the various publications listed in bibliography at the end of the paper.



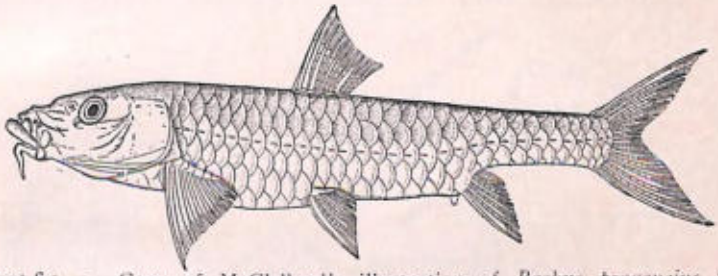
The *Jungha* of the Assamese.
BARBUS (TOR) PROGENEIUS McClelland.

History and Nomenclature.

In describing the *Jungha* under the name *Barbus progeneius*, McClelland (8, p. 270) observed in a foot-note that the name implies that the fish 'has a prominent chin or long beard; in allusion to the singular appendage to the lower jaw of this species by which it may be easily recognized.' It seems that McClelland was greatly influenced by this structure, for in the detailed description of the species on page 334, in referring to this character, he observed :

> ' . . . from the lower lip a fleshy appendix is extended, by which it is distinguished from the neighbouring species; nevertheless it is figured in Buchanan's collection of drawings as *Cyp. tor*, to which it bears so close an affinity that he may probably have considered it to be the same.'

If a comparison is made between Buchanan's figures of *Cyprinus tor* (5, p. 520, text-fig. 1) and that of McClelland's *B. progeneius*



Text-fig. 1.—Copy of McClelland's illustration of *Barbus progeneius* from Assam.

reproduced here, it will be evident that the two cannot represent the same species. In *tor* the head is more pointed and the body is considerably deeper and more pronounced along the ventral surface, while in *progeneius* the head is evenly pointed and is more or less equal to the depth of the body, which is slender and graceful. The presence of a labial fold in both the forms is not a very sound taxonomic character, as the development of this structure probably depends on certain, undetermined, environmental factors (4, pp. 279-282; 6, p. 787). It is, however, a common feature of the true Mahseers, such as *B. putitora*, *B. tor* and *B. mosal*. *B. progeneius* in its general facies is similar to *B. mosal* and it is likely that when more material of the two forms becomes available they may prove to be identical. For the present and to elicit further information I propose to regard them as distinct species. More information would be welcome regarding the fan-shaped development above the upper lip in certain specimens of *progeneius*.

Günther (2, p. 130) used *B. mosal*, and Day (1, p. 564) used *B. tor* as a collective name for the various species of mahseers found in India; and no earlier worker appears to have recognised *B. progeneius* as a distinct species. In 1936, I (3, p. 328) regarded *B. progeneius* as a valid species, while *B. mosal* was considered a synonym of *B. putitora*.

SYNONYMY AND DESCRIPTION.

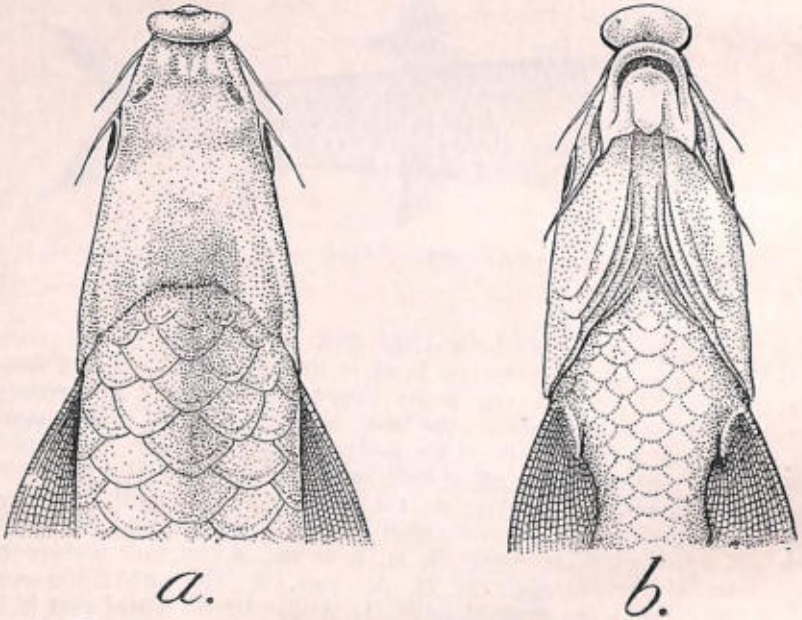
Barbus (Tor) progeneius McClelland.

1839. *Barbus progeneius* McClelland, *As. Res.*, XXIX, pp. 270, 334, pl. lvi, fig. 3.

1936. *Barbus progeneius* Hora, *Rec. Ind. Mus.*, XXXVIII, pp. 328-330, text-figs. 7-9.

D. 4/9; A. 3/5; P. 1/14; V. 2/8; C. 19.

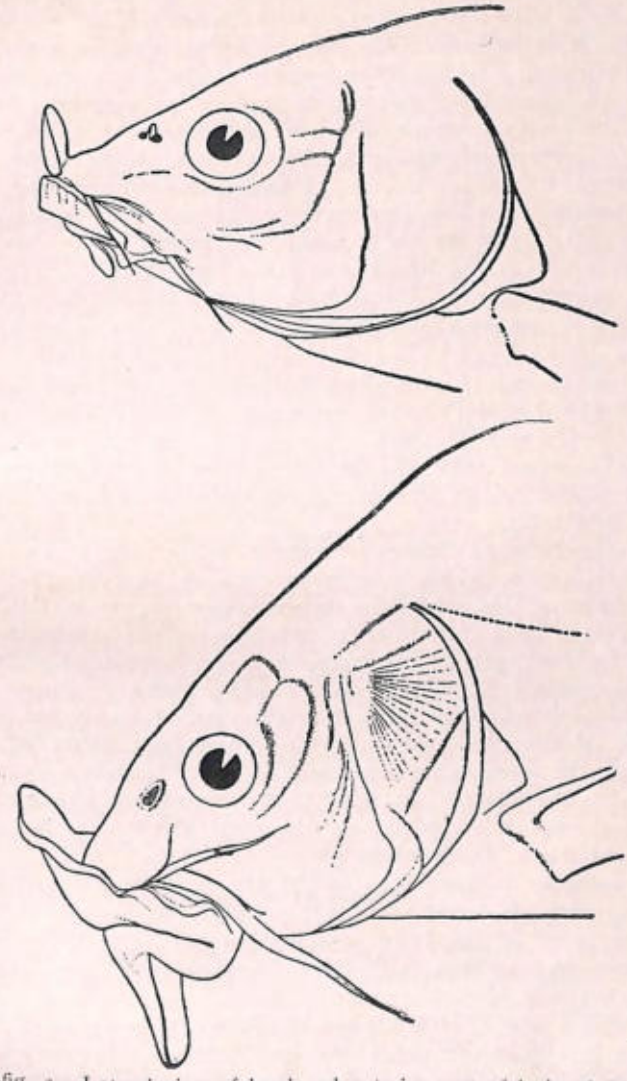
Barbus progeneius is a graceful species in which, as in *B. mosal*, the head is almost as long as the depth of the body and the dorsal profile is somewhat more elevated than the ventral. The head is sharpish in front; its length is contained from 4.5 to 4.9 times in the total length and from 3.5 to 3.8 times in the standard length. The height of the head is contained from 1.3 to 1.5 times and its width from 1.6 to 2.2 times in its length. The head is relatively much narrower in smaller examples. The position of the eye varies



Text-fig. 2.—Dorsal and ventral surfaces of head of the stuffed specimen of *Barbus* (*Tor*) *progeneius* McClelland. ×¾.
a. Dorsal view; *b*. Ventral view.

with growth, but generally it is nearer to the tip of the snout than to the posterior border of the operculum. The eyes are moderately large; the diameter of the eye is contained in the length of the head from 3 times in the young to about 4.7 times in the adult. In the smaller individuals the length of the snout is almost equal to the diameter of the eye while in the adult it is about one and a half times. In the young the eyes are more approximated dorsally

and the interorbital space is less than the diameter of the eye while in the adult it is almost twice the eye-diameter. The depth



Text-fig. 3.—Lateral view of head and anterior part of body of *Barbus* (*Tor*) *tor* (Ham.) and *B.* (*Tor*) *progeneius* McClelland showing the nature of the hypertrophied upper and lower lips.

Upper figure: *Barbus* (*Tor*) *progeneius* McClelland. ×2/5.

Lower figure: *Barbus* (*Tor*) *tor* (Hamilton). ×3/5.

These illustrations are reproduced from the *Records of the Indian Museum* (vol. xxxviii, pp. 327, 329, 1936) by the courtesy of the Director, Zoological Survey of India.

of the body is more or less equal to the length of the head and the least height of the caudal peduncle is contained from 1.4 to 1.8 times in its length.

The mouth is of moderate size; its gape does not extend to below the eyes and is somewhat obliquely directed upwards. The lips are fleshy and continuous at the angles of the mouth; the labial groove is present. The posterior lip may or may not be produced backwards as a median lobe, but generally a well-developed median lobe is present. Behind the upper lip there is a rounded, fan-shaped structure which in form and extent is quite different from the hypertrophied lips in *Barbus putitora* (4, pl. ii, fig. 3) and *B. tor* (5, pl. ii, fig. 1; pl. iii). I have not seen any specimen of *B. mosal* with a similar structure, and for this reason I am retaining *B. progeneius* as a separate species. The fan-shaped structure is 32.5 mm. broad and 22.0 mm. long in a specimen 690 mm. in total length. As such a structure has not been observed in any other specimen so far, it may prove to be an abnormal condition.

The rostral and the maxillary barbels may be equal in length, but generally the latter are somewhat longer. The scales are large and well formed; there are 24 to 27 scales along the lateral line, and $2\frac{1}{2}$ rows between the lateral line and the base of the pelvic fin. There is a well-developed scaly appendage in the axil of each pelvic fin.

The dorsal fin commences opposite to or slightly in advance of the pelvics; its origin is midway between the tip of the snout and the base of the caudal fin or somewhat nearer to the former. The dorsal spine is rather weak; the longest ray of the dorsal fin is equal to the depth of the body in young specimens, but in the adult specimens it is considerably shorter. The pectoral fins are lanceolate and are placed low down on the body; they are considerably shorter than the length of the head. The pelvics are similar to the pectorals and are separated from the anal by a considerable distance. The anal fin is somewhat longer than the pelvics and slightly rounded near the tip. The caudal fin is deeply forked with both the lobes pointed.

In specimens preserved in spirit, the surface above the lateral line is grayish, becoming deeper towards the dorsal side, while the lower parts of the head and body are silvery. The bases of the scales are provided with dark blotches which are more prominent along the dorsal surface.

Bionomics and Distribution.—McClelland (8, p. 330) observed that 'The intestines are capacious, and consist of four convolutions extending along the posterior half of the abdominal cavity, leaving the anterior portion of that cavity chiefly to the stomach and liver. The first is a conical sac (larger than the stomach of the Cirrhins) occupying the right side, and terminating simply in the intestine. The liver is broad consisting of several lobes, chiefly placed on the left side of the stomach.'

B. progeneius was described from Assam, and I (3, p. 328) have referred a number of specimens from the Naga Hills, Assam, to this species. If it proves to be a synonym of *B. mosal* then the fish will have a much wider range of distribution.

MEASUREMENTS IN MILLIMETRES.

	Barak River. (Stuffed specimen)	Irang River, Naga Hills			
Total length	690·0	203·5	198·5	168·0	102·0
Standard length ...	540·0	150·0	155·0	85·0	78·5
Length of head ...	141·0	42·5	43·0	24·0	22·5
Height of head ...	109·0	29·0	29·5	17·0	14·5
Width of head ...	85·0	23·5	28·0	12·0	10 0
Diameter of eye ...	30·0	11·0	12·0	7·8	7·5
Length of snout ..	46·0	13·0	14·0	7·5	7·5
Interorbital distance ...	55·5	14·0	14·0	7·0	6·5
Depth of body	138 0	41 0	43·0	23·0	22·0
Width of body	81·0	21·5	21·5	11·5	9·5
Length of caudal peduncle	102·0	29·0	30·5	15·2	14·5
Least height of caudal peduncle	61·0	16·5	17·5	11·0	9·5
Length of dorsal fin ...	101·0	56·0	33·0	21·5	22·0
Length of pectoral fin ...	108·0	34·5	34·5	18·5	17·5
Length of pelvic fin ...	88·0	27·5	26·5	15·5	14·0
Length of anal fin ...	95·0	32·0	30·0	17 0	15·5

ACKNOWLEDGMENTS.

As in the case of the previous articles, the Bombay Natural History Society has very generously borne the entire cost of illustrating this article, and for this my best thanks are due to the authorities of the Society. I am indebted to Mr. K. S. Misra for preparing the table of measurements and to Babu B. N. Bagchi for preparing the illustrations under my supervision.

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Explanation of Plate.

Lateral view of a stuffed specimen of *Barbus* (*Tor*) *progeneius* McClelland from the Barak River on the Imphal-Silchar Road, Naga Hills, Assam. × *ca* ⅓. The specimen is now exhibited in the Fish Gallery of the Indian Museum, Calcutta.

A CONTRIBUTION TO THE FLORA OF THE PUNJAB PLAINS AND THE ASSOCIATED HILL REGIONS

BY

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PART III.

(*Continued from page 379 of this volume*).

[1] LXIX. SALVADORACEAE.

283. SALVADORA *L.*

523. **Salvadora oleoides** Dcne. in Jacquem. Voy. Bot. 140, t. 144.

Locality.—Hissar (Duthie 4191 !).
Flowers.—August.
Distribution.—Aden. India—the Punjab, Rajputana and Sind plains, frequent.

LXX. APOCYNACEAE.

284. CARISSA *L.*

524. **Carissa spinarum** A.DC. Prodr. VIII, 332.

Locality.—Hoshiarpur (* Ait. 286 !); Rawalpindi (Ait. 463 !).
Fruits.—April.
* With **Cuscuta reflexa** as a parasite.
Distribution.—Drier parts of India. Burma; Ceylon.

525. **Carissa grandiflora** A.DC. Prodr. VIII, 335.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6373 !).
Distribution.—S. Africa.

285. RHAZYA *DCNE.*

526. **Rhazya stricta** Decaisne in Ann. Nat. Sc. Ser. 2, IV, 81 and in Jacquem Voy. Bot. t. 111.

Locality.—Rawalpindi-Attock (Ait. 1076 !).
Flowers.—March.
Distribution.—Afghanistan, Baluchistan, Arabia. India—Sind, Peshawar, in the Trans-Indian territory common.

286. HOLARRHENA *Br.*

527. **Holarrhena antidysenterica** Wall. Cat. 1672.

Locality.—Gurdaspur-Dhunera (Bisram 309 !).
Distribution.—Throughout the drier forests of India, tropical Himalaya ascending to 3,500 ft., Malacca.

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[1] When numbering the orders the figure XIII was omitted in the first part, hence all order numbers are one ahead of the correct sequence. This has been rectified in this part. The number of orders is thus 117, not 118 as stated (p. 124).

287. WRIGHTIA *Br.*

528. **Wrightia tinctoria** Br. in Mem. Wern. Soc. I, 73.

Vernacular name.—Inderjow.
Locality.—Gurgaon (Holland 54325 !).
Fruits.—January.
Distribution.—Burma, Timor. Central India and throughout the Western Peninsula.

529. **Wrightia tomentosa** Roem. & Schultes Syst. IV, 414.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13617 !).
Flowers.—May.
Distribution.—Tropical India ascending to 2,000 ft. in the Himalaya and to 4,000 ft. in the Nilgiris. Burma; Ceylon; Penang.

288. NERIUM *L.*

530. **Nerium odorum** Soland. in Hort. Kew. ed., V, 1, 297.

Locality.—Rawalpindi (Ait. 464 !).
Flowers.—April.
Distribution.—Nepal; Afghanistan; Japan. India—Sind, Central India, W. Himalaya, ascendng to 6,500 ft. in Murree.

289. TRACHELOSPERMUM *LEMAIRE.*

531. **Trachelospermum fragrans** Hk. *f.*

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14353 !).
Flowers.—April.
Distribution.—India—temperate and subtropical Himalaya.

532. **Trachelospermum jasminoides** Lem. Jard. Fleur. I (1851) t. 61.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14352 !).
Flowers.—April.
Distribution.—China.

290. ICHNOCARPUS *Br.*

533. **Ichnocarpus frutescens** Br. in Hort. Kew. ed., ii, 60.

Locality.—Gurdaspur (496 !, 497 ! Drum's Herb.); Hoshiarpur (Ait. 501 !), Lahore—Ag. Hort. Gdns. (Parker 14248 !, 7017 !).
Flowers.—September.
Distribution.—Java; Australia; Ceylon. Throughout India, ascending to 1-2,000 ft. in W. Himalaya.

LXXI. ASCLEPIADACEAE.

291. CRYPTOLEPIS *Br.*

534. **Cryptolepis Buchanani** Roem. & Schult. Syst. IV, 409.

Locality.—Rawalpindi-Chaka 3,500 ft. (Jerram 7353 !).
Fruits.—February.
Distribution.—Throughout India, ascending Himalaya to 4,000 ft. Ceylon.

292. PERIPLOCA *L.*

535. **Periploca aphylla** Dene. in Jacq. Voy. Bot. 109, t. 116.

Locality.—Rawalpindi-Kahuta (Parker 6500 !); Kala chitta (Parker 6499 !).
Flowers.—March. *Fruits.*—December.

Distribution.—Afghanistan; Persia; Arabia; Nubia. India—Sind, Rajputana, Plains of W. Punjab.

293. Oxystelma *Br.*

536. **Oxystelma esculentum** Br.

Vernacular name.—*Makkanvel.*
Locality.—Lahore—islands in the Ravi near Chung (Parker 13781 !, 13779 !, 13780 !).
Flowers.—September.
Distribution.—Ceylon; Java; Ava.—Throughout the plains and lower hills of India.

294. Calotropis *Br.*

537. **Calotropis procera** Br. in Ait. Hort. Kew. ed. 2, II, 78.

Locality.—Peshawar College (Quizilbash 64 !); Changa Manga (Kanjilal !).
Flowers.—January.
Distribution.—Ava; Persia; tropical Africa. India—W. and C. parts, Sind, Rajputana.

295. Pentatropis *Br.*

538. **Pentatropis spiralis** Dcne. in Ann. Sc. Nat. 1838, 327, t. 11 E. and in DC. Prodr. VIII, 536.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 6832 !); Changa Manga (Kanjilal 107 !); Kot Lakhpat (Parker 14883 !); Hissar (Duthie 4204 !).
Flowers.—February.
* Wild in Ag. Hort. Gdns. and growing over *Salvadora.*
Distribution.—Afghanistan and westwards to the Red Sea and Nubia. India—the Punjab, Sind and eastwards to the Jummna river.

296. Daemia *Br.*

539. **Daemia extensa** Br. in Mem. Wern. Soc. I, 50.

Locality.—Hoshiarpur (Ait. 439 !); Hissar (Duthie 5233 !, 4194 !); Lahore—Changa Manga (Parker 6846 !; Kanjilal !).
Flowers.—August-April.
Distribution.—Ceylon; Afghanistan. Throughout India, ascending N.-W. Himalaya to 3,000 ft.

297. Holostemma *Br.*

540. **Holostemma Rheedii** Wall. Pl. As. Rar II, 51 & Cat. 4469.

Locality.—Rawalpindi—Falconer's Herb.
Flowers.—August.
Distribution.—Pegu; Burma; India tropical Himalaya, alt. 3-5,000 ft., Deccan Peninsula.

298. Pergularia *L.*

541. **Pergularia pallida** Wight & Arn. Contrib. 42.

Locality.—Rawalpindi (Ait. 466 !).
Flowers.—July-August.
Distribution.—Throughout India. Burma, Ceylon.

299. LEPTADENIA *Br.*

542. Leptadenia Spartium Wight Contrib., 48.

Locality.—Jhind State (Raitt 23972 !, 23973 !); Multan (Duthie 10789 !, Monro 39 !); Hoshiarpur (Holland 7017 !).
Flowers.—September-February.
Distribution.—Baluchistan; Arabia; Egypt; Senegambia. India—the Punjab, Sind, Rajputana, eastwards to Jummna.

300. CEROPEGIA *L.*

543. Ceropegia bulbosa Roxb. Car. Pl. I, 11, t. 7.

Locality.—Hissar (Coldstream).
Flowers.—July.
Distribution.—Western India, the Punjab and Upper Gangetic plain, southwards to Travancore.

LXXII. LOGANIACEAE.

301. BUDDLEIA *L.*

544. Buddleia asiatica Lour. Fl. Cochinch., 72.

Locality.—Rawalpindi—Sangeri 5,000 ft. (Jerram 7534 !, 7533 !); (Ait. 491 !); Gurdaspur—Siyapurkandi (Bisram 841 !).
Flowers.—March-May.
Distribution.—Malay; Cochin-China; China. Throughout India, ascending to 6,000 ft., very common.

545. Buddleia madagascariensis Lamk. Encyc. I, 513.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12948 !); Hoshiarpur. (*Ait. 547).
Flowers.—April.
Distribution.—Madagascar. *Cultivated.

546. Buddleia Lindleyana Fortune in Lindl. Bot. Reg. (1844) Misc. 25.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12949 !).
Flowers.—April.
Distribution.—China.

LXXIII. GENTIANACEAE.

302. ENICOSTEMA *BLUME.*

547. Enicostema littorale Blume Bijd. 848.

Locality.—Multan (Monro 69 !).
Distribution.—Malaya; Trop. Africa; W. Indies. Throughout India, alt. 0-1,500 ft.

303. ERYTHRAEA *L. C. RICH.*

548. Erythraea ramosissima Pers. Syn. I, 283.

Locality.—Peshawar College (Quizibash 16 !).
Distribution.—Kabul; Baluchistan; W. Asia; Egypt. India—the Punjab, alt. 1-2,000 ft.

549. Erythraea Roxburghii G. Don. Gen. Syst. IV, 206.

Locality.—Rawalpindi (Ait. 468 !); Lahore (Stewart 2623 !).
Flowers.—May.
Distribution.—Throughout India, ascending to 2,000 ft., common in Bengal plains.

304. GENTIANA *L.*

550. **Gentiana decemfida** Ham. Don Prodr. 127.

Locality.—Hoshiarpur (Ait. 531 !).
Distribution.—India—the Punjab, N.-W. and C. Himalaya, alt. 1-8,00 ft.

LXXIV. BORAGINACEAE.

305. CORDIA *L.*

551. **Cordia obliqua** Willd. Sp. Pl. I, 1072.

Locality.—Rawalpindi (Ait. 473 !).
Flowers.—May.
Distribution.—W. India and the Punjab, frequent. Ceylon; Nicobar. Cultivated.

552. **Cordia Rothii** Roem. & Schult. Syst. IV, 798.

Locality.—Multan (Monro 382 !).
Flowers.—April.
Distribution.—Arabia; Abyssinia. W. India, from the Punjab, Hardwar, Rajputana, Sind, to Malabar, frequent.

306. EHRETIA *L.*

553. **Ehretia acuminata** Br. Prodr. 497.

Locality.—Gurdaspur (Fane 4855 !); Hoshiarpur (Ait. 598 !).
Flowers.—June.
Distribution.—Ava; Australia; Japan. India—subtropical Himalaya, ascending to 5,000 ft. and adjacent plains, common.

554. **Ehretia laevis** Roxb. Cor. Pl. 42, t. 55 and Fl. Ind. ed. Carey & Wall. II, 341.

Locality.—Hoshiarpur (Ait. 468 !).
Distribution.—Persia to China; Australia and Polynesia. Throughout India, in tropical and subtropical regions, common.

555. **Ehretia laevis** Roxb. var. *pubescens.*

Locality.—Hoshiarpur (Ait. 172 !).
Distribution.—Throughout India.

556. **Ehretia laevis** Roxb. var. *aspera.*

Locality.—Lahore—Changa Manga (Parker 14355 !, 14357 !).
Flowers.—October.
On irrigated canal best. A shrub 8-10 ft. high.
Distribution.—India.

557. **Ehretia obtusifolia** Hochst.

Locality.—Rawalpindi (Ait. 84 !); Lahore—Changa Manga !.
Distribution.—Abyssinia. India—Sind, the Punjab. Baluchistan.

558. **Ehretia buxifolia** Roxb. Cor. Pl. I, 42, t. 57 and in Fl. Ind. ed. Carey and Wall. II, 343.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38696 !).
Flowers.—May.
Distribution.—Malaya to Formosa and the Philippines. India—Deccan Peninsula.

307. HELIOTROPIUM *L.*

559. **Heliotropium Eichwaldi** Steud; DC. Prodr. IX, 535.

Locality.—Rawalpindi (Ait. 470 !); Lahore (Stewart 2606 !).
Flowers.—April-May.
Distribution.—Central Asia; Australia. India—the Punjab, Sind, Rajputana, in the plains frequent, Kashmir, alt. 5,200 ft.

560. **Heliotropium undulatum** Vahl Symb. I, 13.

Locality.—Lahore (2956 ! Brandis Herb.; Stewart 2583 !, 2592 !); Rawalpindi (Ait. 472 !).
Flowers.—March.
Distribution.—W. Asia; N. Africa. India—the Punjab, Sind, Rajputana, Upper Gangetic plains, alt. 0-1,000 ft., frequent.

561. **Heliotropium paniculatum** Br. Prodr. 494, not of Roxb.

Locality.—Hissar (Harsukh 20690 !).
Flowers.—October.
Distribution.—Ceylon; Siam; Australia. India—Rajputana, Sind, S. Deccan.

562. **Heliotropiums strigosum** Willd. Sp. Pl. I, 743.

Locality.—Rawalpindi (Ait. 471 !); Hissar (Duthie 4219 a).
Flowers—May-August.
Distribution.—W. Asia; Malaya; Australia. Throughout India, very common.

563. **Heliotropium strigosum** Wild. var. *brevifolia.*

Locality.—Lahore (2983 ! Brandis Herb.; Stewart 2809 !, 2584 !, 2506 !, 2810 !, Cleghorn 2642 !).
Flowers—March-April.
Distribution.—Throughout India, even more abundant than *H. strigosum* type.

308. TRICHODESMA *Br.*

564. **Trichodesma indicum** Br. Prodr. 496.

Locality.—Rawalpindi—Barrakow (Ait. 479 !); Gurdaspur—Siyapurkandi (Bisram 842 !).
Flowers—April-May.
Distribution.—Kabul; Baluchistan; Persia; Mauritius. Throughout India, common; not in Bengal plain.

309. CYNOGLOSSUM *L.*

565. **Cynoglossum furcatum** Wall. in Roxb. Fl. Ind. ed. Carey & Wall II, 6 and Cat. 919.

Locality.—Rawalpindi (Ait. 53 !).
Flowers.—September.
Distribution.—Ceylon; Kabul. Throughout India.

566. **Cynoglossum micranthum** Desf. Cat. Hort. Par. 1804, 220, fide A. DC. Prodr. X, 149.

Locality.—Lahore (Stewart 2808 !).
Flowers.—April.
Distribution.—N. India and the Himalaya, alt. 1-8,000 ft.

310. ECHINOSPERMUM *SWARK.*

567. **Echinospermum minimum** Lehm. Asperifol. 126.

Locality.—Rawalpindi—Hurror (Ait. 1085 !).
Flowers.—March.

Distribution.—Kabul; Baluchistan to the Ural Mts. and Altai. India—Punjab, Kashmir, temperate regions.

311. ROCHELIA *REICHB.*

568. **Rochelia stylaris** Boiss. Fl. Orient. IV, 245.

Locality.—Rawalpindi (Ait. 475 !).
Flowers.—March.
Distribution.—Kabul. India—Kashmir and adjoining Punjab Plains.

312. ASPERGO *L.*

569. **Aspergo procumbens.** L.

Locality.—Rawalpindi—Fatteh ganj (Ait. 1084 !).
Flowers.—March.
Distribution.—Europe; N. Africa; W. C. and N. Asia. India—Punjab and Kashmir, alt. 1-7,000 ft.

313. GASTROCOTYLE *BUNGE.*

570. **Gastrocotyle hispida** Bunge Rel. Rehm. 405.

Locality.—Rawalpindi (Ait. 1080 !).
Flowers.—March.
Distribution.—Egypt to Baluchistan; Kabul and Soongaria. India—Punjab, alt. 1,000 ft.

314. NONNEA *MOENCH.*

571. **Nonnea pulla** Lamk. et. DC. Fl. Fr. III, 626.

Locality.—Rawalpindi (Ait. 1082 !, 477 !); Lahore (Stewart 2530 !, 2579 !, 2811 !).
Flowers.—April.
Distribution.—C. and E. Europe; W. Asia. India—Punjab Plains.

315. LITHOSPERMUM *L.*

572. **Lithospermum arvense** L. DC. Prodr. X, 74.

Locality.—Rawalpindi (Ait. 474 !); Peshawar (Stewart 75 !).
Flowers.—March.
Distribution.—Kabul, Siberia to N. Africa, Europe. India.

573. **Lithospermum tenuifolium** L.f. Suppl. 130.

Locality.—Peshawar (Quizilbash 37 !).
Distribution.—Kabul, W. Asia to Egypt and Greece. India.

316. ARNEBIA *FORSK.*

574. **Arnebia hispidissima** DC. Prodr. X, 94.

Locality.—Lahore (Stewart 2571 !, 2572 !); Rawalpindi (Ait. 476 !).
Flowers.—March.
Distribution.—W. Asia to Egypt and Nubia. India—W. India, alt. 500-3,000 ft., Sind, from the Upper Gangetic plains and Rajputana westwards frequent.

575. **Arnebia Griffithii** Boiss. Fl. Orient IV, 213.

Locality.—Rawalpindi—Hurror (Ait. 1081 !).
Flowers.—March.
Distribution.—Baluchistan; Kabul. India—Punjab, Sind.

LXXV. CONVOLVULACEAE.

317. Rivea *CHOIS.*

576. **Rivea hypocrateriformis** Chois. Convol. Or. 26 and in DC. Prodr. 326.

Locality.—Hissar (Duthie 4232 !).
Flowers.—August.
Distribution.—W. India, in dry forests from Lahore and Bihar to Mysore, common.

318. Argyreia *LOUR.*

577. **Argyreia speciosa** Sweet Hort. Brit. ed. 2, 373.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13791 !).
Flowers.—September.
Distribution.—Java, also from China; Mauritius; cultivated. India, alt. 0-1,000 ft.

578. **Argyreia splendens** Sweet Hort. Brit. ed. 2, 373.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15034 !, 15033 !).
Flowers.—November.
Distribution.—India—Kashmir mountains.

319. Ipomoea *L.*

579. **Ipomoea Quamoclit** L. Bot. Mag. t. 244.

Locality.—Hoisharpur (Ait. 635 !).
Distribution.—Common throughout India, in gardens and as a denizen. Native of Tropical America.

580. **Ipomoea hederacea** Jacq. Collect. I, 124 and Ic. Rar. I, t. 36.

Locality.—Rawalpindi—Saidpur (Ait. 208 !).
Flowers.—September.
Distribution.—Tropical and subtropical regions of both hemispheres. India both cultivated and apparently wild, common.

581. **Ipomoea eriocarpa** Br. Prodr. 484.

Locality.—Rawalpindi (Ait. 207 !).
Flowers.—September.
Distribution.—Ceylon; Afghanistan, and Tropics of the Old World. Throughout India, alt. 0-4,000 ft., common.

582. **Ipomoea bonariensis** Hook. Bot. Mag. t. 3665.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14245 !, 14246 !).
Flowers.—September.
Distribution.—Argentine.

583. **Ipomoea Learii** Paxt. Mag. Bot. VI (1839) 267.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6372 !).
Flowers.—June.
A Garden Plant.
Distribution.—Tropical America.

584. **Ipomoea carnea** Jacq. Enum. Pl. Carib. 13.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13727 !, 11448 !).
Flowers.—May. *Fruits.*—February.
A Garden Plant.
Distribution.—S. America.

320. CONVOLVULUS *L.*

585. **Convolvulus microphyllus** Sieb.; Vis. Pl. Aeg—Nub. 12.

Locality.—Montgomery (Parker 13134 !); Multan (Monro 30 !, 349 !, 362 !).
Flowers—March-October.
Distribution.—Baluchistan to Egypt and Nubia. India—Sind, Rajputana.

586. **Convolvulus pluricaulis** Chois. Convol. Or. 95 and in DC. Prodr. IX 403 (the Plains plant).

Locality.—Lahore (Stewart 2510 !, 2531 !).
Flowers.—March.
Distribution.—India—Sind and plains of Hindustan and Bihar.

587. **Convolvulus pluricaulis** Choiss. *var.—macra.*

Locality.—Rawalpindi (Ait. 481 !).
Flowers.—April.
Distribution.—India—Punjab, common, from 3,000 ft. alt. in Kashmir to Delhi.

588. **Convolvulus arvensis** L. Engl. Bot. t. 312.

Locality.—Rawalpindi (Ait. 480 !); Lahore (3011 !).
Flowers.—April.
Distribution.—Nearly all temperate and subtropical regions. India—Sind, W. India, from Kashmir to the Deccan, a weed of cultivation.

321. EVOLVULUS *L.*

589. **Evolvulus alsinoides** L.

Locality.—Rawalpindi (Ait. 161 !).
Flowers.—August.
Distribution.—Ceylon, very common; the tropical and subtropical area of the globe; rare in very damp regions. Throughout India, very common.

322. PORANA *BURM.*

590. **Porana paniculata** Roxb. Cor. Pl. III, 31, t. 235 and Fl. Ind. I, 466 and ed. Carey & Wall. II, 39.

Locality.—Pathankote (Ellis !); Hoshiarpur (Ait. 515 !).
Flowers.—December.
Distribution.—Ceylon; Ava; Java. Throughout India, less common in the South Deccan.

323. CUSCUTA *L.*

591. **Cuscuta reflexa** Roxb. Cor., Pl. II, 3, t. 104 and Fl. Ind. I, 466 and ed. Carey & Wall. I, 466.

Locality.—Rawalpindi (* Ait. 563 !).
Flowers.—December.
* On *Carissa diffusa, Zizyphus vulgaris, Acacia robusta. Acacia arabica, Inga dulcis, Linum usitatissimum, Duranta* sp., *Jasminum* sp.
Distribution.—Ceylon; Malaya. Throughout India, alt. 0-8,000 ft., Bengal plains abundant.

LXXVI. SOLANACEAE.

324. SOLANUM *L.*

592. **Solanum nigrum** L.

Locality.—Rawalpindi (Ait. 583 !); Lahore (Stewart 2541 !).
Flowers.—October.

Distribution.—All temperate and tropical parts of the world. Throughout India and Ceylon, alt. 0-7,000 ft., common.

593. **Solanum verbascifolium**

Locality.—Hoshiarpur (Ait. 508 !).
Distribution.—S.-E. Asia; Malaya; N. Australia; Tropical Africa. Throughout India, in the tropical and subtropical zone, common.

594. **Solanum torvum** Swartz Prodr. Veg. Ind. Occ. 47.

Locality.—Lahore—Changa Manga (Parker 24329 !, 24973 !, 24974 !, 13728 !).
Flowers.—May-December.
Distribution.—Malaya; China; Philippines; Tropical America. Throughout India in the tropical region except the western desert area, very common in Bengal.

595. **Solanum coagulans** Forsk. Fl. Aeg. Arab. 47.

Locality.—Rawalpindi (* Ait. 212 !).
Flowers.—September.
* Everywhere.
Distribution.—S.-W. Asia; Arabia; Egypt. India—W. India, Punjab, Sind.

596. **Solanum xanthocarpum** Schrad. & Wendl. Sert. Hanov. I, 8, t. 2.

Locality.—Rawalpindi (Ait. 482 !); Lahore (Cleghorn 2648 !).
Flowers.—April.
Distribution.—S.-E. Asia; Malaya; Tropical Australia and Polynesia. Throughout India, common.

597. **Solanum gracilipes** Dcne. in Jacquem. Voy. Bot. 113, t. 110.

Locality.—Rawalpindi (Ait. 482 !).
Flowers.—March.
Distribution.—Baluchistan. India—W. India, Punjab and Sind.

598. **Solanum hispidum** Pers. Syn. I, 228.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21224 !).
Fruits.—Globose.
* Cultivated.
Distribution.—Peru.

599. **Solanum macranthum** Dun.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38694 !).
Flowers.—April.
Distribution.—Brazil.

600. **Solanum Rantonnetii** Carr.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13610 !).
Flowers.—July.
Distribution.—Argentine.

601. **Solanum malacoxylon** Sendt. in Mart. Fl. Bras. X, 52.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15029 !).
Flowers.—July.
Native of Brazil.
Distribution.—Argentine.

325. Lycopersicum *MILLER.*

602. **Lycopersicum esculentum** Miller.

Locality.—Rawalpindi (Ait. 483 !).
Flowers.—May.
Distribution.—India, cultivated and as an escape. Native of Tropical America.

326. Withania *PAUQ.*

603. **Withania somnifera** Dunal. in DC. Prodr. XIII, Pt. I, 453.

Locality.—Lahore—Changa Manga (Parker 7726 !); Lahore (Stewart 2823 !, 2626 !); Rawalpindi (Ait. 484 !); Peshawar College (Quizilbash 19 !).
Flowers.—March-December.
Distribution.—Mediterranean region, with the Canaries; Cape of Good Hope. Throughout drier subtropical India, frequent in the west and Hindustan, rare in lower Bengal.

327. Lycium *L.*

604. **Lycium europaeum** L.

Locality.—Hissar (Harsukh 20681 !).
Flowers.—October.
Distribution.—Mediterranean region; W. Asia. W. India, alt. 0-5,000 ft., frequent.

328. Datura *L.*

605. **Datura Stramonium** L.

Locality.—Rawalpindi (Ait. 210 !).
Flowers.—September.
Distribution.—Nearly throughout the globe, in temperate and warm climate. India—temperate Himalaya.

606. **Datura fastuosa** L. var. *alba.*

Locality.—Lahore—Changa Manga (Parker 24817 !, 20146 !, 24269 !, 24270 !; Stewart 2512 !).
Flowers.—December.
Has increased during the last few years in unirrigated places.
Distribution.—Malaya; Tropical Africa. Throughout India, in waste places, a weed.

607. **Datura Metel** L.

Locality.—Lahore—Changa Manga (Parker 20143 !, 20144 !, 20145 !, 20139 !, 20140 !, 20141 !, 20142 !).
Flowers.—August.
Distribution.—Tropical America, widely naturalised in the Old World. India—W. Himalaya and Mts. of W. Deccan Peninsula, introduced.

329. Hyoscyamus *L.*

608. **Hyoscyamus muticus** L. Mant. 45.

Locality.—Lahore (Stewart 2614 !).
Flowers.—April.
Dsitribution.—Kabul, westwards to Egypt. India.—W. Punjab, Sind.

330. Cestrum *L.*

609. **Cestrum nocturnum** L. Sp. Pl. 191.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11409 !, 12967 !).
Flowers.—February-April.
8 ft. high.
Distribution.—S. America.

LXXVII. SCROPHULARIACEAE.

331. VERBASCUM *L.*

610. **Verbascum Thapsus** L.

Locality.—Rawalpindi (Ait. 485 !).
Flowers.—April.
Distribution.—India—Temperate Himalaya. Westwards to Britain.

332. CELSIA *L.*

611. **Celsia coromandeliana** Vahl Symb. III, 79.

Locality.—Hoshiarpur (Ait. 50 !); Rawalpindi (Ait. 85 !, 487 !, 486 !); Lahore (Stewart 2802 !, 2568 !).
Flowers.—March-July.
Distribution.—Afghanistan; Ava; China. Throughout India.

333. LINARIA *L.*

612. **Linaria ramosissima** Wall. Pl. As. Rar. II, 43, t. 153 and Cat. 3911.

Locality.—Rawalpindi (Ait. 213 !); Peshawar College (Quizilbash 50 !).
Flowers.—September.
Distribution.—Afghanistan; Ava. Throughout India on rocks and stony places, ascending the hills to 5,000 ft.

613. **Linaria minor** Desf.; Benth. in DC. Prodr. X, 287.

Locality.—Rawalpindi—Hussand and Tilla (Ait. 1089 !).
Flowers.—March.
Distribution.—India—the Punjab plains. Westwards to Britain.

334. ANTIRRHINUM *L.*

614. **Antirrhinum Orontium** L. Benth. in DC. Prodr. X, 290.

Locality.—Rawalpindi, Barrakow (Ait. 485 !); Hurrod (1088 !).
Flowers.—March-April.
Distribution.—India—the Punjab plains and W. Himalaya ascending to 4,000 ft., an escape in the Nilgiris. Westwards to N. Africa and Britain.

335. SCROPHULARIA *L.*

615. **Scrophularia scabiosaefolia** Benth. in DC. Prodr. X, 313.

Locality.—Rawalpindi (Ait. 489 !).
Flowers.—March.
Distribution.—W. Tibet 10-12,000 ft.; Afghanistan. India—Peshawar hills, W. Himalaya, alt. 10-1,200 ft.

336. MIMULUS L.

616. **Mimulus gracilis** Br. Prodr. 439.

Locality.—Peshawar College (Quizilbash 2 !); Rawalpindi (Ait. 490 !).
Flowers.—March.
Distribution.—China; Australia; Tropical and S. Africa. India—Punjab plains, W. Himalaya, alt. 1-3,000 ft.

337. MAZUS *LOUR.*

617. **Mazus rugosus** Lour. Fl. Coch. 386.

Locality.—Lahore (Stewart 2612 !); Hoshiarpur (Ait. 51 !).
Flowers.—April.

Distribution.—Afghanistan; Java; China; Japan; Philippine Isles. India—Plains in N. India, temperate and subtropical Himalaya.

338. HERPESTIS *GAERTN. f.*

618. **Herpestis Moniera** H. B. & K.

Locality.—Peshawar College (Quizilbash 48!); Hoshiarpur (Ait. 395!); Rawalpindi—Hussan (Ait. 584!).
Flowers.—October.
Distribution.—Marshes throughout India, ascending to 4,000 ft., Punjab to Singapore & Ceylon common. All warm countries.

LXXVIII. OROBANCHACEAE.

339. CISTANCHE *HOFFM. & LINK.*

619. **Cistanche tubulosa** Wight Ic. t. 1420 bis (*C. lutea* in letter press).

Locality.—Multan (* Fitzherbert!; Stewart 2824!).
Flowers.—November.
* Said to be growing on the roots of *Acacia arabica.*
Distribution.—Asia and westwards to Arabia. India—Punjab, Sind, Rajputana.

LXXIX. BIGNONIACEAE.

340. BIGNONIA *L.*

620. **Bignonia capreolata** L. Sp. Pl. 624.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12975!).
Flowers.—April.
Distribution.—N. America.

341. TECOMA *JUSS.*

621. **Tecoma undulata** G. Don. Gen. Syst. IV. 223.

Locality.—Hoshiarpur (Ait. 260!).
Distribution.—Arabia. India—W. India, alt. 0-3,000 ft., Sind, Baluchistan. Punjab, Gujarat, Rajputana, extending eastwards to Jummna.

622. **Tecoma australis** R. Br.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14873!).
Flowers.—March.
Distribution.—Australia.

623. **Tecoma capensis** Lindl.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13764!).
Flowers.—September.
Distribution.—S. Africa.

624. **Tecoma grandiflora** Delaun.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13654!, 13653!).
Flowers.—May-September.
Distribution.—Indigenous to China and Japan. Cultivated in India in gardens in the plains and on the hills.

625. **Tecoma jasminoides** Lindl.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12960!).
Flowers.—April.
Distribution.—Australia.

626. **Tecoma radicans** Juss.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13641 !).
Flowers.—June.
Distribution.—N. America.

627. **Tecoma Stans** Juss.

Locality.—Jullandur—Phillur Rest House (Parker 8957 !).
Flowers.—February.
Distribution.—S. and N. America.

342. DOLICHANDRA *Cham.*

628. **Dolichandra cynanchoides** Cham.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13626 !).
Flowers.—September.
Distribution.—Brazil; S. America.

343. JACARANDA *JUSS.*

629. **Jacaranda ovalifolia** R. Br.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13188 !).
Flowers.—April.
Distribution.—S. America.

344. PHYLLARTHRON *DC.*

630. **Phyllarthron comorense** DC. Prod. IX, 244.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13770 !, 13773 !, 13776 !).
Flowers.—September.
Distribution.—Comoro Islands.

345. KIGELIA *DC.*

631. **Kigelia pinnata** DC.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13129 !).
Flowers.—April.
Distribution.—Tropical Africa.

LXXX. PEDALIACEAE.

346. PEDALIUM *L.*

632. **Pedalium Murex** L. DC. Prodr. IX, 256.

Locality.—Gurgaon (Ram Balab 3017 !).
Distribution.—Ceylon; Trop. Africa. India—Deccan Peninsula.

LXXXI. ACANTHACEAE.

347. THUNBERGIA *L.*

633. **Thunbergia fragrans** Roxb. Cor. Pl. I, 47. and Fl. Ind. III, 33.

Locality.—Hoshiarpur (Ait. 489 !).
Cultivated.
Distribution.—Ceylon; Malaya to the Philippines and N. Australia. Throughout India, alt. 1-4,000 ft.

348. HYGROPHILA *Br.*

634. **Hygrophila polysperma** T. Anders. in Journ. Linn. Soc. XI, 456.

Locality.—Hoshiarpur (Ait. 610 !).
Distribution.—Kabul. Throughout India in wet places, alt. 0-5,000 ft.

349. RUELLIA *L.*

635. **Ruellia patula** Jacq. Misc. Bot. II, 358 and Ic. Pl. Rar. I, t. 119.

Locality.—Hissar (Duthie 4285 !).
Flowers.—August.
Distribution.—India—Deccan Peninsula extending to Sind, Rajputana and Bundelkhand.

350. DAEDALACANTHUS *T. ANDERS.*

636. **Daedalacanthus nervosus** T. Anders. in Journ. Linn. Soc. IX, 487.

Locality.—Rawalpindi—Nand Kot 4,000 ft. (Jerram 7802 !, 7806 !).
Distribution.—India—base of the Himalaya, alt. 1-3,000 ft. from the Punjab to Bhotan frequent. Cultivated in various tropical countries.

351. ACHMANTHERA *NEES.*

637. **Aechmanthera tomentosa** Nees in Wall. Pl. As. Rar. III, 87.

Locality.—Hoshiarpur (Ait. 540 !).
Distribution.—India—Temperate Himalaya, alt. 3-5,000 ft., Kumaon.

352. STROBILANTHES *BLUME.*

638. **Strobilanthes glutinosus** Nees in Wall. Pl. As. Rar. III, and 86 in DC. Prodr. XI, 144.

Locality.—Rawalpindi—Murree 6,000 ft. (Ait. !).
Distribution.—India—Kashmir, Gharwal, Kumaon. Nepal.

639. **Strobilanthes anisophyllus** T. Anders. in Cat. Hort. Calcutt. 43 and in Journ. Linn. Soc. IX, 478.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11535 !).
Flowers.—February.
Distribution.—Himalayas.

353. BLEPHARIS *JUSS.*

640. **Blepharis sindica** Stocks; T. Anders. in Journ. Linn. Soc. IX, 500.

Locality.—Multan (Monro 217 !); Hissar (Duthie 4138 !; Harsukh 20689 !).
Flowers.—August-October.
Distribution.—India—Sind, Punjab, Rajputana.

354. BARLERIA *L.*

641. **Barleria cristata** L. Benth. Fl. Hongk. 262.

Locality.—Rawalpindi (Ait. 215 !); Hoshiarpur (Ait. 270 !).
Flowers.—September.
Distribution.—Malaya; China. Subtropical India, N.-W. Himalaya, Burma, Central India, Nilgiris common, gardens of India.

355. LEPIDAGATHIS *WILLD.*

642. **Lepidagathis purpuricaulis** Nees in Wall. Pl. As. Rar. III, 96 and Mongr. Lepidg 27.

Locality.—Hoshiarpur (Ait. 590 !).
Distribution.—Himalayan Region. Burma.

643. **Lepidagathis hyalina** Nees in Wall. Pl. As. Rar. III, 95 and Mongr. Lepidag. 16.

Locality.—Hoshiarpur (Ait. 591 !).
Distribution.—Burma ; S. China. Throughout N. India, alt. 0-4,000 ft.

356. JUSTICIA *L.*

644. **Justicia Gendarussa** Linn. f. Suppl. 85.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13127 !).
Flowers.—May.
Distribution.—Malaya and China to the Philippines. Throughout India, often an escape from cultivation.

645. **Justicia quinquecangularis** Koen. ; Roxb. Fl. Ind. ed. Carey & Wall, I, 134.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38816 !) ; Rawalpindi (Ait. 218 !).
Flowers.—August-September.
Distribution.—India—Central India common, from Bengal & Agra to Belgaum.

357. ADHATODA *NEES.*

646. **Adhatoda Vasica** Nees in Wall. Pl. As. Rar. III, 103 and in DC. Prodr. XI, 387.

Locality.—Rawalpindi (Ait. 495 !).
Flowers.—March.
Distribution.—Malaya, S.-E. Asia. India, common, frequently cultivated.

358. JACOBINIA *MORIC.*

647. **Jacobinia tinctoria** Hemsl. Biol. Centr. Am. Bot. ii, 522.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6374 !) ; Ferozepore (Peck 3585 !, 3393 !).
Flowers.—April-June.
Distribution.—Guatemala.

359. RUNGIA *NEES.*

648. **Rungia parviflora** Nees in Wall. Pl. As. Rar. III, 110 and in DC. Prodr. XI 469, excl. syn.

Locality.—Hoshiarpur (Ait. 479 !).
Distribution.—India—S. Deccan Peninsula. Ceylon.

360. DICLIPTERA *JUSS.*

649. **Dicliptera Roxburghiana**-var. *bupleuroides* Nees in Wall, Pl. As. Rar. III and in DC. Prodr. XI 485, excl. syn. Roxb. (sp.).

Locality.—Rawalpindi (Ait. 217 !, 216 !) ; Hoshiarpur (Ait. 247 !) ; Lahore—Changa Manga (Parker 24132 ?, 24136 !).
Flowers.—September-December.
Abundant in sandy places.
Distribution.—Afghanistan. Throughout India in the hills, alt. 1-6,000 ft. ; abundant in the north, becoming rare in the Malabar Ghats, in the Himalayas from Kashmir to Upper Assam and Chittagong hills ; the Central India.

361 PERISTROPHE *NEES.*

650. **Peristrophe bicalyculata** Nees in Wall. Pl. As. Rar. III, 11 and DC. Prodr. XI, 496.

Locality.—Multan (Monro 237 !).
Distribution.—Tropical Africa. Tropical and subtropical India, from the Punjab, Rajputana, Sind to Assam, Madras very common. Not known from Ceylon.

LXXXII. VERBENACEAE.

362. LANTANA *L.*

651. **Lantana indica** Roxb. Hort. Beng. 46 and Fl. Ind. III, 89.

Locality.—Rawalpindi (Ait. 87 !).
Flowers.—July.
Distribution.—Ceylon. Tropical Africa. Throughout India in the warmer parts common, on the river banks of Bengal one of the commonest weeds. Baluchistan.

652. **Lantana Camara** L.

Locality.—Peshawar College (Quizilbash 60 !); Gurdaspur, Madhopur (*Parker 14391 !).
Flowers.—November.
* Naturalised and abundant, said to be poisonous to the cattle, which however do not eat these plants and also to camels. Camels are not allowed to browse loose in this district owing to it (abstract from Parker's note).
Distribution.—A native of Tropical America, has run wild in India specially in the Bhabar in U.P. and in W. Peninsula and Ceylon.

363. LIPPIA *L.*

653. **Lippia nodiflora** Rich. in Michz, Fl. Bor. Amer. II, 15.

Locality.—Peshawar College (Quizilbash 12 !); Rawalpindi (Ait. 506 !); Lahore (Stewart 2829 !).
Flowers.—April-May.
Distribution.—Ceylon; all tropical and warm temperate regions. Throughout India in wet grass, abundant.

364. STACHYTARPHETA *VAHL.*

654. **Stachytarpheta mutabilis** Vahl.

Locality.—Lahore—Ag. Hort. Gdns. (Mostoe 6375 !); Parker (13765 !).
Flowers.—September.
Distribution.—Venezuela. W. India.

365. VERBENA *L.*

655. **Verbena officinalis** L.: Schauer in DC. Prodr. XI, 547.

Locality.—Lahore (Stewart 2620 !); Rawalpindi (Ait. 254 !).
Flowers.—April-September.
Distribution.—Temperate and subtropical regions. India—Himalaya, alt. 1-6,000 ft. from Kashmir to Bhotan frequent, Bengal plain to the Sunderbunds frequent.

656. **Verbena bonariensis** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38863 !).
Flowers.—August.
Weed in gardens.
Distribution.—Tropical regions.

657. **Verbena bipinnatifida** Schau.

Locality.—Lahore—Changa Manga (Parker 19556 !).
Flowers.—May.
A perennial herb cultivated in gardens in the Punjab, e.g. Lahore, Shahdara etc., comes up freely, self sown in moist shady plains. Flowers blue or white. (Parker).
Distribution.—N. America.

366. PETREA *HOUST.*

658. **Petrea volubilis** Linn. Sp. Pl. 626.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15030 !).
Flowers.—April.
Distribution.—Tropical America.

367. CITHAREXYLUM *MILL.*

659. **Citharexylum quadrangulare** Jacq. Enum. Pl. Carib. 26.

Locality.—Ferozepore (Barvoin 5608 !).
Flowers.—August.
Distribution.—W. India.

660. **Citharexylum spinosum** Linn. Sp. Pl. 625.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38780 !, 17193 !, 17196 !).
Flowers.—August-October.
Distribution.—Barbados Islands.

368. CALLICARPA *L.*

661. **Callicarpa macrophylla** Vahl. Symb. III, 13 t. 53.

Locality.—Rawalpindi 4,000 ft. (Jerram 8496 !).
Flowers.—July.
Distribution.—Throughout N. and E. India, ascending to 6,000 ft. in the W. Himalaya, Deccan Peninsula.

662. **Callicarpa Reevesii** Wall. Cat. 1830.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13778 !); Lawrence Gdns. (Parker 11563 !).
Flowers.—September-November.
Distribution.—S. China.

663. **Callicarpa purpurea** Juss.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13648 !, 13669 !).
Flowers.—June.
Distribution.—China.

369. TECTONA *L. f.*

664. **Tectona grandis** Linn f. Suppl. 151.—The Teak, cultivated.

Locality.—Hoshiarpur (Ait. 490 !).
Distribution.—Burma; Malay Peninsula alt. 500-4,000 ft.; Sumatra; Java. India—W. Deccan Peninsula, alt. 500-4,000 ft., common; from Central India to Orissa.

370. PREMNA *L.*

665. **Premna scandens** Roxb. Fl. Ind. III, 82.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13729 !).

Flowers.—May.
Distribution.—India—Tarai of N. and E. Bengal, Assam.

666. **Premna latifolia** Roxb. Hort. Beng. 46 and Fl. Ind. III, 76.

Var.—*mucronata* C.B.Cl.
Locality.—Hoshiarpur (Parker 15045 !); Gurdaspur (Fane ex Engincor 4858 !; Bisram 301 !).
Flowers.—June-August.
Distribution.—N. India from Kumaon to Bhotan ascending to 5,000 ft. and spreading into Bengal Plains, common.

371. VITEX *L.*

667. **Vitex Negundo** L. Roxb. Fl. Ind., III, 70.

Locality.—Hoshiarpur (Ait. 380 !).
Distribution.—Ceylon; Kabul; E. Asia to the Philippines. Throughout India, in the warmer zone a universal plant.

668. **Vitex leucoxylon** Linn. f. Suppl. 293.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13805 !, 13657 !).
Flowers.—May.
Distribution.—S. Deccan Peninsula and Ceylon upto 3,000 ft.

669. **Vitex Agnus-castus** Linn. Sp. Pl. 638.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14385 !).
Flowers.—June-July.
Distribution.—Mediterranean region; Orient.

372. CLERODENDRON *L.*

670. **Clerodendron inerme** Gaertn. Fruct. I, 271, t. 57, fig. 1.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13650 !).
Flowers.—May.
Distribution.—India and Ceylon near the sea.

671. **Clerodendron phlomoides** Linn. f. Suppl. 292.

Locality.—Lahore—Changa Manga (Parker 13774 !); Hissar (Harsukh 20680 !).
Flowers.—September.
Distribution.—From the N.-W. Himalaya Tarai to Ceylon; general in the drier climates, extending to Bihar and Orissa.

672. **Clerodendron infortunatum** Gaertn. Fruct., I, 271, t. 57, fig. 1.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6381 !).
Flowers.—April.
Distribution.—Malaya. Throughout India, from Gharwal and Assam to Ceylon and Singapore, in the warm region, very common.

673. **Clerodendron Siphonanthus** Br. in Ait. Hort Kew. ed. 2, IV, 65.

Locality.—Hoshiarpur (Ait. 528 !).
An indigenous plant in the low hills also cultivated in gardens (Ait.).
Distribution.—Sumatra; extensively cultivated in both hemispheres. India—Mts. of S. Deccan Peninsula, Kumaon.

674. **Clerodendron fragrans** Ait.

Locality.—Hoshiarpur (Ait. 558 !).
Cultivated.

657. **Verbena bipinnatifida** Schau.

Locality.—Lahore—Changa Manga (Parker 19556!).
Flowers.—May.
A perennial herb cultivated in gardens in the Punjab, e.g. Lahore, Shahdara etc., comes up freely, self sown in moist shady plains. Flowers blue or white. (Parker).
Distribution.—N. America.

366. PETREA *HOUST.*

658. **Petrea volubilis** Linn. Sp. Pl. 626.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15030!).
Flowers.—April.
Distribution.—Tropical America.

367. CITHAREXYLUM *MILL.*

659. **Citharexylum quadrangulare** Jacq. Enum. Pl. Carib. 26.

Locality.—Ferozepore (Barvoin 5608!).
Flowers.—August.
Distribution.—W. India.

660. **Citharexylum spinosum** Linn. Sp. Pl. 625.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38780!, 17193!, 17196!).
Flowers.—August-October.
Distribution.—Barbados Islands.

368. CALLICARPA *L.*

661. **Callicarpa macrophylla** Vahl. Symb. III, 13 t. 53.

Locality.—Rawalpindi 4,000 ft. (Jerram 8496!).
Flowers.—July.
Distribution.—Throughout N. and E. India, ascending to 6,000 ft. in the W. Himalaya, Deccan Peninsula.

662. **Callicarpa Reevesii** Wall. Cat. 1830.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13778!); Lawrence Gdns. (Parker 11563!).
Flowers.—September-November.
Distribution.—S. China.

663. **Callicarpa purpurea** Juss.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13648!, 13669!).
Flowers.—June.
Distribution.—China.

369. TECTONA *L. f.*

664. **Tectona grandis** Linn f. Suppl. 151.—The Teak, cultivated.

Locality.—Hoshiarpur (Ait. 490!).
Distribution.—Burma; Malay Peninsula alt. 500-4,000 ft.; Sumatra; Java. India—W. Deccan Peninsula, alt. 500-4,000 ft., common; from Central India to Orissa.

370. PREMNA *L.*

665. **Premna scandens** Roxb. Fl. Ind. III, 82.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13729!).

Flowers.—May.
Distribution.—India—Tarai of N. and E. Bengal, Assam.

666. **Premna latifolia** Roxb. Hort. Beng. 46 and Fl. Ind. III, 76.

Var.—*mucronata* C.B.Cl.
Locality.—Hoshiarpur (Parker 15045 !); Gurdaspur (Fane ex Engincor 4858 !; Bisram 301 !).
Flowers.—June-August.
Distribution.—N. India from Kumaon to Bhotan ascending to 5,000 ft. and spreading into Bengal Plains, common.

371. VITEX *L.*

667. **Vitex Negundo** L. Roxb. Fl. Ind., III. 70.

Locality.—Hoshiarpur (Ait. 380 !).
Distribution.—Ceylon; Kabul; E. Asia to the Philippines. Throughout India, in the warmer zone a universal plant.

668. **Vitex leucoxylon** Linn. f. Suppl. 293.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13805 !, 13657 !).
Flowers.—May.
Distribution.—S. Deccan Peninsula and Ceylon upto 3,000 ft.

669. **Vitex Agnus-castus** Linn. Sp. Pl. 638.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14385 !).
Flowers.—June-July.
Distribution.—Mediterranean region; Orient.

372. CLERODENDRON *L.*

670. **Clerodendron inerme** Gaertn. Fruct. I, 271, t. 57, fig. 1.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13650 !).
Flowers.—May.
Distribution.—India and Ceylon near the sea.

671. **Clerodendron phlomoides** Linn. f. Suppl. 292.

Locality.—Lahore—Changa Manga (Parker 13774 !); Hissar (Harsukh 20680 !).
Flowers.—September.
Distribution.—From the N.-W. Himalaya Tarai to Ceylon; general in the drier climates, extending to Bihar and Orissa.

672. **Clerodendron infortunatum** Gaertn. Fruct., I, 271, t. 57, fig. 1.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6381 !).
Flowers.—April.
Distribution.—Malaya. Throughout India, from Gharwal and Assam to Ceylon and Singapore, in the warm region, very common.

673. **Clerodendron Siphonanthus** Br. in Ait. Hort Kew. ed. 2, IV, 65.

Locality.—Hoshiarpur (Ait. 528 !).
An indigenous plant in the low hills also cultivated in gardens (Ait.).
Distribution.—Sumatra; extensively cultivated in both hemispheres. India—Mts. of S. Deccan Peninsula, Kumaon.

674. **Clerodendron fragrans** Ait.

Locality.—Hoshiarpur (Ait. 558 !).
Cultivated.

675. **Clerodendron aculeatum** Linn.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13114!, 6366!).
Flowers.—April.
Distribution.—America.

676. **Clerodendron heterophyllum** R. Br. in Ait. Hort. Kew. ed. II, IV, 64.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38864!, 13769!, 6370!).
Flowers.—August.
Distribution.—Madagascar.

677. **Clerodendron Thomsonae** Balg. in Edinb. New. Phil. Journ. N. S. XV. (1862) 233.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13730!).
Flowers.—May.
Distribution.—Tropical Africa.

373. Holmskioldia *RETZ.*

678. **Holmskioldia sanguinea** Retz. Obs. VI, 31, and in Hoffm. Phyt. Blaett. 35, t. 3.

Locality.—Hoshiarpur (Ait. 559!).
Indigenous in the low hills, forest near Hoshiarpur and also cultivated in gardens and an escape (Ait.).
Distribution.—India—subtropical Himalaya, alt. 0-4,000 ft. from Kumaon to Bhotan.

374. Caryopteris *BUNGE.*

679. **Caryopteris Wallichiana** Schauer in DC. Prodr. XI, 625.

Locality.—Rawalpindi—Kachut 4,000 ft. (Jerram 7781!, 7780!; Hoshiarpur (Ait. 568!).
Flowers.—April.
Distribution.—India—subtropical Himalaya, alt. 0-4,500 ft., from the Punjab to Bhotan, frequent.

680. **Caryopteris grata** Benth. in Gen. Pl. II, 1158.

Locality.—Rawalpindi—4,500-5,500 ft. (Jerram 8094!); Dhirkot (Jerram 7355!, 7356!, 7327!).
Flowers.—January-February.
Pericarp of fruit red when ripe.
Distribution.—India—Kumaon, below Naini Tal, alt. 4,000 ft.

LXXXIII. LABIATAE.

375. Ocimum *L.*

681. **Ocimum americanum** L. Cent. Pl. I, 15; Amoen Acad IV, 276 = *canum.*

Locality.—Pabbi Hills (* Parker 24228!).
Flowers.—December.
* Small shrub 2 ft. high with a different aroma to *basilicum.*
Distribution.—Asia and Tropical Africa.

682. **Ocimum Basilicum** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11536!).
Flowers.—February; Shrubby.
Distribution.—Ceylon; Malacca; hotter W. Asia; Africa; the Malay and Pacific Islands. Throughout tropical and hotter India—cultivated from the Punjab to Ava, indigenous in the Punjab on low hills.

683. **Ocimum gratissimum** L.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 13660 !, 13659 !, 13661 !).
Flowers.—May.
A shrub 3 ft. high, stem woody.
Distribution.—E. Nepal; Ceylon; Java; Tropical Africa and America. India—Bengal, Chittagong and throughout the Deccan Peninsula.

376. PLECTRANTHUS *L'HERIT.*

684. **Plectranthus rugosus** Wall. Pl. As. Rar. II, 17 and Cat. 2745.

Locality.—Rawalpindi, Barrakow Trete (Ait. 496 !).
Flowers.—August.
Distribution.—Afghanistan. India—W. Himalaya, dry hills from Kashmir to Gharwal, alt. 3-8,000 ft.

377. POGOSTEMON *DESF.*

685. **Pogostemon plectranthoides** Desf. in Amm. Mus. II, 156, t. 6.

Locality.—Hoshiarpur (Ait. 472 !).
Distribution.—India—W. Himalaya, lower Bengal and Bihar, Konkan, Canara, Circars.

378. MENTHA *L.*

686. **Mentha sylvestirs** Linn.

Locality.—Peshawar College (Quizilbash 461 !).
Distribution.—Afghanistan; Temperate Europe and W. and C. Asia. India—Temperate W. Himalaya.

379. THYMUS *L.*

687. **Thymus vulgaris** Linn. Sp. Pl. 591.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13124 !).
Flowers.—May.
Distribution.—S. Europe; N. Asia.

380. MICROMERIA *BENTH.*

688. **Micromeria biflora** Benth. Lab. 378 and in DC. Prodr. XII, 220.

Locality.—Gurdaspur—Siyaparkandi (Bisram 844 !).
Flowers.—May.
Distribution.—Afghanistan; Arabia; Abyssinia; S. Africa. India—tropical and temperate Himalaya, Nilgiri and Anaimalai Hills.

381. MERIANDRA *BENTH.*

689. **Meriandra bengalensis** Benth. Lab. 189. in Wall. Pl. As. Rar I., 29. and in DC. Prodr. XII, 262.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14872 !).
Flowers.—April.
Distribution.—India, cultivated. Native of Abyssinia.

382. SALVIA *L.*

690. **Salvia plebeia** Br. Prodr. 501.

Locality.—Lahore (Stewart 2897 !, 2898 !, 2680 !, 2622 !); Hoshiarpur (Ait. 574 !).
Flowers.—April.
Distribution.—China; Malay Islands; Australia. Throughout India, in the plains and ascending the hills to 5,000 ft.

691. **Salvia aegyptiaca** Linn.

Locality.—Rawalpindi (Ait. 499 !).
Flowers.—April.
Distribution.—Afghanistan; W. Asia; N. Africa to the Cape Verde Islands. India—Punjab plain, Sind, Rajputana from Delhi westwards, alt., 1-2,000 ft.

383. Nepeta *L.*

692. **Nepeta graciliflora** Benth. in Wall. Pl. As. Rar. I, 65; Lab. 476 and in DC. Prodr. XII, 382.

Locality.—Rawalpindi—Mt. Tilea (Ait. 1101 !).
Flowers.—March.
Distribution.—India—Punjab Plains from Hardwar to the Indus and subtropical Himalaya, ascending to 4,000 ft.

384. Lallemantia *FISCH & MEY.*

693. **Lallemantia Royleana** Benth. in DC. Prodr. XII, 404.

Locality.—Lahore (Stewart 2567 !); Rawalpindi Hussad (Ait. 1100 !).
Flowers.—March.
Distribution.—Afghanistan; Persia; Turkestan. India—Punjab plains and hills.

385. Scutellaria *L.*

694. **Scutellaria repens** Ham. in Don. Prodr. 110.

Locality.—Hoshiarpur (Ait. 543 !); Gurdaspure—Dhunera (Bisram 303 !).
Flowers.—June.
Distribution.—India—subtropical Himalaya, Ava.

386. Anisomeles *Br.*

695. **Anisomeles ovata** Br. in Ait. Hort. Kew. ed. 2, II, 364.

Locality.—Rawalpindi—Barrakow to Trete (Ait. 500 !).
Flowers.—September.
Distribution.—Malay Archipelago; China; Philippines. Tropical and subtropical India, Indus to Assam, ascending the Himalaya to 5,000 ft. and south to Ceylon.

387. Stachys *L.*

696. **Stachys parviflora** Benth. in DC. Prodr. XII, 490.

Locality.—Rawalpindi, Fattehgunj (Ait. 497 !, 501 !).
Flowers.—April-August.
It was strongly scented of Peppermint.
Distribution.—Afghanistan. India—Punjab plains and hills, from the Jhelum eastwards and northwards to Murree.

388. Otostegia *BENTH.*

697. **Otostegia limbata** Benth. mss.

Locality.—Rawalpindi, 3,500-5,000 ft. (Jerram 7895 !).
Flowers.—May.
Distribution.—India—Punjab, lower hills in rocky places west of the Jhelum to the salt range.

389. LEUCAS *Br.*

698. **Leucas urticaefolia** Br. Prodr. 504.

Locality.—Hissar (Harsukh 20696 !).
Flowers.—October.
Distribution.—Arabia : Abyssinia. India—Rajputana, Upper Gangetic Plain, from Patna to the Punjab and southwards to Sind, Coromandel and Malabar. Baluchistan.

390. AJUGA *L.*

699. **Ajuga bracteosa** Wall. Cat. 2032.

Locality.—Lahore—Changa Manga (Gamble 22497 !); Rawalpindi, Barrakow (Ait. 505 !).
Flowers.—January-April.
Distribution.—Afghanistan ; China ; Japan ; Abyssinia. India—W. Himalaya alt. 1-7,000 ft. and in the plains near them from Oudh to Peshawar.

LXXXIV. PLANTAGINACEAE.

391. PLANTAGO *L.*

700. **Plantago amplexicaulis** Cav. Ic. II, 22, t., 125. *var.—camphula* Edgew.

Locality.—Lahore (Stewart 2536 !, 2537 !); Rawalpindi (Ait. 508 !).
Flowers.—March-May.
Distribution.—India—Punjab Plains, Sind. Westwards to Greece and Egypt.

701. **Plantago ovata** Forsk. Fl. Aeg. Arab. 31.

Locality.—Rawalpindi (Ait. 507 !); Lyallpur (Inayat brother !); Multan (Monro 256 !); Lahore (Stewart 2820 !, 2535 !).
Flowers.—April-November.
Cultivated in Jalalpur.
Distribution.—India—Punjab plains and low hills, from the Sutlej westwards. Westwards to Spain and the Canaries.

702. **Plantago Psyllium** L.

Locality.—Peshawar College (Quizilbash 24 !), near Khyber Pass at Jamrud (Milne !).
Distribution.—India—N.-W. Punjab. Westwards to Greece and Egypt.

LXXXV. NYCTAGINACEAE.

392. BOERHAAVIA *L.*

703. **Boerhaavia repens** Linn.

Locality.—Hissar (Duthie 4327 !); Lahore (2962 !); Multan !.
Flowers.—August.
Distribution.—Ceylon ; Tropical and subtropical Asia ; Africa and America. Throughout India, from the Punjab to Assam and south to Travancore and Singapore, ascends in the hot Himalayan valleys to 7,000 ft.

LXXXVI ILLECEBRACEAE.

393. HERNIARIA *L.*

704. **Herniaria hirsuta** Linn.

Locality.—Lyallpur (Inayat brother !); Rawalpindi (Ait. 509 !).
Flowers.—March.
Distribution.—India—W. Himalaya, from Kashmir to Kumaon alt. 4-8,000 ft., the Punjab from the Sutlej to Peshawar. Westwards to the Atlantic and the Canary Islands.

LXXXVII. AMARANTACEAE.

394. Deeringia *Br.*

705. **Deeringia celosioides** Br. Prodr. 413.

Locality.—Hoshiarpur (Ait. 510 !).
Distribution.—Malay Islands; China; Australia. India—subtropical Himalaya.

395. Celosia *L.*

706. **Celosia argentea** Linn.

Locality.—Rawalpindi (Ait. 225 !).
Flowers.—September.
Distribution.—Tropical Asia; Africa; America. Cultivated or introduced. Throughout India and Ceylon, ascending the hills to 4,000 ft., nowhere really indigenous.

396. Bosia *L.*

707. **Bosia Amherstiana** Hook f.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13618 !).
Flowers.—April.
Distribution.—India—W. temperate Himalaya, alt. 4-7,000 ft.

397. Digera *FORSK.*

708. **Digera arvensis** Forsk. Fl. Aeg. Arab. 65. Moq. in DC. Prodr, XIII, 2, 324.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38818 !); Hissar (Hursukh 20694 !); (Lahore 29 !, 2959 !); Rawalpindi (Ait. 566 !) * Multan (25 ! Forest Department).
* Average fodder for cattle. No fodder for ponies. Also eaten by poorer classes as vegetable.
Distribution.—Ceylon—N. part of the island; Java; Afghanistan and Baluchistan to Arabia and N. Africa. India—Rajputana, Sind, Bengal and N.-W. India in the plains to Peshawar and the Salt Range, S. Deccan.

398. Amarantus *L.*

709. **Amarantus viridis** Linn. Sp. Pl. 1405.

Locality.—Multan—Sakmurrat (Monro 28 !); Rawalpindi (Ait. 525 !).
Flowers.—April-May.
Distribution.—All tropical and warm countries. Throughout India in waste places.

710. **Amarantus Blitum** Linn. Sp. Pl. 990.

Locality.—Lahore (24 ! Forest Department; 3000 ! Brandis Herb.; Stewart 2818 !, 2817 !; Cleghorn 2655 !); Rawalpindi (Ait. 523 !).
Flowers.—March.
Distribution.—Temperate and tropical regions. Waste places throughout India and Ceylon.

711. **Amarantus polygamus** Linn. Amoen. Acad. IV, 294. (not of Roxb.).

Locality.—Hissar (Duthie 4329 !).
Flowers.—August.
Distribution.—All hot countries. Throughout India and Ceylon, abundant.

399. PUPALIA *JUSS.*

712. **Pupalia lappacea** Moq. in DC. Prodr. XIII, 2, 331.

Locality.—Rawalpindi (Ait. 524!); Hoshiarpur (Ait. 37!).
Flowers.—July.
Distribution.—Tropical Asia and Africa. India—Upper Gangetic Valley and Punjab, W. tropical Himalaya, alt. 1-3,000 ft., from Kashmir to Kumaon, Bihar, Sind, Rajputana, Gujarat and the Deccan Peninsula.

400. AERUA *FORSK.*

713. **Aerua javanica** Juss. in Ann. Mus. XI, 131.

Locality.—Montgomery (Champion 45326!; Parker 10002!); Rawalpindi (Ait. 225!, 226!); Hurroo Bridge—(Ait. 562!, 565!); Lahore (Stewart 2597!, 2596!; Cleghorn 2649!); Hissar (Duthie 4328!; Harsukh 20691!); Multan (Duthie).
Flowers.—October-December.
Distribution.—Burma; Ceylon; westwards to Arabia; W. & E. Tropical Africa, and the Cape Verde Islands. India—from Oudh Terai to the Punjab, Sind, Central India, the Deccan from the Konkan southwards.

714. **Aerua scandens** Wall. Cat. 6911. excl. M.

Locality.—Rawalpindi—Barrakow (Ait. 522); Gurdaspur—Siyapurkandi (Bisram 843!).
Flowers.—May.
Distribution.—China; Malay Islands; Philippines; E. and W. Tropical Africa. India—Plains of Bengal and from Assam to the Punjab, ascending the Himalaya to 5,000 ft. from Kumaon to Bhotan, Central India, Bihar and the summit of Parasnath.

401. ACHYRANTHES *L.*

715. **Achyranthes aspera** Linn. Sp. Pl. 204.

Locality.—Hissar (Duthie 4331!); Hoshiarpur (Ait. 284!).
Flowers.—August.
Distribution.—Tropical Asia; Africa; Australia and America. Throughout India and Ceylon, an abundant weed in dry places.

402. ALTERNANTHERA *FORSK.*

716. **Alternanthera sessilis** Br. Prodr. 417.

Locality.—Peshawar (Quizilbash 27!); Hissar (Duthie 4333!); Rawalpindi (Ait. 690!); Lahore (Stewart 2626!, 2819!).
Flowers.—April-October.
Distribution.—All warm countries. Throughout hotter India and Ceylon, in damp places, ascending the Himalaya to 4,000 ft.

LXXXVIII. CHENOPODIACEAE.

403. CHENOPODIUM *L.*

717. **Chenopodium album** Linn.

Locality.—Peshawar College (Quizilbash 14!); Rawalpindi (Ait. 520!); Barrakow (Ait. 519!); Changa Manga (* Parker 14379!, 14380!).
Flowers.—March-July.
* Worst weed in C. M. It reaches a height of 10 ft. (From Parker's note).
Distribution.—India—Tropical and temperate Himalaya, the plains of Bengal, the Gangetic valley and the Punjab, Sind, Rajputana, Deccan Peninsula. Ubiquitous.

718. **Chenopodium murale** Linn. Sp. Pl. 219.

Locality.—Lahore—(Stewart 2816 !); Ag. Hort. Gdns. (Parker 21751 !).
Flowers.—March.
Weed in wheat crop.
Distribution.—India—Upper Gangetic valley and the Punjab, Deccan Peninsula. Ceylon, ubiquitous.

719. **Chenopodium Botrys** Linn. Sp. Pl. 219.

Locality.—Rawalpindi, Hurroo (Ait. 588 !).
Flowers.—October.
Distribution.—Europe; N. and W. Asia; N. Africa, introduced into America. India—Temperate Himalaya, alt. 4-10,000 ft.

720. **Chenopodium ambrosioides** Linn. Sp. Pl. 219.

Locality.—Rawalpindi (Ait. 223 !).
Flowers.—September.
Distribution.—Widely spread in the Old World, introduced into America. India—Bengal, Silhet and the Deccan.

404. SPINACIA *L.*

721. **Spinacia oleracea** Linn. Sp. Pl. 1027.

Locality.—Lahore (Stewart 2803 !).
Flowers.—March.
Distribution.—Cultivated throughout India.

405. ATRIPLEX *L.*

722. **Atriplex crassifolia** C. A. Mey. in Ledeb. Fl. Alt. IV, 309.

Locality.—Rawalpindi (Ait. 224 !).
Flowers.—September.
Distribution.—India—N.-W. India and the Punjab, from Jummna westwards.

723. **Atriplex nummularia** Lindl. in Mitch. Journ. Trop. Austr. (1848) 64.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14880 !).
Flowers.—February.
Distribution.—Australia.

406. KOCHIA *ROTH.*

724. **Kochia prostrata** Schrad. Neue. Journ. 1809, 85.

Locality.—Karnal !
Distribution.—Spain and N. Africa; Siberia; Central Asia. India—western Himalaya, in the dry regions of Kunwar and Zanskar.

725. **Kochia indica** Wight. Ic. t. 1791. Vern. n. Bui.

Locality.—Lahore (Parker 39057 !; Stewart 2641 !, 2520 !); Rawalpindi, Huzroo (Ait. 689 !).
Flowers.—March-October.
Abundant in the Punjab and sometimes a troublesome weed. On freshly irrigated somewhat saline soil. After a few years when the salts are washed out of the soil it disappears.
An annual, sometimes reaching 6-8 ft. high. In autumn twigs become rather woody and a tall patch of it is very difficult to break through.
Distribution.—Afghanistan. India—N.-W. India, from Delhi to Indus common, Deccan Peninsula, salt soils at Coimbatore.

407. SUAEDA *FORSK.*

726. **Suaeda fruticosa** Forsk. Fl. Aeg. Arab. 70.

Locality.—Sirsa (Drum 36956!, 36957!); Lahore (Stewart 2812!, 2813!, Cleghorn 2656!).
Flowers.—April-December.
Distribution.—The Atlantic; Africa and America. N.-W. India, from Delhi and throughout the Punjab, westwards to the Indus, common in the plains.

408. HALOXYLON *BUNGE.*

727. **Haloxylon recurvum** Bunge in Boiss. Fl. Orient. IV, 949.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14337!); Sirsa (10096!, 10055!, 10056!, 10057!, 10058!, 10059!, 10060!, 10063!, 10064!, 10066!, 10067!, 10068!, 10069!, 10073!); Multan (Monro!); Salt Range (Naraindas 10061!; Drum 36934!, 3018!).
Flowers.—September-December.
Distribution.—Afghanistan; Yunnan. India—W. Punjab plains and Salt Range ascending to 2,500 ft., Rajputana, Sind.

728. **Haloxylon salicornicum** Bunge in Boiss. Fl. Orient. IV, 949.

Locality.—Peshawar College (Quizilbash 4!); Lahore, Rakh chunian (Parker 14334!).
Flowers.—October.
Distribution.—Afghanistan. India—Rajputana; Sind. Baluchistan.

729. **Haloxylon multiflorum** Bunge in Boiss. Fl. Orient. IX, 949.

Locality.—Multan (Monro).
Flowers.—December.
Distribution.—Afghanistan. India—N.-W. Punjab plains, Rajputana.

409. SALSOLA *L.*

730. **Salsola Kali** Linn.; Boiss. Fl. Orient. IV, 954.

Locality.—Peshawar College (Quizilbash 47!).
Distribution. Atlantic; N. Asia; N. and S. Africa; Australia and N. America. India—N.-W. Punjab.

731. **Salsola foetida** Del. Fl. Aegypt. 57.

Locality.—Lahore—Kot Lakhpat (Parker 14330!, 14331!); Changa Manga—unirrigated area (Parker 14332!, 14333!; Gamble 22495!); Multan (Monro 10794!); Hissar (* Duthie 4335!); Shahpur, Daphar (Parker 2392!); Lahore (Stewart 2521!).
Flowers.—August-March.
Distribution.—Persia; Arabia; N. Africa. India—Punjab plains, upper Gangetic plain, Rajputana, Sind. Baluchistan.

LXXXIX. PHYTOLACCACEAE.

410. RIVINA *PLUM.*

732. **Rivina humilis** Linn. Sp. Pl. 121.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13768!).
Flowers.—September.
Distribution.—Tropical America,

411. PHYTOLACCA *L.*

733. **Phytolacca dioica** Linn. Sp. Pl. ed II, 631.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 38639 !, 17194 !, 13772 !).
Flowers.—May-October.
* Introduced in 1912 from seed from Vilmorin. Doing well and does not suffer from heat or frost in Lahore. This tree is commonly grown in Gibraltar.
Distribution.—S. America.

XC. POLYGONACEAE.

412. CALLIGONUM *L.*

734. **Calligonum polygonoides** Linn. Sp. Pl. (1753) 530.

Locality.—Multan Khanewal (* Parker 18076 !, 18075 !, Elliot !); Muzzafargarh (** Wingate !; Monro 305 !).
Flowers.—January-April.
* According to Brandis [*Indian Trees*, p. 521] this plant is found as far north as Lahore. This statement is, I believe, untrue. I have not seen it anywhere in either Lahore or Montgomery Districts. On the railway from Lahore to Karachi it starts suddenly at Mian Channa just within the border of Multan District. It is always found on sand dunes (Parker.).
** The flowers are eaten by the poorer classes of people.
Distribution.—Persia; Armenia; Syria. India—the Punjab, Rajputana, Sind.

413. POLYGONUM *L.*

735. **Polygonum plebejum** Br. Prodr. 420.

Locality.—Peshawar College (Quizilbash 3 !); Lahore (Stewart 2806 !, 2605 !, 2663 !, 2545 !).
Flowers.—April.
Distribution.—Afghanistan; Tropical Asia; Java; Philippines; Australia; Madagascar; Egypt; Tropical and S. Africa. India—Rajputana, Sind.

736. **Polygonum plebejum** Br. var. *indica.*

Locality.—Lahore (Stewart 2807 !).
Flowers.—April.
A common Australian and African form.

737. **Polygonum plebejum** Br. var. *brevifolia.*

Locality.—Multan (* Monro 261 !).
Flowers.—March.
* Eaten greedily by cattle.
Distribution.—India; Africa.

738. **Polygonum plebejum** Br. var. *micranthema.*

Locality.—Lahore (2617 !, Stewart 2509 !).
Flowers.—April.
Distribution.—India.

739. **Polygonum barbatum** Linn.

Locality.—Rawalpindi (Ait. 222 !).
Flowers.—September.
Distribution.—Tropical Asia and Africa. Throughout the hotter parts of India.

740. **Polygonum serrulatum** Lagasc. Boiss. Fl. Orient. IV, 1028.

Locality.—Lahore (Stewart 2804 !).
Flowers.—April.

Distribution.—W. Asia; S. Europe; Africa; America; Australia. Plains and low hills of India.

741. **Polygonum Hydropiper** Linn.

Locality.—Hoshiarpur (Ait. 47!); Lahore (3006!).
Distribution.—Europe and N. Africa; Temperate and subtropical Asia; Java; N. America; Australia. Plains and hills of India, in wet places.

414. RUMEX *L.*

742. **Rumex orientalis** Benth. Boiss. Fl. Orient. IV, 1009.

Locality.—Peshawar College (Quizilbash 5!).
Distribution.—Asia Minor; Syria and Greece. India—W. Himalaya.

743. **Rumex dentatus** Linn.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 21718!, 21719!; Stewart 2805!); Rawalpindi (Ait. 516!); Hoshiarpur (Ait. 607!).
Flowers.—March-April.
Distribution.—India.

XCI. PIPERACEAE.

415. PIPER *L.*

744. **Piper longum** Linn. Sp. Pl. 29.

Locality.—Hoshiarpur (*Ait. 493!).
* Cultivated in gardens for market.
Distribution.—Ceylon; Malacca; Malay Islands. Hotter provinces of India from Assam, Khasia Mts. and Bengal westwards to Bombay and to Travancore, wild or cultivated.

XCII. LAURACEAE.

416. MACHILUS *NEES.*

745. **Machilus odoratissima** Nees in Wall. Pl. As. Rar. II, 70, and Syst. Laurin, 172.

Locality.—Husanabad, Abbottabad (Inayat!); Rawalpindi—Punjar (Parker 8670!).
Flowers.—May-June.
Distribution.—Java; Sumatra; Cochin China. India—Subtropical and temperate Himalaya.

417. LITSAEA *LAMK.*

746. **Litsaea sebifera** Pers. Syn. II, 4.

Locality.—Rawalpindi 3,000 ft. (Jerram 7329!); Gurdaspur (Fane 4861!).
Flowers.—June.
Distribution.—Ceylon; Malay Islands; China; Australia. Throughout the hotter parts of India, from the Punjab to Assam, the Gangetic Plain and Bengal, and southwards throughout the Deccan Peninsula.

747. **Litsaea polyantha** Juss. in Ann. Mass. VI, 211.

Locality.—Gurdaspur (Fane 4860!).
Flowers.—July.
Distribution.—Java; China. India—Punjab and the Salt Range along the foot of the Himalaya, eastwards to Assam and southwards to the Satpura Range.

XCIII. THYMELAEACEAE.

418. Daphne L.

748. **Daphne cannabina** Wall in Asiat. Research XIII, 315. t. 7, 8.

Locality.—Rawalpindi 5,000 ft. (Jerram 7471 !).
Flowers.—March.
Distribution.—India—temperate Himalaya.

XCIV. LORANTHACEAE.

419. Loranthus L.

749. **Loranthus cordifolius** Wall. in Roxb. Fl. Ind. ed Carey and Wall. II, 223 and Cat. 517.

Locality.—On road from Shahpur to Sihunta 3,000 ft. Chamba state (Parker 21614 !).
Flowers.—January.
On *Vitex Negundo.*
Distribution.—India subtropical Himalaya, Central India.

750. **Loranthus longiflorus** Desrouss. in Lamk. Encyc. III, 498.

Locality.—Rawalpindi, Saligraon (Parker 9998 !); Hoshiarpur (Ait. 502 !).
Flowers.—February.
Distribution.—India—tropical and temperate Himalaya, Gangetic plains from Oudh to Assam and southwards on plains and hills throughout both peninsulas to Travancore. Ceylon; in the warm parts.

420. Viscum L.

751. **Viscum japonicum** Thunnb. in Trans. Linn. Soc. II, 329.

Locality.—Rawalpindi, Murree 7,000 ft. (Ait !).
On *Quercus.*
Distribution.—Mauritius; China; Japan; Australia. India—temperate Himalaya, alt. 5-7,000 ft., Nilgiri Hills, ascending to 7,000 ft., Central Provinces in the most elevated parts.

XCV. EUPHORBIACEAE.

421. Euphorbia L.

752. **Euphorbia hypericifolia** Linn. Hort. Cliff. 148.

Locality.—Rawalpindi (Ait. 529 !); Hissar (Duthie 4375 !).
Flowers.—July-August.
Distribution.—Ceylon; Tropics of both the hemispheres, except Australia and the Pacific Islands. Common throughout the hotter parts of India, from the Punjab to the S. Deccan.

753. **Euphorbia hirta** Linn. Sp. Pl. (1753) 454.

Locality.—Changa Manga (42605).
Flowers.—September.
Distribution.—Throughout the hotter parts of India from the Punjab to Ceylon. All tropical and subtropical countries.

754. **Euphorbia thymifolia** Burm. Fl. Ind. 2 and Thes. Zeylan, t. 105, f. 2

Locality.—Changa Manga (Parker 42606 !); Hissar bir (Harsukh 20688 !; Duthie 437a).
Flowers.—August-October.
Distribution.—Throughout India and Ceylon in the plains and lower hills. All hot countries except Australia.

755. **Euphorbia granulata** Forsk. Fl. Aeg. Arab. 94.

Locality.—Lahore—(2661 !; Stewart 2533 !).
Flowers.—March-April.
Distribution.—Afghanistan; Arabia; Egypt; Canaries. India—Punjab plains, Rohilkhand, Rajputana, Sind.

756. **Euphorbia Clarkeana** Hook. f.

Locality.—Lahore (Cleghorn 2647 !); Rawalpindi (Ait. 525 !); Hissar (Duthie 4374 !).
Flowers.—May-August.
Distribution.—India—N.-W. India, Rajputana, Sind.

757. **Euphorbia Tirucalli** Linn. Hort. Cliff. 147.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13616 !).
Flowers.—June.
Distribution.—India—naturalised in Bengal and the Deccan Peninsula, cultivated in N.-W. India, Burma and E. Peninsula. Ceylon naturalised; a native of Africa.

758. **Euphorbia helioscopia** Linn. Sp. Pl. 459.

Locality.—Rawalpindi (Ait. 528 !); Lahore (Stewart 2839 !).
Flowers.—April.
Distribution.—Afghanistan and westwards to the Atlantic; Japan; introduced elsewhere. India—the Punjab and W. Himalaya in fields, introduced into the Nilgiris.

759. **Euphorbia dracunculoides** Lamk. Encycl. II, 428.

Locality.—Jhelum (Ait. !); Lahore (Stewart 2532 !).
Flowers.—March.
Distribution.—Arabia and Tropical Africa. India—from the Punjab to Bihar in the plains and low hills, and southward to Canara and Coromandel.

760. **Euporbia falcata** L. Sp. Pl. 456.

Locality.—Rawalpindi (Ait. 630 !).
Flowers.—March.
Distribution.—Afghanistan and westwards to Arabia, Middle and S. Europe, and N. Africa. India—the Punjab.

761. **Euphorbia prolifera** Ham. in Don Prodr. 62.

Locality.—Rawalpindi (Ait. 531 !, 532 !).
Flowers.—April-May.
Distribution.—Yunnan. India—C. and W. Himalaya, plains and rocky hills from Oudh to the Punjab.

762. **Euphorbia pulcherrima** Willd. ex Klotzsch, in Otta & Dietr. Allg. Gartenz II (1834) 27.

Locality.—Hoshiarpur (Ait. 481 !).
Distribution.—Mexico.

422. Sarcococca *LINDL.*

763. **Sarcococca pruniformis** Lindl. Bot. Reg. t. 1012.

Locality.—Rawalpindi above 5,000 ft. (Jerram 7472 !).
Flowers.—March.
Distribution.—Ceylon; Afghanistan; Sumatra. India—temperate Himalaya, Deccan Peninsula, on the W. Ghats from Canara southwards.

423. BUXUS *L.*

764. **Buxus papillosa** C. K. Schneider, Ill. Handb. Laubholzk II, 139 (1907)

Locality.—Peshawar College (Quizilbash 58544 !); Rawalpindi—Kala chitta (Parker 10188 !).
Flowers.—December-March.
Distribution.—India.

424. ANDRACHNE *L.*

765. **Andrachne cordifolia** Muell. Arg. in DC. Prodr. XV, 234.

Locality.—Rawalpindi over 6,000 ft. (Jerram 8277 !).
Flowers.—July.
Distribution.—Afghanistan. India—C. and W. temperate Himalaya, alt. 5-8,000 ft.

425. PHYLLANTHUS *L.*

766. **Phyllanthus Niruri** Linn. Sp. Pl. 98.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38823 !).
Flowers.—August. A weed.
Distribution.—Ceylon; Malacca; Tropics generally except Australia. Throughout the hotter parts of India, from the Punjab to Assam and southwards to Travancore, ascending the hills to 3,000 ft.

426. GLOCHIDION *FORST.*

767. **Glochidion assamicum** Hook. f.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14881 !).
Flowers.—March.
Distribution.—India—W. Himalaya, foot and low valleys of the Himalaya, Bengal, Assam.

768. **Glochidion velutinum** Wight Ic. t. 1907-2.

Locality.—Rawalpindi, Panjuri (Parker 10190 !).
Flowers.—February.
Distribution.—India—hot valleys of the Himalaya, Deccan Peninsula from the Konkan to the Nilgiri Hills.

427. BREYNIA *FORST.*

769. **Breynia rhamnoides** Muell. Arg. in DC. Prodr. XV, ii, 440 (excl. vars. a., r.)

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13619 !).
Flowers.—June.
Distribution.—Ceylon; Malacca; China; Malay Islands, Philippines. Throughout tropical India.

770. **Breynia cernua** Muell. Arg. in DC. Prodr. XV, ii, 439.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13763 !, 38824 !).
Flowers.—September.
Shrub 4 ft. high.
Distribution.—Australia; Timor Island.

428. JATROPHA *L.*

771. **Jatropha gossypifolia** Linn. Sp. Pl. 1006.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13130 !).
Distribution.—Native of Brazil.

772. **Jatropha panduraefolia** Andr. Bot. Rep. t. 267; Woodr. Gard. in Ind. ed. 5, 442.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15031 !).
Flowers.—May.
Distribution.—Native of Cuba.

429. ALEURITES *FORST.*

773. **Aleurites moluccana** Willd. Sp. Pl. IV, 590.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13137 !, 12968 !).
Flowers.—April.
Distribution.—India. Native of Pacific Islands.

430. CROTON *L.*

774. **Croton caudatus** Geisel Croton. Mongr. 73.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38846 !).
Flowers.—August.
Distribution.—Ceylon; Malacca; Java; Philippines. India—E. Himalaya, Assam, Bengal and Silhet to the Deccan.

431. CHROZOPHORA *NECK.*

775. **Chrozophora hierosolymitana** Spreng. Syst. III, 850 = verbascifolia.

Locality.—Multan (Monro 206 !); Rawalpindi (Ait. 533 !).
Flowers.—May.
Distribution.—Mediterranean region; Orient.

432. ACALYPHA *L.*

776. **Acalypha ciliata** Forsk. Fl. Aeg. Arab. 162.

Locality.—Rawalpindi (Ait. 168 !, 228 !).
Flowers.—September.
Distribution.—Arabia; Tropical Africa. India—W. Himalaya, alt. 3-6,000 ft., the Deccan Peninsula from the Konkan southwards.

433. SAPIUM *P. Br.*

777. **Sapium sebiferum** Roxb. Fl. Ind. III, 693.

Locality.—Peshawar College (Quizilbash 62 !); Hoshiarpur (Ait. 566 !); Rawalpindi (Ait. 164 !).
Distribution.—Cultivated in various parts of India and elsewhere in warm countries. A native of China.

XCVI. URTICACEAE.

434. TREMA *LOUR.*

778. **Trema politoria** Planch. in Ann. Sc. Nat. Ser. iii, X (1848) 326.

Locality.—Hoshiarpur (Ait. 506 !).
Distribution.—India.

435. CANNABIS *TOURNEF.*

779. **Cannabis sativa** Linn. Sp. Pl. 1027.

Locality.—Rawalpindi (Ait. 230 !).
Flowers.—September.
Distribution.—Central Asia, wild; cultivated in temperate and tropical regions. Throughout India, wild in the N.-W. Himalaya and cultivated elsewhere.

436. MACLURA *NUTT.*

780. **Maclura aurantiaca** Nutt. Gen. Am. II, 234.

Locality.—Changa Manga (Parker 21042 !).
Flowers.—April.
Distribution.—N. America.

437. MORUS *L.*

781. **Morus alba** Linn. Sp. Pl. (1753) 986.

Locality.—Lahore—Changa Manga (Parker 39584 !); Rawalpindi (* Ait. 535 !, 534 !).
Flowers.—March-May. *Fruits.*—Deep purple.
* A cultivated tree in the Punjab proper. On the Hurrow road banks and on Indus banks on rocks it seems indigenous (Ait.).
Distribution.—Afghanistan; N. and W. Asia, wild or cultivated (for its fruit). India—cultivated in the Punjab, N.-W. Himalaya.

782. **Morus indica** Linn. Sp. Pl. 986.

Locality.—Lahore—Race course road (Parker 11413 !, 11451 !, 11414 !).
Flowers.—February-April.
Distribution.—China; Japan. India—temperate and subtropical Himalaya, Bengal, Assam, Burma, wild and cultivated.

783. **Morus laevigata** Wall. Cat. 4649.

Locality.—Rawalpindi—Wate's Garden (Parker 10238 !).
Flowers.—March.
Distribution.—India—tropical and subtropical Himalaya, Indus to Assam and Bihar, wild and cultivated.

438. FICUS *L.*

784. **Ficus bengalensis** Linn. Hort. Cliff. 471, n. 4.

Locality.—Kalesar, alt. 1,150 ft. (Lace. Herb. 35 !).
Distribution.—Plants in all the plains of India, wild only in the subtropical Himalayan forests and on the lower slopes of the Deccan hills.

785. **Ficus Rumphii** Blume Bijd. 437.

Locality.—Kangra—Shahpur (Parker 10529 !).
Flowers.—May.
Distribution.—Malay Islands. India—on the dry lower slopes of the mountains of the Punjab; N.-W. and C. India, Assam to Burma.

786. **Ficus religiosa** Linn. Hort. Cliff. 471.

Locality.—Hoshiarpur (Ait. 126 !).
Distribution.—Wild in the Sub-Himalayan forests, in Bengal and in Central India; universally planted in India and Ceylon, less frequently in Burma and rarely in the Malay region.

787. **Ficus scandens** Roxb. Fl. Ind. III, 536.

Locality.—Kangra—Shahpur (Parker 10528 !).
Flowers.—March.
Distribution.—Tropical Himalaya from Kumaon eastwards; Assam, Khasia Hills, Chittagong, Burma, and the Andaman Islands; Bihar on Parsunath.

788. **Ficus foveolata** Wall. Cat. 4493.

Locality.—Rawalpindi, Sangseri, 5,000 ft. (Jerram 7602 !).
Flowers.—April.
Distribution.—China. India—Outer Himalaya from Chamba to Bhotan Khasia Hills, Chittagong and Burma.

789. **Ficus palmata** Forsk. Fl. Aegypt. 179.

Locality.—Rawalpindi (Ait. 211); Phagwar, 5,000-6,000 ft. (Jerram 8095 !); Peshawar (Stewart !); Gurdaspur, Dhunera (Bisram 306 !).
Flowers.—June-September.
Distribution.—N.-W. India from the Indus eastwards to Oudh, ascending to 3,000 ft. in the Himalaya. Westwards to Egypt and Abyssinia.

790. **Ficus Roxburghii** Wall. Cat. 4508.

Locality.—Rawalpindi (Ait. 165).
Distribution.—India—Outer Himalaya, from the Indus to Bhotan, Khasia Hills, Chittagong, Burma, ascending to 5,000 ft.

791. **Ficus glomerata** Roxb. Cor. Pl. II, t. 123 and Fl. Ind. iii, 558.

Flowers.—September.
Distribution.—Outer Himalaya and plains and low hills of India, from Rajputana and the Salt Range to the Khasia Hills, Burma, the Deccan Peninsula, and Ceylon.

792. **Ficus macrophylla** Desf. Tabl. ed. I, 209.

Locality.—Changa Manga (Parker 19341 !).
Distribution.—Australia.

439. Artocarpus *FORST.*

793. **Artocarpus integrifolia** Linn. Fl. Suppl. 412.

Locality.—Hoshiarpur (Ait. 476 !); Bhullan (Parker 10237 !).
Flowers.—January.
Distribution.—Deccan Peninsula, native of the forests of the Western Ghats; cultivated throughout the hotter parts of India and E. Asia.

794. **Artocarpus Lakoocha** Roxb. Fl. Ind. iii, 524.

Locality.—Hoshiarpur (* Ait. 484 !).
* Cultivated in Hoshiarpur gardens and does not produce fruit.
Distribution.—Malacca. India—tropical Himalaya, ascending to 4,000 ft. from Kumaon eastwards to Burma and southwards to Travancore.

440. Boehmeria *JACQ.*

795. **Boehmeria platyphylla** Don. Prodr. 60.

Var.—scabrella Wedel.
Locality.—Hoshiarpur (Ait. 534 !).
Distribution.—India. Ceylon.

441. Pouzolzia *GAUZ.*

796. **Pouzolzia pentandra** Benn. Fl. Jav. 64, t., 14.

Locality.—Rawalpindi (Ait. 190 !); Lahore (2987 ! Brandis' Herb.).
Flowers.—September.
Distribution.—China; Japan. India—tropical Himalaya from Kangra, eastwards to Assam, the Khasia Hills and Bengal, and southwards to Orissa and Canara.

442. Parietaria *TOURNEF.*

797. **Parietaria debilis** Forst. Prodr. 387.

Locality.—Rawalpindi (Ait. 1107 !).
Flowers.—May.
Distribution.—Many temperate and tropical regions, extending to Australia and Chili. India—temperate Himalaya, from the Punjab to Sikkim, alt. 8-1,200 ft., the Konkan and Nilgiri Hills.

443. FORSKOHLEA *L.*

798. **Forskohlea tenacissima** Linn. Mant. 72.

Locality.—Rawalpindi, Attock (Ait. 1108!); Near Peshawar (Collett!).
Flowers.—April.
Distribution.—Egypt; Arabia; Afghanistan. India—W. Punjab, Sind. Baluchistan.

XCVII. PLATANACEAE.

444. PLATANUS *L.*

799. **Platanus orientalis** Linn. Sp. Pl. 999.

Locality.—Rawalpindi, Saidpur (Ait. 1136!).
Distribution.—Wild from N. Persia westwards to South Italy. India—N.-W. Himalaya; from the Sutlej westwards, cultivated only.

XCVIII. JUGLANDACEAE.

445. ENGELHARDTIA *LESCHEN.*

800. **Engelhardtia Colebrookiana** Lindl. in Wall. Pl. As. Rar. III, 4, t. 208 and Cat. 494.

Locality.—Hoshiarpur (Ait. 529!).
Distribution.—China. India—W. Himalaya, from the Chenab to Nepal, Assam and the Khasia Hills, Burma.

XCIX. CASUARINACEAE.

446. CASUARINA *FORST.*

801. **Casuarina equisetifolia** Forst. Char. Gen. 103, f. 53.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14387!, 14388!); Ravi Park (Parker 38703!).
Flowers.—April-June.
Distribution.—Malay Islands; Australia; Pacific. India—On the east of the Bay of Bengal, from Chittagong southwards, cultivated elsewhere in India.

C. SALICACEAE.

447. SALIX *L.*

802. **Salix tetrasperma** Roxb. Cor. Pl. i, 66, t. 97; Fl. Ind. III, 573.

Locality.—Gurdaspur (Bisram 848!).
Flowers.—May.
Distribution.—Sumatra; Java. Throughout tropical and subtropical India, from the Punjab eastwards to Assam and southwards to Travancore.

803. **Salix acmophylla** Boiss. Diagn. VII, 98; Fl. Orient. IV, 1183.

Locality.—Rawalpindi—Hurroo (Ait. 1113!).
Flowers.—February.
Distribution.—Afghanistan; Baluchistan and westwards to Syria. N.-W. India.

448. POPULUS *L.*

804. **Populus nigra** Linn. Sp. Pl. 1034.

Locality.—Lombardy (Ait.!).
Cultivated.
Distribution.—Europe.

805. **Populus euphratica** Oliv. Voy. iii, 449, t. 45, 46.

Locality.—Lahore—Islands in the Ravi (Parker 14381 !, 18105 !, 18106 !, 14382 !); (Ait. 110 !).
Flowers.—February. *Fruits.*—September.
Distribution.—W. and C. Asia, and westwards to Syria and Egypt. India—along the Indus Valley, in Sind, the Punjab and planted in the N.-W. Provinces.

CI. GNETACEAE.

449. EPHEDRA *L.*

806. **Ephedra foliata** Boiss. Fl. Orient V (1881) 716.

Locality.—Rawalpindi (Ait. 536 !); Changa Manga (U. Kangilal !).
Flowers.—May-July.
Distribution.—Afghanistan to Syria. India—Punjab, Rajputana, Sind.

CII. CONIFERAE.

450. CALLITRIS *VENT.*

807. **Callitris quadrivalvis** Vent. Decad. 10.

Locality.—Lahore—Anarkali gdns. (Parker 7515 !, 7516 !, 6046 !).
Flowers.—February-March.
Distribution.—N. Africa.

451. THUYA *L.*

808. **Thuya orientalis** Linn. Sp. Pl. 1002.

Locality.—Hoshiarpur (Ait. 486 !).
Distribution.—China; Japan.

452. CUPRESSUS *L.*

809. **Cupressus lusitanica** Mill. Gard. Dict. ed. VIII, n. 3.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14386 !, 7518 !)
Flowers.—February.
Distribution.—India. Orient.

453. PINUS *L.*

810. **Pinus longifolia** Roxb. Fl. Ind. iii. 651.

Locality.—Hoshiarpur (Ait. 292 !).
Distribution.—Afghanistan. India—outer Himalayan Ranges, from the Indus to Bhotan.

CIII. CYCADACEAE.

454. ZAMIA *L.*

811. **Zamia angustifolia** Jacq. Coll. III, 263.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38859 !)
A stemless tufted Cycad.
Distribution.—Bahama Islands.

CIV. HYDROCHARITACEAE.

455. HYDRILLA *RICHARD.*

812. **Hydrilla verticillata** Casp. in Monatsber. Akad. Berl. 1857.

Locality.—Rawalpindi, Hurroo (Ait. 543 !).
Distribution.—Central Europe; Mauritius; Madagascar; Tropical Asia and Australia. Still and slowly running waters throughout India and Ceylon.

CV. ORCHIDACEAE.

456. EULOPHIA *Br.*

813. **Eulophia campestris** Wall. Cat. 7617.

Locality.—On islands in the river at Urezerabad (Clarke 545 !); Lahore (Stewart 2625 !).
Flowers.—March-May.
Distribution.—Afghanistan. Plains of India, from the Punjab to Oudh, Bengal, Chittagong and the Deccan.

457. ZEUXINE *LINDL.*

814. **Zeuxine sulcata** Lind. Gen. & Sp. Orchid. 485.

Locality.—Hoshiarpur (Ait. 73 !); Lahore (Stewart 2825 !, 2522 !).
Flowers.—March-April.
Distribution.—Afghanistan; Java; China; Philippines. Throughout India in the plains and low hills from the Punjab and Sind to Assam, Chittagong, and southwards to Ceylon.

CVI. HAEMODORACEAE.

458. OPHIOPOGON *KER.*

815. **Ophiopogon japonicus** Ker-Gawl. in Bot. Mag. t. 1063.

Locality.—Rawalpindi 5,000 ft. (Ait. 126 !).
Flowers.—August.
Distribution.—Japan.

CVII. DIOSCOREACEAE.

459. DIOSCOREA *L.*

816. **Dioscorea belophylla** Voigt. Hort. Suburb. Calcutt. 653 (1845), nomen; Haines, For. Fl. Chota-Nagpur 530 decr. = *D. sagittata* Royle.

Locality.—Hoshiarpur (Ait. 586 !).
Distribution.—India.

CVIII. LILIACEAE.

460. SMILAX *L.*

817. **Smilax aspera** Linn. Sp. Pl. 1028.

Locality.—Rawalpindi—Hokraker, 5,000 ft. (Jerram 8066 !, 7790 !, 7789 !).
Fruits.—June.
Distribution.—Ceylon; Syria; S. Europe; N. Africa. Throughout India.

818. **Smilax prolifera** Roxb. Fl. Ind. iii, 795.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14876 !).
Flowers.—January.
Distribution. Throughout India. Ceylon.

461. Asparagus *L.*

819. **Asparagus capitatus** Baker in Journ. Linn. Soc. XIV, 607.

Locality.—Rawalpindi—Barrakow (Ait. 556 !, 137 !).
Flowers.—April. *Fruits.*—August.
Distribution.—India—foot of the W. Himalaya.

820. **Asparagus racemosus** Willd. Sp. Pl. ii, 152.

Locality.—Hissar bir (Duthie 4450 !).
Distribution.—Tropical Africa; Java; and Australia. Throughout tropical and subtropical India and Ceylon, ascending the Himalaya to 4,000 ft.

821. **Asparagus adscendens** Roxb. Fl. Ind. iii, 153.

Locality.—Hoshiarpur (Ait. 629 !); Rawalpindi (Ait. 235 !, 557 !).
Flowers.—September.
Distribution.—Afghanistan. India—Rohilkhand, the W. Himalaya and the Punjab, from Murree eastwards to Kumaon.

822. **Asparagus Sprengeri** Regal in Act. Hort. Petrop. XI (1890) 490, f. 8.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14361 !).
Flowers.—April.
Distribution.—S. Africa, Orient.

462. Yucca *DILL.*

823. **Yucca gloriosa** L. Sp. Pl. 319.

Locality.—Lahore (Parker 15044 !).
Distribution.—N. America.

463. Asphodelus *L.*

824. **Asphodelus tenuifolius** Cavan. in Anal. Cienc. Nat. iii, 46, t. 27; and Icon, t. 587, f. 2.

Locality.—Peshawar College (Quizilbash 10 !).
Distribution.—Plains of India, in fields, from Bengal westwards to Gujarat and the Punjab. Westwards to the Canary Islands.

464. Allium *L.*

825. **Allium rubellum** M. Bieb. Fl. Jaur. Cauc. i, 264.

Locality.—Rawalpindi (Ait. 551 !, 550 !, 549 !).
Flowers.—April.
Distribution.—India—Punjab and W. Himalaya, from Kashmir to Kumaon. Westwards to the Ural and Caucasus, and in Siberia.

465. Dipcadi *MEDIC.*

826. **Dipcadi serotinum** Medic. in Act. Palatin. VI, 431.

Locality.—Rawalpindi—Mt. Tilla (Ait. 554 !).
Flowers.—March.
Distribution.—Europe. India—Punjab, Kumaon.

466. Scilla *L.*

827. **Scilla Hohenackeri** Fisch. & Mey. in Bull. Soc. Nat. Masc. 1838, I, 256.

Locality.—Peshawar (Rodger 43399 !); Rawalpindi—Hurroo (Ait. 552 !).
Flowers.—March.
Distribution.—Afghanistan; Persia. India—Punjab.

467. MERENDERA *RAMOND.*

828. **Merendera persica** Boiss. & Kotsch. Diagn. XIII, 37; Fl. Orient V, 169.

Locality.—Rawalpindi—Futtehganj (Ait. 1124!).
Flowers.—February-March.
Distribution.—Afghanistan; N. Persia. India—the Punjab.

468. GLORIOSA *L.*

829. **Gloriosa superba** Linn. Sp. Pl. 305.

Locality.—Rawalpindi—Barrakow (Ait. 547!).
Flowers.—September.
Distribution.—Ceylon; Tropical Africa; Malaya; Cochin-China. Throughout tropical India.

CIX. COMMELINACEAE.

469. COMMELINA *L.*

830. **Commelina bengalensis** Linn. Sp. Pl. 41.

Locality.—Rawalpindi (Ait. 169!); Multan (* Monro 63!).
Flowers.—September.
* Ointment made from leaves mixed with cotton leaves and butter used for boils.
Distribution.—Tropical Asia and Africa. Throughout India, ascending to 6,000 ft. in the Himalaya.

831. **Commelina glabra** Clarke. Monogr. 163.

Locality.—Rawalpindi (Ait. 170!).
Flowers.—September.
Distribution.—India—the Southern Deccan Peninsula.

CX. PALMAE.

470. SABAL *ADANS.*

832. **Sabal Adansoni** Guerns. in Bull. Soc. Philom. III (1803) 206, t. 25.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 13658!).
Flowers.—May.
* Stemless.
Distribution.—N. America.

471. CHAMAEROPS *L.*

833. **Chamaerops humilis** Linn. Sp. Pl. 1187.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11450!).
Flowers.—February.
Stem 1-5 ft. high.
Distribution.—W. Mediterranean region.

CXI. TYPHACEAE.

472. TYPHA *L.*

834. **Typha elephantina** Roxb. Fl. Ind. iii, 556.

Locality.—Rawalpindi (Ait. 695!).
Flowers.—September.
Distribution.—Algiers. Marshes from N.-W. India to Assam and southwards.

835. **Typha angustata** Chaub. & Bory Exped. Scient. Morée Bot. 338.

Locality.—Multan (4!); Makhdumpur (Monro 356!); Rawalpindi (Ait. 694!); Lahore—Kot Lakhpat (* Parker 14359!, 14360!).
Flowers.—September-October.
* Introduced in Kot Lakhpat Plantation by canal water, found in wet Borrow Pits near the canal. Used for making chicks, winnowing trays, etc.
Distribution.—N. Asia and westwards N. Africa and S. Europe. Northern India, from Kashmir to Munnipore and southwards to Sind and Coromandel.

473. SPARGANIUM *L.*

836. **Sparganium ramosum** Huds. Fl. Angl. 40.

Locality.—Rawalpindi (Ait. 540!).
Flowers.—March.
Distribution.—N. Temp. regions. India.

CXII. ARACEAE.

474. COLOCASIA *L.*

837. **Colocasia Antiquorum** Schott Melet. I, 18; Syn 40; Prodr. 38.

Locality.—Rawalpindi (Ait. 537!).
Flowers.—March.
Cultivated for vegetable purposes.
Distribution.—Throughout the hotter parts of India and Ceylon, in moist and dry places, wild or cultivated. Cultivated in all hot countries.

CXIII. LEMNACEAE.

475. LEMNA *L.*

838. **Lemna paucicostata** Hegelm. Lemnac. 139, t. 8.

Locality.—Rawalpindi (Ait. 572!, 538!).
Distribution.—Cosmopolitan tropical. In various parts of India and Ceylon.

476. WOLFFIA *HORKEL.*

839. **Wolffia microscopica** Kurz in Journ. Linn. Soc. IX, 265.

Locality.—Lahore (Kashyap 18466!); Rawalpindi—Futtehgunj (Ait. 539!).
Distribution.—India.

CXIV. ALISMACEAE.

477. ALISMA *L.*

840. **Alisma Plantago** Linn.

Locality.—Hoshiarpur (Ait. 332!; Bisram 339!).
Flowers.—June.
Distribution.—N. and S. temperate regions. India—Marshes, etc. of the lower Himalaya, alt. 1-7,000 ft.

CXV. NAIADACEAE.

478. POTAMOGETON *L.*

841. **Potamogeton perfoliatus** Linn. Sp. Pl. 126.

Locality.—Rawalpindi (Ait. 232!).
Flowers.—September.
Distribution.—Malay and Sandwich Islands. Throughout the plains of India, ascending the Himalaya to 9,000 ft.

842. **Potamogeton crispus** Linn. Sp. Pl. 126.

Locality.—Rawalpinli (Ait. 569 !).
Distribution.—N. and S. temperate and subtropical regions. Plains of India and temperate Himalaya.

843. **Potamogeton pectinatus** Linn. Sp. Pl. 127.

Locality.—Rawalpindi (Ait. 542 !).
Distribution.—Plains of India. Most regions.

CXVI. CYPERACEAE.

479. CYPERUS *L.*

844. **Cyperus niveus** Retz. Obs. V, 12.

Locality.—Hoshiarpur (Ait. 134 !); Rawalpindi (Ait. 94 !).
Flowers.—July.
Distribution.—Kabul; China. India—from Kashmir to Upper Burma, alt. 0-6,000 ft., Rajputana and southwards to Calcutta and Hyderabad.

845. **Cyperus arenarius** Retz. Obs. IV, 9.

Locality.—Charkhi Dadri in sandy soil (Duthie 4491 !); Rawalpindi (Ait. 239 ! named *C. laevigatus* Koen.).
Flowers.—August-September.
Distribution.—Persia; Arabia; Trop. Asia. India—Rajputana, Sind, Punjab Plains.

846. **Cyperus Atkinsoni** C. B. Clarke in Journ. Linn. Soc. XXI, 109.

Locality.—Charkhi Dadri in sandy soil (Duthie 4491a !).
Flowers.—August.
Distribution.—India.

847. **Cyperus Iria** Linn. Sp. Pl. 67. (Excl. Rheede).

Locality.—Rawalpindi (Ait. 129 !).
Flowers.—August.
Distribution.—Old World. India—Rajputana, general in rice fields.

848. **Cyperus eleusinoides** Kunth Enum. ii, 39.

Locality.—Rawalpindi (Ait. 245 !, 244 !).
Flowers.—September.
Distribution.—Asia; Africa; Australia. India—Punjab to Ceylon, Rajputana.

849. **Cyperus tegetum** Roxb. Fl. Ind. i, 208.

Locality.—Hissar (Duthie 4483 !).
Flowers.—August.
Distribution.—Tropical Africa; Mauritius; Ceylon. Throughout India—Rajputana, Sind.

850. **Cyperus rotundus** Linn. Sp. Pl. 67 (not in Linn. Herb).

Locality.—Multan (Monro 340 !, 179 !, 20 !, 18 !); Rawalpindi (Ait. 109 !); Lahore (Stewart 2615 !).
Distribution.—All warm regions. India—Rajputana, Sind, a pestiferous weed.

851. **Cyperus stoloniferus** Retz. Obs. IV, 10.

Locality.—Lahore (Monro 19 !); Multan (Monro 389 !).
Flowers.—September.
Distribution.—Malay Peninsula; Mauritius; China; Malaya; Australia. Shores of India, especially in sea sand, from Sind to Ceylon and Coromandel.

852. **Cyperus serotinus** Rottb. Desc. Nov. Pl. 31; Prog. 18=*Monti.*

Locality.—Rawalpindi (Ait. 246!).
Flowers.—September.
Distribution.—Europe; Orient.

480. Kyllinga *ROTTB.*

853. **Kyllinga brevifolia** Rottb. Descr. et. Ic. 13, t. 4, f. 3.

Locality.—Rawalpindi (Ait. 240!).
Flowers.—September.
Distribution.—Throughout India, from the Punjab to Assam, Ceylon and Malacca. All warm regions except the Mediterranean.

481. Eleocharis *R. Br.*

854. **Eleocharis palustris** Br. Prodr. 224 (in note).

Locality.—Peshawar (Quizilbash 40!); Rawalpindi (Ait. 558!).
Flowers.—May.
Distribution.—Cosmopolitan. India—from the W. Himalaya to Sind and Bengal.

482. Fimbristylis *VAHL.*

855. **Fimbristylis dichotoma** Vahl. Enum. ii, 287.

Locality.—Muzaffargarh (Monro 270!, 272!).
Flowers.—April.
Distribution.—Warm regions of the Old World. Throughout India—Rajputana, Sind, in rice fields.

856. **Fimbristylis ferruginea** Vahl. Enum. 291.

Locality.—Rawalpindi (Ait. 242!).
Flowers.—September.
Distribution.—All warm regions. Throughout India, Rajputana, Sind, abundant near the sea.

483. Scirpus *L.*

857. **Scirpus quinquefarius** Ham. in Wal. Cat. 3465.

Locality.—Rawalpindi (Ait. 259!).
Flowers.—September.
Distribution.—Turkestan, Afghanistan; Africa. N. India, Rajputana, Sind,

858. **Scirpus mucronatus** Linn. Sp. Pl. 73.

Locality.—Rawalpindi (Ait. 559!).
Flowers.—May.
Distribution.—Europe; Madagascar; warmer Asia; Australia. Throughout India.

859. **Scirpus littoralis** Schrad. Fl. Germ. i, 142, t. 5, f. 7.

Locality.—Rawalpindi (Ait. 560!).
Flowers.—May.
Distribution.—Central Asia; Mediterranean region; Persia; Africa; Ceylon. India—Rajputana, Sind.

484. Carex *L.*

860. **Carex setigera** Don in Trans. Linn. Soc. XIV, 330 & Prodr. 43.

Locality.—Rawalpindi—Murree 6,500 ft. (58!, 55!, 18!).
Flowers.—May.
Distribution.—India.

861. **Carex Wallichiana** Prescott in Wall. Cat. 3380.

Locality.—Rawalpindi—Hurroo (Ait. 1127 !).
Flowers.—March.
Distribution.—Afghanistan. N. India.

CXVII. GRAMINEAE.

485. PASPALUM *L.*

862. **Paspalum sanguinale** Lamk. Illustr. I, 176.

Locality.—Rawalpindi (Ait. 120 !).
Flowers.—August.
Distribution.—All warm countries. Throughout India, in dry and moist situations ascending the Himalaya to 6,000 ft.

863. **Paspalum longiflorum** Retz. Obs. IV, 15 (non Trin).

Locality.—Karnal (Drum !).
Flowers.—August-September.
Distribution.—Tropical and subtropical regions of the Old World. Throughout India.

486. ISACHNE *Br.*

864. **Isachne australis** Br. Prodr. 196.

Locality.—Rawalpindi (Ait. 250 !).
Flowers—September.
Distribution.—Australia; New Zealand. Hotter parts of India, from Assam and Burma to Central India and southwards to Ceylon.

487. PANICUM *L.*

865. **Panicum Crus-galli** Linn. Sp. Pl. 56.

Locality.—Karnal (Drum !); Multan !
Flowers.—August.
Distribution.—All warm countries. Throughout India, especially in wet and rich soils.

866. **Panicum colonum** Linn. Syst. Ed. X, 870.

Locality.—Multan (Monro 16; Forest Dept. 8 !); Muzaffargarh (Monro 26 !, 27 !); Rawalpindi (Ait. 96 !); Hissar bir (Duthie 5026 !).
Flowers.—July-September.
Best fodder for cows, buffaloes, horses. The seed is eaten by people. Hindus make sweetmeat of it during fast days.
Distribution.—All warm countries. Throughout India and Ceylon.

867. **Panicum prostratum** Lamk. Illustr. i, 171; Encycl. IV, 745.

Locality.—Rawalpindi (Ait. 107 !).
Flowers.—July.
A good fodder grass.
Distribution.—Tropics generally. Plains of India from the Punjab, Sind to Assam and Burma and southwards to Ceylon.

868. **Panicum ramosum** Linn. Mant. i, 29.

Locality.—Hissar (Duthie 5019 !) Karnal (Drum !); Hansee 187 !; Multan (Monro 369 !; * Forest Dept. 2 !).
Flowers.—August.
* Grows on sandy soil with enough moisture. Good fodder for cattle, worse fodder for camels and goats.
Distribution.—Afghanistan; Ceylon. Plains of India from Sind, Rajputana and the N.-W. Provinces to Bihar and southwards to Madras.

869. **Panicum hydaspicum** Edgew. in Journ. Linn. Soc. vi (1862) 207.

Locality.—Karnal jungle (Drum !); Rawalpindi (Ait. 123 !).
Flowers.—August-September.
Distribution.—India—the Punjab and Upper Gangetic Plain.

870. **Panicum antidotale** Retz Obs. IV, 17.

Locality.—Hissar bir (Harsukh 20715 !, Duthie 5025 !); Multan (Monro 81 !; Duthie 10802 !); Rawalpindi (Ait. 113 !); Hoshiarpur (Ait. 1114 !).
Flowers.—July-February
Distribution.—Afghanistan; Africa; Tropical Australia. India—the Punjab, Rajputana, Sind, Upper Gangetic Plain and southwards to S. Deccan and Ceylon.

488. Oplismenus *BEAUV.*

871. **Oplismenus compositus** Beauv. Agrost. 54.

Locality.—Hooshiarpore (Ait. 480 !).
Distribution.—Ceylon, most tropical regions (except Australia). Throughout India.

489. Setaria *BEAUV.*

872. **Setaria glauca** Beauv. Agrost. 51.

Locality.—Karnal (Durm !); Rawalpindi (Ait. 108 !).
Flowers.—May-July.
Distribution.—All warm, temperate and tropical regions. Throughout India, especially in cultivated ground.

490. Pennisetum *PERS.*

873. **Pennisetum orientale** Rich. in Pers. Syn. i, 72.

Locality.—Rawalpindi—Murree (Wingate 35 !); Barrakow 2,500 ft. (Wingate 4 !).
Flowers.—April-May.
Distribution.—Asia Minor and N. Africa. India—W. Himalaya, the Punjab, Sind, the Konkan and Bihar.

874. **Pennisetum cenchroides** Rich. in Pers. Syn. i, 72.

Locality.—Multan (Monro 14 !, 13 !; * Forest Dept. 14 !); Lahore (Stewart 2524 !; Duthie !; Brandis' Herb. 2960 !); Rawalpindi (Ait. 99 !).
Flowers.—August-September.
* Best fodder to increase milk for cattle. Average kind of fodder for ponies. Grows on good sandy and moist soils.
Distribution.—Canary Islands; Tropical Africa; Sicily. India—plains and low hills throughout W. India, Rajputana, Sind. Baluchistan.

875. **Pennisetum Prieurii** Kunth Revis. Gram. ii, 411, t. 119; Enum. Pl. i, 162; Suppl. 119.

Locality.—Lahore (Hein !); Multan (Monro 14 !).
Flowers.—August-September.
Distribution.—Tropical Africa. India—The Punjab, Rajputana.

876. **Pennisetum typhoideum** Rich. in Pers. Syn. I (1805) 72.

Locality.—Lahore (Stewart 2844 !).
Distribution.—Africa and S. Europe. Throughout the hotter parts of India, widely cultivated.

491. CENCHRUS *L.*

877. **Cenchrus biflorus** Roxb. Fl. Ind. i, 233.

Locality.—Lahore (2957; Stewart 2845!); Hissar bir (Harsukh 20708!; Duthie 5034!); Sialkot (Bairus' father!).
Flowers.—April-October.
Distribution.—Arabia; Africa. India—the Punjab, Rajputana, Sind, Upper Gangetic Plain, the Konkan. Baluchistan.

878. **Cenchrus catharticus** Delile Cat. Hort. Monsp. 1838; in Linnaea XIII (1839) Litterb 103.

Locality.—Hissar bir (Harsukh 20702!); Panipat (Drum!).
Flowers.—October.
Distribution.—Arabia; Tropical Africa. India—the Punjab, Rajputana, Upper Gangteic Plains.

492. ORYZA *L.*

879. **Oryza sativa** Linn. Sp. Pl. 333.

Locality.—Rawalpindi (Ait. 255!).
Fruits.—September.
Distribution.—Ceylon; Tropical Australia. Indigenous in marshes of Rajputana, Sikkim, Bengal, the Khasia Hills, Central India, the Circars.

493. TRAGUS *HALLER.*

880. **Tragus racemosus** Scop. Introd. Hist. Nat. 73.

Locality.—Rawalpindi (Ait. 110!); (Barrakow 1!).
Flowers.—May-August.
Distribution.—Warm regions generally. Dry plains of India, Burma, Ceylon.

494. IMPERATA *CYRILL.*

881. **Imperata arundinacea** Cyrill. Pl. Rar. Neap Fasc. ii, 26, t. 11.

Locality.—Rawalpindi—Barrakow (Ait. 568!, 94!).
Flowers.—April-September.
Distribution.—Hotter parts of India, from the Punjab southwards, and eastwards to Malacca and Ceylon.

495. SACCHARUM *L.*

882. **Saccharum spontaneum** Linn. Mant. ii, 183.

Locality.—Multan (Monro 34!); Rawalpindi (Ait. 131!).
Flowers.—September-October.
Distribution.—S. Europe and warm regions of the Old World; E. Australia. Throughout the warmer parts of India and Ceylon, ascending to 6,000 ft., in the Himalaya.

883. **Saccharum arundinaceum** Retz. Obs. IV, 14.

Locality.—Multan (Monro 33!); Karnal Gdns (3006! Drum's Herb).
Flowers.—October.
Distribution.—Ceylon; China. Throughout the plains and low hills of India.

496. ERIANTHUS *MICHX.*

884. **Erianthus Ravennae** Beauv. Agrost. 14.

Locality.—Karnal (Jabraya 3008! Drum's Herb); Lahore (For. Economist 20162!, 20163!).
Flowers.—October-December.

Distribution.—India—W. Himalaya, from Kashmir to Kumaon, the Punjab and Upper Gangetic Plain, from the Indus to Delhi. Westwards to the Mediterranean.

497. ISCHAEMUM *L.*

885. **Ischaemum angustifolium** Hook. Monogr. Androp. 241.

Locality.—Rawalpindi—Barrakow (Ait. 563 !).
Flowers.—April.
Distribution.—Afghanistan; China; Philippines. India—Lower Himalaya, the Punjab, Rajputana, Mt. Aboo, the Satpura Hills, Bihar on Parusnath, Central India.

498. POGONATHERUM *BEAUV.*

886. **Pogonatherum saccharoideum** Beauv. Agrost. 56, t, f. 7.

Locality.—Hoshiarpur (Ait. 542 !).
Distribution.—China; Malaya. Throughout the hilly parts of India, in dry places, from the Punjab eastwards to Bhotan, Manipur, Burma, ascending the Himalaya to 4,000 ft. and southwards to Central India and Ceylon.

499. ROTTBOELLIA *L.* f.

887. **Rottboellia compressa** Linn. f. Suppl. 114.

Locality.—Multan (Monro 209 !).
Distribution.—Throughout the hotter parts of India, generally in wet places, Burma and Ceylon. Westwards to Spain and the Canaries and in most warm climates.

888. **Rottboellia compressa** Linn.—var. *fasciculata* Hack.

Locality.—Rawalpindi (Ait. 252 !); Lahore (For. Dept. 6 !).
Flowers.—September.
Distribution.—India—common especially on the borders of pools, often climbing among bushes.

889. **Rottboellia perforata** Roxb. Pl. Corom. ii, 43, t. 182; Fl. Ind. I, 356.

Locality.—Rawalpindi (Ait. 122 !).
Flowers.—July.
Distribution.—Afghanistan; Java. Throughout India from the Indus to Burma and southwards to Ceylon.

500. ELIONURUS *HUMB. & BONPL.*

890. **Elionurus hirsutus** Munro ex Benth. in Journ. Linn. Soc. XIX (1881) 68.

Locality.—Hissar bir (Harsukh 20700 !; Duthie 5053 !); Rawalpindi (Wingate !); Multan (Monro !).
Flowers.—April-November.
Distribution.—India—N. Punjab, Rajputana, Sind. Westwards to N. Africa.

501. ANDROPOGON *L.*

891. **Andropogon foveolatus** Del. Fl. Egypt. 16 a, t. 8, f. 2.

Locality.—Hissar bir (Duthie 5064 !); Rawalpindi (Ait. 98 !).
Flowers.—August.
Distribution.—Drier parts of India, from the Punjab and Sind to Bengal, Chota Nagpur, Central Provinces, Circars, and Coromandel. Baluchistan; westwards to the Cape Verde Islands.

892. **Andropogon Ischaemum** Linn. Sp. Pl. 1047.

Locality.—Hissar bir (Duthie 5060 !); Rawalpindi (Ait. 93 !).
Flowers.—August.
Distribution.—N.-W. India. Westwards to S. Europe, and tropics generally or sporadically.

893. **Andropogon hallpensis** Brot. Fl. Lusit, i. 89.

Locality.—Lahore (Monro 24 !); Rawalpindi (Ait. 116 !).
Flowers.—August.
Distribution.—Most warm countries. Throughout India, Burma and Ceylon in open places.

894. **Andropogon squarrosus** Linn. f. Suppl. 433. (*A. vetiverica zizanoides* Stapf.).

Locality.—Rawalpindi (Ait. 142 !); Peshawar (Stewart !); Hissar bir (Duthie 5061 !); Muzaffargarh (Monro 28 !).
Flowers.—August-September.
Distribution.—Java; Tropical Africa. Throughout the plains and lower hills of India, Burma and Ceylon.

895. **Andropogon monticolus** Schult. Mant. iii, 665.

Locality.—Rawalpindi (Wingate !).
Flowers.—April.
Distribution.—Burma; Afghanistan; S. Africa. India—W. Himalaya, from the Punjab to Bihar and southwards to Ceylon.

896. **Andropogon monticola** Schult. var. *Trinii.*

Locality.—Rawalpindi (3 !, 7 !, Ait. 92 !).
Flowers.—May-August.

897. **Andropogon annulatus** Forsk. Fl. Aeg. Arab. 173.

Locality.—Hissar bir (Duthie 5063 !, 5063 a !); Multan (Monro 22 !).
Flowers.—August-September.
Distribution.—Tropical Africa; China; Australia; Pacific Islands. Throughout the hills and plains of India.

898. **Andropogon contortus** Linn. Sp. Pl. 1045.

Locality.—Hissar bir (Duthie 5058 !); Rawalpindi (Ait. 117 !).
Flowers.—August.
Distribution.—Mediterranean region and tropics generally. Throughout India, Burma and Ceylon.

899. **Andropogon Iwarancusa** Jones in Asiat. Research IV (1795) 109. = Cymbopogon Iwarancusa Schult. fide Stapf.

Locality.—Hissar bir (Duthie 5062 !); Lahore (Stewart 2600 !; Brandis Herb. 2922 !); Multan (* For. Dept. 17 !; Duthie 10796 !).
Flowers.—April-December.
*Grows in good sandy soil. Its flowers have got a nice smell and are used to make native scent. Average sort of fodder for cattle. Its roots are perhaps used as Khas for Tatties.
Distribution.—Plains of N.-W. India, Sind, W. Himalaya, N, Canara and the Deccan. Westwards to N. Africa.

900. **Andropogon Iwarancusa** Jones in Asiat. Research. IV (1795) 109. var. *laniger* Desf. Fl. Atlant. ii, 379 = *Cymbopogon Schoenanthus* Spreng. fide Stapf.

Locality.—Rawalpindi.—Barrakow (Ait. 562 !); Multan (Monro 2 !); Hissar bir (Duthie 5062 !; Harsukh 20705 !).
Flowers.—April-September.

Distribution.—Plains of N.-W. India, Sind, W. Himalaya, N. Canara and the Deccan. Westwards to N. Africa

901. **Andropogon Schoenanthus** Linn. Sp. Pl. 1046.

Locality.—Hissar bir (Harsukh 20709!); Patiala State (35!).
Flowers.—October.
Distribution.—Hotter parts of India, wild or cultivated from the Punjab to Burma, and southwards to Travancore and Ceylon. Westwards to Tropical Africa.

502. Iseilema *HACK.*

902. **Iseilema Wightii** Anders. in Nov. Act. Soc. Sc. Upsal. Ser. 3, ii, 251.

Locality.—Hissar bir (Harsukh 20706!, Duthie 5076!); Sialkot (Bairu's father!); Lahore (For. Dept. 16!).
Flowers.—August-October.
Distribution.—Throughout India.

503. Apluda *L.*

903. **Apluda varia** Hack. Mongr. Androp. 196. var. *aristata.*

Locality.—Rawalpindi (Ait. 257!); Lahore (For Dept. 16!); Karnal (Drum!).
Flowers.—May-September.
Distribution.—E. Tropical Asia, Malaya; Australia; Pacific Islands. Through out India.

504. Phalaris *L.*

904. **Phalaris minor** Retz. Obs. iii, 8.

Locality.—Lahore (Stewart 2525!).
Distribution.—Plains of W. India and the Himalaya. Westwards to Canaries; S. Africa; Australia.

505. Aristida *L.*

905. **Aristida Adscenscionis** Linn. Sp. Pl. 82.

Locality.—Hissar (Duthie 5078!; Harsukh 20701!); Rawalpindi (Ait. 95!).
Flowers.—July-October.
Distribution.—Baluchistan and most warm countries. Throughout the plains and low hills of India, Burma and Ceylon.

906. **Aristida Hystrix** Linn. f. Suppl. 113.

Locality.—Rawalpindi (Ait. 118); Hissar bir (Duthie 5079!).
Flowers.—August.
Distribution.—India—the Deccan Peninsula, from the Konkan and Central Provinces southwards.

907. **Aristida funiculata** Trin. & Rupr. in Mem. Acad. Petersb, Ser. VI, vii (1849) 159.

Locality.—Multan (Ram Nath 50481!; 50480!, 50479!).
Distribution.—Arabia; Tropical Africa. India—Punjab plains, Rajputana, Sind, and the Konkan. Baluchistan.

908. **Aristida hystricula** Edgew. in Journ. Linn. Soc. VI (1862) 208.

Localtiy.—Hissar bir (Harsukh 20712!).
Flowers.—October.
Distribution.—India—Punjab, Sind. Baluchistan.

909. **Aristida hirtigluma** Steud. Nom. Ed. II, ii, 231, Syn. Gram. 144.

Locality.—Muzaffargarh (Monro 304 !).
Flowers.—April.
Distribution.—Westwards to Egypt and Abyssinia. India—the Punjab. Sind.

506. STIPA *L.*

910. **Stipa orientalis** Trin. ex. Ledeb. Fl. Alt. i, 83.

Locality.—Peshawar (* Stewart !).
* Not common.
Distribution.—W. Tibet, westwards to Persia, Altai Mts.

507. ALOPECURUS *L.*

911. **Alopecurus nepalensis** Trin. ex Steud. Syn. Gram. 148.

Locality.—Rawalpindi (Wingate !).
Distribution.—India—the Punjab, Upper Gangetic Plains, Gharwal.

508. POLYPOGON *DESF.*

912. **Polypogon monspeliensis** Desf. Fl. Atlant. i, 66.

Locality.—Hoshiarpur (Ait. 626 !); Lahore (Brandis Herb. 2921 !).
Distribution.—Ceylon. Tropical and temperate regions. Throughout continental India.

509. SPOROBOLUS *Br.*

913. **Sporobolus diander** Beauv. Agrost. 25.

Locality.—Multan (Monro 6 !).
Flowers.—September-November.
Distribution.—Asia and Tropical Australia. Throughout India, Burma and Ceylon.

914. **Sporobolus indicus** Br. Prodr. 170.

Locality.—Rawalpindi (Wingate !).
Flowers.—April.
Distribution.—All warm countries. Throughout India, Burma and Ceylon.

915. **Sporobolus minutiflorus** Link. Enum. Hort. Berol. i, 88.

Locality.—Hissar (Duthie 5083 !).
Flowers.—August.
Distribution.—India—Deccan Peninsula, Canara.

916. **Sporobolus glaucifolius** Hochst. in Flora, XXV (1842) I, Bieb. 123.

Locality.—Multan (Monro 11 !, 364 !, 12 !; Duthie 1080 !; *For. Dept. 10 !); Hissar bir—damp ground (Duthie 5085 !).
Flowers.—September-December.
* On good sandy soil. Easily killed by deposit of silt. Best fodder for cows, buffaloes and horses. Makes good hay.
Distribution.—Tropical Africa. India—the Punjab, Sind.

917. **Sporobolus arabicus** Boiss. Diagn. Pl. Or. Ser. I, XIII, 47.

Locality.—Multan (Monro 12 !, 3 !, 48 !; Duthie 10804 !); Rawalpindi (Ait. 249 !); Hissar (Duthie 5082 !, 5084 !).
Flowers.—August-December.
Distribution.—Arabia; Baluchistan; Waziristan. India—Punjab plains, Sind, Rajputana.

918. **Sporobolus coromandelianus** Kunth Revis. Gram. I, 681, Enum. Pl. 213

Locality.—Multan (Monro 5 !).
Flowers.—September.
Distribution.—Afghanistan. N. and S. Africa. Plains of India from the Punjab eastwards to Burma and southwards to Ceylon.

510. Agrostis *L.*

919. **Agrostis alba** Linn. Sp. Pl. 63.

Locality.—Rawalpindi (Ait. 571 !).
Flowers.—May.
Distribution.—N. temperate regions. India—W. Himalaya.

511. Avena *L.*

920. **Avena fatua** Linn. Sp. Pl. 80.

Locality.—Lahore (Stewart 2677 !); Rawalpindi (Ait. 569 !).
Flowers.—May.
Distribution.—Temperate Europe; N. Africa; N. Asia. India—the Punjab. N.-W. Himalaya, in cultivated fields.

512. Gracilea *KOEN.*

921. **Gracilea Royleana** Hook. f. in Fl. B. I. VII (1896) 284.

Locality.—Hissar bir (Harsukh 20707 !; Duthie 5096 !).
Flowers.—October.
Distribution.—Socotra; Nubia. India—the Punjab plains, Rajputana, Sind, Central India, Konkan, Canara.

513. Cynodon *PERS.*

922. **Cynodon dactylon** Pers. Syn. i, 85.

Locality.—Multan (Monro 1 !); Rawalpindi (Ait. 119 !); Muzaffargarh (Monro 238 !).
Flowers.—August-September.
Distribution.—All warm countries. Throughout India, Burma and Ceylon, ascending to 5,000 ft., in the Himalaya. Baluchistan.

514. Chloris *Sw.*

923. **Chloris tenella** Roxb. Fl. Ind. i, 329.

Locality.—Hissar (Coldstream !).
Flowers.—October.
Distribution.—Arabia; Abyssinia. India—Rajputana, Sind, Oodeypur, Khandesh, S. India.

924. **Chloris villosa** Pers. Syn. i, 87.

Locality.—Rawalpindi (Ait. 100 !).
Flowers.—July.
Distribution.—India—the Punjab, Rajputana, Sind, Oodaypore. Baluchistan; westwards to the Canaries.

515. Eleusine *GAERTN.*

925. **Eleusine flagellifera** Nees. in Linnaea XVI (1842) 220.

Locality.—Multan (Monro 21 !; For. Dept. 12 !; Duthie 805 !); Hissar (Harsukh 20710 !; Duthie 5099 !); Lahore (Duthie !; For. Dept. 5 !); Hansee (187 !).
Flowers.—April-December.

909. **Aristida hirtigluma** Steud. Nom. Ed. II, ii, 231, Syn. Gram. 144.

Locality.—Muzaffargarh (Monro 304 !).
Flowers.—April.
Distribution.—Westwards to Egypt and Abyssinia. India—the Punjab. Sind.

506. Stipa *L.*

910. **Stipa orientalis** Trin. ex. Ledeb. Fl. Alt. i, 83.

Locality.—Peshawar (* Stewart !).
* Not common.
Distribution.—W. Tibet, westwards to Persia, Altai Mts.

507. Alopecurus *L.*

911. **Alopecurus nepalensis** Trin. ex Steud. Syn. Gram. 148.

Locality.—Rawalpindi (Wingate !).
Distribution.—India—the Punjab, Upper Gangetic Plains, Gharwal.

508. Polypogon *DESF.*

912. **Polypogon monspeliensis** Desf. Fl. Atlant. i, 66.

Locality.—Hoshiarpur (Ait. 626 !); Lahore (Brandis Herb. 2921 !).
Distribution.—Ceylon. Tropical and temperate regions. Throughout continental India.

509. Sporobolus *Br.*

913. **Sporobolus diander** Beauv. Agrost. 25.

Locality.—Multan (Monro 6 !).
Flowers.—September-November.
Distribution.—Asia and Tropical Australia. Throughout India, Burma and Ceylon.

914. **Sporobolus indicus** Br. Prodr. 170.

Locality.—Rawalpindi (Wingate !).
Flowers.—April.
Distribution.—All warm countries. Throughout India, Burma and Ceylon.

915. **Sporobolus minutiflorus** Link. Enum. Hort. Berol. i, 88.

Locality.—Hissar (Duthie 5083 !).
Flowers.—August.
Distribution.—India—Deccan Peninsula, Canara.

916. **Sporobolus glaucifolius** Hochst. in Flora, XXV (1842) I, Bieb. 123.

Locality.—Multan (Monro 11 !, 364 !, 12 !; Duthie 1080 !; *For. Dept. 10 !); Hissar bir—damp ground (Duthie 5085 !).
Flowers.—September-December.
* On good sandy soil. Easily killed by deposit of silt. Best fodder for cows, buffaloes and horses. Makes good hay.
Distribution.—Tropical Africa. India—the Punjab, Sind.

917. **Sporobolus arabicus** Boiss. Diagn. Pl. Or. Ser. I, XIII, 47.

Locality.—Multan (Monro 12 !, 3 !, 48 !; Duthie 10804 !); Rawalpindi (Ait. 249 !); Hissar (Duthie 5082 !, 5084 !).
Flowers.—August-December.
Distribution.—Arabia; Baluchistan; Waziristan. India—Punjab plains, Sind, Rajputana.

918. **Sporobolus coromandelianus** Kunth Revis. Gram. I, 681, Enum. Pl. 213

Locality.—Multan (Monro 5 !).
Flowers.—September.
Distribution.—Afghanistan. N. and S. Africa. Plains of India from the Punjab eastwards to Burma and southwards to Ceylon.

510. AGROSTIS *L.*

919. **Agrostis alba** Linn. Sp. Pl. 63.

Locality.—Rawalpindi (Ait. 571 !).
Flowers.—May.
Distribution.—N. temperate regions. India—W. Himalaya.

511. AVENA *L.*

920. **Avena fatua** Linn. Sp. Pl. 80.

Locality.—Lahore (Stewart 2677 !); Rawalpindi (Ait. 569 !).
Flowers.—May.
Distribution.—Temperate Europe; N. Africa; N. Asia. India—the Punjab. N.-W. Himalaya, in cultivated fields.

512. GRACILEA *KOEN.*

921. **Gracilea Royleana** Hook. f. in Fl. B. I. VII (1896) 284.

Locality.—Hissar bir (Harsukh 20707 !; Duthie 5096 !).
Flowers.—October.
Distribution.—Socotra; Nubia. India—the Punjab plains, Rajputana, Sind, Central India, Konkan, Canara.

513. CYNODON *PERS.*

922. **Cynodon dactylon** Pers. Syn. i, 85.

Locality.—Multan (Monro 1 !); Rawalpindi (Ait. 119 !); Muzaffargarh (Monro 238 !).
Flowers.—August-September.
Distribution.—All warm countries. Throughout India, Burma and Ceylon, ascending to 5,000 ft., in the Himalaya. Baluchistan.

514. CHLORIS *Sw.*

923. **Chloris tenella** Roxb. Fl. Ind. i, 329.

Locality.—Hissar (Coldstream !).
Flowers.—October.
Distribution.—Arabia; Abyssinia. India—Rajputana, Sind, Oodeypur, Khandesh, S. India.

924. **Chloris villosa** Pers. Syn. i, 87.

Locality.—Rawalpindi (Ait. 100 !).
Flowers.—July.
Distribution.—India—the Punjab, Rajputana, Sind, Oodaypore. Baluchistan; westwards to the Canaries.

515. ELEUSINE *GAERTN.*

925. **Eleusine flagellifera** Nees. in Linnaea XVI (1842) 220.

Locality.—Multan (Monro 21 !; For. Dept. 12 !; Duthie 805 !); Hissar (Harsukh 20710 !; Duthie 5099 !); Lahore (Duthie !; For. Dept. 5 !); Hansee (187 !).
Flowers.—April-December.

Distribution.—Afghanistan; N. Africa. India—the Punjab plains, Rajputana, Sind. Baluchistan.

926. **Eleusine verticillata** Roxb. Fl. Ind. i, 346.

Locality.—Hissar bir (Harsukh 70703!; Duthie 5098!); Hansee (187!), Rawalpindi (Ait. 121!); Multan (Monro 4!).
Flowers.—August-October.
Distribution.—Tropical Asia; Africa and Australia. Plains of India.

927. **Eleusine aegyptiaca** Desf. Fl. Atlant. i, 85.

Locality.—Hissar bir (Duthie 5101!; Harsukh 20713!); Rawalpindi (Ait. 105!); Multan (Monro 3!).
Flowers.—August-October.
Distribution.—India—Rajputana, Sind. Burma; Ceylon; warm regions of the Old World; introduced into the New.

516. Leptochloa *BEAUV.*

928. **Leptochloa filiformis** Roem. & Sch. Syst. ii, 580.

Locality.—Rawalpindi (Ait. 253!).
Flowers.—September.
Distribution.—Ceylon; Tropical Asia; Africa; and America. Throughout India and Burma in the low country.

517. Pappophorum *NEES.*

929. **Pappophorum Aucheri** Jaub. & Spach. Ill. Pl. Orient. IV, 32, t. 323.

Locality.—Rawalpindi (Ait. 112!, Wingate!).
Flowers.—April-July.
Distribution.—Afghanistan; Persia; Turkistan. India—W. Punjab.

518. Arundo *L.*

930. **Arundo Donax** Linn. Sp. Pl. 81.

Locality.—Rawalpindi (Ait. 1135!).
Flowers.—February.
Distribution.—India—lower Himalaya and from the Punjab to Silhet, Naga Hills, Burma, the Circars, Nilgiri and Coorg Hills. Westwards to Europe; N. Africa; N. Asia.

519. Phragmites *TRIN.*

931. **Phragmites communis** Trin. Fund. Agrost. 134.

Locality.—Rawalpindi (Ait. 258!, 256!).
Flowers.—September.
Distribution.—N. and S. temperate regions. India.

932. **Phragmites Karka** Trin. ex. Steud. Nom. Ed. ii, 324.

Locality.—Multan (Monro 40!, 354!); Rawalpindi (Ait. 258!).
Flowers.—September-October.
Distribution.—Afghanistan; Japan; Tropical Asia; Africa and Australia. Throughout India, from the Punjab to Burma and southwards to Ceylon.

520. Eragrostis *BEAUV.*

933. **Eragrostis interrupta** Beauv. Agrost. 71 (non Roem. & Sch. nec. Trin.).

Locality.—Hissar bir (Harsukh 20714!; Duthie!); Multan (Monro 10!, 42!, For. Dept. 20!); Lahore (Monro 23!; For. Dept. 20!).
Flowers.—August-January.
* Average kind of fodder for cows and buffaloes only.

Distribution.—Mesopotamia; Tropical Africa. Throughout India, Burma and Ceylon.

934. **Eragrostis tremula** Hochst. ex Steud. Syn. Gram. 269.

Locality.—Multan (* For. Dept. 4!); Hissar bir (Duthie 5510!); Lahore—(For. Dept. 17!); Multan (Monro 231!, 390!).
Flowers.—May-August.
* Worse fodder for cattle.
Distribution.—Afghanistan; Tropical Africa. Northern India from the Punjab to Bengal and Burma and southwards to Carnatic.

935. **Eragrostis major** Host. Gram. Austr. IV, 14, t. 24.

Locality.—Hissar bir (Harsukh 20704!).
Flowers.—October.
Distribution.—Throughout the plains and lower hills of India and Burma, ascending to 5,000 ft. in the Himalaya. Ceylon; Westwards to S. Europe; Tropical and subtropical Asia.

936. **Eragrostis minor** Host. Gram. Austr. IV, 15, Fl. Austr. i, 135.

Locality.—Rawalpindi (Ait. 104!); Lahore (Cleghorn 2640!).
Flowers.—July.
Distribution.—Plains of N. India from the Punjab eastwards to Bengal, ascending the Himalaya to 8,000 ft., Sind, Rajputana, Konkan. Westwards to S. Europe and N. Asia.

937. **Eragrostis pilosa** Beauv. Agrost. 71.

Locality.—Hissar bir (Harsukh 20716!; Duthie 5109!); Multan (* For. Dept. 28!); Rawalpindi (Ait. 106!, 115!, 101!).
Flowers.—July-October.
* Average kind of fodder for cattle.
Distribution.—Ceylon; S. Europe; and most warm countries. Throughout India and Burma, ascending the Himalaya to 5,000 ft. or more.

938. **Eragrostis cynosuroides** Beauv. Agrost. 71, 162.

Locality.—Rawalpindi (Ait. 103!); Multan (* For. Dept. 18!; Monro 91!); Hissar bir (Duthie 5108!).
Flowers.—July-September.
* The roots of this as well as those of *Saccharum spontaneum* are used by Syces to enlarge their bundles of grasses.

521. Aeluropus *TRIN.*

939. **Aeluropus villosus** Trin. ex C.A. Mey. Verz. Pfl. Cauc. 18.

Locality.—Multan—on saline soil (Ram Nath 49456!; Duthie 10798!; *For Dept. 7!; Monro 277!, 236!).
Flowers.—July-December.
* Good fodder.
Distribution.—Ceylon, Mediterranean region; Caspian Sea; Arabia; Persia; Afghanistan. India—Salt plains of the Punjab and Sind, sandy shores of the Deccan Peninsula.

522. Poa *L.*

940. **Poa annua** Linn Sp. Pl. 68.

Locality.—Rawalpindi (Ait. 569!); Lahore (Stewart 2664!).
Flowers.—July.
Distribution.—Ceylon; Europe; Temperate Asia. India—throughout the temperate and subalpine Himalaya, the Khasia and Nilgiri Hills.

523. BROMUS *L.*

941. **Bromus tectorum** Linn. Sp. Pl. 77.

Locality.—Rawalpindi (Wingate !).
Flowers.—April.
Distribution.—Europe; N. Africa; N. and W. Asia. India—W. Himalaya from Gilgit to Kumaon.

524. LOLIUM *L.*

942. **Lolium temulentum** Linn. Sp. Pl. 83.

Locality.—Lahore (Stewart 2665 !).
Flowers.—March.
Distribution.—Europe; N. Asia. India—Upper Gangetic Plain, Punjab, Sind, and W. Himalaya.

525. OROPETIUM *TRIN.*

943. **Oropetium Thomaeum** Trin. Fund. Agrost 98, t. 3.

Locality.—Hissar bir (Harsukh 20711 !; Duthie 5123 !).
Flowers.—August-October.
Distribution.—Plains of India, from the Punjab to Bengal, Burma and southwards in the western Peninsula.

944. **Oropetium biflorus** Stapf.

Locaity.—Hissar (Drum ! 3002 !).

526. TRITICUM *L.*

945. **Triticum vulgare** Vill. Hist. Pl. Dauph. II, 153.

Locality.—Lahore (Stewart 2523 !).
Distribution.—India—cultivated in many parts of N. India and the Deccan Peninsula, especially in the N.-W. and upto 13,000 ft. in the Himalaya.

527. BAMBUSA *SCHREB.*

946. **Bambusa nana** Roxb. Fl. Ind. II, 190.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38646 !).
Flowers.—May.
Distribution.—Cultivated in Ceylon and many parts of India. Malay Peninsula; Native of China and Japan.

CRYPTOGAMIA.

FILICES.

528. ADIANTUM *L.*

947. **Adiantum capillus Veneris** L. The true Maiden Hair Fern.

Locality.—Rawalpindi (Ait. 236 !).
Flowers.—September.
Distribution.—Europe; Africa; America; Australia; common in gardens. India—Bombay Presidency; Madras Presidency, westside; common on banks of rivers in the plains and upto 5,000 ft.; N. India.

529. PTERIS *L.*

948. **Pteris longifolia** L.

Locality.—Rawalpindi (Ait. 237 !).
Sori—September.
Distribution.—India—throughout Bombay and Madras Presidencies, Bengal in the Plains and upto 50,000 ft. Burma; Ceylon; widely distributed over the whole world.

FURTHER OBSERVATIONS ON THE FLYING-FOX (*PTEROPUS GIGANTEUS* BRÜNN.) AND THE FULVOUS FRUIT-BAT (*ROUSETTUS LESCHENAULTI* DESM.).

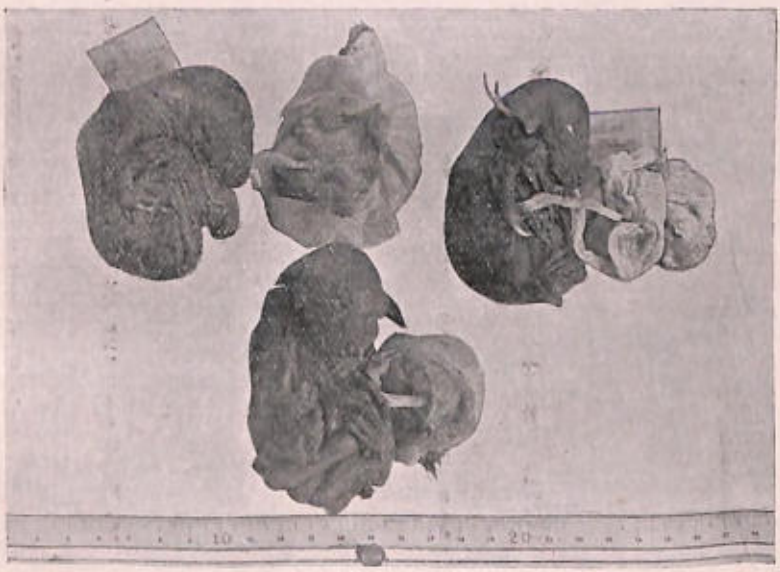
BY

CHARLES MCCANN, F.L.S.

(*With* 1 *photo and* 1 *text-figure*).

In volume xxxvii, p. 143, of the Society's *Journal*, I dealt with some of the phases in the life-history of the Flying-Fox (*P. giganteus*); but animal life-histories are rarely, if at all, exhaustive, and my observations were far from complete. I now add a few more links to the chain.

On the 25th January (1941) I witnessed a couple in copulation at the Victoria Gardens roost, Byculla, at about 4 p.m. One approached the other from a neighbouring branch, as soon as the ventral surfaces were juxtaposed copulation ensued. The wings took no part in the hold. There was some squeeling, the act was brief, and the pair separated.



Foetuses of the Flying-Fox (*P. giganteus*). The top specimen on the left shows the correct position.

On the night of the 22nd February I shot some Flying-Foxes visiting the flowers of the Silk Cotton Tree (*Bombax Ceiba* L.) at Andheri. Among them were two gravid females, each containing a single foetus. At a rough estimate I would suggest that these two foetal specimens were about two weeks from full time. The skin was deeply pigmented and had a coating of short hair. This

clearly indicated that the young are not born naked. On the 26th (February) I secured another foetus of about the same age. The foetal specimens were large; measured within the foetal membranes they were approximately 76 x 54 mm. The back and neck were strongly arched and the long axis of the head was almost parallel with that of the back. The 'wrists' of both the wings rest on the neck just behind the right ear. The forearms pass obliquely across the body to the lower left side, one 'elbow' being hidden in the folds of the lower membranes; the other, the left, being exposed a little below the snout. The pollex or 'thumb' of the left wing is exposed below the toes, the other is hidden. The chin rests in the V formed by the forearm and the upper arm (humerus) of the left wing. The feet are gathered up, the right being hidden under the membranes of the wings. The left foot lies exposed on the right side, partially over the left forearm. The knee of the right leg is prominent, but the left is hidden from view. The ear of the right side is folded backwards; the left forwards. The umbilical cord passes out at the bottom of the V formed by the fore- and upper-arm. A comparison of the foetuses of the Flying-Fox and the Fulvous Fruit-Bat (*R. leschenaulti*) show that the position of the foetus of these two bats within the foetal investments is totally different. A short description of the position of the foetus of *Rousettus* will be found in my article on the Fulvous Fruit-Bats (*Journ. Bomb. Nat. Hist. Soc.* vol. xli, p. 813.).

On the 27th February, my son, Carl., found an adult *Pteropus* electrocuted on the mains. He got it down and to his surprise found a recently born young one clinging to the putrifying body of its mother. It was still alive and apparently uninjured. On examination I found the umbilical cord still adhering, but quite dry. The little fellow called frequently, a quaint, though loud call, quite unlike anything I have heard the adults produce. Though it baffles description, the call may be likened to the noise made by rapidly twisting a glass stopper in the neck of a bottle! My boys were anxious to try and rear it, so I allowed them the pleasure. Four days later the cord dropped off. The young bat fed on milk administered through a pipette and appeared to be thriving, but it died on the 5th March. On the day of its capture, its wing-span measured 450 mm.; the fore-arm 72 mm.

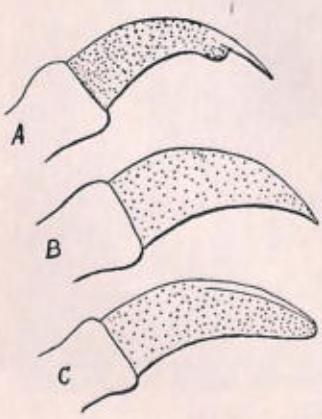


Fig. 1.—A. Claw of newly-born young.
B. ,, adult
C. ,, foetus.

While handling the little creature I noticed that the claws were extremely sharp and that they punctured the skin very readily. I examined the claws with a strong lens and soon discovered the reason for this. The claws were deep brown except the tips which were almost white and provided with extremely fine-pointed cusps. For the sake of comparison, I examined the claws of adults. The

claws were sharply pointed, but the cusps were entirely absent (see figures). The cusps in the young undoubtedly serve as a means of securing a firm hold on the body of the parent. The general tone of the fur was darker than in the adults; the wings and other naked portions of the body were a deep brown. The eyes were black and beady. The large size of the feet was remarkable. A peculiar odour hung about the animal. It clung well to branches and wire mesh, and there was little danger of it ever falling. It never moved about much, but when it was in difficulties it began to squeel.

These observations confirm my suggestion that the majority of births occur in March. The high birth rate at that time of the year in our area coincided with the greatest food supply for the parents, for it is the time when most trees are in bloom, a suitable period for nectar feeding animals. All males shot at this period clearly indicated that the breeding season was over as the testes were in a quiescent condition, and were not at all visible externally. During the breeding season the organs are pronounced.

In the breeding season one would expect the animals to be in the pink of condition, both internally and externally, but this does not always appear to be the case. One of the females, containing a well-developed foetus, was partially naked. The entire head and the greater part of the body were completely devoid of fur. The naked skin was a polished blackish brown, but to me, showed no signs of disease. In spite of this outward defect, she was well provided with fat internally. The foetus appeared as healthy and as well-developed as the others I had secured. I did not find any more parasites on this specimen than on the others—all were well supplied! The only ectoparasites I found on the bats were numerous spider-like wingless flies belonging to the family *Nycteribidae*[1], *Cyclopodea sykesi* Westw. These parasites are well known and have been recorded before from Flying-Foxes. So far I have not discovered any internal parasites visible to the naked eye.

In my previous article on these bats I referred to a number of food plants visited by them. To this I must now add the Cashu (*Anacardium occidentale* L.) and the Mango (*Mangifera indica* L.). The bats attack the fleshy pedicels of the *Cashu* on the verge of ripening for the sake of the copious juice. In previous years I had often noticed these bats hanging on mango trees during the flowering season, but at the time I did not suspect any association between the bat and the mango. This year, however, my curiosity was aroused by the litter of flowers and branches of the inflorescence lying on the road as I 'padded' my way to work. At first I could not explain this destruction, but it dawned on me that it might possibly be due to the work of bats; natural causes could not account for healthy flowers on the road. My suspicions aroused, I determined to watch the bats, and it was not long before evidence was forthcoming. I noticed that the animals clambered about the

[1] I am indebted to Dr. B. Prashad for the identification.

inflorescences, and as they went detached part of the branches. At the same time, they appeared to be chewing, but what? I shot some and found that their mouths were crammed with mango blossom. Here then were the culprits. On dissection an examination of the stomach contents revealed that the stomachs contained only liquid and in the liquid microscopical fragments of petals, sepals, pollen, and fragments of the larvae of the Mango Hopper (*Idiocerus* sp.) and small *Diptera* which had passed unavoidably down with the nectar. It was now time to turn my attention to the mango flowers and learn a little more about them. Mango flowers open at dusk and a very copious amount of nectar begins to exude from the large nectaries. So plentiful is the exudation that it soon begins to drip like dew from a roof—this is what the bats are after, and, as the flowers are small, quantities have to be masticated. Any movement of the inflorescence, as for example, by the wind, causes the sprinkling of the neighbouring area with nectar. Though the bats destroy a considerable quantity of the blossom, yet sufficient escapes their attention to produce a good crop in good years when the blossom is not attacked by other enemies.

Incidentally, this year there was a bumper crop of mango bloom in Salsette, though all came to nothing—the crop has failed, but the bats were not responsible for this. As already indicated, the flowers produce a considerable quantity of nectar which drips like dew and is sprinkled on everything around. In some years the drip of nectar is excessive, and the trees and the ground below become coated with the sticky secretion. It forms a thin film over the foliage and the inflorescences. In the sun this film hardens and glistens. At night the heavy dew moistens it and is partly washed down, but fresh secretion from the flowers makes up for the loss. This goes on from day to day. The film of nectar forms a suitable culture for the development of a black fungus which soon spreads over the trees coated with nectar. In a short while the trees appear blackened as though charred or covered with soot. The local people refer to this condition as 'burnt' (*jul gāyā*). Actually the fungus masks the leaves and tender parts, thereby seriously obstructing the normal functions of the tissues. The inflorescences disintegrate soon after a covering of the fungus has appeared, and nothing is left, not even those flowers that 'set' fruit. It is the end of the mango crop for that year. As the weather becomes drier, the fungus film cracks and flakes off, and what remains is washed away by the rains. That the fungus is a result of an excessive secretion of nectar is borne out by the examination of isolated trees. Only the side or sides on which the blooms appear are affected by the fungus while the non-flowering portions remain unaffected. When trees are crowded and branches are interlocked, the entire trees are affected and these conditions perhaps assist largely in the spread of the disease[1]. When trees

[1] The bats probably assist in the spread of the disease by carrying the fungus from one tree to another on their bodies.

are badly affected the whole tree and the ground below, protected by the circumference of the crown, is coated black.

Apart from the failure of the fruit crop, the trees actually suffer little damage from the fungus attack. The excessive exudation of nectar leads me to another point, namely, a local belief and practice. The locals annually hack a ring of deep incisions round the stem in the belief that this practice is instrumental in ensuring a good crop. The reason for this practice is the belief that by doing so they reduce the amount of sap reaching the young fruit which, if excessive, causes the fruit to drop soon after setting. How this belief arose is difficult to imagine, but perhaps the practice, if properly carried out without seriously injuring the trees, may truely help to reduce an excessive ascent of sap to the flowers, and thereby reduce an excessive nectar secretion. A consequent reduction in the danger of fungus growth might be the result. However interesting this subject, it is beyond the scope of this paper and I must return to the bats.

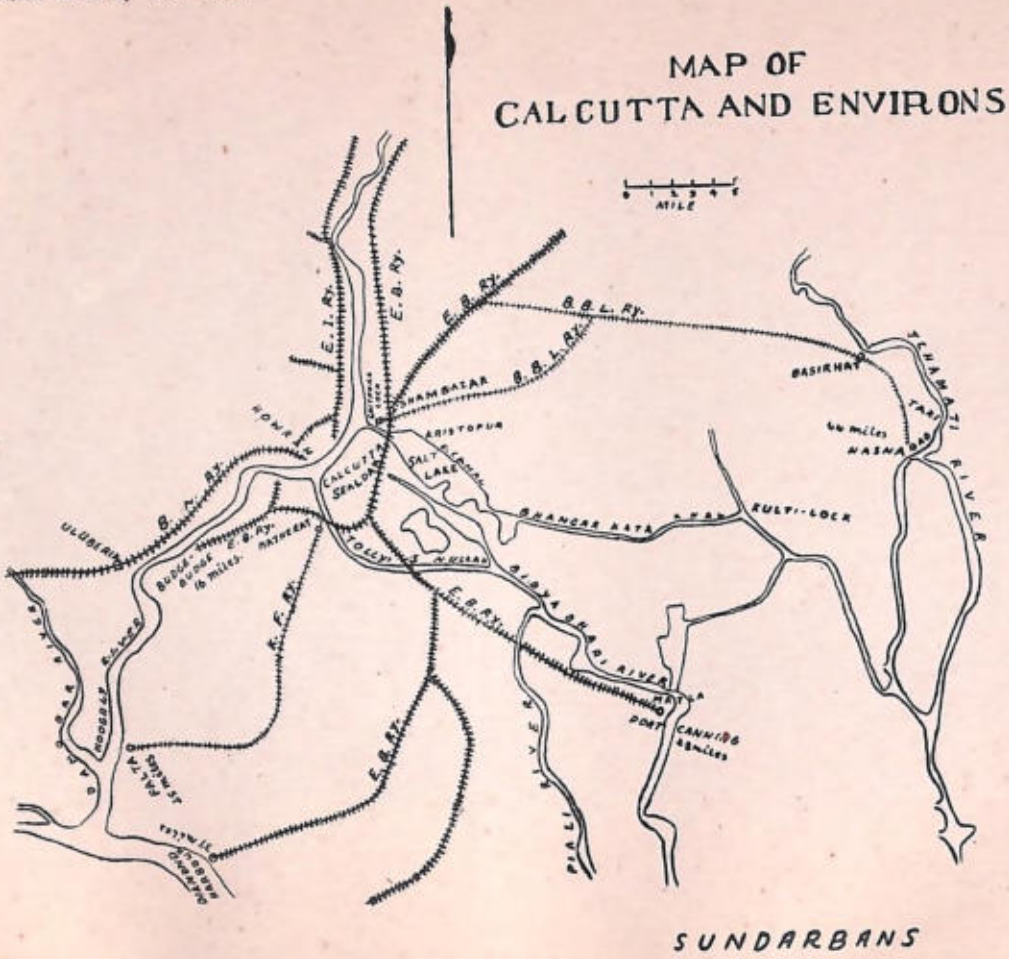
As the flowers of *Bombax* and mango became less the bats became fewer in proportion till finally they disappeared from the area. *Erythrina indica* and *E. stricta* now came into full bloom, but these blossoms were not visited by the bats. The flowers of *Erythrina* open towards morning and the greatest amount of nectar is produced during the hours of daylight, and are thus not suited for bat visitors. These flowers are chiefly pollinated by bird visitors and other diurnal animals. Strangely enough in the cases of *Bombax* and *Erythrina* we see trees with similarly coloured flowers—red—one adapted for nocturnal pollination and the other for diurnal pollination! The fact that *Bombax* is a night flowering plant is borne out by the fact that the buds open in the evening and the greatest amount of nectar is produced soon after. True the flowers keep open for a considerable time before they fall, and what pollination may have escaped the efforts of the bats, may be completed by the early birds and other visitors; but the chances of pollination by diurnal visitors is small. However, my casual observations on the fertilization of *Bombax* suggest yet another means, that the flowers are not merely adapted for cross-fertilization, but for self-fertilization also! I have examined numerous flowers at various times of day and night and I have been led to the conclusion that the outer bundles of stamens, forming a ring around the edge of the 'cup' of the flower, mature first and are shorter than the style. The bat visitors must first come in contact with the stigma before coming to the staminal ring where the muzzle becomes dusted with pollen and so on for each flower to effect cross-fertilization, as they attempt to get at the bottom of the cup for nectar. Besides this staminal ring there is another bundle of stamens surrounding the base of the style. At first this group of stamens is shorter than the style, the stigma is well above them. Later some stamens of this bundle begin to elongate and the anthers at the top of these stamens reach the same level as the stigma, this usually takes place the day after the opening. Failing cross-fertilization the stigma now stands a chance of self-fertilization by pollen from these lately elongated stamens.

Nature appears to take few chances and so provides for emergencies when the question of propagation is at stake! I am aware of several cases in which there is this double provision. However, in spite of the time I have spent, and the many flowers I have examined, the observation must be taken with reserve until further light is shed on the subject. It is beyond the scope of this paper to discuss the values of cross- and self-fertilization, which belongs to another department of natural history.

Turning from the activities of the Flying-Foxes to those of the Fulvous Fruit-Bat (*R. leschenaulti*) which often feeds in company with its bigger relative, I have just a little to add to what I have already written in my article on this species in volume xli, p. 805 of the *Journal*. At the same time as I observed the Flying-Foxes feeding on mango flowers, *Rousettus* often came into the picture. Like *Pteropus, Rousettus* was also feeding on the mango blossoms. Many of the specimens were sticky with nectar and occasionally I saw some just hanging and licking themselves clean. Likewise *Rousettus* was feeding on *Bombax* and Cashu. They also fed on the fruit of *Mimusops hexandra* Roxb. During the flowering season of this tree these bats also visit it. The females secured were all gravid and contained well-developed foetuses. This period coincides with my former observations.

The fact that the breeding, or rather the birth, of *Pteropus* and that of *Rousettus* coincide, confirms the fact that the period is largely influenced, if not entirely governed, by the food supply of the parents when the nursing mothers require nourishing and sustained supply for the well being of themselves and their young. These further observations on the two bats confirm my belief that the fruit-bats are in reality nectar feeders and juice feeders, only eating such fruit entire which readily liquefy.

Though these bats feed on mango flowers, they evidently do not do as much damage to the crop as at first sight might appear to be the case, for in good years when the blossom is free from fungus and other attacks there is generally a bumper crop of fruit in spite of the attacks of the bats. Therefore I am not in favour of the destruction of the bats on this account. Their destruction may mean a great loss in some other direction yet unknown and unforeseen.



Sen—Distribution of *Anopheles Sundaicus* Rodenw.

DISTRIBUTION OF *ANOPHELES SUNDAICUS* RODENW. THROUGH MECHANICAL MEANS.[1]

BY

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(With a map).

Mechanical transport of insect pests from one country to another through sea-going vessels or country craft has been long known, and quarantine measures against several of such pests are in practice in almost all progressive countries. The list of pests thus accidentally introduced is very exhaustive. While these instances mostly relate to the agricultural and forest pests, mosquitoes making long distance journeys and passing from one country to another, in railway carriages are also on record (Howard, Dyar & Knab, 1912).

An example of dispersal of a more limited nature, inside the same country, is afforded by the species *Anopheles sundaicus* Rodenw., a virulent carrier of malaria, which, so far as the records go, was originally known in this province only from the coastal tracts such as the Sundarbans, the species being a saltwater breeder. In 1910 the range of the species was upto Matla and Port Canning about 30 miles away from Calcutta (Gravely 1912). In 1930, the species made a further push inland to Budge-Budge, only 16 miles from Calcutta (*vide* map attached), where a sudden malarial outbreak was experienced in the locality (Iyengar 1931).

Since then, the distribution of the species has been under constant investigation, and an explanation for the factors responsible for similar invasions towards inland areas has been sought for and a close watch has been kept on the vast marshy areas to the immediate east of Calcutta, the salt lakes, which apparently seem very suitable for the establishment of the species.

Constant vigilance led to the detection for the first time in 1931 of an instance of transport of the mosquito into this area by means of a country boat which entered the canal bordering the salt lakes and which had evidently passed *en route* through a *sundaicus* infested zone in the Sundarbans, (Sen 1938). After this discovery, systematic searches of boats and trains reaching Calcutta at different termini were carried out, and it soon became evident that the invasion of the species was taking place not only by boats through the canal but by trains and through other routes as well.

Trains from Falta (Kalighat Falta Railway), where the species was breeding profusely, on being searched at Majherat, the city

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[1] Read before the 28th Session of the Indian Science Congress, 1941.

station of the railway, as also trains from Basirhat and Hasnabad (Barasat Basirhat Railway), another *sundaicus* zone, arriving at Shambazar (Calcutta) and certain local trains stopping overnight at Uluberia and Port Canning, some of the known *sundaicus* areas, on examination at Howrah (Bengal Nagpur Railway) and Sealdah South (Eastern Bengal Railway) showed the transport of adult *A. sundaicus* by this means during the period June to August or September 1934 (Table 1). The species was carried by trains to Howrah and Shambazar (both these stations being situated on the outskirts of Calcutta) during the month of November 1933, showing that the mosquito transport is possible in the cold weather as well. Besides *A. sundaicus* the following Anophelines, not concerned in the transmission of malaria in the area involved, were also transported in the years 1933 and 1934 through trains: *A. hyrcanus, A. barbirostris, A. annularis, A. ramsayi, A. philippinensis, A. vagus, A. subpictus, A. varuna, A. aconitus* and *A. stephensi.*

TABLE I

Transport in trains.[1]

Stations where trains were examined	Period of Investigation	No. of trains examined	No. of trains showing *A. sundaicus*	No. of adult *A. sundaicus* caught	Other species recorded
Majherat ...	August 1933	?	nil.	nil.	?
	September ,,	?	,,	,,	?
	October ,,	7	,,	,,	*A. vagus, A. annularis, A. hyrcanus, A. ramsayi.*
	November ,,	12	,,	,,	*A. barbirostris, A. hyrcanus, A. annularis, A. vagus, A. varuna.*
	December ,,	11	,,	,,	*A. subpictus, A. vagus, A. hyrcanus, A. philippinensis.*
	January 1934	7	,,	,,	*A. subpictus, A. vagus, A. hyrcanus.*
	February ,,	1	,,	,,	*A. vagus.*
	March ,,	3	,,	,,	*A. subpictus, A. vagus, A. hyrcanus.*
	April ,,	2	,,	,,	*A. vagus.*
	May ,,	1	,,	,,	*A. vagus.*
	June ,,	12	3	9	*A. subpictus, A. vagus, A. annularis.*
	July ,,	14	4	10	*A. subpictus, A. vagus, A. varuna, A. hyrcanus, A. ramsayi.*

[1] Detailed data from month to month are not available for Sealdah, and the station is therefore omitted from Table I.

TABLE I—(*continued*)

Stations where trains were examined	Period of Investigation	No. of trains examined	No. of trains showing *A. sundaicus*	No. of adult *A. sundaicus* caught	Other species recorded
Majherat ...	August 1934	16	1	1	*A. subpictus, A. vagus, A. varuna, A. aconitus, A. hyrcanus, A. ramsayi.*
	September ,,	10	nil.	nil.	*A. subpictus, A. vagus, A. hyrcanus.*
	October ,,	7	,,	,,	*A. vagus, A. hyrcanus.*
Shambazar.	November 1933	4	1	1	*A. vagus, A annularis, A. hyrcanus, A. ramsayi.*
	December ,,	6	nil.	nil.	*A. annularis, A. hyrcanus, A. barbirostris.*
	January 1934	2	,,	,,	*A. subpictus, A. annularis.*
	February ,,	?	,,	,,	?
	March ,,	1	,,	,,	*A. subpictus, A. annularis.*
	April ,,	3	1	1	*A. vagus.*
	May ,,	1	nil.	nil.	*A. vagus, A. subpictus.*
	June ,,	7	3	26	*A. subpictus, A. vagus, A. annularis.*
	July ,,	8	6	25	*A. subpictus, A. vagus.*
	August ,,	8	4	12	*A. subpictus, A. vagus, A. annularis, A. hyrcanus.*
	September ,,	15	3	7	*A. subpictus, A. vagus, A. varuna, A. aconitus, A. hyrcanus, A. ramsayi.*
Howrah ...	August 1933	?	nil.	nil.	?
	September ,,	?	,,	,,	?
	October ,,	3	,,	,,	*A. hyrcanus.*
	November ,,	5	1	1	*A. vagus, A. annularis, A. hyrcanus, A. barbirostris*
	December ,,	9	nil.	nil.	*A. vagus, A. annularis, A. hyrcanus, A. barbirostris, A. aconitus.*

TABLE I—(*continued*)

Stations where trains were examined	Period of Investigation	No. of trains examined	No. of trains showing *A. sundaicus*	No. of adult *A. sundaicus* caught	Other species recorded
Howrah ...	January 1934	2	nil.	nil.	*A. aconitus.*
	February ,,	5	,,	,,	*A. subpictus, A. vagus, A. annularis, A. varuna, A. hyrcanus, A. barbirostris, A. stephensi.*
	March ,,	10	,,	,,	*A. vagus, A. varuna, A. aconitus, A. hyrcanus, A. philippinensis.*
	April ,,	6	,,	,,	*A. vagus, A. annularis, A. varuna, A. aconitus, A. barbirostris, A. ramsayi.*
	May ,,	9	,,	,,	*A. subpictus, A. vagus, A. ramsayi.*
	June ,,	10	2	2	*A. subpictus, A. vagus, A. ramsayi.*
	July ,,	8	2	2	*A. subpictus, A. vagus, A. hyrcanus, A. barbirostris.*
	August ,,	8	4	4	*A. subpictus, A. vagus, A. hyrcanus, A. barbirostris.*
	September ,,	2	nil.	nil.	*A. subpictus, A. vagus, A. annularis, A. aconitus, A. hyrcanus.*
	October ,,	1	,,	,,	*A. vagus.*♂
Total ...		234	35	101	

Although 35 out of 234, or nearly 15 per cent, of the trains examined carried *A. sundaicus,* it is however, believed that the transport through boats and not trains, has been really responsible for the ultimate establishment of the species during recent years in the Calcutta Salt Lakes area. The reason is that no trains stop anywhere close to the Salt Lakes proper and the species first started to breed in the Kristopur end of the lakes towards the end of December 1932, where, as already mentioned, infested boats (Fig. 1) were known to be arriving since 1931. Boats to Calcutta are sometimes detained overnight at Kristopur for the realisation of tolls. Moreover, there is ample evidence that active dispersal of the species occurred in 1933 and 1934 by means of boat traffic coming to Calcutta either through (1) the river Hooghly which is in direct line with the *Sundarbans,* or through (2) the river Ichamati which traverses some of the worst *sundaicus* infested zones and to Kristopur Canal bordering the Calcutta Salt Lakes area as will be seen from Table II.

TABLE II

Transport in country boats.

Points where boats were examined	Period of Investigation	No. of boats examined	No. of boats showing *A. sundaicus*	No. of adult *A. sundaicus* caught	Other species recorded
Kulti-Lock.	July 1933	83	14	19	*A. subpictus, A. vagus.*
	Aug., Sept. and Oct. 1933	674	22	29	*A. subpictus, A. vagus.*
	Nov. and Dec. 1933	747	29	38	*A. subpictus, A. vagus, A. varuna.*
	Jan. and Feb. 1934	199	1	2	
	July, Aug. and Sept. 1934	284	31	41	*A. subpictus, A. vagus.*
	Oct., Nov. and Dec. 1934	238	23	?	
Kristopur Toll Office	Aug., Sept. and Oct. 1933	280	2	3	*A. subpictus, A. vagus.*
	Nov. and Dec. 1934	256	5		
Chitpur-Lock	February and March 1934	65	nil.	nil.	
Canning Town	December 1933	206	9	10	
	January and February 1934	30	nil.	nil.	
Total...		3,062	136	142	

It has been found from observations covering a period of one year and a half, i.e., from July 1933 to December 1934, that 136 boats out of 3062 examined, i.e. over 4 per cent, coming up the different routes to Calcutta, were serving as transporting agencies of *A. sundaicus*. Three other species—*A. subpictus*, *A. vagus*, and *A. varuna*—were also sheltering in the country boats; these three species are however ubiquitous in distribution and of no importance from the malarial point of view in the area.

Of the various types of cargo carried in the country boats sheltering *A. sundaicus*, such as paddy (rice), jute, straw, sugar, molasses, salt, pulses, wood, ginger, garlic, kerosene, matches, nut, banana, goats, fowl, earthen pots, etc., paddy, jute and straw appear to provide a favourable resting place for the species.

The forward and upward thrust of the species to range beyond its original boundary is thought to be due to the extensive clearance of mangrove forests in the Sundarbans and the reclamation of lands for rice cultivation and fishery purposes, thereby creating

conditions for an excessive rise in the insect population. Secondly easier and quicker communications during recent years have provided more advantageous means of safe dispersal of the species into inland areas. Some unaccountable meteorological factors existing some time about the year 1930, the year of *A. sundaicus* invasion to Budge-Budge, as pointed out by Covell (1932), may also be largely responsible for their recent dispersal towards inland areas.

Summary.

Mechanical transport of *Anopheles sundaicus* through trains and country boats during the years 1933 and 1934 is recorded.

Catches made from carriages at the terminal stations of the different railways in Calcutta, having train connections with the outlying *sundaicus* zones in the delta, showed that in addition to *A. sundaicus*, several other species such as *A. hyrcanus*, *A. barbirostris*, *A. annularis*, *A. ramsayi*, *A. philippinensis*, *A. vagus*, *A. subpictus*, *A. varuna*, *A. aconitus*, and *A. stephensi* are also mechanically transported into the city.

Country boats passing through the *Sundarbans* and other *sundaicus* infested areas on arrival at Calcutta by different routes revealed the presence of *A. sundaicus* under shelter of the cargo. Along with *A. sundaicus*, the species *A. subpictus*, *A. vagus*, and *A. varuna* were also dispersed through these boats.

Nearly 15 per cent of the trains examined carried *A. sundaicus*, while about 4 per cent of the country boats examined were responsible for the spread of the species. The dispersal of the species by means of trains was more noticeable from June to September and by country boats during the last six months of the year, July to December.

It is thought that the eventual establishment of *A. sundaicus* in the Salt Lake area to the east of Calcutta has been the outcome of mechanical importation of the species through the agency of country boats.

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Plumbago zeylanica Linn.

SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

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(With three plates).

(Continued from page 282 of Vol. xlii No. 2).

VII.—PLUMBAGO ZEYLANICA Linn.

(PLUMBAGINACEAE).

SYSTEMATIC DESCRIPTION.

Plumbago zeylanica Linn. Sp. Pl. (1753), 151; H. F. B. I., iii, 480; Cooke. Fl. Pres. Bomb., ii. Pt. i, 78; Dalz. & Gibs. Bomb. Fl. 220; Gamble Fl. Pres. Madras., iv, 744; Kirt. Ind. Med. Plts. II, 1466; Wt. Ill. t. 179.

A subscandent perennial herb; stem somewhat woody, striate. Leaves alternate, entire, ovate, reticulately veined, suddenly narrowed into a short petiole; petiole narrow, amplexicaul at the base where it is often dilated into stipule-like auricles. Flowers in long spikes; rachis glandular, striate; bracteoles ovate, acuminate, shorter than the calyx, glandular. Calyx narrowly tubular, persistent densely covered with stalked glands; limb 5-fid. Corolla white; tube long, slender; lobes 5, obovate-oblong, acute, apiculate. Stamens 5; filaments as long as the corolla-tube, linear, dilated at base; anthers oblong, exserted just beyond the throat. Pollen grains oblong when dry, and spherical when moistened. Ovary free, 1-celled; ovule solitary; style simple, filiform; stigmas 5. Fruit an oblong pointed capsule, 1-seeded. (Plates I-II). Flowers: Aug.-Sept. Medicinal (Kirtikar, 5).

INDIAN NAMES.

Chitalakri (*Urdu*), Chita, Chitarak (*Hindi*); Agnimata, Chitramulamu (*Telugu*); Kanilan, Sittragam (*Tamil*); Chitraka, Chitu (*Marathi*); Tumpukotuveli (*Malayalam*); Chitramula (*Canarese*); Agni, Chitra, Chitraka (*Sanskrit*); Chita, Chitruk (*Bengali*); Shitarak (*Persian*); Shitaraj (*Arabic*).

HABITAT.

Throughout India, wild in the south (Hooker, 4); hills throughout the Konkan (Dalz. & Gibs, 2); all districts in the Plains,

common, wild or in cultivation (Gamble, 3); wild in Hyderabad (Sayeedud-Din, 7); in hedges and jungles in Madras (Mayuranathan, 6).

Distribution: Throughout India, much cultivated, wild in the W. Peninsula and probably in Bengal, Ceylon, Tropics of the Old World.

Anatomical Notes.

Structure of the leaf. The epidermal cells are large, and possess a thick cuticle, which is striated. Stomata occur on both sides of the leaf in more or less equal abundance, and are rather depressed. They are of the cruciferous type (Plate iii, Fig. 3), as is recorded by Solereder and Strasburger in other species (Solereder, 8). The mesophyll is hardly differentiated into palisade and spongy tissue. There is no hairy covering, but the presence of chalk-glands is very characteristic. They occur on the branches also. A chalk-gland consists of a hemispherical group of eight cells (Plate III, Fig. 1) which have very thin walls, except those which separate the gland from the adjacent tissue. Along with water salts of lime are excreted, as is evident from the white coating on the surface of the leaves and branches. These excretions are a safeguard against excessive transpiration, and in keeping with the dry habitat of this plant. Not only this, but the glands are also depressed below the level of the epidermal surface like the depressed stomata.

Oxalate of lime occurs in the form of small clustered crystals. Cells filled with a granular secretion, probably plumbagin, occur in abundance. They are also found in the stem (Plate III, Fig. 5).

Structure of the petiole (Plate III, Fig. 4). It is v-shaped in transverse section owing to the lateral dilations, and is traversed by as many as eighteen vascular bundles.

Structure of the stem. The primary cortex contains collenchyma and sclerenchyma more or less in a continuous ring. The ridges contain more of these tissues than the furrows. The vascular bundles are collateral. There are broad medullary rays.

Hairs on the calyx. The calyx is densely covered with long-stalked glandular shaggy hairs (Plate III, Fig. 6) full of secretion. These hairs consist of a long unicellular stalk and a round head. Besides these, mucilage glands occur (Plate III, Fig. 7). Each gland which is circular in outline with a wavy margin, consists of a group of about 30-35 thin-walled epidermal cells filled with mucilage.

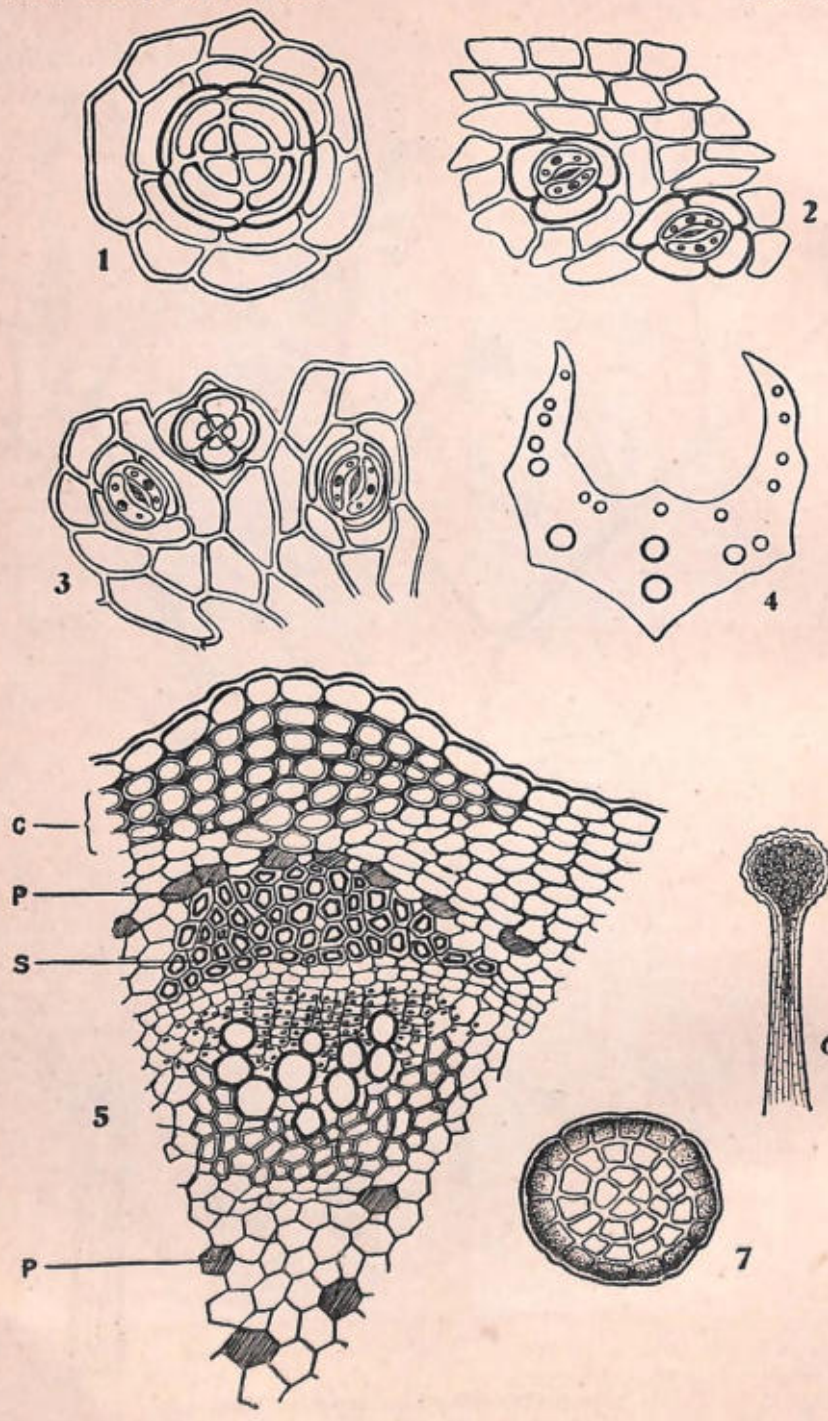
Conclusions.

The following are the chief features revealed by the anatomical study of this plant:

1. Stomata are of the cruciferous type.
2. Characteristic chalk-glands occur on the leaves and on the branches.
3. The only hairy covering is found on the calyx, and consists of long-stalked glandular shaggy hairs.

Sayeedud-Din—*Plumbago zeylanica* Linn.

For explanation see end of article.



Sayeedud-Din—*Plumbago zeylanica* Linn.

For explanation see end of article.

4. Mucilage glands also occur on the calyx.

5. Oxalate of lime occurs in the form of clustered crystals in the leaf.

6. Mesophyll is undifferentiated.

7. Cells filled with a secretion, probably plumbagin, occur in the leaf and stem.

8. In the structure of the stem more or less a continuous ring of collenchyma and sclerenchyma may be noted.

ACKNOWLEDGEMENTS.

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EXPLANATION OF PLATES I TO III.

Plumbago zeylanica Linn.

PLATE I.

Photograph of a portion of *Plumbago zeylanica* Linn.

PLATE II.

Fig. 1.—Black and white drawing of *Plumbago zeylanica* Linn. a small uppermost portion (× ½).
Fig. 2. Corolla opened out. (× 5).
Fig. 3. Pistil with calyx attached. (× 5).
Fig. 4. Ovary cut across. (× 5).
Fig. 5. Pollen grain in dry condition. (× 150).
Fig. 6. Pollen grain, moistened. (× 150).

PLATE III.

Fig. 1. A chalk-gland from the stem-epidermis. (× 600).
Fig. 2. Stem-epidermis, showing stomata of the cruciferous type. (× 300).
Fig. 3. Leaf-epidermis, showing stomata and a chalk-gland. (× 300).
Fig. 4. T. S. Petiole, diagrammatic. (× 20).
Fig. 5. T. S. Stem, showing c, collenchyma; s, sclerenchyma; p, cells filled with plumbagin, and a vascular bundle. (× 300).
Fig. 6. A stalked glandular shaggy hair from calyx. (× 80).
Fig. 7. A mucilage gland from calyx. (× 300).

TWO NATURALISTS VISIT KARWAR, NORTH KANARA.

BY

CHARLES MCCANN, F.L.S.

(*With one plate*).

With Dr. M. Suter, a naturalist with a weakness for fishing, I went last September on a fishing trip to Karwar. As my interest in fish is limited to the eating of them, it was agreed that while the fisherman was occupied with his fish, I should 'prowl' around alone, otherwise we would seek together the things which interest naturalists. We left Poona by car at dawn on the 2nd September (1940) in order to arrive at Karwar the same evening. The Deccan country, familiar to both of us, did not offer much of interest, but having written previously, jointly with Mr. Hughes (*Journ., B.N.H.S.*, vol. xli, p. 446) on some aspects of bird-life observed along the same route at the break of the monsoon, I was naturally interested to see what it was like towards the end. In the paper quoted above, we remarked on the absence of the drongos, rollers and orioles from the open Deccan. Again these birds were conspicuous by their absence. The drongos and orioles were seen in the forested areas as before, but the rollers were not to be seen at all! It seems clear that these birds move to more suitable localities during the rains.

At Khanapur—a most appropriate name—we stopped to eat and to give the driver a rest. In the ensuing investigation into the anatomy of *Gallus domesticus*, we both proved ourselves excellent 'myologists'; the study of the osteology was left to the expert attention of the local pie-dog. Towards evening we reached the Arbail Ghat. The forest looked inviting and we walked down part of the Ghat in the hope of seeing something to interest us. We were not disappointed. Hanging on fine rootlets in the pockets of old cuttings along the roadside were the beautiful, inverted pear-shaped nests of the wasp *Paravespa eva* Bell. With its lace-like entrance finished off with a leaf-like appendage this nest in its beauty and delicacy, is one of the finest examples of insect craftsmanship. Here and there in the same cuttings were the great burrows of the large, brown, velvety spider, Mygale—the largest Indian spider. Mygale will stand up to almost anything in defence, but being nocturnal none were seen. The Giant Malabar Squirrel (*Ratufa indica* Exrln.) was occasionally heard. Flowers were not yet profuse, but a beautiful *Osbeckia* was fairly common; its large pink flowers standing out obtrusively from the surrounding green. As we were anxious to get to Karwar before dark we did not delay too long on the Ghat and arrived at the Grand Hotel a little before dark. News was already abroad that Dr. Suter was due that evening, so the interested were ready to receive us at the gate as the car drew up. Not having been in Karwar for twenty years, I was unknown, but Dr. Suter exchanged greetings with old friends,

1. A good catch of Ravas. (*P. tetradactylus*)

2. Mr. Adams with a 25 lb. Ravas.

A 35 lb. Dagool. (*Scomberoides toloo* Cuv. & Val.)

Fishing for Ghol (*Sciaena sina* Cuv. & Val.) in Karwar Harbour.

Photos by Dr. M. Suter.

prominent among whom was his *tindal,* Januba. The success of the fishing depended much on the good work of this gentleman. Later came Mr. William D'Souza, chairman of the local municipality, commander of the Civic Guard, and last, but not least, proprietor of the Grand Hotel. As he was responsible for the information regarding the frequency of Ravas (*Polynemus*) and the possibilities of a good season, Dr. Suter naturally wanted to hear all the 'fishy' news. Mr. D'Souza had made a fair catch that day, so the prospect seemed promising. We were the only visitors at the time in the hotel and so were able to spread ourselves out. After dinner, plans were decided upon for the morrow—and so to bed.

Before sunrise the next morning, Dr. Suter disappeared in his dug-out over the horizon to tempt the Ravas. He knew just where to find them and was sure to get some, if they were there and in the mood to bite. Soon after my host's departure, I set out on a reconnoitering trip in the forests behind the hotel. I am not going to describe the beauties of Karwar, natural or human, for these have been fully described in that all informative book, the Gazeteer. Legend has it that Karwar was once famous for its beautiful women, but if this were so, it must have been in the Stone Age, or perhaps my eyes are inert to such attractions!

When I set out burdened with the necessary collecting gear, the sky was overcast and there were light showers from time to time, but later in the day it cleared up leaving the wet foliage glistening in the bright sunshine. Butterflies were plentiful and the rain did not seem to hamper their activity in any way. *Papilio aristolochiae* was by far the commonest. They drifted about in great profusion. Now and again a great Bird-wing (*Troides helena minos* Cr.) floated quietly into the picture. Unlike the occasional *Papilio polymnestor* Cr., it was in no hurry, but a false stroke with the net spurred it to an exhibition of high speed. Not being an expert in the art of netting butterflies, I was often left standing gazing after the rapidly departing flashes of black and golden yellow. Very occasionally a metalic green flash announced the arrival and departure of *Papilio buddha* Wd. — a prize for butterfly hunters. This 'speed merchant' was too much for amateurish me, I just raised my hat as it passed—I was beaten! and I do not think that I am the only one who must acknowledge defeat nor shall I be the last. *Pareronia ceylanica* Fd. was common and many others, too numerous to mention.

As I wandered along, small troops of the Common Langur (*Semnopithecus entellus* Dup.) stopped in the midst of their breakfast on the pulp of the fruit of the Strychnine tree (*Strychnos Nux-vomica* L.), and in keeping with the 'law of the jungle' eyed me suspiciously, prepared to take their departure. Satisfied that I was harmless they resumed their repast. One group of the fauna made its presence felt without being looked for—the mosquitoes. These blood-thirsty gentry were very persistant and with them there were, the leaches, also members of the 'blood' brigade. Their elastic bodies expand and contract like an accordeon in full blast. They do their work unobtrusively only betraying

their departure by a gentle trickle of blood from the spot on which they had sat unnoticed at their crimson meal. Fortunately there were not many of them about.

It was afternoon before I was back at the hotel, when I spotted Dr. Suter's dug-out rounding the Karwar headland. I wandered down to the landing to see what success he had had. At the bottom of this boat, lay some fine *Ravas*. According to him the catch was poor and the fish small. In former seasons he had had much better sport. The *Ravas* come into Karwar harbour towards the end of the rains and make their way up the estuary of the Kalanuddi River to spawn, but for some reason or other, perhaps Adolf Hitler—or the peculiar weather conditions experienced this year, the run was not good. The fish seemed fewer than in former years.

Evenings were devoted to joint effort in natural history. Day after day we set out on our respective hobbies. As the fishing had not been up to expectations, Dr. Suter suggested a visit to Kurmagad Island on the 6th morning. Dr. Suter had informed me of the existence of a terrapin on Kurmagad Island, he suggested that it differed from the mainland form. Later he presented me with three from the island and one from the mainland. These terrapins belong to the genus *Geoemyda*, probably *G. trijuga*, but as I have the species under observation I must leave these conclusions for a subsequent paper. There is certainly some differences between the two forms. The mainland terrapin appears to be larger, while the island form is more variable both in shape and texture of carapace. The difference in size is probably due to an almost unlimited food supply on the mainland and its limitations on the island. The greater variability in the carapace of the island form may arise from inbreeding due to the more limited supply of partners.

Being interested, I was glad of an opportunity to visit the island and look over it myself. Kurmagad is a small island, rising some 180 ft. above sea level. Its shores are girdled with rocks covered thickly with oysters—but a semblance of a beach on the south-eastern side affords a safe landing. The island was formerly encircled with walls which have now almost disappeared or are fast crumbling. It was a fort, built by Shivaji, which played an important part in the defence of Karwar. At the time of our visit, the island was covered in dense, rank vegetation which shrouded the greater part of the ruins.

Though uninhabited, it is visited by fishermen who fish round it. During the rains, a few cattle are released on it for grazing but they are removed after the rains—there is little to support them during the dry months. Uninhabited by mortals, the Island is the abode of a deity—Narsinh, whose shrine, after the rains, is also buried under vegetation. The solitude of the god is disturbed annually during the cold season (December) by a great concourse of people from the mainland who gather there to pay him homage. In this lonely spot, Narsinh rules over a quaint little fauna and flora. Sweet water is scarce. There is a small well just above the sandy beech, but it is neglected and the water is foul. Clumps

of *Clerodendron inerme* border the sandy strip of beech. To the left is the twisted trunk of a weather beaten mangrove (*Avicennia* sp.). A few cocoanuts have been planted. The forest is of the deciduous type, differing little from the adjoining mainland. *Sterculia urens* Roxb. with its pinkish, pealing bark stands out prominently. From the beach a rude stairway of broad steps leads up a short distance to a path going round the island. Along the path, to the right, is a small rock-cut cistern, at the time filled with putrid water. In it there were several specimens of the Skipper Frog (*Rana cyanophlictis*), not to mention a host of insect larvae. The Bull-Frog (*Rana tigrina* Daud.) is yet another inhabitant. While I was on the beach, a half-grown bull-frog hopped up as fast as it could from the sea—covered in sand. It evidently did not like its saline bath. Did it fall into the sea from the island, or was it a new arrival washed out to sea from the mainland?

As we proceeded along the overgrown path we passed through an almost pure association of *Costus speciosa* Smith. In places this plant had taken possession of the ground to the exclusion of all else. As it was in flower it attracted numerous insect visitors. Some species of vine (*Vitis* spp.) scrambled about here and there. We noted two different species of *Habenaria* in fruit. In places there were flourishing clumps of bamboos. These combined with *Zizyphus* and other thorny bushes made progress in places difficult.

On our way to the island we saw many butterflies, including bird-wings (*Troides*) and various *Papilio* making their way across the sea to various islands. The White-bellied Sea-Eagle [*Haliaëtus leucogaster* (Gmelin)] quartered the sky, keeping a sharp look out for prey. Several of these birds were seen and heard around Karwar. They breed at various points and one pair had a nest, a large affair, on a tree at the eastern corner of Kurmagad, which was clearly visible as one approached the island. The birds were sitting at the time. At the top of the island we came to a flat piece of ground covered with *Costus* sheltered by some *Eugenia*; here we set about catching insects. Grasshoppers were very plentiful. Butterflies were common, particularly *Pareronia ceylanica* Fd. Occasionally a bird-wing appeared and other *Papilio*. Once the fast-flying *P. helena* made its appearance, but all attempts to bring it to bag failed. Two specimens of the Atlas moth (*Attacus atlas* L.) were also observed, and one brought to bag. While insect hunting we almost barged into a hornets' nest (*Vespa cincta* Fabr.). I shall have more to say about this nest presently. The main object of our visit was to obtain further examples of the terrapins. Owing to the dense nature of the vegetation we were obliged to cut our way through here and there. When so engaged, Dr. Suter discovered a baby terrapin 65 × 56 mm. in dimensions. In great glee I picked up the little creature and found myself, at once, enveloped in an appalling stench. The author of this 'gas attack' was the terrapin. These animals were versed in 'chemical warfare' long before man! It is well-known that some of the tortoises produce foul odours as a means of defence. This is produced from special glands or by the voiding of the faeces, or by both when attacked. Despite this little reptile's malodorous attempt to ward me off,

it found a place in my collecting bag, and is now a docile resident in my vivarium. Once these animals have got accustomed to handling, they do not generally resort to their vile mode of defence. The terrapins I have in captivity no longer submit me to a 'gas' attack when handled.

At the top of the island there were some drying puddles, which clearly showed prints of terrapin. But we saw none; being nocturnal terrapin retire during the day. We now took to turning over loose stones in damp places, in the hope of finding other animal life—we were not disappointed. I am no 'Col. Longbow', but I can confidently say that under every stone we turned, we found at least one large black rock scorpion[1] (*Palamnaeus* sp.)! Though called the 'black' scorpion in contrast to the 'red' (*Buthus*) it is not black but a very deep green, the chelae being darker than the body. In most cases the adults were with their young. It was breeding time in the scorpion world. The young were well advanced, pigmented but not strongly chitinised. The segments were a light blackish brown, the intersegment tissue being paler. They lived together with the adults on the most filial terms, giving the lie to the old belief that the young commit matricide and devour their mothers. When they are very young, still soft-bodied and creamy white, the mother carries her infants on her back; but once passed that stage, they no longer find room to play 'pic-a-back'. The continuance of the young with the parents suggests that either the 'old dame' does the foraging, and brings home the prey for the young, or that the family go hunting together. In one instance I counted as many as 32 young with a parent! The place was really a hot bed of scorpions.

With the scorpions under the stones lived fat earthworms and some snake-like skinks ([2]*Riopa guentheri* Smith) which scuttled away as soon as they were exposed; and, an occasional frog. A solitary luminous 'centipede' (*Geophillus* sp.) was also observed. Tired of turning stones and of uncovering scorpions and more scorpions, we resumed our quest for terrapins. We searched long and in vain. We had found a young one—the adults must be somewhere in the neighbourhood. Perhaps we did not know how or where to look for them, or had local epicureans forestalled us and captured the lot. This terrapin is relished as a dish by Goans and others. On a previous occasion Dr. Suter had seen some Goan sailors remove eighteen from the island.

Our search led us down the southern slope of the hill. The squealing and racket from a colony of Flying-Foxes (*Pteropus giganteus* Brünn.) drew my attention. Hidden by the undergrowth I was able to approach them quite close. It was a fair sized colony and the first I have seen so far away from a village. Here the bats hung on quite low trees and shrubs, some were barely ten feet from the ground. The colony was composed of adults

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[1] Mr. H. Abdulali when he visited an island off Malwan, found the scorpion in abundance also.

[2] Mr. H. Abdulali found this species a common associate of the scorpions on the island off Malwan.

and young—young of the current year. The young were at once recognizable by their size; while still forming part of the colony, they more or less kept together. A point that struck me was that the usual creamy-coloured areas of the body were much darker in the young—more russet.

I joined Dr. Suter on the beach. He had brought with him some Painted Grasshoppers (*Aularches scabiosae*[1] F.), a few yet in copula! The 'painted' grasshopper, has a permanent 'make up' and its purpose, oh ladies, is not attraction but detraction. The 'make up' is the same for both sexes. The colours of the insects are 'warning colours'. Dame Nature has gone yet further in the protection of this creature, she has supplied it with an odorous insect's device. There is a small opening at the base of each of the jumping legs. When attacked, an evil smelling frothy mass exudes from these openings—making the succulent grasshopper a thing to be avoided by insect eaters.

I had designs on the beautiful hornets' nest, mentioned before, as I wanted it for the Museum. There was no harm in wanting, but the getting of it was quite another proposition. It was a large egg-shaped affair hanging from some thin branches only about five feet from the ground. The structure was about 18 inches long by a foot wide, the whole enclosed in parchment casing which formed a protection to the horizontally arranged combs within. There was a single entrance about an inch and a half wide. This hanging 'aerodrome' was very much alive. The attack on such a 'fortress' had to be carefully planned. Hornets, have a particularly 'hot tail'. I had nothing with me to commence the attack so I decided to leave the nest alone for the present. The terrapin hunt, having failed, we decided to revisit the island at a later date.

Dr. Suter turned his attention once more to fishing, and I to the jungles. On the 8th another fisherman arrived at the hotel from Poona on a long week-end. His efforts were more successful than Dr. Suter's in way of size, he caught a 16 lb. Ravas. This angler left on the 11th, and we were once more in full possession of the hotel. On the 12th we decided on another terrapin hunt, and the preliminary attack on the hornet stronghold. This time we traversed the island from its south-westerly slope and gradually worked our way up to the top. Cutting a path through the dense growth of *Ficus heterophylla* and other obstructions, we finally came to the spot where we had been on the previous occasion. We had been searching for terrapin for some time when one of the boatmen discovered one. A shout! and we all assembled to see how and where it had secluded itself. We now learnt just how to look for terrapin. A tell-tale trail usually led to the spot. In a short while we collected quite a number. With each capture there was a fresh determined 'gas attack'. The boatman carrying them pulled awful faces — I don't blame him! The effluvia were overwhelming.

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[1] The Bombay insect is frequently referred to as *A. millaris* F. but this species does not occur here.

Now for my hornets' nest. My plan was first to plug the entrance with a wad of cotton wool, soaked in chloroform and large enough to stop the hole. The big idea was to kill those imprisoned, and then to deal with the remainder with fire and smoke. In a rain coat with the sleeves tied at the wrists, and a two yard length of sacking over my head, I approached to within eight or ten feet of the nest. I now lay flat on the ground. After thoroughly soaking the cotton wad tied to the end of a bamboo I succeeded in plugging the entrance. Immediately the nest vibrated with angry hornets. The drone of wings from hundreds of hornets trying to escape was menacingly audible. 'Guards' were up looking for the intruder, and those that returned from foraging joined in the hunt. A weak point in my plan of attack was now made clear to me. The bamboo on which the wad was tied, ended under my sacking—a convenient bridge leading direct from the nest to me. The wasps in their rage walked up and down the bamboo, my position was, to say the least, alarming. To keep the offensive patrol from intruding under the sacking and thus getting at me, I gently, but firmly, drew it tightly round the bamboo. Some of the wasps wandered over my head. I have a sturdy skull; unfortunately it is covered with tender skin. I was not too happy, equally was I concerned about my bare ankles, yet another weak spot I had forgotten to protect. Having been stung before by hornets I knew just what they could do to provide a vivid experience in pain. I fearfully watched searching movements as best as I could through the mesh of the coarse sacking. My companions had very wisely retired to a safe distance. I lay as motionless as possible for some time—the minutes ticked away too slowly! When I considered it safe to move, I gradually, very gradually, crept away on my belly backwards to a safe distance. Here I got behind a tree trunk, divested myself of the sacking and the rain coat, and watched the commotion. Any detected movement would have brought the horde of hornets to me. Despite the chloroform hornets were round the nest in hundreds—probably those that had returned from foraging during the assault. The first part of the plan had succeeded, but the second seemed an impossible task by day light, without running the risk of being badly stung—an experience I was not anxious to repeat, so I decided to leave the chloroform plug in for that day and return to finish the job under cover of darkness.

Next evening I returned alone to the attack with a couple of boatmen. On arrival at the spot, I found that the original entrance had been enlarged and a new one made in the external envelope. The nest was very much alive with angry hornets which paraded the outside—these had first to be disposed of. Two flares at the end of bamboos were made and a pile of dry rubbish got together in the sacking. As soon as it was dark I took my stance at the former spot, lit one flare and applied it round the nest singeing the wings of those still outside, and then applied it to the entrances to meet those that poured out. The ground was alive with flightless hornets, but numbers still flew around. Some came dangerously close to my unprotected face, but I kept perfectly still. Gradually

the numbers diminished. The first flare was not enough, so a second was started. By the time it was also exhausted there were still a few hornets emerging from the nest, I was forced to resort to my 'last straw'—the rubbish heap. In the light of the fire I could see that almost all the wasps had gone. I now called to one of the men to hack down the small tree to get the nest clear of the increasing flames. Alas too late! The nest, cinder-dry with the constant heat, caught fire, just as the tree was about to fall. Before I could quench the flames half the nest had been destroyed. Very disappointed indeed, I returned to the hotel with the charred remains of the nest to show Dr. Suter. In spite of the chloroform and the fire many grubs were still alive in the various combs. The nest, or rather what was left of it, was consigned to the sea.

The various islands in Karwar harbour are biologically interesting, and a careful survey of the fauna and flora would, I am sure, yield interesting results. Unfortunately, the brief period of the trip did not permit of more than a very superficial survey of one or two of the islands. To the southwest of Kurmagad is another forested island, Sunghiri (often referred to as Mudlingad). The approach is difficult owing to the rocky shore. Local belief has it that it is infested with cobras (*Naia tripudians* Linn.). The northern cliffs are inhabited by Blue Rock Pigeons (*Columba livia intermedia* Strick.). Further to the westward on Devgad Island is the Karwar lighthouse. Between Devgad and Mudlingad is another small island clad in forest, often referred to as Little Devgad. The two Devgads are separated by a narrow channel. Owing to the war, visitors are prohibited from landing on the lighthouse island. During the time of our visit the island was covered with rank vegetation. A large Aroid (*Amorphophallus campanulatus* Blume?) had made it a stronghold. In places the plants monopolized large portions of the area, almost to the exclusion of all else. Many of the specimens were extraordinarily well developed. *A. campanulatus*, known in the vernacular as *suran*, is often cultivated for its corms; but I was told that though common on the island, the plant in its wild state, is inedible, as even after cooking, it irritates the mouth. This is due to the abundance of needle-like crystals in its tissue—a characteristic of the order. Dr. Suter, who is well acquainted with many of the islands, told me that he once saw a family of otters[1] (*Lutra* sp.) playing about on the shore of Little Devgad, and that large monitor Lizards (*Varanus monitor* probably) inhabit the island. The lizards, he said, feed largely on marine crabs. The shores of the two Devgad islands abound in large sea-urchins (*Echinodermata*). Later in the season sea-cucumbers (*Holothuroidae*) and other marine animals abound.

While we were at Karwar we saw the commencement of the fishing season. In places the sea was covered with dark patches, often an acre or more, appearing like wind ripples. These patches travelled in various directions—they represented the course of thousands of sardines. The local fisherman went out in pursuit of

[1] Otters may have come down the Kalanuddi River where they are known to exist.

these shoals to secure the first catches of the season. Dolphins followed in the wake of these shoals and ate their fill. The larger predatory fish, such as the *Seer* or *Surmai* (*Cybium guttatum* B. & Sch.), the Dagool (*Scomberoides toloo* Cuv. & Val.) and other large mackerel had not arrived yet. Both these are good sporting fish. A small mackerel, locally known as the *Kokar* (cougher, on account of the coughing sound it makes) was not uncommon. Dr. Suter had caught several of them during our visit. A large perch, locally known as the *Gobra* (Groper), a species of *Serranus*, often attaining great size, was not uncommon. Dr. Suter caught one of 40 pounds. This fish is not considered a sporting fish, as it has the habit of taking the bait and sitting tight between or against rocks. To dislodge such a fish on a sporting line, may be compared to 'Catching a rock' and trying to haul it in. On the 13th the local fishermen were on the lookout for Ghol (*Sciaena sina* Cuv. & Val.). The next day they brought in a big catch of some 2000 fish together with a haul of the Cock-up [*Lates calcarifer* (Bloch)], known as *Kajuri*, around Bombay. This is a fine sporting fish. These fish too were late in their arrival this season judging from the local observers. Various sharks were also among the bag.

Our trip was at its close, so on the 14th night we bid farewell to all our friends, both old and new. Prominent among the former was an old member of the Society, Mr. T. R. Bell[1], who is, 'still going strong' and, 'keeps on walking still'! Among the new (as far as I was concerned) was Mr. Adam, the lighthouse keeper. My name brought back old recollections to him. It turned out that in his youth he was in the same department as my father, and he talked of many old friends that had already been gathered to the majority. He also informed me that he had at the light some old documents signed by my grandfather half a century back, when the old man was Superintendent of Lights. Enough of this family history—good luck Adam, and goodbye. On the 15th morning in the grey dawn the car purred out of Karwar on its long return journey to Poona. Memories were all that were left of the enjoyable trip, and the specimens—silent but forceful recollections. We reached Poona the same night. Before concluding, I must take the opportunity of expressing my sincere thanks to Dr. and Mrs. Suter for their kind hospitality.

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[1] Mr. Bell is engaged in entomological research, and is at present working out the life-histories of moths.

CIRPHIS ALBISTIGMA H.—A PEST OF GRASSES IN SOUTH INDIA.

BY

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INTRODUCTION.

Cirphis albistigma H. (Family: *Noctuidae*)—known as the climbing cutworm of paddy, has been noticed as a serious pest of fodder grasses. During the past decade, its almost frequent occurrence in grasses grown at the cattle farm at Hosur, has demanded a detailed study of this pest in its various aspects. The observations made at Hosur and at Coimbatore during 1937 and 1938 are recorded in this paper.

DISTRIBUTION AND TIME OF OCCURRENCE OF THE PEST.

The occurrence of the pest in paddy in South India has been noted during certain years (Ramachandra Rao, 1927, 1928, 1929 and Ramakrishna Ayyar 1932) in places like Madanapalle, Krishnagiri, Coimbatore, Pollachi in the central districts, from Chingleput down to Tanjore in the coastal tracts on the east coast, and in parts of Malabar on the west coast. While its appearance is sporadic and irregular in paddy, it is a serious pest of grasses in the hilly tracts like Hosur, where it is found usually during the months of October, November, and December. In the year 1937, there was an outbreak in May in addition to the usual occurrence during December. As a pest on paddy it has been recorded during May, October, and also in December during certain years.

NATURE AND EXTENT OF DAMAGE.

At the Hosur cattle farm, situated at an elevation of 3,000 ft. above sea level, and commanding an extensive area of about 1,600 acres, a major portion of which is pasture land, the pest has been noted during successive years from 1928 to 1931, and again in 1937 and 1938 in a serious form. It appears in enormous numbers. The caterpillars cut the tender side shoots of the grass close to the ground reducing a thick grass bed to mere stumps, or they strip the long wiry stems of all the leaves. The ground below the creeping stems and around clumps of grasses is strewn with pellets of castings of

the numerous larvae. Several detached paddocks in different localities in the area are affected almost simultaneously; while during an outbreak, the larvae, in all the foci of infestation, appear almost of the same age. Larvae march in all directions, unimpeded by roads, pathways or other obstructions. As is the case with cutworms in general, in all these outbreaks the density of the pest population subsides to surprisingly insignificant numbers during the course of a fortnight, but even in this short interval, much damage is done by mass feeding, and heavy loss in yield of hay is caused. If the damage happens to be during the tender stage of the grass, the hay for the season is shortened in length and its quality suffers.

The Adult Moth.

The adult moth is a dark brown stout insect. The forewings of the female are more lightly coloured than those of the male which are dusky black. The male is slightly smaller than the female whose abdomen is more stout and pointed. The end of the abdomen in the male is beset with a tuft of elongated scale like hairs, while the hairs in the female abdomen are short and less conspicuous.

The adult moths begin to emerge in the field at dusk; and when disturbed at the approach of a powerful light take to short haphazard flights. They rest on dry grasses near the place of emergence, and are scarcely visible during day time. At night they rise into the darkness with great rapidity. The longevity of male moths was found to be 3-10 days, with an average of 7.14 days for 14; for females it was 4-14 days, with an average of 9.45 for 22.

Egg laying Habits.

Eggs are generally laid about five to six days after emergence. In a series of observations made at the Insectary at Coimbatore, as many as 597 larvae constituted the progeny of a single female. The eggs are generally laid inside the leaf sheaths, a few may be found on open leaf tips, leaf folds, on stems, and occasionally in the laboratory cages; a few were scattered on the earth. The major portion of normal egg laying is confined to the space between stem and leaf sheath. The maximum number of eggs laid by a single female was 597, the minimum 110; with an average of 314-5 for 12. In one particular instance, 396 eggs were found in 43 clusters of which the distribution was as follows:—190 between stem and sheath, 72 in leaf folds, 118 on leaf, 7 on stem and 8 on soil. The eggs are laid in rows or in small clumps or masses, each row or group containing 2-19 eggs. A few isolated hairs are scattered in between, but the eggs are not covered by hairs. They are, however, protected to some extent by the sheath or fold of the leaf. Eggs are never found on tender leaves, but the larvae hatching out of them soon find a place on the tender regions of the plant.

Description of Stages.

Egg.—Each egg is roughly spherical in form measuring about $\frac{1}{2}$ mm., pale, creamy white in colour, with the surface smooth and shining. The eggs get a golden yellow tint just before hatching.

Larva—1st instar.—Newly hatched caterpillar about $2\frac{1}{4}$-$2\frac{1}{2}$ mm. in length. Head nearly as big as the body segments. Head shield pale glossy brown, prothoracic shield small, distinct and of the same colour as the head. Body slender, pale greenish, with whitish isolated hairs or setae. Viewed under high magnification, the setae on the body are seen to arise from minute black spots. Eye spots on the head shield brownish black, mandibles brownish. The larva exhibits looping movements though five pairs of prolegs are seen. The first pair of prolegs is least developed and look like minute stumps; the last three pairs well developed. The larva is able to lift the anterior portion of its body on its posterior three pairs of prolegs, the front

portion of the body remaining in a bent posture without touching the substratum. While moving on leaf, the portion of the body between thorax and abdominal segment 4 is bent upwards in a loop. Lines on the body are very feebly indicated towards the end of the stage. The first instar lasts 4-7 days.

2nd instar.—The larva about 5 mm. long. Head as big as body segments or slightly bigger, head shield pale transparent and shining, with faint brownish markings or lines; ocelli black; two brownish lines on head shields, closely approximated to each other towards the centre and diverging at the 'vertex' and basal portion of 'front', labrum and mandibles brownish, front and adfrontal areas whitish. Body with five black longitudinal lines on either side of the median dorsal whitish streak. These may be termed and are hereafter referred to as dorsal, subdorsal, lateral, sublateral, and ventrolateral lines. A few irregular brownish streaks visible below the ventrolateral lines. Legs and prolegs pale whitish, prolegs fully developed, outer side of each slightly chitinised and of lightly darker shade. Setae sparse, indistinct and short. The stomata appear as minute black spots. Ventral side of the body pale white or, greenish white. With growth, the five lines on each side get a brownish tint and the body looks greenish brown. The abdominal segments become thicker by growth and the prothorax and head appear smaller in comparison.

Feeding commences one hour after moulting. During the instar, the larva, when at rest, keeps its anterior portion of the body raised up in a curve, the whole body resting on the posterior three pairs of prolegs. Larva when active makes looping movements. In cages, the 1st and 2nd stage larvae were found to feed also on flowers of grasses. The 2nd instar lasts 2-6 days.

3rd instar.—Brownish black markings on head shield more prominent. The formation of a thin black vertical short line in the centre of 'front' a characteristic and distinguishing feature. The outer side of the epicranium bears irregular brownish black mottlings. Body stouter and smooth from voracious feeding, lines on the body darker and modified, lateral line broader and modified. General colouring greenish, head and posterior ends brownish. Stomata seen as black spots slightly bigger than in the previous stage. Towards the end of the stage, the coloration becomes dull and there is a tendency for the transformation of the lines into bands incorporated by numerous striae.

The larva feeds actively on grass leaves and some of the larvae show very rapid growth and there is also a shortening of the length of the instar. Two more brown lines appear at the outer side of the epicranium on each side and these, descending in the region of the ocelli, enfold the latter. The third instar lasts 2-7 days.

4th instar.—The size in the beginning varies from 6 to 12 mm. when the head shield is as broad as the body segments. Brown lines on the head with the characteristic mottlings on the epicranium clearer and more accentuated, 'front', adfrontal area and its continuation upwards pale whitish and glossy, centre of 'front' with brownish black vertical streak. Prothoracic shield indistinct, prothoracic and anal shields whitish. Legs and prolegs pale white, ventral side of body greenish.

The coloration on body surface is changed materially. The intervening whitish spaces between black lines, of the previous stage, are reduced to very narrow imperceptible streaks of a yellow tinge or into irregularly mottled bands. Pinkish lines appear as transverse, border lines between segments. In continuation of the adfrontal whitish area and vertex, the median dorsal line of white tint, is seen as a very narrow streak in between the closely approximated two black dorsal lines. The subdorsal black line is now reduced to a pinkish faint black band, and below this a prominent yellow streak is formed anew. A lateral pinkish broad band appears in place of the lateral black line. Below this, a broad sublateral black band is formed by the coelescence of the sublateral and ventrolateral lines of the previous stage; the interspace between the two latter is merged and almost obliterated in the broadened band now formed. Ventral of this broad sublateral black band, a few irregular lines of yellowish tinge, now formed, appear as a distinct band, which is made more conspicuous during further growth and is studded with irregular pinkish patches

forming a line in its middle. During this stage the larva exhibits its most vivid coloration. There is great variation in minute details of lines and bands which defy description in individual larvae. The body grows more uniformly cylindrical and smooth. Setae are indistinct and a few are seen to arise from black tubercles. The spiracles are black and those in segments 3, 4 and 5 are seen in the yellowish ventrolateral band, while the others are placed in the black band above or in the border. Towards the end of the stage, the larva grows to about 20 mm. The general coloring turns greenish black, interspersed by pinkish and yellowish bands at the sides. The median dorsal whitish streak between the two dorsal lines is replaced by a pinkish brown band in the centre, the dorsal lines growing faint. The subdorsal line towards the end of the stage develops into a broad pinkish brown band bounded by a narrow clear yellow streak below formed of the interspace between the original subdorsal and lateral lines. The lateral line is now a broad reddish pink band bounded by an upper yellow streak and a lower whitish yellow streak. The sublateral and ventrolateral lines have completely coalesced obliterating the interspace totally. This band is black and conspicuous, in contrast to the yellowish pink area below which now forms the ventrolateral border. The fourth instar lasts 2-8 days.

5th instar.—The larva, to start with, is on an average 23 mm. long and 4-5 mm. broad. The general color pattern from being vivid and attractive tends to become dull. The larva is dusky grey or dull blackish. A central median dorsal blackish broad band, a lateral area or band constituted of yellow and black lines close together, and a sublateral thick distinct black band, bordered below by the ventrolateral dusky greenish area, are the characteristic stripes. Closely examined, all these are formed of numerous minute longitudinal striae. Some of the larvae show at the outer border of the median dorsal broad band, elongated black spots or thickenings over each segment, forming almost an interrupted straight line. The stout smooth larva, with dirty greenish grey color alternating with faint greyish pink bands and yellow striae, now resembles *Spodoptera mauritia* and displays the same habit of curling into a ring when disturbed. The larva grows to about 28-32 mm.; just before pupation even the light pinkish tinge vanishes, and it takes the color of the soil. The spiracles are vertically oval spots with a jet black elevated rim and pale dark central portion. Preparatory to pupation, the larva seeks the soil, when excepting head, and segments 1 and 10, all other segments are of uniform thickness and color. The black lines on the head and the characteristic vertical streak in 'front' are distinct. The head region is dull black due to the mottlings and lines. The black bands over the dorsal and sublateral regions fade into a grey tint, retaining the original black color, localised to linear spots, one over each segment. The pink color of the lateral and ventrolateral line is less conspicuous. In this condition the larva approaches Spodoptera in form and colour, the difference however being noticeable particularly in the coloration and markings of the head shield. In some larvae, the black color is retained but the numerous longitudinal lines fade and in such examples, the head is darker still. When feeding has ceased the larva in the soil, takes a curved posture inserting its head into the earth, the body color simulating the color of the soil or dry grass stems from amidst which it is scarcely visible. The fifth instar lasts 3-8 days.

Pupa.—The full-grown larva burrows into the soil, constructs a thin cell of earth within which it moults and pupates. The pupa is about 13 mm. long, brownish red or yellowish red. Two horny spines, projecting from the tip of abdomen tipped black, two smaller, thinner, curved spines or setae placed, one on each side, on the penultimate segment, close to the segment bearing terminal spines. At the posterior region of the abdomen there are two smaller vertical slits or thin short streaks, one in front of the other. Male pupa, yellowish brown, the anterior slit in the middle of an elevated flat swelling. Female pupa, brownish red, anterior slit not so prominent but flush with the surface. Slits black in both, posterior one darker and thicker. The pupae are found usually 1-3 inches below soil.

Under field conditions, in the course of investigations at Hosur grass lands the pupae were found in a variety of situations such as in soil in the middle of the paddock, sides of bunds, shady portions below trees, or close to tree

trunks, and also in between grass clumps which form a fibrous matting or meshwork just below surface layer of soil. Hard clayey soil as well as loose dry sandy situations are avoided; and the largest number of pupae were found in situations where the soil was moist enough for larvae to burrow in and the surface covered with dry matting of grass or mulch of dead leaves.

The Life Cycle.

The egg, larval and pupal periods were 4-5, 19-28 and 8-11 days respectively. The total period from egg to adult was about 32-43 days with an average of 36.48 days for 21 specimens, when larvae were reared in individual cages. In the case of bulk rearing, allowing batches of larvae to feed more freely and with ample scope for their activities, a few of each batch were found to reach the adult stage in a shorter period; in such cases, the period varied between 27-40 days with an average of 31.9 days for 14 series.

Habits of the Pest.

From observations made at Hosur pastures, where the pest outbreaks have been more or less of frequent occurrence, there are no evidences of pupae or larvae tiding over adverse seasons, as such. During 1937, the caterpillars in the field were enclosed by field cages for observation during May, and again in December. Wire gauze cages, $2\frac{1}{2}' \times 2\frac{1}{2}' \times 2'$, with one side open were inverted over the soil, the edges of the open end fitting closely on to grooves on a square frame of wood embedded in the soil so as to leave no hole or opening for the escape of the specimens from inside the soil. 200 larvae feeding on grass and in contact with soil below were under observation in four different situations in the farm, and the cage contents were examined in the subsequent months, allowing enough time for normal emergence. In such examinations of larvae in soil, there was no instance of a single larva or pupa surviving as such. The same course of observation was repeated during December the same year, leaving 300 larvae in one cage. So far, there is no record of an aestivating or hibernating stage for this insect. It is quite possible that the insect continues to breed all through the year, selecting different localities, far away from each other, for each brood. A long period of drought and depression followed by heavy flooding rains seems to be a favourable condition for the occurrence of severe outbreaks.

Natural Enemies.

Crows.—Crows congregate in numbers in plots infested by these caterpillars to devour them. The birds are seen in large numbers during the morning and late in the evening feeding on the caterpillars. When the grass is mowed the birds remain in the field throughout the day destroying a large part of larval population.

Ants have been noted destroying large numbers of pupae in soil, covered by field cages in the field. In spite of the depredations of ants a large number of pupae in the field survive to develop into moths.

Parasites.—During the outbreak of 1937, a large number of larvae and pupae were examined in the field for parasites. In the collections, there were three kinds of Tachinid parasites which have been identified as (1) *Actia monticola* Mall, (2) *Cyphocera varia* F, and (3) *Sturmia inconspicuoides* Bar. *Actia monticola* is a parasite of comparatively small size breeding as an internal parasite in the caterpillar which harbours more than one parasite-pupa inside its body. The caterpillar is killed before it pupates. *Cyphocera varia* is slightly bigger in size and moves out of the body of the full-grown caterpillar for pupation. The parasitic grub leaves the host just before the latter is about to pupate. The host larva barely survives for a day. *Sturmia inconspicuoides* is fairly big in size and invariably pupates inside the host. Some of the host caterpillars feed and pupate with the parasite inside, but are ultimately destroyed by the time the parasite emerges. The big-sized reddish brown pupa of the parasite is often seen through the thin skin of the host pupa. The extent of parasitisation was very small.

the numerous larvae. Several detached paddocks in different localities in the area are affected almost simultaneously; while during an outbreak, the larvae, in all the foci of infestation, appear almost of the same age. Larvae march in all directions, unimpeded by roads, pathways or other obstructions. As is the case with cutworms in general, in all these outbreaks the density of the pest population subsides to surprisingly insignificant numbers during the course of a fortnight, but even in this short interval, much damage is done by mass feeding, and heavy loss in yield of hay is caused. If the damage happens to be during the tender stage of the grass, the hay for the season is shortened in length and its quality suffers.

The Adult Moth.

The adult moth is a dark brown stout insect. The forewings of the female are more lightly coloured than those of the male which are dusky black. The male is slightly smaller than the female whose abdomen is more stout and pointed. The end of the abdomen in the male is beset with a tuft of elongated scale like hairs, while the hairs in the female abdomen are short and less conspicuous.

The adult moths begin to emerge in the field at dusk; and when disturbed at the approach of a powerful light take to short haphazard flights. They rest on dry grasses near the place of emergence, and are scarcely visible during day time. At night they rise into the darkness with great rapidity. The longevity of male moths was found to be 3-10 days, with an average of 7.14 days for 14; for females it was 4-14 days, with an average of 9.45 for 22.

Egg laying Habits.

Eggs are generally laid about five to six days after emergence. In a series of observations made at the Insectary at Coimbatore, as many as 597 larvae constituted the progeny of a single female. The eggs are generally laid inside the leaf sheaths, a few may be found on open leaf tips, leaf folds, on stems, and occasionally in the laboratory cages; a few were scattered on the earth. The major portion of normal egg laying is confined to the space between stem and leaf sheath. The maximum number of eggs laid by a single female was 597, the minimum 110; with an average of 314-5 for 12. In one particular instance, 396 eggs were found in 43 clusters of which the distribution was as follows:—190 between stem and sheath, 72 in leaf folds, 118 on leaf, 7 on stem and 8 on soil. The eggs are laid in rows or in small clumps or masses, each row or group containing 2-19 eggs. A few isolated hairs are scattered in between, but the eggs are not covered by hairs. They are, however, protected to some extent by the sheath or fold of the leaf. Eggs are never found on tender leaves, but the larvae hatching out of them soon find a place on the tender regions of the plant.

Description of Stages.

Egg.—Each egg is roughly spherical in form measuring about ½ mm., pale, creamy white in colour, with the surface smooth and shining. The eggs get a golden yellow tint just before hatching.

Larva—1st instar.—Newly hatched caterpillar about 2¾-2½ mm. in length. Head nearly as big as the body segments. Head shield pale glossy brown, prothoracic shield small, distinct and of the same colour as the head. Body slender, pale greenish, with whitish isolated hairs or setae. Viewed under high magnification, the setae on the body are seen to arise from minute black spots. Eye spots on the head shield brownish black, mandibles brownish. The larva exhibits looping movements though five pairs of prolegs are seen. The first pair of prolegs is least developed and look like minute stumps; the last three pairs well developed. The larva is able to lift the anterior portion of its body on its posterior three pairs of prolegs, the front

portion of the body remaining in a bent posture without touching the substratum. While moving on leaf, the portion of the body between thorax and abdominal segment 4 is bent upwards in a loop. Lines on the body are very feebly indicated towards the end of the stage. The first instar lasts 4-7 days.

2nd instar.—The larva about 5 mm. long. Head as big as body segments or slightly bigger, head shield pale transparent and shining, with faint brownish markings or lines; ocelli black; two brownish lines on head shields, closely approximated to each other towards the centre and diverging at the 'vertex' and basal portion of 'front', labrum and mandibles brownish, front and adfrontal areas whitish. Body with five black longitudinal lines on either side of the median dorsal whitish streak. These may be termed and are hereafter referred to as dorsal, subdorsal, lateral, sublateral, and ventrolateral lines. A few irregular brownish streaks visible below the ventrolateral lines. Legs and prolegs pale whitish, prolegs fully developed, outer side of each slightly chitinised and of lightly darker shade. Setae sparse, indistinct and short. The stomata appear as minute black spots. Ventral side of the body pale white or greenish white. With growth, the five lines on each side get a brownish tint and the body looks greenish brown. The abdominal segments become thicker by growth and the prothorax and head appear smaller in comparison.

Feeding commences one hour after moulting. During the instar, the larva, when at rest, keeps its anterior portion of the body raised up in a curve, the whole body resting on the posterior three pairs of prolegs. Larva when active makes looping movements. In cages, the 1st and 2nd stage larvae were found to feed also on flowers of grasses. The 2nd instar lasts 2-6 days.

3rd instar.—Brownish black markings on head shield more prominent. The formation of a thin black vertical short line in the centre of 'front' a characteristic and distinguishing feature. The outer side of the epicranium bears irregular brownish black mottlings. Body stouter and smooth from voracious feeding, lines on the body darker and modified, lateral line broader and modified. General colouring greenish, head and posterior ends brownish. Stomata seen as black spots slightly bigger than in the previous stage. Towards the end of the stage, the coloration becomes dull and there is a tendency for the transformation of the lines into bands incorporated by numerous striae.

The larva feeds actively on grass leaves and some of the larvae show very rapid growth and there is also a shortening of the length of the instar. Two more brown lines appear at the outer side of the epicranium on each side and these, descending in the region of the ocelli, enfold the latter. The third instar lasts 2-7 days.

4th instar.—The size in the beginning varies from 6 to 12 mm. when the head shield is as broad as the body segments. Brown lines on the head with the characteristic mottlings on the epicranium clearer and more accentuated, 'front', adfrontal area and its continuation upwards pale whitish and glossy, centre of 'front' with brownish black vertical streak. Prothoracic shield indistinct, prothoracic and anal shields whitish. Legs and prolegs pale white, ventral side of body greenish.

The coloration on body surface is changed materially. The intervening whitish spaces between black lines, of the previous stage, are reduced to very narrow imperceptible streaks of a yellow tinge or into irregularly mottled bands. Pinkish lines appear as transverse, border lines between segments. In continuation of the adfrontal whitish area and vertex, the median dorsal line of white tint, is seen as a very narrow streak in between the closely approximated two black dorsal lines. The subdorsal black line is now reduced to a pinkish faint black band, and below this a prominent yellow streak is formed anew. A lateral pinkish broad band appears in place of the lateral black line. Below this, a broad sublateral black band is formed by the coelescence of the sublateral and ventrolateral lines of the previous stage; the interspace between the two latter is merged and almost obliterated in the broadened band now formed. Ventral of this broad sublateral black band, a few irregular lines of yellowish tinge, now formed, appear as a distinct band, which is made more conspicuous during further growth and is studded with irregular pinkish patches

forming a line in its middle. During this stage the larva exhibits its most vivid coloration. There is great variation in minute details of lines and bands which defy description in individual larvae. The body grows more uniformly cylindrical and smooth. Setae are indistinct and a few are seen to arise from black tubercles. The spiracles are black and those in segments 3, 4 and 5 are seen in the yellowish ventrolateral band, while the others are placed in the black band above or in the border. Towards the end of the stage, the larva grows to about 20 mm. The general coloring turns greenish black, interspersed by pinkish and yellowish bands at the sides. The median dorsal whitish streak between the two dorsal lines is replaced by a pinkish brown band in the centre, the dorsal lines growing faint. The subdorsal line towards the end of the stage develops into a broad pinkish brown band bounded by a narrow clear yellow streak below formed of the interspace between the original subdorsal and lateral lines. The lateral line is now a broad reddish pink band bounded by an upper yellow streak and a lower whitish yellow streak. The sublateral and ventrolateral lines have completely coalesced obliterating the interspace totally. This band is black and conspicuous, in contrast to the yellowish pink area below which now forms the ventrolateral border. The fourth instar lasts 2-8 days.

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Pupa.—The full-grown larva burrows into the soil, constructs a thin cell of earth within which it moults and pupates. The pupa is about 13 mm. long, brownish red or yellowish red. Two horny spines, projecting from the tip of abdomen tipped black, two smaller, thinner, curved spines or setae placed, one on each side, on the penultimate segment, close to the segment bearing terminal spines. At the posterior region of the abdomen there are two smaller vertical slits or thin short streaks, one in front of the other. Male pupa, yellowish brown, the anterior slit in the middle of an elevated flat swelling. Female pupa, brownish red, anterior slit not so prominent but flush with the surface. Slits black in both, posterior one darker and thicker. The pupae are found usually 1-3 inches below soil.

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Control Methods Tried.

In the past, during times of large-scale damage to grass, several methods have been tried with a view to destroy the caterpillars, to minimise damage, or to prevent future outbreaks, but no satisfactory method has yet been evolved. Ramachandra Rao (1930) has recorded trials of dusting with Paris green and calcium arsenate on a small scale, but the treated hay was found on analysis to contain residue enough to make it unfit for fodder purposes. Baits and light traps were tried without success. Shielding, ploughing and burning of paddocks after the crop did not succeed in preventing future outbreaks and could not be carried out on an extensive scale. Crushing the larvae using stone rollers was first attempted by Ramachandra Rao (1930) and later, in 1937, with no appreciable success. Egg mass collection and destruction are impracticable, due to the habit of the moths of concealing the egg masses within sheaths of leaves and distributing the eggs in small clusters on several plants. By keeping close watch, by noting newly hatched or growing caterpillars during the pest season, some relief is likely to be achieved by preventing spread of the swarms from plot to plot. If the outbreak happens to occur towards the end of the year early harvesting of the crop minimises loss as well as spread of the pest.

ACKNOWLEDGMENTS.

The authors are thankful to the Livestock Development Officer, and the Superintendent of the Research Station, Hosur, for help rendered in facilitating observations, and to the Imperial Institute of Entomology, London, for identifying the specimens.

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THE MEDICINAL AND POISONOUS PLANTS OF INDIA.

Dammers, Guttifers, Silk-cottons, Teas, Tutsans, Water-peppers.

BY

J. F. Caius, S.J., F.L.S.

I

The Dipterocarpaceae are all natives of the hot damp forests of India and Malaya, except a few African species. Many are among the biggest trees in the forests and are valued for their magnificent timber. Many also produce useful gums, and some yield a very good quality of camphor. The seeds are generally oleaginous. There are 25 genera with 350 species.

The medicinal and poisonous Dammers belong to 5 genera, all represented within our limits: Dipterocarpus (Indo-Malaya); Dryobalanops (Borneo, Malaya); Hopea (Indo-Malaya); Shorea (Ceylon to Philippine Islands); Vateria (Seychelles, South India).

A. Calyx scarcely enlarged in fruit, segments reflexed ...	Vateria
B. Calyx much enlarged in fruit, segments erect.	
1. Fruiting calyx with a distinct tube covering the fruit. Fruit free.	
a. Sepals developed into long wings, 4	Dryobalanops
b. Sepals developed into wings 2, the others very short	Dipterocarpus
2. Fruiting calyx with an obscure tube; aestivation of the calyx imbricate.	
a. Wings 3 long, 2 shorter	Shorea
b. Wings 2 large, 3 small	Hopea

Dipterocarpus.

The genus consists of 70 Indo-Malayan species.

Many species produce a valuable oleo-resin, known as wood oil, which is used in medicine.

The following are used in Dutch India—*D. gracilis* Blum., *D. littoralis* Blum., *D. retusus* Blum., *D. Spanoghei* Blum., *D. trinervis* Blum.—; in the Philippine Islands—*D. affinis* Brandis, *D. grandiflorus* Blanco, *D. pilosus* Roxb., *D. polyspermus* Blanco, *D. trinervis* Blum., *D. vernicifluus* Blanco—; in Indo-China—

D. alatus Roxb., *D. artocarpifolius* Pierre, *D. intricatus* Dyer, *D. Jourdainii* Pierre, *D. tuberculatus* Roxb., *D. turbinatus* Gaertn.—.

A. Calyx-tube in fruit without ribs or wings.
   1. Young branches glabrous or canescent ... *D. turbinatus.*
   2. Young branches more or less hairy ... ... *D. pilosus.*

B. Calyx-tube in fruit 5-angled or winged.
   1. Angles confined to the upper portion of the calyx-tube ... ... *D. tuberculatus.*
   2. Angles or wings prolonged to the base of the calyx-tube or nearly so.
      Angles winged ... ... *D. alatus.*

1. **Dipterocarpus alatus** Roxb. occurs in Chittagong, Burma, Tenasserim, the Andamans, Penang; extending to Siam and Indo-China.

In Cambodia the bark is considered tonic and depurative and prescribed in rheumatism. The bark of the young plant is used externally in rheumatism and in liver troubles. The oil is applied to ulcerated wounds.

In general the oleo-resin is applied externally in gonorrhoea.

Andamans: Gurjun—; *Bengal*: Battisal, Garjan, Shwetagarjan—; *Burma*: Kanyin, Kanyinbyu, Kanyinni, Kanyinwettaung—; *Cambodia*: Chhoeuteal, Trach—; *Chittagong*: Duliagurjan—; *Indo-China*: Chhoeu teal thom, Chhoeu teal tuc, Chor tuc, Dau con rai trang—; *Sinhalese*: Horagaha—.

2. **Dipterocarpus pilosus** Roxb. occurs in Sylhet, Chittagong, South Tipperah, Burma, Martaban, Mergui, the Andamans, the Malay Peninsula, and Siam.

The balsam is used in the treatment of gonorrhoea, gleet, and similar affections of the urinary organs.

Assam: Hollong—; *Tagalog*: Hagachac—.

3. **Dipterocarpus tuberculatus** Roxb. is distributed over Burma, Siam, and Cochin-China.

The oleo-resin is used with asafoetida and cocoanut oil as an application for large ulcers.

In Cambodia the roots are used in the treatment of hepatic troubles.

Burma: Eng, In Inbo, Kanyingok—; *Cambodia*: Khlong—; *Laos*: Mai bao, Mai tung—; *Siamese*: Mai rang—; *Taleing*: Sooahn—.

4. **Dipterocarpus turbinatus** Gaertn. f. occurs in Assam, Chittagong, Burma, the Andamans; extending to Siam and Cochin-China.

The oleo-resin is applied externally to ulcers, ring-worm, and other cutaneous affections. It is stimulant of mucous surfaces, particularly that of the genito-urinary system, and also diuretic. In gonorrhoea and other affections in which copaiba is generally employed, it has proved an effectual remedy.

Assam: Kuralsal, Kuroil, Tiliagurjan—; *Bengal*: Gurjan, Shwetagurjan, Tihyagurjan—; *Burma*: Inbo, Inkanyin, Kanyinbyu, Kanyingyi, Kanyinni, Kanyinnin, Kanyinwettaung, Kanyinwettaw, Kanyinywetgyi, Kanyinywetthe,

Maihow—; *Canarese*: Challane, Guge, Valivara—; *Chittagong*: Kaligurjan, Teliagurjan, Tiliagurjan—; *English*: Wood Oil Tree—; *Gujerat*: Gurjun—; *Magahi*: Kanyoung—; *Tagalog*: Mayapis—.

Dryobalanops.

The genus consists of 7 species, natives of the Malay Peninsula and Islands.

Dryobalanops aromatica Gaertn. inhabits the forests and lowlands on low hills of the Malay Peninsula and Archipelago.

The tree produces camphor oil and camphor, much used as a tonic and sudorific. The camphor is chiefly exported to China, where it is employed as a tonic and aphrodisiac; in Borneo itself it is used as a diuretic and in nephritic affections, and as a popular remedy for rheumatism.

China: Lung Nao Hsiang—; *Indo-China*: Camphrier de Baroum, Camphrier de Barros, Camphrier de Bornéo, Long nao thu, Ping pien—; *Malay*: Kapur barus—.

Hopea.

This genus numbers 50 Indo-Malayan species.

Hopea odorata Roxb. occurs from Pegu and Tenasserim to Cochin-China. It is also found in the Andamans.

In Cambodia the bark is used as an astringent in gingivitis.

Among the Burmese the resin, reduced to powder, forms a popular styptic.

Andamans: Rimda—; *Burma*: Thengan—; *Cambodia*: Koki—; *Lao*: Mai takien—.

Shorea.

This genus numbers 90 species spread from Ceylon to the Philippine Islands.

All the species abound in various kinds of copalline resins.

The following are used medicinally:—in the Philippine Islands—*S. Guiso* Blum., *S. malaanonan* Blum., *S. mangachapuy* F. Vill.—; in Cambodia—*S. cambodiana* Pierre, *S. Harmandii* Pierre.

The oil from the seeds of *S. stenoptera* Buck is officinal in Holland. The resin from S. Wiesneri Stapf. and various other species are officially recognized in Austria, Russia, and Spain.

Stamens 20-∞.

1. Leaves 15-25 by 10-15 cm. Petiole 2-2.5 cm. ... *S. robusta.*
2. Leaves 6.3-20 by 3.2-11.5 cm. Petiole 2.5-5 cm. *S. Tumbuggaia.*

1. **Shorea robusta** Gaertn. f. occurs in the Kangra district of the Punjab, from the Kalesar forest in the Ambala district along the sub-Himalayan tract to the Darrang district of Assam,

sometimes in the outer Himalayan valleys up to 5,000 feet; in the Garo Hills, Kamrup, the Khasia Hills, the Jaintia Hills, from the Santal Parganas through Chota Nagpur and Orissa to Ganjam, Jeypore, the Central Provinces, Vizagapatam.

Ayurveda practitioners freely prescribe the bark, leaves, fruit, and resin. Among Yunani doctors the resin and the oil seem to be more especially favoured.

The resin is regarded as astringent and detergent. It is used in dysentery, and for plasters and fumigations. It is commonly given for weak digestion, gonorrhoea, and as an aphrodisiac.

Arabic : Kaikahr—; *Bengal* : Sakher, Sakhu, Sakhua, Sakoh, Sal, Sala, Salwa, Sarj, Shal—; *Bhumij* : Sargi—; *Bombay* : Sal—; *Burma* : Enkhyen—; *Canarese* : Asina, Asu, Ashvakarna, Guggula, Kabbu, Sarja, Vamsa—; *Central Provinces* : Rinjal, Sal, Sarai—; *Deccan* : Ral—; *English* : Common Sal, Indian Dammer, Sal Tree—; *Garhwal* : Kandar—; *Garo* : Bolsal—; *Gujerati* : Ral—; *Hindi* : Sakher, Sakhu, Sakhua, Sakoh, Sal, Sala, Salwa, Shal—; *Kharwar* : Sakwa—; *Khond* : Jargi—; *Kolami* : Sarjum, Sekura—; *Kumaon* : Sal—; *Lepcha* : Takral, Teturl—; *Malayalam* : Maramaram, Mulappumarutu—; *Marathi* : Guggilu, Rala, Sajara—; *Nepal* : Sakwa—; *North-Western Provinces* : Kandar, Koron, Sakhu, Sal—; *Oudh* : Koroh—; *Persian* : Lalemoabbari, Lalemohari—; *Punjab* : Sal, Seral—; *Sanskrit* : Agnivallabha, Ashvakarna, Ashvakarnika, Chiraparna, Dhanya, Dirghaparna, Dirghashakha, Divyasara, Jaladashara, Jaranadruma, Kala, Kalalajodhbhava, Karshya, Kashayi, Kaushika, Kaushikahva, Kushika, Lalana, Latashankha, Latataru, Rala, Ralakarya, Sala, Salaniryas, Salaveshta, Sarja, Sarjakarya, Sarjarasa, Sarjjaka, Sasyasambara, Sayasamvera, Shankataru, Shankurriksha, Shasyasambara, Shura, Sidhaka, Sureshtaka, Tarkshyaprasava, Vallivriksha, Vansha, Vastakarna, Yakshadhupa—; *Santal* : Sarjom—; *Sinhalese* : Dammala—; *Tamil* : Attam, Kungiliyam, Shalam—; *Telugu* : Gugal, Guggilamu, Saluva, Sarjakamu, Sarjamu—; *Tharu* : Sakwa—; *Uraon* : Sekwa—; *Urdu* : Ral—; *Uriya* : Rengal, Sagua, Salo, Salwa, Shalua, Sodingi, Soringhi, Sorjjo—.

2. **Shorea Tumbuggaia** Roxb. is found in the forests of the Cudappah, North Arcot, and Chingleput hills, up to 3,000 feet.

The resin is used as an external stimulant.

English : Green Dammer—; *Malayalam* : Tampakam—; *Tamil* : Karundanbai, Karuppudamar, Tambagam, Tambai, Tambugai—; *Telugu* : Guggilamu, Jalari, Nalladammara, Nallaguggilamu—.

Vateria.

The genus consists of 3 species confined to South India and the Seychelles.

Vateria indica Linn. is found from North Kanara to Travancore up to 3,500 or 4,000 feet, chiefly in evergreen forests, but occasionally along rivers in deciduous forests. In Coorg both in the Ghat forests and east of the Ghats up to 3,500 feet, in the latter locality always in evergreen forest.

The fruit yields a solid fatty oil, which has obtained considerable repute as a local application in chronic rheumatism and some other painful affections.

Under the influence of gentle heat, the resin combines with wax and oil and forms an excellent resinous ointment; it is a good

substitute for officinal resin. Fine shavings are administered internally to check diarrhoea.

Arabic: Mukilijraka—; *Bengal*: Chundrus—; *Bombay*: Ral—; *Canarese*: Bilidhupa, Biliguggula, Dhupa, Dhupada, Dupa, Guggula, Maddidhupa, Mandadupa, Rala, Shandike—; *Ceylon*: Pinai—; *Coorg*: Bilidupa—; *Deccan*: Sufeddamar—; *English*: Indian Copal Tree, Piney Varnish Tree, White Dammer Tree—; *Greek*: Sandaraki—; *Hindi*: Kahruba, Sageddamar, Sandras—; *Malayalam*: Kunturukkam, Pantam, Payani, Payin, Perumpayani, Telli, Vellakkunturukkam—; *Persian*: Buejhudan—; *Sanskrit*: Ajakarna, Dhupa, Kundura, Mandadhupa, Marichapatraka, Pitaphada, Sarjaka, Shala—; *Sinhalese*: Hal, Haldumula—; *Tamil*: Attam, Kukkil, Kukkulu, Kundurukkam, Kungiliyam, Kungulu, Sadagulai, Tubam, Vellaikkundurukkam, Vellaikkungiliyam—; *Telugu*: Dupadamaru, Telladamaru, Tellaguggilamu—; *Tulu*: Lobhana, Paini, Tandoligeda—; *Urdu*: Guggul—.

II

The GUTTIFERAE are trees or shrubs with a resinous yellow or greenish juice. Except a few natives of the warm regions of North America, they are all intertropical; they are more numerous in America than Asia, and are comparatively rare in Africa. There are 40 genera with about 630 species.

The members are the source of gum resins endowed with emetic and cathartic properties. The seeds are mostly oleaginous and the oils and fats are used medicinally. Some of the barks are diuretic. The rind of the fruit may be astringent.

Among the gum-resins gamboge may be mentioned as containing α—, β—, and γ— garcinolic acids.

An essential oil was found to consist of terpene and camphor.

Cambogin, a toxic resin, has been obtained from *Garcinia cambogia* Desr.

The medicinal and poisonous Guttifers of the world belong to 11 genera: ALLANBLACKIA (tropical Africa); CALOPHYLLUM (tropics, chiefly Old World); CLUSIA (warm America); GARCINIA (tropical Asia, Africa, and Polynesia); MAMMEA (West Indies); MESUA (tropical Asia); MORONOBEA (Guiana, North Brazil); OCHROCARPUS (palaeotropical); PENTADESMA (Western tropical Africa); RHEEDIA (tropical America, Madagascar); SYMPHONIA (Madagascar, tropical Africa and America).

The medicinal Guttifers of India belong to 4 genera: CALOPHYLLUM, GARCINIA, MESUA, OCHROCARPUS.

A. Ovary-cells 1-ovuled; stigma sessile or subsessile, peltate, entire or with radiating lobes; berry indehiscent.
   1. Calyx of 4 or 5 sepals ... ... GARCINIA.
   2. Calyx closed in bud, bursting in 2 valves ... OCHROCARPUS.

B. Ovary with 1, 2, or 4 erect ovules; styles slender (rarely styles 2); stigma peltate or 4-fid or acute; fruit fleshy, rarely dehiscent.
   1. Ovary 1-celled, 1-ovuled, style 1, stigma peltate CALOPHYLLUM.
   2. Ovary 2-celled, 4-ovuled, style 1, stigma peltate MESUA.

CALOPHYLLUM.

The genus consists of 80 tropical species, mostly inhabiting the Old World.

The bark is diuretic; the resin is emetic and cathartic.

The following species are used medicinally: in China, Indo-China, and the Islands of the Indian Ocean—*C. inophyllum* Linn.—; in Madagascar— *C. laxiflorum* Drake, *C. parviflorum* Bojer, *C. Tacamahaca* Willd.—; in the West Indies—*C. Calaba* Jacq.—; in Brazil—*C. brasiliense* Camb.—; in Colombia—*C. Calaba* Jacq., *C. Mariae* Pl. and Tr.—.

1. Leaves 10-20 by 7.5-10 cm., petiole 3.8-3.2 cm. ... *C. inophyllum.*
2. Leaves 7.5-12.5 by 3.2-5 cm.; petiole 13-20 mm. ... *C. elatum.*
3. Leaves 5-10 by 3.2-5 cm.; petiole 4 mm. ... *C. apetalum.*

1. **Calophyllum apetalum** Willd. occurs in the Western Ghats of the Bombay Presidency, and from Mysore to Travancore up to 1,000 feet; on the banks of rivers and backwaters on the West Coast from North Kanara southwards.

The resin acts as a vulnerary resolvent, and anodyne.

The oil obtained from the seeds is used as medicine in leprosy and cutaneous affections, and in infusion, mixed with honey, in scabies and rheumatism.

Bombay: Cherupinnai, Sarapuna—; *Canarese*: Babbe, Bobbe, Bobbi, Irai, Iria, Kalhonne, Kalpun, Kirihonne, Kullponne—; *Marathi*: Bobbi, Irai—; *Tamil*: Sirubinnai—; *Travancore*: Attupunna, Kattapunna, Mannapunna, Purapunna, Serupunna—; *Tulu*: Kaiponne, Kalponne, Seruponne, Siriponne—.

2. **Calophyllum elatum** Bedd. is found in the evergreen forests of the Western Ghats, and adjoining hills, from South Kanara to the Pulneys.

The gum is feebly astringent.

Bombay: Pun, Sirpon—; *Canarese*: Bobbi, Holehonne, Kuve, Siripunchuve, Siripunekuve, Siruponne, Srihonna, Surponnebobbi—; *English*: Malabar Poon, Poon Tree, Sirpoon Tree—; *Kadir*: Karanguttiyan, Viri—; *Malayalam*: Kattupunna, Malampunna, Pun, Pungu, Punna, Punnappai—; *Marathi*: Nagani—; *Sinhalese*: Kina—; *Tamil*: Kattupinnai, Pinnai, Pongu, Pungu—; *Tulu*: Pune—.

3. **Calophyllum inophyllum** Linn. is essentially a littoral species to be found along the East and West coasts of the Peninsula, Burma, the Andamans, Malaya, and Ceylon. It is distributed to the sea-shores and the islands of East Africa, Australia, and Polynesia.

The bark is astringent and useful in internal haemorrhages. The juice is used as a purgative, and is said to be very powerful in its action.

In Java the tree is supposed to possess diuretic properties.

In Cambodia the leaves are prescribed as an inhalation in migraine and vertigo. The oil from the kernels of the seeds is used in scabies.

The leaves, soaked in water, are employed as an application to inflamed eyes, in the Malay Archipelago.

In Madagascar the leaves are applied to sore eyes; the pounded bark is used topically in orchitis; the gum resin is considered vulnerary, resolvent, and anodyne; the oil from the seeds is a

reputed antisoric, and is much used in the treatment of rheumatism; a decoction of the root is used in dressing ulcers.

The tears which distil from the tree and its fruit are emetic and purgative (Rheede).

The gum which flows from the wounded branches, mixed with strips of the bark and leaves, is steeped in water, and the oil which rises to the surface is used as an application to sore-eyes. It is said to be a useful remedy for indolent ulcers.

In New Caledonia the gum resin is applied to ulcerous wounds.

The fixed oil, expressed from the kernels of the seeds, is said to cure scabies. It exercises a great beneficial influence over the mucous membrane of the genito-urinary organs, and is therefore highly useful in the treatment of gonorrhoea and gleet. Externally, it is a good and useful embrocation in rheumatism and gout. The watery paste of the kernel of the seeds, applied to the painful joints and dried by the heat of fire, often affords a great relief in the same diseases, and may be resorted to in the absence of the oil.

Bengal: Punnag, Sultanachampa, Sultanachampaca—; *Betsileo*: Foraha—; *Betsimisaraka*: Forho—; *Bicol*: Dancalan—; *Bombay*, Udi, Undi—; *Burma*: Pengnyet, Phounniya, Phungnyet, Ponnyet, Pungnyet—; *Cambodia*: Kchyuong—; *Canarese*: Honne, Huhonne, Nameru, Pinnaikai, Ponne, Surahonne, Vuma, Wuma—; *Ceylon*: Domba, Dommakkottai, Punnai—; *Chinese*: Hu T' ung Lei—; *Cutch*: Udi—; *Deccan*: Surfan, Surpanda, Undi—; *English*: Alexandra Laurel, Alexandrian Laurel—; *Fiji*: Dilo—; *Guam*: Daog, Daok—; *Hawaii*: Ramani, Kamanu—; *Hindi*: Sultanachampa, Surpan, Surpunika, Undi—; *Hova*: Tsindelo—; *Ilocano*: Bitaog, Bitog, Pamitaoguen, Pamitlaten—; *Indo-China*: Ho dong, Mu u—; *Konkani*: Unddi—; *Madagascar*: Foraha, Vintanina—; *Malay*: Betan, Bintangor bunga, Penaga laut, Pudik—; *Malayalam*: Pouna, Punna—; *Marathi*: Nagchampa, Puniag, Surangi, Undag, Undela, Undi, Wundi—; *Mauritius*: Bois Tacamaca—; *New Caledonia*: Pit, Tamanu, Vara—; *Oceania*: Ndilo—; *Pampangan*: Bitaog, Palomaria—; *Philippines*: Birog, Bitanhol, Bitoc, Dingcalin, Palomaria de playa, Tamanian, Vitam—; *Rarotonga*: Tamanu—; *Samoa*: Fetau—; *Sanskrit*: Nagachampa, Nameru, Punnaga, Purosakeshara, Surangi, Tungakeshara—; *Seychelles*: Takamaka—; *Sind*: Dugger-phul, Dugurphort, Purraya, Purreya, Surangi, Undi—; *Sinhalese*: Domba, Dombagaha, Dombatel, Teldomba—; *Spanish*: Palo Maria, Palo de Santa Maria—; *Tagalog*: Bancalan, Bitanhol, Dancalan, Dincalin, Palomaria, Tamauian—; *Tahiti*: Tamanu—; *Taimoro*: Voakotry—; *Tamil*: Nagam, Nameru, Pinnai, Punnagam, Punnai—; *Telugu*: Nameru, Pouna, Punnaga—; *Tongking*: Cay mu hu—; *Tulu*: Ponne—; *Uriya*: Polang, Punang, Punnango—; *Visayan*: Bitaog, Dancalan—; *Zambales*: Bitaoi—.

GARCINIA.

The genus numbers 200 species scattered over the tropical regions of the Old World.

Astringent properties are met in the bark and in the rind of the fruit of some species. The gum resins are powerful, drastic cathartics.

The following are used medicinally:—in China—*G. Mangostana* Linn., *G. Morella* Desc.—; in Indo-China—*G. Hanburyi* Hook, f., *G. Mangostana* Linn.—; in Cambodia—*G. Harmandii* Pierre, *G. Lanessanii* Pierre, *G. Mangostana* Linn., *G. Olivieri* Pierre, *G. Vilersiana* Pierre—; in Malaya—*G. dulcis* Kurz., *G. Mangostana* Linn.—; in the Philippine Islands—*G. Mangostana* Linn., *G. spicata*

Hook. f., *G. venulosa* Chois.—; in New Caledonia— *G. corallina* Vieil.—; in West Tropical Africa—*G. Conrauana* Engl., *G. Elliotii* Engl., *G. gnetoides* Hutch. and J. M. Dalz., *G. guineensis* Willd., *G. Kola* Heckel, *G. Mannii* Oliv., *G. ovalifolia* Oliv., *G. polyantha* Oliv.—; in Southern Africa— *G. Livingstonii* T. And.

A. Sepals and petals 4 each.

1. Stigma entire. Stamens of male flowers in a globose central mass ... ... *G. atroviridis.*

2. Stigma divided into rays, or deeply 4-lobed.

I. Stamens of male flowers in 4 masses or in a 4-lobed mass surrounding the rudimentary ovary; anthers oblong, dehiscing vertically.

a. Leaves 15-25 cm. ... ... *G. Mangostana.*

b. Leaves 10-15 cm. ... ... *G. cornea.*

II. Stamens of male flower in a central shortly-stalked 4-angled or columnar mass; anthers quadrate, dehiscing vertically; rudimentary ovary usually absent.
Male flower in 3-∞-flowered, terminal and axillary fascicles; fruit subglobose or ovoid, tip mamillar.

a. Leaves 6.3-9 cm. ... ... *G. indica.*

b. Leaves 7.5-12.5 cm. ... ... *G. Cowa.*

III. Stamens of the male flowers in a subglobose mass; anthers adnate, orbicular, dehiscence circumsciss, rudimentary ovary absent.

a. Leaves 10-15 by 3.8-7.5 cm. ... ... *G. Morella.*

b. Leaves 15-20 by 7.5-10 cm. ... ... *G. heterandra.*

B. Sepals and petals 5, very rarely 4; filaments connate in 5, rarely 4 erect distant pedicelled spathulate bodies, antheriferous at the top, free portions very short.

I. Leaves 23-45 by 5-10 cm. long ... ... *G. xanthochymus.*

II. Leaves 12.5-25 cm. long ... ... *G. dulcis.*

1. **Garcinia atroviridis** Griff. is found in Upper Assam, at Tabong, in Singapore, Johor, Malacca, Perak, and Penang.

The fruit is used medicinally by the Malays.

Malay: Asam gelugur—.

2. **Garcinia cornea** Linn. is found from East Bengal to Tenasserim, whence it extends to the Malay Archipelago.

The tree yields an inferior kind of gamboge used medicinally in Burma.

3. **Garcinia Cowa** Roxb. occurs in Eastern Bengal, Assam, the Eastern Peninsula, and the Andaman Islands.

The gum-resin is used medicinally by Burman practitioners.

Bengal: Kowa—; *Burma*: Madow, Taungthale, Toungdalai—; *Hindi*: Cowa—; *Ho*: Soroa—; *Uriya*: Sarbana—.

4. **Garcinia dulcis** Kurz is found cultivated in the Malay Peninsula. It is distributed to the Malay Islands.

The oily seeds are sold in the drug shops of Malaya as a remedy for dysentery and chronic diarrhoea.

Malay: Bijimundu, Mundu—.

5. **Garcinia heterandra** Wall. is found in Pegu and Tenasserim up to 4,000 feet.

The gum-resin is occasionally, though not extensively, employed as a medicine by Burman native practitioners.

Burma: Thanatdau, Thanattau—.

6. **Garcinia indica** Chois. is often cultivated; it is found in Konkan, North Kanara, Goa, the Western Ghats of Bombay, South Kanara, Coorg, and Wynaad.

The fruit, either green or ripe, is much used by Ayurveda practitioners.

The Apothecaries of Goa prepare from the juice of the fruit a very fine purple syrup, which is used in bilious affections. The bark is astringent, and the young leaves, after having been tied up in a plantain leaf and stewed in hot ashes, are rubbed with cold milk and given as a remedy for dysentery.

The oil of the seeds is much used for the preparation of ointments, suppositories and other pharmaceutical purposes. It has been used as a local application to ulcerations, fissures of the lips, hands, etc., by partly melting it and rubbing on the affected part.

Bombay: Kokam—; *Canarese*: Ambsol, Dhupadamara, Murgala, Murginahali, Tittidika—; *Deccan*: Kokamb, Ratambi—; *English*: Wild Mangosteen—; *Goa*: Brindao, Brindoeiro—; *Gujerati*: Kokam—; *Hindi*: Kokam—; *Konkani*: Birondd, Birondi, Ratambi—; *Malayalam*: Punampuli—; *Marathi*: Amsole, Bhirand, Chirand, Katambi, Kokam, Kokamb, Ratambe—; *Matheran*: Kokam, Ratamba—; *Sanskrit*: Amlabija, Amlapura, Amlashaka, Amlavriksha, Amlavrikshaka, Atyamla, Bijamla, Chudamla, Chukra, Chukramla, Chukraphala, Phalamlaka, Puramla, Raktapuraka, Rasamla, Shakamla, Shreshthamla, Tintidika, Tittidiphala, Vrikshamla—; *Tamil*: Murgal—; *Tulu*: Puranapuli—.

7. **Garcinia Mangostana** Linn. is cultivated on the Western Coast of the Madras Presidency, the Nilgiris, in Goa, but very rarely in the Bombay Presidency. It is also cultivated all over the Malay Peninsula.

According to Rumphius, the bark and young leaves are employed by the Macassars in diarrhoea, dysentery and affections of the genito-urinary tracts, and also as a wash for aphthae of the mouth.

In Cambodia the bark of the plant and the rind of the fruit are used as astringents in dysentery and diarrhoea.

The rind of the fruit is a well-known astringent useful in the treatment of diarrhoea and dysentery. Waring and others have strongly recommended its use in chronic diarrhoea of children. It has also been employed successfully as a febrifuge. A very strong decoction is also recommended as an external astringent application.

The powdered rind of the dried fruit in daily doses of 60-120 grains dispensed in 3-4 portions gave satisfactory results in 63.8 per cent of amoebic—36 treated—and 66.6 per cent cases of non-amoebic—15 treated—dysentery, and in 72.0 per cent cases of diarrhoea other than dysentery—45 treated—. Mangostin was extracted from the dried rind and tried clinically. It was found to be very inferior to the powdered rind as an antidiarrhoeal agent (Caius and Mhaskar).

Bengal: Mangustan—; *Bombay*: Mangostin, Mangustan—; *Burma*: Mangkob, Mengkop, Mengut, Mimbu, Mingut, Youngzalai—; *Cambodia*: Mongkhut—; *Chinese*: Shan Chu Kuo, Tu Nien Tzu—; *English*: Mangosteen—; *French*: Mangoustan cultivé—; *Hindi*: Mangustan—; *Indo-China*: Mang cut, Mung khut—; *Jolo*: Manguis—; *Malaya*: Manggis, San chook hok—; *Malayalam*: Manggusta, Sulampuli—; *Marathi*: Mangastin—; *Portuguese*: Mangosta—; *Sinhalese*: Mangus—; *Spanish*: Mangostan, Mangostan de la India—; *Tamil*: Sulambuli—.

8. **Garcinia Morella** Desrous. occurs in Eastern Bengal and the Khasia Hills; in the evergreen forests of North Kanara and the Western Ghats, from South Kanara and Mysore to Travancore, up to 3,000 feet; in Ceylon, Malacca, Singapore, and Siam.

The gamboge is considered a valuable hydragogue cathartic. It also possesses anthelmintic properties. It is used in dropsical affections, amenorrhoea, obstinate constipation, and as a vermifuge.

The stem rubbed with water is a household remedy as a local application to rising pimples and boils, and often cuts them short.

Bengal: Tamal—; *Burma*: Thamengut—; *Canarese*: Aradala, Arasinagurse, Devanahuli, Jarize, Jarigehuli, Kankutake, Kankutgal, Punarapuli—; *Ceylon*: Korakkappuli, Makki—; *Chinese*: T'eng Huang—; *English*: Gamboge Tree—; *Hindi*: Tamal—; *Kadir*: Sikiri—; *Malayalam*: Daramba, Karukkampuli, Makki, Pinnarpuli, Pulinjakka, Valakkanna, Valogam—; *Marathi*: Tamil—; *Sanskrit*: Amritadruma, Kalaskandha, Kalatala, Lokaskandha, Mahabala, Niladvaja, Nilatala, Tama, Tamala, Tapichcha, Tapinja, Tapitha—; *Sinhalese*: Gokatu, Kanagoraka, Kanogoraka, Kokatiya—; *Tamil*: Irevalsinni, Makki, Solaipuli—; *Telugu*: Pasupuvarne, Revalchinni—; *Tulu*: Jarige, Jarigepuli, Kanakotekay—.

9. **Garcinia xanthochymus** Hook. f. occurs in Eastern Bengal and Eastern Himalaya, Burma, Penang, the Andamans, the Northern Circars, Ganjam, the Western Peninsula on the Ghats from Bombay to North Kanara, Mysore, Coorg, the Nilgiris and North Travancore up to 3,500 feet.

The fruit, which is yellow and of the size of a small apple and very acid, sweetish when ripe, edible, is used for the same purposes as that of *G. indica;* it is dried and made into a kind of Amsul. A sherbet made with about 1 oz. of the Amsul, with a little rock-salt, pepper, ginger, cumin and sugar, is administered in bilious conditions.

Assam: Tepor, Tezpur, Tihur—; *Bengal*: Chalate, Dampel, Tamal—; *Bombay*: Dampel, Onth, Osth—; *Burma*: Madau, Matau—; *Canarese*: Devangi, Deavkai, Devagarige, Devajarige, Divarige, Gansargi, Gurse, Hirekanigu, Janagi, Javangi, Neralemavu—; *Ceylon*: Egg-tree, Simaigoraka—; *Coorg*: Divarige, Nelamavu, Vate—; *Garo*: Manhola—; *Gujerat*: Karamala,

Ota—; *Hindi*: Dampel, Ota, Tamal—; *Kadir*: Anavaya—; *Konkani*: Dharambe—; *Lao*: Mai dah—; *Marathi*: Jharambi, Ota—; *Sanskrit*: Avika, Bhavana, Bhavishya, Bhavya, Kalakhanda, Kusumodar, Lamphala, Pichchalabija, Samputanga, Tamala, Tapinjha, Vakrashodana—; *Saora*: Lollorimanu—; *Sinhalese*: Cochingoraka, Ratagoraka—; *Tamil*: Kulavi, Malaippachai, Malaippuli, Pachilai, Pachumbadi, Tabinjam, Tamalam—; *Telugu*: Ivarumamidi, Sikatimramu, Sitakamraku, Tamalamu—; *Tulu*: Jarige—; *Uriya*: Cheoro, Chiuri, Sitambu—.

Mesua.

The genus consists of 3 species, natives of tropical Asia.

Mesua ferrea Linn. occurs in the mountains of Eastern Himalaya and Eastern Bengal, Assam, Tenasserim, Burma, the Andamans; in the evergreen rain-forests of North Kanara and South Konkan; in the forests of the Western Ghats from South Kanara to Travancore, up to 5,000 feet; and in Ceylon.

The bark and roots are considered to be, in infusion, an excellent tonic bitter.

The bark is mildly astringent and feebly aromatic. Combined with ginger it is given as a sudorific.

The flowers are astringent and stomachic. In many localities they are used for cough, especially when attended with much expectoration. A paste made of the flowers with butter and sugar is used in bleeding piles and burning of the feet.

In North Kanara and Bengal the oil of the seeds is used as an embrocation in rheumatism, and found useful in the treatment of itch. It is also employed as an antidote for snake poison.

The unripe fruits of this plant are aromatic and sudorific. The flower buds are used in dysentery. A syrup of flower buds 1 in 10 was used in acute cases of dysentery in the out-patient department; mild cases were cured by its use, but in very acute and severe cases, it was found to be inefficacious (Koman).

The leaf and the flower are among the best snake remedies of Ayurveda, and they are still very much used in Bengal as an antidote to snake and scorpion venoms. But Caius and Mhaskar have shown experimentally that no part of the plant is an antidote to either snake or scorpion venom.

Assam: Nahor—; *Behar*: Nagkeshur—; *Bengal*: Nagesar, Nagkesar—; *Bombay*: Nagchampa, Thorlachampa—; *Burma*: Gangau, Kangau—; *Canarese*: Kanchana, Kasara, Nagachampa, Nagakesara, Nagasampage, Nagasampige—; *Ceylon*: Naka—; *Coorg*: Atta, Iruppumara—; *Deccan*: Nagchampa—; *English*: Ceylon Iron-wood, Ironwood of Assam—; *French*: Arbre de fer, Bois d'anis, Bois de fer—; *Hindi*: Naghas, Nagkesar—; *Indo-China*: Thiet luc moc, Vap—; *Kadir*: Peri, Suruli—; *Konkani*: Nagchampa—; *Magahi*: Kainggo—; *Malay*: Matopus, Penaga kunyet, Penaga lilin, Penaga patih, Penaga sabat, Penaga suga—; *Malayalam*: Nagachempakam, Nanga, Peri, Vainavu, Veluttachempakam, Veluttapala—; *Marathi*: Nagachampa, Nagchampa, Nagchampha, Nagchapha—; *Michi*: Nahshor—; *Persian*: Narmishka—; *Pulaiya*: Atuponnai—; *Punjab*: Nagkesar—; *Sanskrit*: Bhujangakhya, Champeya, Hema, Hemakinjalka, Ibhakhya, Kanchana, Kanchanavhaya, Kanakavhaya, Kesara, Keshara, Kinjalka, Mahaushadha, Naga, Nagakeshara, Nagakhya, Nagakinjalka, Nagapushpanaga, Nagaya, Phalaka, Phanikeshara, Pinjara, Sunnagakeshara, Pushparachana, Rajapushpa, Rukma, Shatapadapriya, Suvarna, Suvarnakhya,

Svaraghatana—; *Sind*: Nakesuru—; *Sinhalese*: Deyana, Na, Nagaha—; *Tagalog*: Malabocboc, Malabuebuc—; *Tamil*: Irul, Karunangu, Malainangu, Mannainangu, Naganchambagam, Nagappu, Nagesuram, Nangu, Nirnangu, Patai, Pudangoli, Sirunagappu, Tadinangu—; *Telugu*: Gajapushpamu, Kesaramu, Kinjalkamu, Nagachampakamu, Nagakesaramu, Sikatimanu, Suvarnamu—; *Tinnevelly*: Nang—; *Tulu*: Kesara, Nagasampai—; *Urdu*: Narmishka—; *Uriya*: Nageshvar, Nageshvoro, Nagokesoro—.

Ochrocarpus.

The 10 species of this genus inhabit the tropical regions of the Old World.

O. pentapetalus Blanco is used medicinally in the Philippine Islands, *O. Harmandii* Pierre in Indo-China, and *O. africanus* Oliv. in Tropical West Africa.

Ochrocarpus longifolius Benth. and Hook. fil. occurs in the Western Ghats of the Konkan, North Kanara, Malabar and Coimbatore; it is cultivated in the Northern Circars.

The flower-buds possess astringent and aromatic properties. They are used as a tonic in Persia.

The flowers are stimulant and carminative, useful in some forms of dyspepsia and in haemorrhoids.

Bengal: Nagakesar Punnangachcha, Rajachampaka—; *Bombay*: Suringi, Tambranagkesar—; *Canarese*: Gadhavunate, Phatapale, Punay, Puniye, Punnaga, Suragi, Surgi, Surungi, Unate, Wundy—; *Deccan*: Gardundi—; *Gujerat*: Punnaga, Ratinagkesar, Surapunnaga—; *Hamadan*: Normush—; *Hindi*: Nagkesar, Pulaga, Punnaga, Sultanachampaka—; *Konkan*: Ramundi, Suringi, Surong, Surongi—; *Malayalam*: Surampurna—; *Marathi*: Godiyundina, Punnag, Suringi, Undali—; *Matheran*: Godundipuwag, Harkia, Satwin, Surangi—; *Persian*: Nagkeshur, Tambra—; *Sanskrit*: Aruma, Devavallabha, Kamboge, Kesari, Keshara, Keshava, Kumbhika, Nagakeshara, Nagapushpa, Pandunaga, Pataladruma, Punnaga, Purusha, Purushakhya, Raktakeshara, Raktapushpa, Raktarenu, Raktavriksha, Surangi, Tunga— *Tamil*: Surabunnagam, Surabunnai, Valai—; *Telugu*: Suraponna, Surapunnagamu—; *Uriya*: Churiana, Surongo—.

III

The Bombacaceae number about 150 species grouped in 21 genera. They are all arborescent, and principally tropical, and include some of the largest trees.

Medicinal properties are exhibited by members of 4 genera: Adansonia, Bombax, Ceiba, Pachira. The last named is not represented in India.

A. Calyx 5-cleft ... ... Adansōnia.

B. Calyx truncate or irregularly 3-5-lobed.

I. Branches of the staminal tube 1-antheriferous ... Bombax.

II. Branches of the staminal tube 2-3 antheriferous ... Ceiba.

Adansonia.

This genus consists of 10 species inhabiting the tropics of the Old World.

A. digitata is used medicinally in whatever country it is found growing. *A. Grandidieri* Baill. and *A. Za* Baill. are similarly used in Madagascar, *A. madagascariensis* Baill. in Madagascar and South Africa, and *A. Gregorii* F. Muell. in North Australia.

Adansonia digitata Linn., indigenous in tropical Africa, is grown in many places in India. It is pretty common about Madras, but is chiefly met with in Bombay, being plentiful on the coast.

The fruit is composed largely of a dry acid pulp which, in Bombay, is mixed with butter-milk and used as an astringent in diarrhoea and dysentery. In the Konkan, the pulp with figs is given in asthma; with the addition of cumin and sugar it is made into a sherbet, and administered in bilious dyspepsia.

According to the Bombay Gazetteer, the wood possesses antiseptic properties, and the bark is antiperiodic and a useful substitute for quinine in low fever.

The bark was at one time exported to Europe and used as a febrifuge in lieu of cinchona bark. It is still highly commended as an antiperiodic in the West Indies and in some parts of South Africa. In Cameroons it is sometimes used medicinally like the leaves.

In Gold Coast the bark is used instead of quinine for curing fever. The cream of tartar surrounding the seeds is made into a cooling drink in cases of fever. The pulp of the fruit is considered a specific in putrid pestilential fevers.

The native medicinal use of the pulp as a remedy or palliative and diaphoretic for fever and dysentery is widespread in tropical Africa, and the article was for a time exported to Europe from the East Sudan for this purpose. In Senegal, dysentery is treated by giving rice-water in which rust has been boiled and the baobab pulp added. Smallpox is similarly treated, and also a thick emulsion of the pulp is put in the eyes of the patient several times a day.

In Gambia the root is used as a febrifuge.

The dried leaves in powder form are credited with medicinal properties, promoting perspiration and preventing kidney and bladder troubles; they have been proved serviceable in diarrhoea, fevers, and other maladies. In Senegal an infusion of the powder is used internally or locally applied for a variety of inflammatory conditions, as a preventive of fever, for dysentery, internally or as a hip-bath, and similarly for genito-urinary conditions; also as a lotion for earache, ophthalmia, etc.

In Nigeria the leaves coarsely pounded are boiled with bran and salt or plant ashes, and administered to horses in bolus form. As a food, given in large quantity, this preparation keeps a horse in good condition without fattening, or maintains strength on a journey; as a medicine, given in small bulk, it is a tonic and blood maker, and is also given for conditions with subcutaneous swellings due to insect bites.

In Sierra Leone the leaves are used as a prophylactic against fever in the rains, to check excessive perspiration, and as an astringent. An infusion of both flowers and leaves is used for

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respiratory and digestive disorders and for eye inflammations. Locally the leaves are applied to reduce inflammatory swellings, or boiled to make a hot lotion, or burnt as a fumigation.

In Hausa a cooling drink is prepared by breaking off a piece of the shell, pouring in water, loosening and mixing the pulp by stirring, and then boiling the emulsion; the beverage is taken cold. The pulp burns with an irritating smoke, and has been used as a fumigant to keep biting insects at a distance from domestic animals.

In Senegal the inner fibrous part of the shell is made into a decoction and used as an emmenagogue. The seeds, roasted and pulverised, as well as the latex, are applied for toothache and inflammation of the gums. A decoction of the young plant from which the bark has been removed is used as an eye remedy. The gummy fluid from the bark of the tree and a powder scraped from the outside of the fruit are applied to cleanse foul sores, stimulating and promoting granulation.

In Madagascar, La Reunion, and Mauritius the leaves are given as an emollient in dysentery and inflammatory fevers. The pulp of the fruit is used in haemoptysis, dysentery, and diarrhoea.

Afrikaans : Krimmetatboom—; *Ajmere* : Kalbriskh, Kalpbriskh—; *Akwapim* : Dadee, Odadee—; *Angola* : Imbondeiro, Nbondo—; *Arabic* : El omarah, Gongoleis, Homar, Hujed, Humar, Oufa, Tabaldi—; *Awuna* : Alagba—; *Bajo* : Njobwih—; *Bakossi* : Njobwele—; *Bakundu* : Ngubwele—; *Balondo* : Ngubwele—; *Balong* : Njobwih—; *Bambara* : Molodo, Sira, Tedum—; *Basari* : Niturr—; *Batanga* : Ngubwele—; *Bemoba* : Toreg—; *Benin* : Ushi, Usi—; *Bombay* : Choyarichinch, Gorakhaamli, Gorakhchincha, Gorokhchintz—; *Brong* : Ala—; *Canarese* : Brahmamlika, Magimavu—; *Chiswina* : Muwugu—; *Dagomba* : Tua—; *Dagarti* : Tuo—; *Deccan* : Hathikhattyan—; *Delhi* : Kalbriskh, Kalpbriskh—; *Dutch* : Apenbroodbloom—; *English* : African Calabosh, Baobab, Cork Tree, Cream of Tartar Tree, Ethiopian Sour Gourd, Maputa, Sour Gourd—; *Ewe* : Adido, Alagba—; *Falor* : Ba—; *Fanti* : Efuo-bodedwo, Efuobrodidwa—; *French* : Arbre de mille ans, Baobab, Baobab d' Afrique, Boabab, Calebassier du Sénégal, Grosmapou, Pain de singe—; *Fufulde* : Bokki—; *Fulani* : Boha, Boki, Bokki—; *Ga* : Shadzo—; *Gbari* : Kwahi—; *German* : Adansonie, Boabab—; *Gold Coast* : Cream of Tartar Tree—; *Guam* : Toto—; *Gujerat* : Bukha, Gorakhaamli, Moramlreli, Rukhdo—; *Hausa* : Kuka—; *Hindi* : Gorakamali, Gorakhamli, Goramlichora—; *Italian* : Baobab—; *Kabure* : Taelu, Telu—; *Kamba* : Mwamba—; *Kanuri* : Kuka—; *Khartoum* : Gongalasu—; *Konkomba* : Nitule—; *Kontagora* : Kuka—; *Koranko* : Sire, Sirele—; *Kratchi* : Kellai, Kelle—; *Krepi* : Dindo, Dodo—; *Krobo* : Saletcho, Salo—; *Lagos* : Ushe—; *Limba* : Kutidi—; *Lokko* : Hokbawai, Sakwi mbawi—; *Losso* : Telo—; *Makalanga* : Mguya—; *Malinke* : Boki—; *Mandingo* : Sito—; *Marathi* : Gorakhchinch—; *Masai* : Ol imisora—; *Matabele* : Umkomo—; *Mauritius* : Baobab, Gros mapou, Anai pouliya, Bumni umli—; *Mbonge* : Ngubwele—; *Mende* : Bo-wulni—; *Morar* : Vilaytiyimbi—; *Mossi* : Toyega—; *None* : Boh—; *Nupe* : Muchi—; *Porebunder* : Gorakhambali—; *Portuguese Africa* : Embondeiro—; *Portuguese Guinea* : Calabaceira—; *Russian* : Adansonia, Baobab—; *Sakalave* : Sefo—; *Sanskrit* : Chitrala, Choramli, Dirghadandi, Gandabahula, Gopali, Gorakshi, Panchaparnika, Sarpadandi, Sudandika—; *Serere* : Bak—; *Shuwa Arabic* : Hamar, Hamaraya—; *South Africa* : Baobab, Cream-of-Tartar Tree, Lemonade Tree, Monkey Bread Tree—; *Spanish* : Baobab—; *Susu* : Kiri—; *Swahili* : Mbuyu—; *Tamil* : Anaippulli, Papparappuli, Perukku, Puri—; *Telugu* : Barhmamlika, Maggimavu, Simachinta—; *Tigre* : Hoemmer, Hoemret—; *Tigrinia* : Dima, Dumma—; *Timne* : Diaroebai—; *Tschaudjo* : Taelu, Telu—; *Tukulor* : Boki—; *Twi* : Adade, Ototaa, Ototowa—; *Walo* : Alu—; *Wolof* : Gui—; *Yoruba* : Ose, Oshe—.

Bombax.

This genus includes 60 tropical species.

B. Ceiba Linn. is used medicinally in China, Cambodia, Malaya, and the Philippine Islands; *B. brevicuspe* Sprague in Liberia; *B. buonopozense* P. Beauv. in tropical West Africa.

Bombax Ceiba Linn. (=*B. malabaricum* DC.) occurs throughout the hotter parts of India, Burma, and Ceylon. It is abundant on the eastern side of India, ascending to 4,000 feet in altitude. It is distributed to Malaya, Sumatra and Java.

The root has stimulant and tonic properties. The bark and the root are emetic. The young roots, dried in the shade and powdered, form the chief ingredient in the *muslasemul*, a medicine highly thought of as an aphrodisiac; it is also given in impotence.

The roots of saplings upto about three years old are known as 'Semarkanda' in the Central Provinces and are used as a nerve tonic and as an astringent.

The gum or dried juice, *mocha-ras*, which the tree yields, is used as an aphrodisiac. It contains a large proportion of tannic and gallic acids, and may be successfully employed in cases requiring astringents. The gum has also tonic and alternative properties, and is used in diarrhoea, dysentery, and menorrhagia.

The dried flowers, with poppy seeds, goats' milk, and sugar, are boiled and inspissated, and of this conserve two drachms are given three times a day in haemorrhoids.

The flowers and fruit in combination with other drugs are recommended for the treatment of snake-bite and scorpion sting; but Caius and Mhaskar have shown experimentally that neither the flower nor the fruit have any antidotal value against snake or scorpion venoms.

In Cambodia the bark is used as a styptic in abnormal uterine bleeding, the root is considered diuretic, and the gum is occasionally administered in water for gonorrhoea.

In China the flowers are applied externally to boils, sores, and itch.

Basim: Khatsawar—; *Bengal*: Roktosimul, Simul—; *Bhil*: Khatseori—; *Bombay*: Katesaveri, Saer, Saur, Semul, Shembal, Somr—; *Burma*: Didu, La-i, Lepanbin, Letpan—; *Cambodia*: Roka—; *Canarese*: Apurani, Buraga, Burga, Burla, Dudi, Elava, Hatti, Kempuburaga, Kempuburga, Mullelava, Mulluburaga, Pishphele, Sauri—; *Central Provinces*: Semar, Semur—; *Ceylon*: Parutti—; *Chinese*: Mu Mien—; *Deccan*: Kantonkakhatyan, Kantonkasemul, Lalkhatyan—; *English*: Cotton Tree, Red Cotton Tree, Red Silk-cotton Tree, Silk-cotton Tree—; *Formosa*: Moc-main, Pun chi—; *French*: Bombax de Malabar, Cotonnier Mapou, Kapokier du Tonkin—; *Garhwal*: Shimal—; *Garo*: Bolchu, Panchu—; *Gond*: Vallaiki—; *Gujerat*: Ratoshemalo, Sauvor, Sawar, Shemalo, Shimar, Shimlo, Shimul—; *Hazara*: Simbal—; *Hindi*: Kantisembal, Pagun, Ragatsemal, Ragatsembrel, Raktasimul, Semal, Semul, Semur, Shimbal, Simal, Somr—; *Indo-China*: Gao, Sich moc mien thu—; *Khond*: Kamba—; *Kolami*: Del, Edel, Idel—; *Konkani*: Sanvor, Sauvor—; *Kumaon*: Shimbo—; *Lambadi*: Chamblero—; *Lepcha*: Sunglu, Tung-glu—; *Magahi*: Lapaing—; *Malaya*: Mook min, Simur—; *Malayalam*: Ilavu, Mocha, Mullilava, Pichila, Pula, Purani, Unnamuriku—; *Mal Pahari*: Simue—; *Marathi*: Kantasair, Kanterisamar, Kantesavar, Khatsawar, Sair, Sairi, Samar, Savara, Savari, Sayar, Semal, Shevari, Simlo, Tamari—; *Matheran*: Sarvar, Tambdi savar—; *Melghat*: Saori—; *Mund'ari*: Edelsanga—; *Palkonda*: Wuraga—; *Persian*:

Simbal—; *Portuguese*: Algodoeiro do matto, Arvore de panha, Panheira sumauma—; *Punjab*: Sum—; *Sanskrit*: Apurani, Bahuvirya, Chirayu, Chirjivi, Dirghadruma, Dirghapadapa, Dirghayu, Duraroha, Kadala, Kalpavriksha, Kantakadruma, Kantakaria, Kantakashtha, Kukkutavandaka, Kukkutti, Mahavriksha, Mocha, Mochani, Nirgandhapushpi, Nissara, Pnachaparni, Pichhala, Purani, Raktapushpa, Raktotpala, Ramyapushpa, Salmili, Shalmali, Shalmalini, Shimulu, Sthirayu, Sthulaphala, Tulavriksha, Tulini, Tuliphala, Yamadruma—; *Santal*: Edel—; *Saora*: Buroh—; *Sinhalese*: Kattuimbul—; *Sutlej*: Shirlan—; *Tagalog*: Bobuygubat, Buboygubat, Malabulac—; *Tamil*: Agigi, Ilavam, Ilavu, Kongu, Mullilavu, Parutti, Pongar, Pulai, Purami, Sallagi, Samani, Sanmali, Selavagu, Sitten, Surabu—; *Telugu*: Buraga, Kondaburaga, Mundlaburaga, Pinnaburaga, Salmali—; *Tulu*: Ala, Mullala—; *Uriya*: Buro, Mochoroso, Salmali, Simuli—; *Visayan*: Quesero, Salay, Talutu—.

Ceiba.

This genus consists of 10 tropical species, mostly American.

Ceiba pentandra (Linn.) Gaertn. (=*Eriodendron anfractuosum* DC.) occurs in the forests throughout the hotter parts of India and Ceylon; it is distributed to South America, the West Indies, and tropical Africa.

The juice obtained from the roots is considered a most valuable cure for diabetes.

The tree yields a gum which is astringent and used as a remedy for bowel complaints. It is a popular remedy for diarrhoea and dysentery.

The unripe fruit is regarded as demulcent and astringent.

In Cambodia the bark is used as a diuretic, astringent, and febrifuge; the very young plant with its leaves and bark is used externally in fevers as a lotion or a bath, and is given internally as an emetic to cure drunkenness; the fruit is prescribed in migraine and vertigo.

In Annam the bark is considered emetic; the flowers are given in lochiorrhoea, and in plague; the oil from the seeds is used as an emollient.

In Ubangi-Shari a decoction of the root is used internally as a drink and externally as a lotion in cases of emaciation and general debility.

In Guinea the young leaves are used as an emollient, and a decoction or infusion of the flowers is given as a laxative.

In La Reunion the bark is used as an emetic.

The leaves and fruits have emollient properties and are used in various parts of tropical West Africa to wash the head and face in fever, headache, etc. A decoction of the flowers is used in French Guinea for constipation. In parts of Cameroons the bark is pounded and macerated in cold water to apply to a swollen finger. In Liberia an infusion of the bark is used as a mouth-wash.

Abé: Gbi—; *Abuan*: Umum—; *Agni*: Enya—; *Akposso*: Ju, Juna—; *Anago*: Ogufé—; *Anang*: Ukum—; *Angola*: Mafuma, Mafumeira, Suma-uma—; *Annam*: Cay gao, Cay gon, Cay moc khoang, Moc mien—; *Aowin*: Enya—; *Aro-Chuku*: Agpu-ugu—; *Ashanti*: Ongina, Onyang, Onyina—; *Atakpame*: Huti, Wuti—; *Attié*: Muong, Nguéhié—; *Awuna*: Fuleng, Futi, Vu, Vuti—; *Bakwiri*: Buma, Wuma—; *Balundu*: Bum—; *Bambara*: Bana, Banan—; *Banda*: Kopou—; *Bariba*: Gouma—; *Baulé*: Nyé—; *Basari*: Bubumbu, Bufu—;

Bemoba: Gbang—; *Bengal*: Shwetsimul—; *Benin*: Okha—; *Bicol*: Cayo—; *Bobo-Dioulasso*: Pi—; *Boki*: Bokum—; *Bondoukou*: Ton'go, Ton'ko—; *Brignan*: Etchoui—; *Brong*: Ekile—; *Burma*: Thinbawle—; *Bussanke*: Gbée—; *Cambodia*: Kor—; *Canarese*: Apurani, Bilibarlu, Biliburaga, Biliburga, Buraga, Burga, Dudi, Elava—; *Cebu*: Bulacdondol—; *Central America*: Ceiba—; *Ceylon*: Elavam, Illaku, Imbul, Pulunimbul—; *Cuba*: Ceiba—; *Dagarti*: Goni—; *Dagomba*: Gunga—; *Dahomey*: Dehon, Gué dehonsu, Hunti—; *Dakpwa*: kapou—; *Deccan*: Khatyan, Sufedkhatyan—; *Dendi*: Bantan—; *Diola*: Busaira, Busana—; *Ebrié*: Agué—; *Efik*: Ukem, Ukum—; *Engenni*: Akawu—; *English*: Cotton Tree, Kapok, Kapok Floss, White Cotton Tree, White Silk-cotton Tree—; *Ewe*: Ewu, Futi, Vu, Vuti, Wu, Wudesé—; *Fanti*: Nyahene, Nyina—; *Fong*: Huti, Wuti—; *French*: Bois épineux, Fromager commun, Kapokier, Ouatier—; *Fulani*: Bantahi, Bantignei, Bentegnievi, Linini, Rinihi—; *Ga*: Onyai-tsho—; *Gbari*: Gehi, Gyehi—; *Gbaya*: Guela, Guila—; *Gouin*: Belon—; *Gouro*: Ngoué—; *Grand Popo*: Hunti—; *Guam*: Algodon de Manila—; *Guene*: Bentan habu—; *Gujerat*: Doloshamlo—; *Gurunshi*: Gung—; *Hausa*: Rimi, Rini—; *Hindi*: Hattian, Katan,, Safedsemal—; *Hova*: Landihazobe—; *Ibibio*: Ukem akabi, Uman ukem—; *Ibo*: Akbo, Akbu, Akpu—; *Ijaw*: Asisaga, Kpasukaro, Shakka, Shakra, Sishara—; *Ilocano*: Capas, Capassanglay, Dondol—; *Indo-China*: Gon, Kok niou, Kor—; *Java*: Kapok—; *Jekri*: Egungun—; *Jolo*: Capoc—; *Kabure*: Komu—; *Kalabari*: Afalafasi—; *Kanuri*: Tom—; *Khandesh*: Katsavan—; *Konkomba*: Bufu-sogbum, Kpugbum—; *Konno*: Banda—; *Kontagora*: Kimi—; *Kpandu*: Loe—; *Kratchi*: Keshafu—; *Krepi*: Ofwho, Ovua, Wuti—; *Krobo*: Leno—; *Kukuruku*: Okho—; *Kwale*: Akpo—; *Lagos*: Eggun—; *Lahu*: Egna—; *Langwasi*: Kepou—; *Laos*: Kokuiyu—; *La Reunion*: Ouatier—; *Losso*: Bahun, Ubonbe—; *Lower Amazon*: Sumaumeira—; *Malayalam*: Ilavu, Mullillapappula, Nakuli, Panni, Panniyala, Pula—; *Malinke*: Bana, Banan, Busana—; *Mamprussi*: Gunga—; *Mandingo*: Bantang, Bantango, Bentafore, Bentang, Bentango, Bintaforo—; *Mano*: Geh—; *Marathi*: Pandhari, Pandhrasaur, Salmali, Safetasavara, Samoli, Shamieula—; *Mende*: Nguwe—; *Nago*: Ogufe—; *Nankani*: Gonga—; *None*: Len—; *Nzima*: Eguina, Eniémé, Enyan'goua—; *Nupe*: Kuchi—; *Onele*: Tiou—; *Onitsha*: Akpu-ogwu, Ok-akpu—; *Onitsha Olona*: Kpakpa—; *Owerri*: Akpu-udele, Mbom—; *Pampangan*: Bulac castila—; *Portuguese Guinea*: Pelon, Poilao—; *Sakalave*: Moraingy, Pamba, Pemba—; *Salaga*: Kakre—; *Sango*: Ndoulou—; *Sanskrit*: Chiragu, Kutashalmali, Kutsitashalmali, Mocha, Rochana, Salmali, Shvetasalmali, Sthiraya—; *Sarracole*: Batiugne—; *Sassandra*: Go—; *Savalou*: Gué dehunsu—; *Sefwi*: Enya—; *Serere*: Bouday, Mboudaye—; *Shuwa Arabic*: Rum—; *Sinhalese*: Imbul, Kottapulung, Pulung—; *Sobo*: Okahen—; *Spanish*: Algodon de Manila—; *Susu*: Konole—; *Tagalog*: Boboy ,Bubuy, Bulac, Bulac sino—; *Tagouana*: Sérigné—; *Tamil*: Ilavam, Karukkanam, Panji—; *Telugu*: Kadami, Tellaburaga—; *Timne*: Am-polong, A-pullo, Ke-polong, Ma-pullo—; *Tivi*: Vambe, Yambe—; *Tschaudjo*: Komu—; *Tulu*: Ala—; *Turca*: Blo—; *Twi*: Ongina, Onyang, Onyina—; *Umu Ahia*: Akpo—; *Urdu*: Sambal—; *Visayan*: Daldol—; *Wassaw*: Enyina—; *Wele*: Tiou—; *West Indies*: Silk-cotton Tree—; *Wolof*: Bantang, Bantango, Bentang, Bentango, Bentegnié, Benten, Betenbi—; *Yoruba*: Araba—.

IV

The TERNSTROEMIACEAE are trees or shrubs of tropical Asia and America. A few are to be found in Africa.

Stimulant, astringent, and antidysenteric properties. Some barks are powerful vesicants.

The stimulants owe their action to the alkaloids caffeine and theophylline. Methyl salicylate and quercitrin have been isolated from some of them.

Medicinal properties are to be found in 9 genera: ACTINIDIA (Eastern Asia); ANNESLEA (Indo-Malayan); CAMELLIA (India, China, Japan); GORDONIA (Indo-Malaya, China, North America); KIELMEYERA (South Brazil); NESOGORDONIA (Madagascar); SAURAUJA

(tropical Asia, America); SCHIMA (Eastern Indo-Malaya); TERNSTROEMIA (South America, Asia).

The medicinal species of India belong to 6 genera: ANNESLEA, CAMELLIA, GORDONIA, SAURAUJA, SCHIMA, TERNSTROEMIA.

A. Peduncles many-flowered ... ... SAURAUJA.

B. Peduncles one-flowered.

1. Fruit half inferior, drupaceous ... ... ANNESLEA.
2. Fruit superior.
   a. Anthers basifixed ... ... TERNSTROEMIA.
   b. Anthers versatile.
      i. Seeds wingless ... ... CAMELLIA.
      ii. Seeds winged.
         α Radicle inferior. Fruit globose ... SCHIMA.
         β Radicle superior. Fruit oblong ... GORDONIA.

ANNESLEA.

The genus consists of 2 species inhabiting Burma, Camodia, and the Malay Peninsula.

Anneslea fragrans Wall. occurs in the Eastern Peninsula, Moulmein and Martaban.

The bark and the flowers are used medicinally in Cambodia. The former is considered antidysenteric and anthelmintic; the latter are said to be antiperiodic.

Cambodia: Sauphi—.

CAMELLIA.

The genus consists of about 10 species spreading from India to Japan.

Root and bark astringent and antidysenteric; leaves astringent, antidysenteric, digestive, tonic, and diaphoretic.

C. japonica Linn. is used medicinally in China, *C. Thea* Link in China and Indo China.

Flowers erect, sepals deciduous ... ... *C. drupifera.*
Flowers nodding, sepals persistent ... ... *C. Thea.*

1. **Camellia drupifera** Lour. occurs in Eastern Himalaya, at 3,000-7,000 feet, from Nepal to Bhutan; in Assam and the Khasia Mountains, at 5,000-8,000 feet; in Tenasserim and the Andaman Islands.

The oil-cake from the seeds is used in Tongking to stupefy fish.

Indo-China: Cha mai, Dan-che, so—.

2. **Camellia Thea** Link (=*Thea sinensis* Linn.) occurs in Assam and the hilly country to the East of it, and in Upper Burma. It has been cultivated for ages in China and Japan. It is now extensively cultivated in Assam, Cachar, Sikkim, North-Western Himalaya, the Nilgiris, and Ceylon.

Tea is astringent and gently excitant, and exerts a decided influence over the nervous system.

Arabic: Chha—; *Assam*: Hilkat—; *Burma*: Letpet—; *Cachar*: Dullicham—; *Canarese*: Cha, Chaha, Theyale—; *Chinese*: Ming—; *Danish*: The—; *Dutch*:

Thee—; *English*: Assam Tea, China Tea, Indian Tea, Tea—; *French*: Thé, Thé de Chine, Théier—; *German*: Thee—; *Gujerati*: Chah—; *Hindi*: Cha, Chha—; *Hungarian*: Tea—; *Indo-China*: Cao lo, Cha, Cha ginh, Che, Te ve, Tra, Tra hue—; *Italian*: Te—; *Japanese*: Teh, Tsja—; *Malaya*: Cha, Te—; *Malayalam*: Chaya, Teyila—; *Marathi*: Chaha—; *Mundari*: Cadaru—; *Muttack*: Khlap, Misaphlap, Phlap—; *Persian*: Ca, Chha, Chaikathai—; *Polish*: Te—; *Portuguese*: Cha, Cha da India—; *Punjabi*: Cha—; *Roumanian*: Ceaiu—; *Russian*: Tshay—; *Sanskrit*: Chaha, Chavika—; *Scotch*: Te—; *Sinhalese*: Thaygas—; *Spanish*: Te, Te de China—; *Swedish*: Thee—; *Tamil*; Karupputteyilai, Pachaitteyilai, Teyilai—; *Telugu*: Nallateyaku, Teyaku, Tiyaku—; *Tulu*: Cha—; *Turkish*: Chai—; *Urdu*: Chai—; *Uriya*: Cha—.

Gordonia.

The genus numbers 20 species, found in the Indo-Malayan region, China, and North America.

Gordonia obtusa Wall. occurs in the Konkan, the Western Ghats of the Madras Presidency chiefly of the Eastern side, usually from 5,000 to 7,000 feet, lower in Travancore.

In the Nilgiris an infusion of the leaves is given as a stomachic, stimulant, and appetiser.

Badaga: Nagatte—; *Kadir*: Attangi, Ola—; *Nilgiris*: Nagetta—; *Tamil*: Miyilai—.

Saurauja.

The genus numbers 60 species distributed over tropical Asia and America.

Saurauja napaulensis DC. occurs in Temperate Himalaya, from Bhutan and Sikkim—at 5,000-7,000 feet—to Garhwal—at 2,400-5,000 feet; in the Khasia Mountains, at 5,000 feet; in the Mishmi Hills.

In Tongking the bark is used as a poultice to help the extraction of splinter imbedded in the flesh.

Hindi: Gogina—; *Jaunsar*: Ratendu—; *Kumaon*: Gogin, Gogna, Gugna—.

Schima.

The genus consists of 10 Indo-Malayan species.

The bark is vesicant.

S. Noronhae Reinw. is used medicinally in Indo-China.

Flowers in a loose terminal corymb, peduncles smooth slender ... ... *S. crenata.*

Flowers in a short terminal raceme, peduncles with minute white warts ... ... *S. Wallichii.*

1. **Schima crenata** Korth. occurs in the Eastern Peninsula from Tenasserim to Penang, and in Burma. It is distributed to Borneo and Sumatra.

The stem and the sap are used medicinally in Cambodia. The stem is given in nausea; its bark is vesicant. The extremities of the young shoots are gently warmed and the sap that exudes is dropped in the ear for otitis.

Cambodia: Trathok—; *Indo-China*: Rma, Sang soc, sat hat—.

2. **Schima Wallichii** Choisy occurs in Nepal, Sikkim up to 5,000 feet, Bhutan, Assam, the Khasia Hills, Manipur, Chittagong, and Upper Burma.

The bark is nearly black externally, with deep clefts; the liber is made up of an abundance of white, needle-shaped cells, which are readily detached and act as cowage, in producing painful irritation, when brought into contact with the skin.

Anthelmintic and rubefacient.

Assam: Chilauni, Makria, Makusal, Mukriasal—; *Bhutia*: Samching—; *Burma*: Ananpho, Laukya, Theetya—; *Cachar*: Jam—; Duars: Chilauni—; *Garo*: Boldak—; *Goalpara*: Gugera—; *Hindi*: Chilauni, Makriya, Makriyachilauni, Makusal—; *Khasia*: Dingan—; *Lepcha*: Sambrong—; Sung-brong kung, Sung-sung kung—; *Nepal*: Chilauni, Goechassi—; *Sema*: Michi-sii—; *Sikkim*: Chilauni—.

Ternstroemia.

The genus numbers 35 species inhabiting tropical Asia and America.

Ternstroemia japonica Thunb. occurs in Eastern Bengal and the Eastern Peninsula, from the Khasia Mountains at 4,000-5,000 feet to Moulmein; in the Western Peninsula, in the Nilgiris; and in Ceylon. It is distributed to Sumatra, China, Japan, and the Loochoo Islands.

The bark and the root are astringent. They are used in Japan as an antidysenteric.

Indo-China: Giang nui, Hoa bi huong, Son cha hoa—.

V

The Hypericaceae are herbs, shrubs or trees, spread over the temperate and hot regions of the globe, and especially in the northern hemisphere. There are 8 genera with about 210 species.

The medicinal Tutsans of the world belong to 5 genera: Cratoxylon (Indo-Malayan); Haronga (tropical Africa, Madagascar, Mauritius); Hypericum (cosmopolitan, temperate regions); Psorospermum (tropical Africa, Madagascar); Vismia (tropical America).

Two of the above, Cratoxylon and Hypericum, are represented in India.

1. Capsule dehiscing loculicidally. Seeds winged ... Cratoxylon.
2. Capsule dehiscing septicidally or at the placentas. Seeds not winged ... ... Hypericum.

Cratoxylon.

The genus consists of 12 species inhabiting tropical Asia.

C. Hornschuchii Blume is used medicinally in Java, *C. neriifolium* Kurtz in Indo-China.

Cratoxylon neriifolium Kurtz is found in Chittagong, and in Burma: Teiyet, Pegu, Prome hills.

In Tongking, an infusion of the leaves is considered a very powerful digestant.

Indo-China: Nganh nganh, Thank nganh—.

HYPERICUM.

The genus numbers 220 species, spread over the whole world, chiefly in temperate regions.

Vulnerary, astringent, and anthelmintic. The seeds may be diuretic and antispasmodic.

The following are used medicinally:—in Europe—*H. Androsaemum* Linn., *H. barbatum* Jacq., *H. Coris* Linn., *H. elegans* Steph., *H. hircinum* Linn., *H. hirsutum* Linn., *H. humifusum* Linn., *H. montanum* Linn., *H. perfoliatum* Linn., *H. perforatum* Linn., *H. pulchrum* Linn., *H. quadrangulum* Linn., *H. Richeri* Vill., *H. tetrapterum* Fries.—; in Indo-China—*H. ascyron* Linn., *H. chinense* Linn., *H. erectum* Thunb., *H. japonicum* Thunb. *H. patulum* Thunb., *H. Sampsoni* Hance—; in Malaya—*H. japonicum* Thun.—; in Southern Africa—*H. aethiopicum* Linn., *H. lalandii* Chois.—; in La Reunion—*H. angustifolium* Lam.—; in Madagascar— *H. japonicum* Thunb.—; in North America—*H. Ascyron* Linn., *H. maculatum* Walt., *H. mutilum* Linn., *H. perforatum* Linn.—; in Colombia—*H. Brathys* Lam., *H. Chamaemyrtus* Tr. and Pl., *H. Humboldtianum* Steuder, *H. mexicanum* Linn., *H. platyphyllum* Gleason, *H. thesiifolium* H. B. K.—; in Brazil—*H. connatum* Lam., *H. laxiusculum* St. Hil.—.

A. Sepals 5, unequal; petals deciduous; stamens 5-adelphous at the base; ovary 5-celled.
   1. A glabrous shrub, 30-90 cm. high ... ... *H. patulum.*
   2. Stem none but branches innumerable ... ... *H. chinense.*

B. Sepals 5, connate at the base, equal or unequal; petals persistent; stamens 3-adelphous at the base; ovary 3-celled.
   1. Styles twice the length of the ovary, equalling the stamens ... ... *H. perforatum.*
   2. Styles very short ... ... *H. Sampsoni.*
   3. Styles half the length of the ovary ... *H. humifusum.*

C. Sepals 5; petals persistent; stamens connate at the base; ovary 1-celled ... ... *H. japonicum.*

1. **Hypericum chinense** Linn., a native of China, is cultivated in many Indian gardens.

The plant is astringent and alternative. In Indo-China the leaves and the green stems are made into a paste and applied to bites from dogs and stings from bees.

Indo-China: Kim ty dao—.

2. **Hypericum humifusum** Linn. grows in the Nilgiris. It is distributed over Europe, the Atlantic Isles, and South Africa.

In Europe the flowers are infused in olive oil or in alcohol and used as a vulnerary, chiefly for old sores and eczema.

English: Trailing St. John's Wort—.

3. **Hypericum japonicum** Thunb. is found in temperate and subtropical Himalaya, the Khasia Hills, Assam, Burma, Eastern and Western Peninsula, and Ceylon. From Japan it spreads to China and Indo-China, the Philippine Islands, Java, Australia, New Zealand, and Madagascar.

In China and Indo-China the plant is credited with astringent and alterative action, and externally it is used as vulnerary.

In Madagascar the plant is used as a vulnerary, styptic, anti-asthmatic, and antidysenteric.

Betsimisaraka : Manitsorohina—; *Cantonese* : Thin Kee Wang—; *Chinese* : T'ien Chi Wang—; *Hova* : Anangoaika, Anantatara, Tsikotrakotra, Voantrotroka—; *Imérina* : Tsikotrokotroka—; *Indo-China* : Ban—.

4. **Hypericum patulum** Thum. occurs in the Khasia Hills 5,000-6,000 feet; throughout the temperate Himalaya (except Sikkim) at 3,000-7,000 feet, from Bhutan to the Ravi. It is also found in China, Formosa, and Japan.

The scented seeds are employed as an aromatic stimulant in Patna, where they are imported from Nepal (Irvine).

In Indo-China they are used both externally and internally as a remedy for the bite of dogs and the sting of bees.

Behari : Tumbhul—; *Indo-China* : Kim ty mai—.

5. **Hypericum perforatum** Linn. occurs in the temperate Western Himalaya at 6,000-9,000 feet; in Kashmir and Simla, apparently not in Kumaon. It is distributed to Northern temperate Asia, Europe, and North Africa.

The plant has been, and is still, recognized in Europe as aromatic bitter, astringent, resolvent, expectorant, and nervine. It is used in all pulmonary complaints, bladder troubles, in suppression of urine, dysentery, worms, diarrhoea, hysteria and nervous depression, hoemoptysis and other haemorrhages, and jaundice. For children troubled with incontinence of urine at night an infusion or tea given before retiring will be found effectual; it is also useful in pulmonary consumption, chronic catarrh of the lungs, bowels, or urinary passages. Externally for fomentations to dispel hard tumours, caked breasts, ecchymosis, etc.

It is recommended in Arabian medicine as a vermifuge; and is also used to cure piles, prolapsus uteri and ani.

The red juice is esteemed in Europe and China as one of the most popular and most curative applications for excoriations, wounds, and bruises.

The juice gives a red colour to the spirit of wine with which it is mixed, and to expressed oils. The oil of St. John's Wort is made from the flowers infused in olive oil. This oil is highly useful for healing bed sores, and is commended as excellent for ulcers.

The flowering tops are bitter, terebinthinate, acrid, and vulnerary. A salve compounded from the flowers, and known as St. John's Wort Salve, is still much used and valued in English villages.

Homoeopathic practitioners prepare a medicinal tincture with spirit of wine from the entire fresh plant, collected when flowering, or in seed, and this proves of capital service for remedying injuries to the spinal cord, both by being given internally and used externally. It has been employed in like manner with benefit for lock-jaw.

Yunani practitioners consider the leaves a good application for

scorpion sting. However, Caius and Mhaskar have shown experimentally that the leaves are not an antidote to scorpion venom.

The weed is poisonous to horses.

Arabic: Lioufarikoun, Khashkhash-el-asoued, Mesmoune—; *Catalan*: Herba de cop, Herba foradada, Herba de Sant Joán, Hypericon, Pericó groc—; *Chinese*: Ia Iou—; *Danish*: Jordhumbe, St. Hans urt—; *Dutch*: St. Jans Kruid—; *English*: Amber, Devil's Scourge, Grace of God, Hard Hay, Hundred Holes, Lord God's Wonder Plant, St John's Grass, St John's Wort, Terrestrial Sun, Witch's Herb—; *Finland*: Werdu heino—; *French*: Chasse diable, Herbe à millepertuis, Herbe à mille trous, Herbe aux piqûres, Herbe de la Saint-Jean, Herbe saint Jean, Millepertuis, Millepertuis officinal, Trascalon perforé, Trescalan, Trucheron jaune, Truscalan—; *German*: Christiankraut, Christignadenkraut, Christikreuzblume, Christikreuzblut, Christiwundkraut, Christwundkraut, Conradskraut, Durchwachs, Elfenbeutkraut, Frauvonwurde, Gartheu, Harthau, Hartenan, Hartheu, Hasenkraut, Hexenkraut, Jagemichel, Jageteufelkraut, Johannesblume, Johanniskraut, Hohannesblut, Hohanneskraut, Hohannsinkrut, Kannsblut, Sankt Johanniskraut, Scharnokel, Schernekel, Tausendloch, Teufelsflucht, Teufelsraub, Unsereliebenfrauenbettstroh, Urldgartheil, Wolfkraut—; *Hindi*: Bassant, Dendhu—; *Italian*: Cacciadiavoli, Erba di San Giovanni, Iperico, Ipericone, Perforata, Pilatro—; *Languedoc*: Trescalan, Trescoulaou—; *Malta*: Pitted St. John's Wort, Cacciadiavoli, Erba di San Giovanni, Iperico—; *North America*: Balm-of-warrior's-wound, Cammock, Common St John's Wort, Penny-John, Rosin-rose, Tipton-weed—; *Polish*: Dziurawice—; *Portuguese*: Herva de San Joao, Hypericao, Milfurada—; *Provence*: Herbo de l'oli rouge, Herbo de la San-Jean—; *Punjab*: Bassant, Dendlu—; *Roumanian*: Iarba lui Sfant Ioan, Iarba sfantului Ioan, Pojarnita, Sunatoare—; *Russian*: Zweroboi—; *Spanish*: Corazoncillo, Hierba de las heridas, Hypericon, Pericon, Yerba de San Juan—; *Swedish*: Johannisoert—; *Urdu*: Balsana—.

6. **Hypericum Sampsoni** Hance occurs in the Khasia Mountains. It is distributed to South China and Formosa.

In Tongking the plant is used as a vulnerary.

Indo-China: Nguyen bao thao—.

VI

The ELATINACEAE are herbs or undershrubs, widely dispersed, especially in the Old World. They inhabit ditches and the submerged shores of ponds and rivers. There are 30 species grouped in 2 genera.

The plants credited with medicinal properties all belong to the genus BERGIA.

BERGIA.

The genus consists of 25 species, inhabiting tropical and temperate regions.

B. decumbens Planch. is used medicinally in South Africa, *B. guineensis* Hutch. and J. M. Dalz. in Northern Nigeria.

Bergia odorata Edg. is found in Sind, Western Rajputana, and Gujerat. It is distributed over Persia, Egypt, and tropical Africa.

Used for cleaning teeth and, in Jodhpur, applied to broken bones. The leaves rubbed down in water are used as a poultice for sores (Macadam).

Hadeija: Babargiwa—; *Porebunder*: Gangharun, Lavadiyun, Okharal—; *Rajputana*: Karbuja, Kakria, Rohwan—; *Sokoto*: Bushi, Dushiya, Jisshiya—.

OBITUARY

CLAUD BUCHANAN TICEHURST.

Dr. C. B. Ticehurst died at Hastings on the 17th February 1941. His death has removed from our midst a man whose name will rank with those great ornithologists who in their time have contributed so much to our knowledge of the avifauna of India and the adjoining countries.

Born at St. Leonards-on-Sea, on the 8th January, 1881, Claud Ticehurst was the third son of Dr. Augustus R. Ticehurst. He was educated at Tonbridge School, and at St. John's College, Cambridge, where he distinguished himself in 'Natural Science'. Ticehurst elected to follow his father's profession and, after taking his medical degrees at Guy's Hospital, London, settled down to practice. Except for a brief interval during the first World War, when he was commissioned as a Captain in the R.A.M.C. and served between the years 1917 and 1918 as surgical specialist at the British Military Hospital, Karachi, the whole of his professional career centered in private practice at Lowestoff, Suffolk and finally at Appledore in Kent.

When quite a boy Claud Ticehurst revealed his love for the subject which became the absorbing interest of his life, and of which he was destined to become so able an exponent. His leisure was given to exploring the bird life of his native downs and marshes, while annual holidays in Norway, in company with his father, widened his knowledge of his hobby. Later a scientific training and education developed this early interest and gave Ticehurst that thorough understanding of varied ornithological problems, that precision and meticulous regard for fact which became the hall mark of all his work.

As an ornithologist, Ticehurst's main interests centered in systematics and in problems relative to the migration and geographical distribution of birds. He was also interested in questions relating to plumage and its development—a study which had been scarcely touched when he made his initial contribution to it.

He achieved international repute. Besides his many and varied contributions to British Ornithology, his studies extended to many parts of Europe, to North and South Africa and to India and the adjoining countries.

In paying this tribute to his memory we wish to associate it particularly with his ornithological work in the East. Ticehurst's work here was mainly directed to the avifauna of the great Palaearctic Desert which extends from the shores of North Africa through Arabia, Mesopotamia and Persia to the province of Sind. His interest in the bird life of this great and little known region commenced during his service at Karachi, where he devoted his spare time to the study of local bird life. He started to write a paper on the birds of the district, but extended it to what became finally the most up to date and authoritative account of the birds of

the Province. His study of the birds of Sind naturally implied a consideration of the birds of the neighbouring province of Baluchistan. There was little on record to help him. Fortunately the Society was able at the time to place at his disposal a large collection of birds made by Mr. Hotson, I.C.S. (afterwards Sir Ernest Hotson) during his political travels in Kalat and Mekran. Ticehurst also made brief visits to the Province. He spent the months of September-October 1919 at Ziarat and also visited Quetta and the Las Belas Frontier district. His paper on the Birds of Baluchistan published in our *Journal* provides the most complete account now available of the avifauna of that Province. A further opportunity to extend his studies of the birds of the Palaearctic Desert was provided by the collections brought together by members of the Society in Mesopotamia during the Great War. These collections formed the basis of the first comprehensive account of the Birds of Mesopotamia, published originally in our *Journal*, which Ticehurst wrote in collaboration with Capt. P. A. Buxton and Major R. E. Cheesman. Under war conditions collecting in Mesopotamia was naturally limited, and after the war it was decided to extend the survey of bird life to areas hitherto untouched or very partially worked. Thanks to the interest of Sir Percy Cox, who engaged the services of the Society's Collector, Mr. V. LaPersonne and to the efforts of Major R. E. Cheesman, between the years 1920 and 1923, supplementary collections were obtained which enabled Ticehurst to publish in our *Journal* a second paper on the avifauna of Iraq, written this time in collaboration with Sir Percy and Major R. E. Cheesman.

Collecting was also extended to the Islands of the Persian Gulf some of which were visited by Sir Percy and Major Cheesman personally and others by LaPersonne. Notes made by these three observers and their collections provided the material for Ticehurst's paper on the Birds of these islands, which was published in our *Journal*.

Sir Percy, was also instrumental in obtaining for Dr. Ticehurst an invitation from the Sultan of Najd to collect birds and mammals in his territory. This gave Ticehurst a unique opportunity of studying the bird life of the Arabian Peninsula and the great South Desert. In company with Major Cheesman, he spent four months of the cold weather of 1923 travelling in this desolate region, which had never been previously entered by Europeans. His paper on the birds of Jabrin, Jafura, and Hasa in Central and Eastern Arabia contains the results of this expedition.

It will be seen that the advance which has been made in recent years in our knowledge of the avifauna of the Asiatic countries lying within the Palaearctic Desert is due largely to the work of Ticehurst. In appreciating the thoroughness and ability with which he would carry it out, the Society and its members gladly gave him such assistance as they were able. Subsequent to his return to England, Ticehurst interested himself in the birds of Burma. He died before completing his work, which would have undoubtedly resulted in the authoritative account of the avifauna of that province which one expected from his researches. He

wrote two papers on Burmese birds for our *Journal*. The first was based on a collection made by Mr. Villar, I.C.S., in South Arrakan. The second was written in association with Mr. J. K. Stanford and dealt with birds of the Prome district in which few ornithologists had worked previously.

Apart from these contributions to faunistic ornithology, Ticehurst's interest in systematics led him into the unravelling of many problems relative to the nomenclature and status of Indian birds. While finality may not be attained always in these matters, his conclusions always carried the assurance of the most critical enquiry into all available data, and the most painstaking study of ascertained facts. He published descriptions of many new species and races of Indian birds, numerous notes on synonymy and nomenclature and critical reviews of genera and species, outstanding among the last was his review of the genus *Phylloscopus*, recently published by the Trustees of the British Museum. Indian Ornithology benefited also from Ticehurst's various studies on the plumage of birds. While in India, he collected notes on the down plumages of Indian birds and with the help of the material he obtained by his own efforts and with the assistance of some members of the Society, he published in our *Journal* a preliminary paper on the subject. He continued to collect data with a view to making further contributions to this wholly neglected phase of Indian Ornithology. During his many years of ornithological work, Ticehurst brought together a fine collection of birds, which was considerably extended during his travels abroad. While in Sind he collected over 1,500 specimens from the province. His collection will now find a permanent resting place in the British Museum. During his brief stay in Bombay, he spent much of his time in the Society's rooms working on our bird collections. This was not the least of the many services for which we must remain grateful to Claud Ticehurst, who in his time did so much for the progress and advancement of Ornithology in India.

S. H. P.

DR. TICEHURST'S PAPERS ON THE BIRDS OF INDIA AND THE ADJOINING COUNTRIES.

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Notes on Asiatic Starlings. *Bomb. Journ. Nat. Hist. Soc.*, 26, 1919, p. 380.

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Remarks on some Indian Birds. *Bull. B.O.C.*, 41, 1921, p. 79.

On plumage development of *Pterocles senegalensis*. *Bull. B.O.C.*, 42, 1921, p. 9.

The Mesopotamian Bulbul. *Bomb. Journ. Nat. Hist. Soc.*, 26, 1918, p. 286.

The Plumage of the Purple Honey-sucker. *Bomb. Journ. Nat. Hist. Soc.*, 26, 1918, p. 183.

Descriptions of new Indian Birds. *Bull. B.O.C.*, 42, 1922, p. 56.
Note on *Acrocephalus babylonicus*. *Bull. B.O.C.*, 43, 1922, p. 46.
Some remarks on names of certain birds and Indian Wheatears. *Ibis*, 1922, p. 147.
The Birds of Sind. *Ibis*, 1922, pp. 526, 605.
Notes on Indian Wagtails. *Journ. Bomb. Nat. Hist. Soc.*, 28, 1922, p. 1082.
Note on downy young of *Phaeton, Sterna, Alaemon*, etc. *Bull. B.O.C.*, 43, 1923, p. 71.
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Birds of Sind, Pts. iii-vi, *Ibis*, 1923, pp. 1, 235, 438, 645.
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Birds from the Red Sea Lights. *Ibis*, 1924, p. 282.
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New forms of *Aegithaliscus, Dendrocitta, Seicercus*. *Bull. B.O.C.*, 46, 1925.
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Remarks on the colour of Short-toed Larks. *Bull. B.O.C.*, 47, 1926, p. 33.
New Indian birds. *Bull. B.O.C.*, 46, 1926, p. 113.
On the down plumages of some Indian birds. *Journ. Bomb. Nat. Hist. Soc.*, 31, 1926, p. 368.
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Addenda to the Avifauna of Sind & of British India. Corrigendum to fauna of Iraq. *Journ. Bomb. Nat. Hist. Soc.*, 32, 1927, p. 376.
Note on two Indian Woodpeckers. *Bull. B.O.C.*, 48, 1928, p. 93.
A new Starling from Persia & critical remarks on other Persian birds. *Bull. B.O.C.*, 48, 1928, p. 117.
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Description of a new race of *Pteruthius*. *Bull. B.O.C.*, 57, 1937, p. 147.
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A systematic review of the genus *Phylloscopus*, 1938, 8vo. (Trustees Brit. Mus.).
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— & others; Egret farm in India and the plumage Bill. *Bull. B.O.C.*, 40, 1920, p. 152.
— & others: Birds of Mesopotamia *Journ. Bomb. Nat. Hist. Soc.*, 28, 1921, p. 210. ditto *Journ. Bomb. Nat. Hist. Soc.*, 28, 1922, pp. 381, 650, 674, 937.
— & R. E. Cheesman: New races of *Prinia* etc. *Bull. B.O.C.*, 42, 1924, p. 19.
— & H. Whistler: New races of *Fulvetta* and *Ixulus*. *Bull. B.O.C.*, 44, 1924, p. 71.
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— & R. E. Cheesman: Birds of Jabrin, Jafura, Hasa, in Central & Eastern Arabia, and of Bahrain Island Persian Gulf. *Ibis*, 1925, p. 1.
— & Sir Percy Cox & R. E. Cheesman: Birds of Persian Gulf Is. *Journ. Bomb. Nat. Hist. Soc.*, 30, 1926, p. 725.
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— & J. K. Stanford: Birds of the Prome district of Lower Burma, with notes by C.B.T. *Journ Bomb. Nat. Hist. Soc.*, pt. II, 34, 1931, p. 901; pt. III, 35, 1931, p. 32.
— & H. Whistler: What is *Curruca affinis* Blyth. *Ibis*, 1933, p. 554.

REVIEWS

I.—'PRELIMINARY GUIDE TO INDIAN FISH, FISHERIES, METHODS OF FISHING AND CURING'. Agricultural Marketing in India. Marketing Series No. 24, pp. 154, pls. 57, 1941. Manager of Publications, Delhi. Price: Re. 1 or 1s. 6d.

Though the potential wealth of Indian fisheries is immense, it is greatly to be regretted that the exploitation of both maritime and riverine fisheries occupies only a very minor place in the economic life of the country. The Royal Commission on Agriculture directed attention to this unfortunate state of affairs, but little has been done so far towards the development of the fisheries. It is, however, a matter of satisfaction that a marketing survey of the fisheries of the country has been included in the programme of work of the Agricultural Marketing Adviser to the Government of India. During the very early stages of such a survey it became evident that the multitude of vernacular names of the fishes current in different parts of the country is a great hindrance in the way of any marketing investigations and accordingly a 'Preliminary guide to Indian fish, fisheries, methods of fishing and curing' was planned so that the marketing investigators and others engaged in the trade should have a common nomenclature of the forms concerned.

Fishes.—It is explained in the 'Foreword' that 'The aim has not been to make the guide a scientific compilation and hence, all the detailed characteristics which define a particular fish are not given in the description.' This, however, is no excuse for some gross scientific inaccuracies which have crept into an otherwise admirable and useful publication. For instance on plate 1, the length of body (AE) is given as the distance between the tip of the snout and the base of the caudal fin, while on plate 2, 'Body' is incorrectly shown as the region between the posterior border of the operculum and the base of the caudal fin, this mistake is unfortunate as on the page opposite the plate a correct definition of the length of the body is given. Again on plate 2, the caudal fin is incorrectly marked as 'Tail'. The tail region of a fish is the portion of the body behind the vent or the anal opening.

Another serious mistake is the inclusion of the Pearlspot, *Etroplus suratensis* (Bloch), in 'The Carps Group'. The Carps, comprising the famous Rohu, Catla, Mrigal, Mahseer, and a host of other similar forms, belong to the order Ostarophysi, whereas *Etroplus* belongs to Percomorphi and as such should have been included among 'The Mackerels and the Perches Group'. The series of spines in its dorsal and anal fins readily indicate its position among the fish popularly known as the 'Perches'.

In the section dealing with 'The "Live fishes" or air-breathing fishes of India Group', the author has included only the Murrals and the Climbing Perch. The stalls of the numerous fish-markets in Calcutta on the other hand show that Magur (*Clarias batrachus*) and Singhi (*Heteropneustes fossilis*) form a large proportion of 'Jiol Machh' or 'Live Fishes'. An account of Magur is given in another place (p. 20), but Singhi is not referred to in the 'Guide'. In this connection, a reference may be made to the reviewer's article 'Trade in Live *Fish* (*Jiol Machh*) in Calcutta' (*Journ. As. Soc. Bengal*, N. S. vol. xxx, pp. 1-15, pls. i-vi, 1934).

The omission of any reference to the valuable *Hilsa* (known as Pulla or Palo in Sind) fishery in Sind (p. 29) may also be noted, besides many other minor faults of omission and commission to which attention could be directed. Though for the scientific names of the various species of fish listed in the 'Guide', Day's nomenclature has rightly been followed, it would have been advantageous to give in the account of each species its up-to-date scientific name. Some of the scientific names are either incorrect, such as *Panulirus fasciatus* should be *Panulirus polyphagus* (p. 69), *Ostrea circullata*

should be *Ostrea cucullata* (p. 73), etc., or wrongly spelt, such as *Muraenesox talabonoides* (pp. iii, 13), *Trichiurus haumela* (pp. iv, 39), *Equula splendens* (pp. iv, 42, 43).

Crustaceans.—The section dealing with Crustacea is, on the whole, a fairly accurate summary of Dr. B. N. Chopra's article listed in the Bibliography. A few mistakes have, however, crept in which should be rectified in a later edition. For instance, on page 68 it is stated: 'In prawns which are found in the sea or in brackish water, the first three walking legs end in claws . . .' Dividing the commercial prawns into 'marine' and 'fresh-water' and then mentioning this distinction between the two would suggest that this character holds good for the four species described as 'marine'. In *Leander*, however, the first three walking legs do not end in claws. This character really distinguishes the Palaemons from the Penaeids, and *Leander* for all scientific purposes is very closely allied to *Palaemon*. The distinction between 'marine' and 'freshwater' species is unsatisfactory. On page 70, it is stated 'In crabs the last leg is in the form of a paddle.' In the swimming crabs the last leg is in the form of a paddle, but in most other crabs it is not so. In the freshwater crab, *Paratelphusa*, for instance, the last leg is not paddle-like. On page 71, in the account of the 'Chilka Lake fishery', it is mentioned that 'enclosures are constructed with circular or oval openings'. As a matter of fact the traps themselves are arranged in the form of a circle (or an oval), and a small gap is left on one side close to the bamboo fence.

Molluscan Shell-fish.—The place assigned to the shell-fishes in the 'Guide' seems to give the impression that the shell-fishes are not of much value as food or as articles of trade and commerce in comparison with fish *sensu stricto*. It is claimed in the 'Foreword' that it is not merely intended as a guide to the departmental men but also 'to fishermen—both amateur and professional—as well as to traders, students and others.' It is not a little surprising therefore to find in this compilation very meagre information on the shell-fisheries of India among which are included only clams and oysters constituting minor shell-fisheries.

The pearl-oyster and chank fisheries of the Palk Bay and the Ramnad Coast in S. India which have been carried on for many years find no place in this publication. Nor is any mention made of the window-pane oysters, the sea, backwater and the freshwater mussels so common along the coasts of India, or of the top- and turban-shells which have been fished along the Andaman and Nicobar coasts for over a decade and exported to Singapore and other Far East markets. These shell-fishes which must be included among the major shell-fisheries are commercially of very great importance.

General.—The descriptive part should prove useful for the identification of various species, but here again considerable improvement could be effected by a careful revision. However, the large number of excellent figures of various species taken from different sources will be of particular help in this connection.

The sections of the work dealing with the 'Preservation and curing of fish', 'Industrial products', 'The Fishing areas of India and the fishing gear used in them', and 'Special note on the fishing methods for Crustaceans' are rather sketchy and could have been improved very greatly as a mass of unsorted material already exists in a number of official publications of the different provinces and in other journals; this would have proved instructive and helpful to industrialists, traders and others interested in the development of fisheries. Perhaps, in a preliminary guide a more detailed knowledge of these subjects was considered beyond the scope of such a publication.

In the 'Foreword', an acknowledgment is made to the Zoological Survey of India for their co-operation in compilation. It is, however, necessary to make it clear that this co-operation consisted in making literature and specimens available to the officer deputed by the Agricultural Marketing Adviser to the Government of India and in general guiding him in the execution of the work through suggestions, discussions and criticisms. The manuscript of the 'Guide' was unfortunately not sent to the Survey before publication as its revision by the specialists in the Department would not only have been useful for eliminating errors but also for suggesting various improvements in the arrangement and treatment of the subject matter.

S. L. H.

II.—'HANDBOOK OF ECONOMIC ENTOMOLOGY FOR SOUTH INDIA'. By T. V. Ramakrishna Ayyar, B.A., PH.D. 8vo., i-xviii+528 pp. Government Press, Madras, 1940. Price Rs. 4-12-0.

Good books on economic entomology in India are few and far between. Only two come to our mind—Lefroy's well known work, *Indian Insect Life* (1909) which is a classic, and Fletcher's excellent volume, *Some South Indian Insects* (1914). It, therefore, gives us special pleasure to review the excellent *Handbook* before us from the pen of India's veteran entomologist, Dr. Ramakrishna Ayyar, who was, until recently, Entomologist to the Madras Government. The book which is the ripe product of an experience of a life-time of research and teaching, is at once up-to-date and authoritative Hundreds of excellent illustrations add greatly to the utility of the volume. It is our considered view that the *Handbook* will be found indispensable not only to the South Indian entomologists for whom it is primarily meant, but also to entomologists, whether teachers or research workers, all over India and in the neighbouring countries, whose entomological problems are similar to those of tropical India.

The book is divided into two parts. Part I, which covers the first eighty-five pages, is divided into six chapters and deals with the fundamentals of general entomology. Among the subjects dealt with are: the position of insects in the animal world; the external and internal morphology of insects; reproduction, metamorphosis, growth and multiplication; general features of insect activity in relation to food, temperature, humidity and other factors in the environment; and finally, insect classification.

Part II deals with economic entomology. The first three chapters cover the fundamental principles underlying insect control, and the methods employed for that purpose, such as dusting, spraying, biological control, etc. Various mechanical appliances necessary for the purpose are also explained. This is followed by a detailed account of the pests of the important crops and fruit-trees in South India, such as paddy, millet, pulses, and palm-trees. A chapter is devoted to the pests of stored products and to the insects affecting domestic and farm animals. Another chapter deals with the household and disease-carrying insects. Finally in the last chapter are discussed beneficial insects such as the honey-bee, the silk-worm, and so on.

The most important and extensive part of the book from the point of view of agricultural economic entomology is naturally devoted to chapters dealing with the crop pests. Under each crop, its important insect pests are considered. Under each pest, an account is given first of its economic importance, structural peculiarities and distribution. This is followed by an account, usually with illustrations of its life-history and habits. Finally, the measures required for its control are discussed.

The book ends with five useful appendices. The first gives a list of the South Indian crop pests, with their chief host-plants, arranged according to the insect orders. The second contains synoptic keys for the systematic recognition of various insect orders and suborders. The third deals with the technique for the collection and study of insects, and also gives some useful chemical formulae for the killing, preservation and control of insects. The fourth deals briefly with the crop-pests other than insects, such as eel-worms, snails and slugs, mites, rats and birds. The fifth consists of a list of references on the insects of economic importance in South India, a list which, incidentally, contains some 154 titles. This is followed by an index.

Having said so much in praise of the book, a few remarks may be made about its minor blemishes. Let it be stressed that these remarks are made not with a view to detract from the general excellence of the book. On page 12 it is stated that the insect head is composed of six segments. There is now clear evidence for seven segments. On page 17, table, it is stated that the compound eyes of insects are homologous to the segmental appendages. This view was abandoned long ago, and there is no proof in its favour. On page 34, under the different kinds of reproduction in insects, the author omits to refer to the important and striking phenomenon of paedogenesis in which insect larvae or pupae undergo parthenogenetic reproduction without first attaining the adult stage.

The chapter on classification, pp. 70-85, is in our opinion, the least satisfactory portion of the book. The author prefers, for practical reasons, to stick to the ancient 9-order classification of insects, in contrast to the modern 23-order classification which he finds unpractical. This has resulted in strange combinations which today seem odd and unfamiliar. Thus, Anoplura are placed under Hemiptera, and Mallophaga under Neuroptera! Under Apterygota, only two orders, Thysanura and Collembola, are included; the Protura being excluded altogether. On page 71 the author gives Hemiptera and Homoptera as separate orders; and Anoplura and Mallophaga are separated, with Isoptera in between. These groupings are untenable. We would strongly urge the adoption of the 23-order classification, as for example that given by Imms in his Text-book. On page 73, the long-horned grasshoppers are referred to the family Locustidae. This name was suppressed long ago by Tettigonidae.

We would like to congratulate both the author and the Madras Government in producing a first-class book which will remain in the field for many years to come. The printing and get-up are extremely good. We can heartily recommend the book to all entomologists.

B. P. & M.L.R.

III.—'INSECT PESTS OF BURMA'. By C. C. Gosh, 1940.

This is a recent work by Mr. C. C. Gosh, till lately Entomologist in Burma, and published under the auspices of the Government of Burma. The outstanding feature of the book is that it is very well illustrated with a number of full page plates the great majority of which are in colour; in addition there are numerous black and white text-figures. In view of the fact that the author has confined himself only to the treatment of insects affecting field crops, stores and households in Burma, it is rather unfortunate that the title of the book should have so comprehensive and therefore liable to be misunderstood. To justify its rather ambitious title, information on other insect pests of Burma—such as pests of useful trees, cattle and other domestic animals, etc., should also have been included in the work. Lastly in view of the fact that rats and crabs have been unceremoniously included under insect pests, a more appropriate title of the book would have been 'Some crop pests of Burma'.

The subject matter of the book which runs to 215 pages is divided into two parts; the first, of forty-two pages, is intended to deal with 'general facts in connection with the insect life and pests', and the second with the 'pests'. To elucidate the facts in connection with the first part the author has selected sixteen insects (perhaps as types?); this list which is headed by the degenerate, nontypical *Head louse*, includes the bed bug, aphis, thrips, silver fish, etc. One fails to find out what were the criteria in selecting these heterogeneous and mostly nontypical forms to explain the general features of insects; a good many of them are only sucking forms and at least two or three are degenerate, absolutely nontypical examples of insects, quite unsuited for the purpose. Even in dealing with these insects no attention has been paid to explain the comparative morphological features of such important structures as body divisions, mouth parts, limbs, etc., or any of the outstanding physiological features like locomotion, breathing, reproductive phenomena, etc. In speaking of the metamorphosis, the author does not explain what the differences are between complete and partial metamorphosis; and in this connection he unfortunately characterises *Lepisma* as an insect with *incomplete metamorphosis*, though it is too well known that *Lepisma* and all other members of the group Aptera are typical examples of insects *without metamorphosis* (Ametabola). Nor is the insect group to which each of these types belongs indicated. In this first part are also added notes on 'Beneficial animals and insects', a rough classification of Insects and 'Prevention and control of damage by insects', which includes insecticides, spraying apparatus, etc.

Though the major portion of Part II deals chiefly with insect pests of different crops, the author has at the beginning selected nine which he calls general pests, and deals with their features and control. If the idea was to give examples of different categories of pests and their treatment, the selection is

extremely unfortunate. Six out of the nine are sucking forms, and the remaining two are not insects at all! (rats among insect pests)! It is a pity the author did not find it more convenient to select some of the commonest types of pests like grass-hoppers, caterpillars, beetles, etc. for the purpose. The remaining portion of the matter in the book deals with insect pests of different crops like rice, cane, etc. grown in Burma. The great bulk of this matter is made up chiefly of the explanations of the various plates and text-figures. It may be interesting to add in this connection that Mr. K. D. Shroff, who was Entomologist in Burma before the author, as early as 1919, published a list of the insect pests of Burmese crops (*vide* Rpt. of 3rd Ent. Meeting Pusa); and though the author has not referred to this list, a comparison of the insects in that list with those noted in this book might be interesting. In dealing with the pests of important crops like Rice, Sorghum, Cane, etc. it is very unfortunate that attempts have not been made to get many of these insects properly identified; some are without names, others with wrong names, and others have old or defunct names—for example: we have Paddy thrips p. 54, the Sorghum chafer p. 68, Sorghum stem fly p. 69, the Wheat aphis p. 74, termite p. 76, Cotton mealy bug p. 117, Blister beetle p. 119, beetle p. 160, etc. It is also strange that even information as to the group or family to which the different pests belong has not been given in most cases. Taking for instance a pest like the saw fly (Athalia) p. 127, how is the reader to know that the insect is neither a caterpillar nor a fly! The remark that the Cane mealy bug is the same as the one on paddy (p. 87) is unfortunate; the one on Cane is *Trionymus sacchari* and that on Rice is *Ripersia oryzae* G. On Cane a woolly aphis (*Oregma lanigera*) is mentioned; this appears to be an interesting record of a pest not commonly recorded from India, but unfortunately the author has neither given a figure of it nor sufficient information *re* its local distribution, incidence, etc. In dealing with pests of pulses some of those previously noted by Shroff have been left out in the book as for e.g. *Adisura* and *Clavigralla*. It is a pity the author still retains the good old name *Pectinophora* (p. 114) for the pink boll worm (*Platyedra*). The author does not refer to the grass-hopper *Aularches* in connection with sesamum though Shroff says it was once bad on that crop. The author's explanation for the term death's head moth (p. 121) is indeed very amusing! The old name (*Euphalerus*) is still retained in the book for the Citrus phyllid (*Diaphorina*) p. 173. Similarly the old names *Dasychira* and *Pachyzancla* are also retained. The title 'White wax mealy bug' (p. 180) for *Ceroplastes cereferus* is not only unfortunate, but inexcusable, since the insect is not a mealy bug at all! Under 'Other minor pests' of the Coconut palm (p. 191) is included the butterfly *Udaspes folus*; this is not a coconut insect, but a specific pest of turmeric, ginger, etc.; this name under coconut palm appears to be a mistake for *Gangar thyrsis*, a butterfly which has been noted before by Shroff on coconut in Burma. It is really unpleasant to have to remark that in dealing with the various insect pests, greater attention has been paid to already known forms—both in India and Burma—especially to those in the colour plates, while those that appear to be specific to Burma and about which we know very little have not received the treatment they deserved—as for example: the woolly aphis p. 88, Cane weevil p. 82, Bean stem borer beetle p. 107, the Citrus bark borer p. 171, Mulberry leaf roller p. 179, Mulberry trips, p. 178, Mulberry stem beetles p. 181, Grape vine Chrysomelid p. 183, Fruit flies on peach, etc. p. 185; the elephant beetle p. 189, etc. The pests of fruit trees have not at all been sufficiently treated (pp. 175, 182, 183 and 185). A fairly good number of insects listed by Shroff have also been left out in the book, as for example insects like *Naranga, Oxya, Menida, Tettigoniella* on Rice, *Thrips* on maize, *Adisura, Clavigralla* on pulses, *Aularches* on sesamum, *Gallobelicus* and *Phyllotreta* on tobacco, etc., etc. The absence of even a passing reference to the unique record of a fruit fly in Plantains (*Chaetodacus diversus*) in Burma by Shroff (see p. 40 Second Notes on hundred Indian Insects 1919) is indeed a great pity, since that is the only record of fruit fly attack on Plantains so far from India and Burma. The sandwiching of Rats (p. 49) and Crabs (p. 57) among insects without a word of explanation is to say the least of it odd.

A few remarks may be made regarding the illustrations on which the author has laid a good deal of emphasis in his introductory remarks. There are in all 87 full page plates and 106 black and white text-figures; of the former over

75 are colour plates. The numbering of these plates lacks uniformity—some are numbered Pl. xlvii (47) while others Pl. 46, etc. The names of insects in Pl. 38 and 72 are quite different from the ones given in the text on the opposite pages 100 and 147. Reference to Pl. 72 under mango fruit flies on p. 166 appears wrong as *D. cucurbitae* is not a mango fruit fly. Though all these plates and many text-figures have already appeared before in Gov. ernment of India publications, the insects in a good many of them do not show the correct names—e.g. Pl. i, v, x, xi, xlvii, lxii, lxvii, etc. There is no reference to Pl. I on p. 127 when speaking of mustard aphis! Fig. 104 p. 211 is *T. abruptella W.* and not *tapetzella L* (see Fletcher 'Hundred notes p. 34). Coming to the text figures a good many are without names or with wrong or imperfect names; for e.g. Figs. 3, 10, 11, 14, 16, 19, 21, 27, 32, 34, 35, 50, 92, etc., etc. It is a pity that the author could not put down the names of even many of the well known forms such as the *housefly*, the *honey bee*, the *flea*, *potter wasp*! As far as one could make out there are some plates both coloured and black and white which do not appear to be prepared at Pusa and which the author has not acknowledged for example Plates 12, 45, 83. Some of the illustrations do not show the exact specific names of the insects e.g. Colour Pl. of *Earias*, mango fruit weevils p. 165, *Idiocerus* p. 164, etc.

The author has baptized some well known insects with some new popular names such as 'Yellow shoot borer' for the white borer, 'Coconut leaf nibbling caterpillar' for *Nephantis*, 'Rice grain nibbling caterpillar' for *Cirphis*, 'Rice leaf binding caterpillar' for *Chloridea assulta*, 'grain binding caterpillars' for meal worms, etc. Such new names unfortunately only add to our confusion *re* popular names.

As regards remedial measures suggested there are some which are truly extraordinary: for mealy bugs on stored potatoes—Dip in strong rosin compound; for sorghum midge—resistent varieties should be grown; rosin compound for thrips; keep watch on fields for hispa, strip the plants of all side leaves for pink mealy bug on Cane; for the leaf roller the leaves are better unrolled and the caterpillars destroyed! etc. Here and there in the text there are some astonishing statements worth noticing—as for example the life history of *Disphinctus* (a capsid) is similar to the green bug (*Nazara*)—, eggs are laid on the trees—, Scales and mealy bug (*lac*) on custard apple—, the offsprings too never know or look after the parents—, one and a half weeks—, young male bug turns into pupa—; mites are tiny spiders—, caterpillars live from shoot to shoot or plant to plant—the caterpillar occurs which is hatched from egg laid by a butterfly and in its turn develops into a butterfly—, prevents the birth of fresh beetles in the field p. 64!

As for spelling and other errors, many of which are perhaps printer's devils, there are a fairly good number, and it is unfortunate an errata slip was not prepared and attached to remedy at least some of these. Some glaring examples are Novia, Bollwarm, Disdercus, Cantarenia, Pempheris, Shaenobius, Gossary, etc. The arrangement and size of the matter, proper types for headings and pages, etc. could have been paid a little more attention. The first line on p. 43 begins 'In this chapter' (in the absence of division into chapters in this book one wonders) what the *Chapter* referred to here is! The big heading on p. 182 is *Mole Rat* and under it appear Tamarind, Papaya, Cashew, etc. in small type headings.

On the whole, however, there is no doubt that as a handy reference collection of colour plates of many Indo-Burmese Insect Pests (which had appeared previously in many different works), the book will always maintain its substantial worth. A list of the illustrations and plates in the book at the beginning or end of the work could have enhanced its value for reference purposes.

IV.—'BIRDS OF BURMA' by B. E. Smythies, Burma Forest Service. Edited by H. C. Smith, I.F.S., and P. F. Garthwaite, B.F.S. With a map and 31 coloured plates from paintings by Lieut.-Commander A. M. Hughes, R.N. Pp. xxix—589. American Baptist Mission Press, Rangoon, 1940. Price Rs. 15.

The names of Eugene W. Oates in the seventies and eighties of the last century, of H. H. Harington, J. C. Hopwood and J. M. D. McKenzie in the years slightly preceding and following the last World War (1914-18), and of

J. K. Stanford, H. C. Smith, P. F. Garthwaite and B. E. Smythies (the present author) within recent years, stand out prominently in the domain of Burmese ornithology. The recent systematic work on Burmese birds of the late Dr. C. B. Ticehurst will endure as a monument to the thoroughness and scientific acumen of that widely celebrated ornithologist.

The sum total of the activities of all these naturalists, as well as of others perhaps less heard of but nonetheless earnest students, has been embodied in the excellent volume now before us. Its avowed object is to provide a concise and accurate account of Burmese birds in simple and untechnical language, a purpose which it admirably fulfils, since readability is here reinforced by good coloured illustrations. The 31 coloured plates, illustrating 290 of the commoner birds, specially painted for this book by Lieut.-Commander A. M. Hughes form an attractive feature. It is obvious that Commander Hughes knew his subjects intimately, and his drawings are not only lifelike but in most cases they show the birds in their characteristic attitudes. A welcome item is the scale given at the foot of each plate which enables the reader to get an idea of the relative sizes of the birds. The reproduction of the plates is good on the whole, but in some cases unfortunately it fails to do full justice to the artist. The plain grey background to the illustrations is pleasingly effective.

The Introduction covers a wide range of information calculated to help the beginner and the layman. The modern system of scientific nomenclature is explained and a short section is devoted to Bird Photography. The account of the general topography and meteorology of Burma is interesting and valuable to the student since elevation and rainfall are now recognised as two of the most important factors that control the distribution of birds in any area. From another section entitled 'Protection' we learn that besides the Reserved Forests which cover 34,799 square miles (i.e. 13% of the total area of Burma) there are now 8 Wild Life Sanctuaries, in all about 600 square miles, where all animals (including birds, of course) enjoy complete protection from year's end to year's end. In this matter Burma's example is one that might be emulated with advantage by our Indian provinces where, with a few notable exceptions, practically nothing has as yet been done.

Following the Introduction comes the general body of descriptions of the 1253 species and subspecies that comprise the rich and varied avifauna of Burma. All the available information has been summarised from previous publications under the following heads:

English and scientific name,
Allied forms,
Local names (where existing),
Identification.
Voice,
Habits and Food,
Nests and Eggs,
Status and Distribution.

It is a pity that the authors' names have been omitted after the scientific names. With the initial chaos in scientific nomenclature, especially following the general acceptance of the trinomial system, absence of the author's name rather tends to confound confusion, and this at a time when we are just settling down to the new order. Students will deplore the fact that once again the archaic inch appears as the unit of measurement instead of the now universally employed, and admittedly more rational and scientific millimetre. If it is argued that the book is of a popular nature and written purely for the layman, the reviewer's reply is that in any case the layman, unaccustomed as he is to handling made-up cabinet specimens—some with necks fantastically drawn out, others comically telescoped—can at best derive questionable benefit from a measurement of length thus obtained in relation to the living bird. Also in the case of eggs surely a measurement like 1.37×0.69 inches cannot be less vague to him than the same measurement given in millimetres. The latter would at least have the virtue of conveying something more tangible to the not-so-raw student.

When a further edition of this book is contemplated it is hoped that the author and editors will give due consideration to this point. It is further suggested that the range of wing measurements in millimetres should be given

AN APPEAL.

SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE EMPIRE.

In a recent issue of the *Journal* of the above Society the Editor commented on the fact that he had received a letter describing the Society as the 'Talkie-Talkie' Society; and another letter addressed to the 'Society for the Talk of the Preservation of the Fauna of the Empire'.

One of the correspondents (if not both) is a member of the Bombay Natural History Society. Such ill-considered criticism betokens only ignorance, on the part of the writers, of the work accomplished by the Society with its comparatively small membership, and the very limited funds at its disposal. To take only three instances: the Society's efforts have largely contributed to measures being taken to save the Moufflon of Cyprus; the Thylacine (or Tasmanian Tiger or Wolf); and the Giant Panda from extinction. In many other directions the Society's interest and intervention have helped to ensure the safeguarding of species in grave danger. The Society's work has been recognised and praised by naturalists of all countries interested in the preservation of wild life.

I would ask those critics who seek to belittle the Society's activities to help a good cause by persuading their friends to become members—the subscription is small. By so doing the Society's influence will be the greater, and its means increased.

R. C. MORRIS.

Honnametti Estate,
Attikan-Mysore P.O.,
S. India.
April 19, 1941.

parenthetically for each bird described. With these minor additions and alterations this work could easily become a first class manual on the birds of Burma even for the rather more advanced student, without in any way lessening its appeal to the layman.

Traditional legends die hard, but it is certainly unfortunate that in spite of the published and verified findings of competent observers, both in this country and in Java, it should have been thought fit to repeat the old time-worn account of the nesting of the Baya Weaver Bird. In the light of recent discoveries it is not at all so difficult to explain the apparent, but not actual, excess of males over females. Moreover, if the texture of a nest be examined in the hand, it will be noticed that the strands do not pass right through the fabric as is implied by the alleged co-operation of the male outside with the female within, in the weaving of the walls. Actually the weaving is done only by the male from without, layer upon layer as it were. The female only occasionally fetches and weaves in a strand inside, but her contribution is in fact no more than what may be called 'interior decoration'.

P. 190. It may be pointed out that the non-breeding plumage of the adult Spotted Munia (both sexes) is also plain brown, as described for the young.

Under 'Habits and Food' the habitats and immediate environments of the birds are well described, and the summaries of Nightjar and Owl calls on pages 306 and 310 will be found of much help in field identification.

The map at the end of the volume shows Burma divided into 10 Distribution Areas. It is to be used in conjunction with the Systematic Handlist which forms the last section of the book. These Distribution Areas and their respective topographical features are more fully defined in the Introduction (pp. xvi-xvii). Their division is based more or less on natural features, definitely a step in the right direction. Civil and political boundaries are often fixed arbitrarily and purely for administrative convenience; they mean nothing when ecology is being studied and have, in the past, led to much confusion.

The text is particularly free from typographical errors. One item on p. 40 has apparently escaped the proof reader. The Lime-Rock Babbler (*Gypsophila crispifrons*) is followed by the Short-tailed Wren-Babbler which also carries the same scientific name. This should of course be *Napothera*.

This is a volume that every bird lover in Burma of course, but also in India, must possess. It is the most concise, handy and up-to-date work on the ornithology of this most interesting transition zone between the two main zoogeographical subdivisions of the Oriental Region.

S. A.

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R. C. MORRIS.

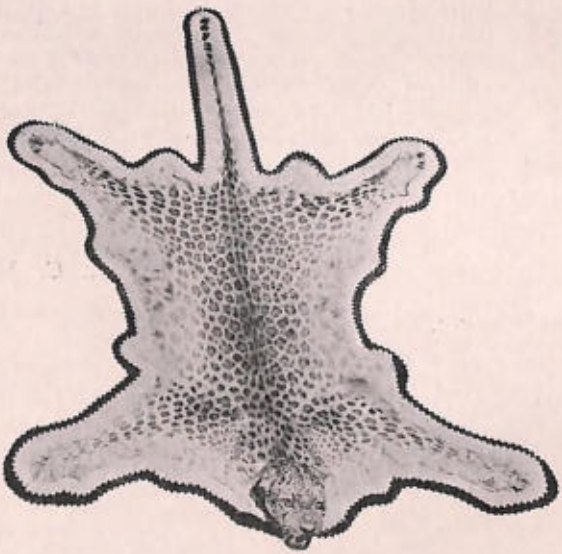
HONNAMETTI ESTATE,
ATTIKAN-MYSORE P.O.,
S. INDIA.
April 19, 1941.

MISCELLANEOUS NOTES

I.—VARIATION IN COLOUR OF TIGERS AND PANTHERS.

(With two photos).

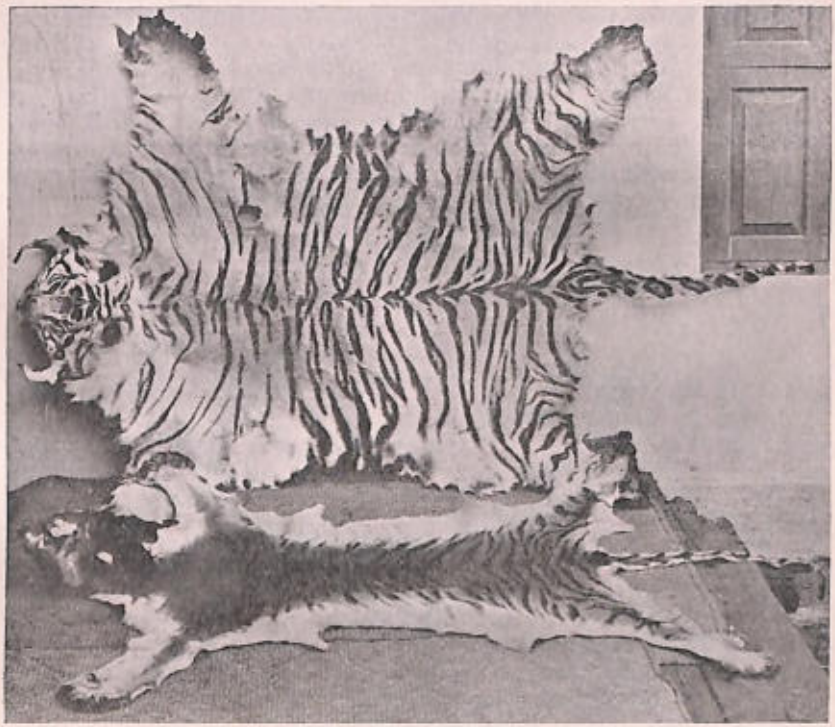
We are sending you two photographs which we think you will find of sufficient interest to publish in the *Journal*. One is a photograph of a Semi-Albino panther and the other is a unique photograph of a red tigress skin together with a white tiger.



Panthers unlike tigers have no tendency to albinoism and except for an instance cited by Mr. Pocock in his account in the *Journal* of panthers, white panthers are unknown. The photograph is of a Semi-Albino panther which was shot last year by the Maharaja Bahadur of Dumraon in Bihar. This panther is white with a pale tan background and rosettes in a darker shade of tan.

The red tigress in the foreground was shot some years ago in Assam by the late Mr. W. G. Forbes. The skin was white with the pale tan background and marked with fine stripes in a

darker shade of tan. Curiously the three last stripes at the tip of the tail were black.



The white tiger shown in comparison was pure white and marked with chocolate stripes. This tiger was shot by the Ruling Chief of Korea also some years ago.

MYSORE, S.I., VAN INGEN & VAN INGEN,
February 14, 1941.

II.—UNUSUAL BEHAVIOUR OF PANTHERS AND TIGERS.

In your August 1939 issue appeared a note by Col. R. W. Burton under the caption 'Unusual behaviour of Panthers and Tigers'. In this Col. Burton remarks that he has never known of, nor seen recorded, previously the association of a half-grown animal with the very small cub of a later litter and its parents.

In March 1921 Mr. A. S. Vernay and I sat up over a panther kill for two evenings in succession on my Honnametti Estate on the Billigirirangan Hills, S. India. A family of 6 panthers visited the kill—the two parents, two half-grown and two little cubs. The

staid procession of all six, led by the male parent, followed by the two half-grown, then the two small cubs, with the mother bringing up the rear from a shola, across the cart-road, and into the coffee—was a remarkable sight.

In the same note Col. Burton refers to the wanton killing of a number of cattle by a tiger and of 33 sheep by a panther.

In 1940 a tiger killed 5 grazing buffaloes near my Honnametti Estate. In 1935 or 1936 a tiger killed eleven head of cattle of a herd; and seven head of cattle of another herd were killed either by the same or another tiger; near Udhatti at the eastern foot of the Billigirirangans. In both cases the herds were returning to their village pens in the evenings from their jungle grazing grounds.

TOBRUCK, CYRENAICA, LIBYA,
April 12, 1941.

R. C. MORRIS.

III.—AN UNKNOWN VISITOR TO A LEOPARD CARCASE.

(*With a photo*).

Returning to camp late one evening I heard two jackals giving their alarm call; deer, peafowl and jungle fowl took it up, so that it was an easy matter to intercept the cause of their alarm, which turned out to be a large male leopard. He dropped to the shot and then disappeared into some grass. As by that time it was dark and I had no torch I left him. On returning early next morning I found him almost thirty yards from where he was standing when hit and I was very surprised to see that the entire skin over the abdomen had been removed and eaten by some animal, without injury to the inner membrane.

The edges showed teeth marks, but the rest of the skin was not injured in any way, not even where covered with blood from the bullet wound in his chest, and no flesh had been eaten.

The only foot prints I could see round the body were those of a full-grown female leopard and a hyena. The latter had walked up to the dead leopard, but not round it, and I concluded that the leopardess had kept the hyena off during the night and it was only when she heard me approaching that she moved off, and the hyena then walked up, but had no time to take even a single bite.

I have had experience of both leopards and tigers, which have been left for any length of time after being shot, being eaten by

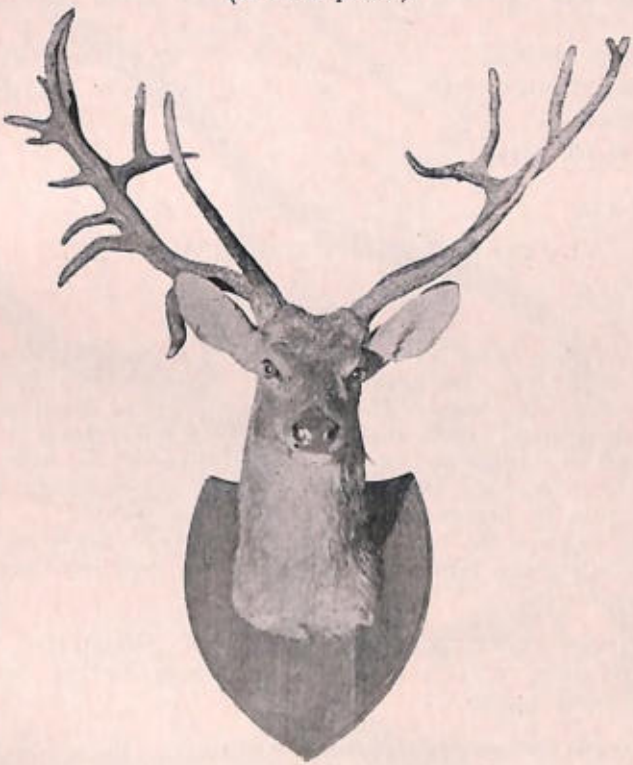
their own kind and by hyenas and jackals, but I have never heard of only the skin being removed and eaten, without injury to the flesh.

Can you or any of your readers throw any light on the matter? I enclose a small photograph of the skin after it had been pegged out and dried.

ROCK HOUSE, C. H. TRESHAM,
SIMLA.
April 2, 1941.

IV.—A FINE SWAMP DEER HEAD.

(With a photo).



The enclosed photograph is of a very fine swamp deer head. It was shot by Mr. S. A. Vahid, I.F.S., Divisional Forest Officer, Chanda. The head is an eighteen pointer and measures :—

Right horn 35″ Left horn 36″
12 + 6
Girth (Midbeam) $5\frac{3}{4}$″.

MYSORE, VAN INGEN & VAN INGEN.
February 14, 1941.

V.—ELEPHANTS LYING DOWN.

The question as to whether an African elephant lies down or not has now I think been settled. That it does so, and not infrequently, has been confirmed by Mr. Roy Home and others in recent years.

The Indian elephant lies down more commonly than is supposed. While out in the Palar Valley, North Coimbatore, with Mr. Salim Ali (March 1940) we saw a tusker lying down flat on his side under a large Tamarind tree. The elephant remained in this position for some time, gently curling and uncurling its trunk or covering itself with dust and tamarind mulch from the ground beside it, while another and larger tusker stood on the other side of the tree. This was one of a number of instances to my knowledge.

HONNAMETTI ESTATE,
ATTIKAN, MYSORE, P.O.,
S. INDIA.
June 16, 1941.

R. C. MORRIS,
Captain.

VI.—BIRD NOTES FROM BALTISTAN.

(*With a map*).

The following notes were made during a five-week trip through Baltistan after Ibex, from July 15th to August 20th. The notes apply chiefly to the Deosai Plains and a stretch of about 80 miles of the Indus valley. Here the Indus runs at about 8,000 ft. elevation, flanked by mountains running up to 16,000 ft. or more. The average elevation of the Deosai Plain is about 13,000 ft., surrounded on three sides by higher mountains.

I took with me the 2nd edition of the 'Fauna' and a collector's gun, and only those birds whose identity was definitely established are included.

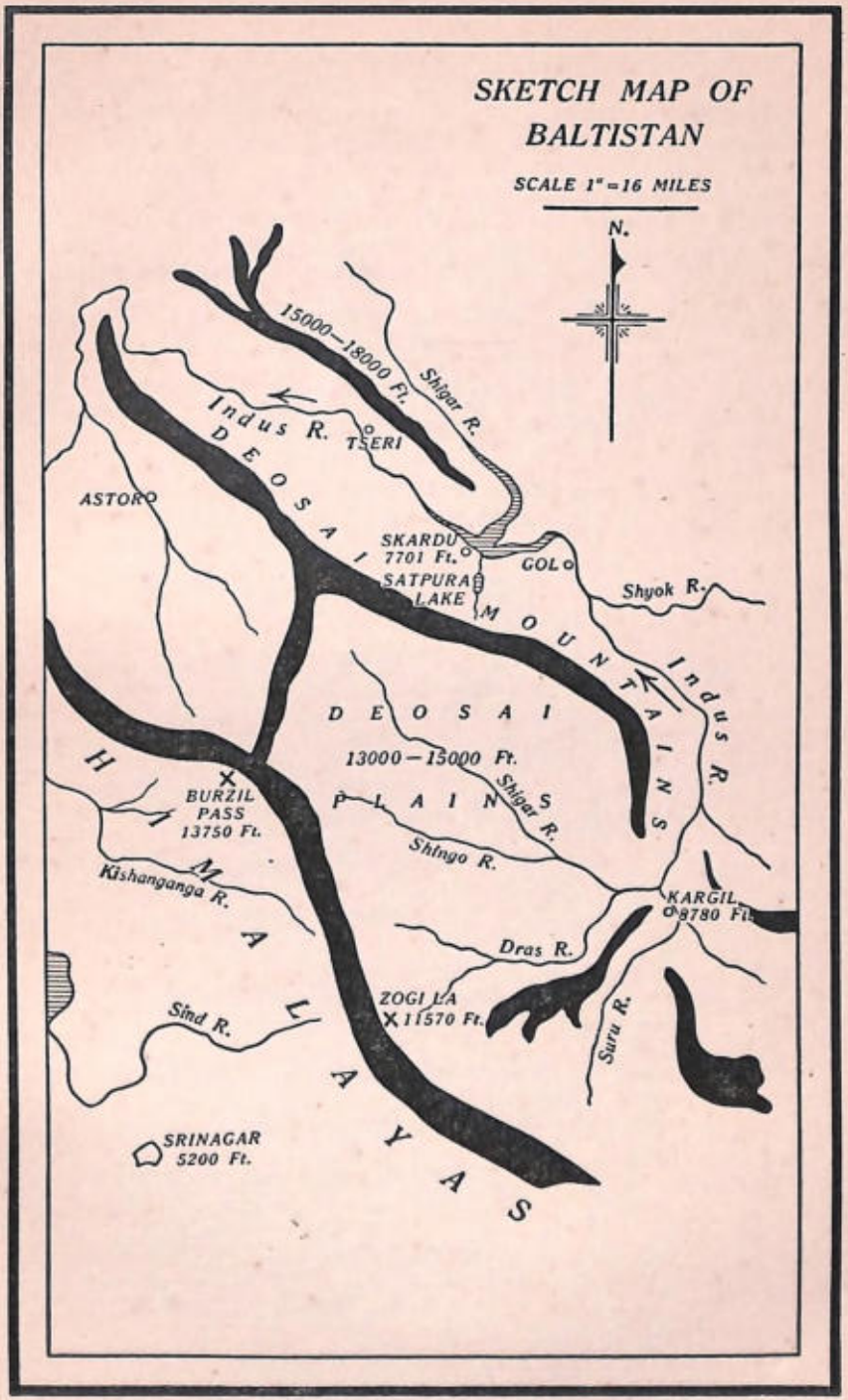
1. **Corvus corax tibetanus** (Hodgs.). Himalayan Raven. Only noted once, when a pair was seen above Gol in the Indus valley at about 14,000 ft.

2. **Corvus coronoidess intermedius** (Adams). Himalayan Jungle-Crow. Occurs sparingly on the Deosai Plain and in the villages of the Indus valley up to 12,000 ft.

3. **Corvus corone orientalis** (Eversm.). Eastern Carrion Crow. Rare. One of a pair was obtained near Gol in the Indus valley at 8,500 ft.

4. **Pica pica bactriana** Borop. Kashmir Magpie. A common and familiar bird in all the Indus villages.

5. **Pyrrhocorax pyrrhocorax** (Linn.). Red-billed Chough.


SKETCH MAP OF
BALTISTAN
SCALE 1" = 16 MILES
N.
15000–18000 Ft.
Shigar R.
Indus R.
TSERI
DEOSAI
ASTORE
SKARDU
7701 Ft.
SATPURA
LAKE
GOL
Shyok R.
MOUNTAINS
Indus R.
DEOSAI
13000–15000 Ft.
PLAINS
Shigar R.
Shingo R.
BURZIL
PASS
13750 Ft.
HIMALAYAS
Kishanganga R.
KARGIL
8780 Ft.
Dras R.
ZOGI LA
11570 Ft.
Sind R.
Suru R.
SRINAGAR
5200 Ft.

6. **Pyrrhocorax graculus** (Linn.). Yellow-billed Chough.

Both species are very common throughout the higher hills on both sides of the Indus, up to 16,000 ft. at least, descending to 8,000 ft. in the neighbourhood of villages. Mostly, these two species were found in company, the 'Yellow-billed' predominating round the villages, while at the higher elevations the 'Red-billed' was commoner and found in great numbers. The curious mewing note of the half-fledged young was one of the most persistent noises at my camp in the Tseri nullah at 15,000 ft.

7. **Parus major kaschmiriensis** Hartert. Kashmir Grey-Tit. Occurs sparingly in the Indus valley villages.

8. **Lophophanes rufonuchalis rufonuchalis** (Blyth). Simla Black-Tit. One specimen obtained above Tseri village at 10,000 ft. The only one seen.

9. **Trochalopterum lineatum gilgit** (Hartert). Gilgit Streaked Laughing-Thrush. Occurs fairly commonly in the Indus valley villages up to 9,000 ft.

10. **Tichodroma muraria** (Linn.). Wall Creeper. Seen daily at my highest camp above Tseri at well over 15,000 ft.

11. **Oenanthe picata** (Blyth). Pied Chat. One of the commonest birds of Baltistan occurring throughout the whole length of the Indus valley visited, haunting alike the outskirts of villages and the boulder-strewn barren stretches in between. Family parties with newly-fledged young were seen everywhere. On leaving the Indus this bird is seen less commonly up to the mouth of the Suru river below Kargil and then disappears altogether.

12. **Oenanthe leucomela leucomela** (Pall). Noted and obtained from about 10 miles east of Skardu, where the Indus broadens out, to as far as Tseri Village, increasing in numbers as one progressed westwards.

13. **Phoenicurus frontalis** Vigors. Blue-fronted Redstart. Only one specimen was seen—above Tseri at 14,000 ft.

14. **Phoenicurus ochrurus phoenicuroides** (Moore). Kashmir Redstart. Occurs sparingly on the Deosai Plain, and more commonly on the higher slopes of the Indus valley above 14,000 ft.

15. **Chaimarrhornis leucocephala** (Vigore). White-capped Redstart. Only one bird was seen—above Gol at 9,000 ft.

16. **Cyanosylvia cyanecula abbotti** (Richmond). Eastern White-spotted Blue-throat. Occurs sparingly in the higher cultivated land above 10,000 ft.

17. **Monticola solitaria pandoo** (Sykes). Indian Blue Rock-Thrush. Occurs fairly commonly throughout the Indus valley, both in the most barren country and on the outskirts of villages.

18. **Myophonus temminckii temminckii** (Vigors). Himalayan Whistling Thrush. Occurs in small numbers in the Indus valley, wherever there is cultivation.

19. **Phylloscopus affinis.** Tickell's Willow-Warbler.

20. **Phylloscopus collybitus sindhianus.** Sind Chiff Chaff.

These two species were only once definitely identified when descending from the Deosai Mountains into the Indus valley.

21. **Phylloscopus griseolus** Blyth. Olivaceous Tree-Warbler. A family party was seen above Tseri at 10,000 ft. searching rocks and boulders for food, almost like wall-creepers.

22. **Oriolus oriolus kundoo** (Sykes). Indian Oriole. Occurs commonly in all the Indus villages.

23. **Pyrrhospiza punicea humii** (Sharpe). Western Red-breasted Rosefinch. Seen on several occasions above 14,000 ft. A family party haunted my highest camp above Tseri. They have a very metallic sparrow-like chirp uttered on the wing.

24. **Carpodacus erythrinus roseatus** (Hodgs.). Hodgson's Rosefinch. Occurs commonly in the higher cultivated areas of the Indus valley from Skardu eastwards.

25. **Metaponia pusilla** (Pall). Gold-fronted Finch. A common bird in the larger Indus villages.

26. **Passer domesticus parkini** Whistler. Kashmir House Sparrow. Common at Skardu and neighbouring villages. Much rarer to the East, and not seen at all at Tseri on the West.

27. **Fringilauda nemoricola altaica** (Eversm.). Stolickza's Mountain Finch. Common on the Deosai Plain. Usually seen in small flocks.

28. **Emberiza cia stracheyi** (Moore). Eastern Meadow Bunting. Found in all the Indus villages. Commoner on the west than the east. Not found on the Deosai Plain.

29. **Delichon urbica urbica** (Linn). House-Martin. All specimens shot were of this sub-species. Frequents the more precipitous villages of the Indus.

30. **Ptyonoprogne rupestris** Scop. Crag-Martin. A common bird observed daily throughout the Indus valley at all elevations up to 10,000 ft.

31. **Motacilla alba personata** (Gould). Masked Wagtail. Occurs sparingly in the Indus valley.

32. **Motacilla alba hodgsoni.** Hodgson's Pied Wagtail. Common throughout the Indus valley.

33. **Motacilla cinerea caspica** (Gmelin). Eastern Grey Wagtail. Fairly common in the cultivated areas of the Indus valley.

34. **Motacilla citreola calcarata** (Hodgs.). Hodgson's Yellow-headed Wagtail. Very common on the Deosai Plain. A nest with four fresh eggs was found on July 17th. Not seen elsewhere in Baltistan.

35. **Anthus hodgsoni hodgsoni** (Richmond). Indian Tree-Pipit. Found breeding in the Deosai Mountains at 15,000 ft.

36. **Anthus roseatus** Blyth. Hodgson's Pipit. A nest with three young ones about a week old found on the Deosai Mountains at 14,000 ft.

37. **Otocorys alpestris deosai** Meinertz. Deosai Horned Lark. By far the commonest bird on the Deosai Plain. The place literally swarmed with them, and newly-fledged young were seen everywhere and were very tame, some being caught by hand.

38. **Alauda gulgula lahmarum.** Ladak Skylark. Occurs sparingly on the Deosai Plain on the higher cultivated and grazing grounds east of Skardu.

39. **Picus squamatus squamatus** Vigors. Scaly-bellied Woodpecker. Found sparingly in most of the Indus villages.

40. **Upupa epops epops** Linn. European Hoopoe. Occurs in all the Indus villages. Common round Skardu.

41. **Micropus apus pekinensis** (Swink.). Eastern Swift. A common bird in Baltistan. Seen daily both on the Deosai Plain and the Indus valley up to 15,000 ft. at least.

42. **Cuculus canorus telephonus** Heine. Asiatic Cuckoo. Heard calling daily on the Deosai Plain, usually from the tops of the most desolate hills. A young bird was seen at Skardu in the willows on the banks of the Indus.

43. **Gyps himalayensis** Hume. Himalayan Griffon. Found throughout Baltistan up to at least 16,000 ft.

44. **Haliaëtus leucoryphus** (Pall.). Pallas's Fishing Eagle. One bird was seen sailing high over the Deosai Plain, and two birds were seen on the Indus.

45. **Milvus migrans lineatus** (Gray). Black-eared Kite. Occurs sparingly around Skardu and neighbouring villages.

46. **Cerchneis tinnunculus** (sub-sp. *tinnunculus*?). A kestrel, probably the European Kestrel occurs throughout Baltistan. No specimens were obtained.

47. **Accipiter nisus melanoschistus.** Indian Sparrow Hawk. Seen on the Deosai Plain.

48. **Columba livia neglecta** Hume. Hume's Blue Rock-Pigeon. Very common throughout the Indus valley up to about 11,000 ft.

49. **Columba leuconota leuconota** Vigors. Snow Pigeon. One flock was seen feeding on the edge of a river on the Deosai Plain. Common above 12,000 ft. at Tseri. The note of this bird, always uttered when taking flight and alighting is a prolonged, high-pitched, and tremulous 'coo', rather reminding one of the note of the Common Myna when taking flight.

50. **Streptopelia orientalis ferrago** (Eversm). Himalayan Turtle-Dove. Common in all the Indus villages. All birds shot had the pure white under tail-coverts of the true 'ferrago'.

51. **Alectoris graeca chukor.** Meisner Chukor. Very common up to 10,000 ft. throughout the Indus valley especially near the villages. Very many coveys with half-grown young were seen, never numbering less than 35 birds in a covey and two pairs of adults.

52. **Tetrogallus himalayensis himalayensis** Gray. Himalayan Snow-Cock. This fine bird was first seen on the Deosai Mountains at 15,000 ft. It was very common in the Ibex ground above Tseri, as many as 40 being seen in one morning. Above Gol, too at 13,000 ft. it was frequently seen and heard. The wild ringing call, so well described by Osmaston (*B.N.H.S. Journal*, vol. xxxii, page 145) was a feature of the early mornings. The note was always uttered before taking flight and on the wing, and it was a magnificent sight to see half a dozen of these birds 'power-diving' across a ravine with the wind literally screaming through their wings. These aerial acrobatics which sometimes went on for a couple of hours seemed to be inspired by sheer exuberance.

53. **Cirrepedesmus mongolus atrifrons** (Wagler). Pamirs Lesser Sand-Plover. I thought I saw this bird twice on the Indus at Skardu, but unfortunately was unable to procure a specimen to make sure.

54. **Tringa hypoleucos** Linn. Common Sandpiper. A pair seen on the Deosai Plain, where they must have been breeding.

55. **Tringa totanus eurhinus.** Eastern Redshank. Heard calling at night on the Deosai Plain.

56. **Sterna hirundo tibetana** Saunders. Tibetan Tern. Two terns with very dark back and wings, like a black-backed gull, were seen on the Indus at Skardu. They were undoubtedly of this sub-species.

57. **Phalocrocorax carbo sinensis** (Shaw and Nod.). Large Indian Comorant. Five birds, evidently summer residents, were seen on the Satpura lake at 9,000 ft. One bird was also seen on the Indus.

58. **Casarca ferruginea** (Vroeg). Brahminy Duck. A flock of about 60 birds was seen on a sandy bank in the middle of the Indus near Skardu on July 24th.

RUNGLI RUNGLIOT P.O., W. H. MATTHEWS.
N. BENGAL.
January 22, 1941.

VII.—SOME NOTES ON BURMESE BIRDS.

1. **Smew.** (*Mergus albellus*).

While out fishing for Mahseer on the Nan Tebet (Myitkyina Dist.) below Chinkram in Nov. last year, I spotted what appeared to be 5 black and white duck and one rufous capped duck swimming about on the far side of the stream. Closer inspection convinced one that this was a party of 5 ♂ and 1 ♀ smew though unfortunately they never came close enough for me to have a shot at them. I could clearly see the white heads and necks of the drakes with black patches on their faces. The only other record of this bird's occurrence in N.-E. Burma is apparently from Fort Hertz.

2. **Glossy Stare.** (*Lamprocorax panayensis strigatus*).

Early one morning in Dec. last year, I noticed a large party of metallic green birds in a tall tree near Lake Hlawga, Rangoon. They were jumping and flying from bough to bough while keeping up an incessant chatter very much after the manner of Starlings or Mynahs. Although the only record of this bird is an uncertain one from Arakan, I can think of no other species to which these birds could have belonged.

3. **Burmese Black-crested Baza.** (*Baza leuphotes burmana*).

A female seen on her nest in a tall tree in open teak forest 6 miles down the Namkham road from Bhamo on May 9th 1941. It is reputed to be a very shy bird but I experienced the greatest difficulty in making it forsake its nest and only achieved this by continually throwing a stick up into the tree. Unfortunately I was unable to reach the nest which was on the tip of a slender branch.

4. **Daurian Redstart.** (*Phoenicurus hodgsoni*).

A ♂ specimen of what must have been this bird was shot by my friend Mr. Braund on a sparsely wooded hillside in the Hills between Kyaukme and Mogok (N.S.S.) in Feb. this year. This bird was in every way similar to the description given by Oates except that the areas given as 'chestnut' by him were much nearer 'chrome yellow'.

5. **Indian Blue-eared Barbet.** (*Cyanops duvauceli cyanotis*).

When out walking in open forest and scrub country near the river at Bhamo in May, I saw a small barbet hopping about on a

large bare tree. I managed to get up within 30 yards of it and clearly identified it as of this species. According to Smithies 'Birds of Burma' this bird has not hitherto been recorded from N.-E. Burma.

6. **Van Hassalt's Sunbird.** (*Cinnyris brasiliana*).

A ♂ bird seen at Lake Hlawga Rangoon in Sept. last year.

7. **Indian Grackle.** (*Gracula religiosa intermedia*).

4 birds seen in a bare tree in deciduous forest at plain's level 6 miles outside Bhamo in May this year.

8. **Sapphire-headed Flycatcher.** (*Muscicapula sapphira*).

♂ birds seen on two occasions on the road up to Bernardmyo near Mogok (March).

9. **Indian Sultan Tit.** (*Melanochlora sultanea sultanea*).

A ♂ bird seen in secondary growth on the hills behind Alexandra Barracks Maymyo Feb.

10. **Siamese Red-vented Bulbul.** (*Molpastes chrysorrhoides klossi*).

Red vented Bulbuls with light brown cheek patches have been seen by me both at Mogok (Feb.) and Bhamo (May). This cheek patch is so outstanding that I am sure both these birds were of the Siamese species.

11. **Yellow-throated Minivet.** (*Pericrocotus solaris solaris*).

A party of 8 was seen in a tree near Lake Hlawga Rangoon in December last year. This Minivet is not common in Burma and is normally a bird of the higher hills though the party seen by me was at sea level.

12. **Burmese Black-necked Tailor Bird.** (*Orthotomus atrigularis nitidus*).

I met a pair of these attractive little tailor birds in a low bush some 4 miles outside Bhamo in May this year and though I imagine they had a nest somewhere in the vicinity I was unable to locate it. This bird has been recorded from Myitkyina but has not so far as I am aware been seen in the Bhamo area before.

BHAMO, J. A. M. SYMNS.

May 24, 1941.

VIII.—BED BUGS AND SWIFTS.

In volume xli, No. 3 (April 1940) of the *Journal*, Humayun Abdulali has written an interesting note on 'Swifts and Terns at Vengurla Rocks' (Misc. Note No. xi). He describes finding the

Swifts' nests as 'all swarming with a bug which proved on identification to be the common bed bug *Cimex rotundatus*'. Vidal is also recorded as having taken these bugs from the nests of swifts, and Dr. Annandale is reported to have collected specimens of this bug at Calcutta from the nests of the swift.

In an excellent article—'Confessions of a Hunter: Know your animal before you raise your gun', by Roy L. Abbott, Professor of Biology, in the February 1940 issue of 'Natural History' the following para occurs: 'A neighbour's boy and I used to stand for hours 'plinking' with a .22 rifle at the swallows and chimney swifts that sported around our old barn. They were under the ban because they carried bed-bugs. We never learned that the so-called 'Bed-bugs' associated with these beautiful birds were not bed bugs at all; nor did we ever discover that the Chimney Swifts built their pretty little nests in our chimney by gluing sticks together with their own saliva'.

The above article has also been reproduced in Part xl, *Journal of the Society for the Preservation of the Fauna of the Empire*, (August 1940). Can it be that the bugs found in the nests of the Vengurla Swift, and also by Vidal and Dr. Annandale, have been incorrectly identified too—that they are not the true bed bug: as apparently is now known of the swifts in the U.S.A.?

TOBRUK, R. C. MORRIS.
CYRENAICA, LIBYA.
April 19, 1941.

[The insects taken from the swifts' nests at Vengurla were identified at the Indian Museum, Calcutta, as *Cimex rotundatus*, the Bed Bug. EDS.]

IX.—OCCURRENCE OF SWINHOE'S SNIPE IN ASSAM.

Since writing to you on November 8th I have shot two more Swinhoe's Snipe (*Capella megala*), making five bagged in the season. The first was at Haltea, about ten miles south-west of Silchar, on April 24th, and the second was shot in a valley some three miles east of Shillong, on May 2nd. Both were solitary birds, though I bagged some pintail snipe on the same day.

I can confirm Mr. Clough's statement that the Swinhoe's Snipe is slightly larger than the average pintail.

BRIGHTWELL, J. C. HIGGINS.
SHILLONG, ASSAM.
May 26, 41.

X.—HABITS OF THE SEESEE PARTRIDGE.

With reference to my notes in the last number of the *Journal* on the habits of the Seesee Partridge (*Ammoperdix g. griseogularis*) I would now like to add that the remarks as to the silence of these

birds apply only to Waziristan apparently. Formerly I had not shot them outside this Agency and here they do not call either on the ground or on taking off. However last week I was shooting near Attock, and there I heard Seesee calling frequently, much as Chuckor do though not of course the same call note. It could not be reproduced as Seesee however. They also uttered an alarm note when put up which I have never heard up here. They were in addition considerably wilder and got up as a rule at about 30 yards.

TOCHI SCOUTS, T. J. PHILLIPS.
MIRANSHAH,
N. WAZIRISTAN, N.W.F.P.
February 20, 1941.

XI.—RAT-SNAKES FIGHTING.

At 8 o'clock this morning I was informed that cobras were mating in an adjoining garden. I hastened across with a stick to find a pair of Rat-snakes or Dhamans (*Ptyas mucosus*) stretched out at length on the ground under a mango, entwined round one another as when mating. Closer investigation, however, showed that they slithered up and down each other's lengths, and the front part of their bodies raised a foot above the ground, swayed to and fro. People had been watching this for quite a time, and I was begged to destroy these venomous snakes. One was killed and an attempt to catch the other resulted in my holding its tail, while about 2′ of its front portion took refuge in a pile of stones. Two people bracing their feet against the stones, were unable to dislodge the animal, and this was eventually too badly injured to be preserved alive.

Dissection revealed that they were both males, one 7′ 6″ and the other 8′ 3″.

Several people had been watching the proceedings for at least 40 minutes, and everybody was certain that the snakes were mating. The chances are that the males were fighting, but no attempt was made to bite each other. It might be interesting to examine other pairs of snakes apparently *in coitu*.

ANDHERI,
May 6, 1941. HUMAYUN ABDULALI.

XII.—THE MATING INSTINCT *versus* SELF PROTECTION.

(*A Snake and Toad Incident*).

On Sunday the 8th instant, I watched a 2½′ *Natrix piscator* devouring a toad (*Bufo*). A closer examination showed two toads, apparently *in amplexu*. The snake had seized the lower one (female) by the hind legs, and had swallowed about half. The male still

hung on to the female, ignoring the snake whose head was now under its belly! The snake continued to swallow, the male uttering an occasional feeble note. When the snake reached the female's armpits, the male lost interest, calmly stepped off her back and slowly hopped away. I then picked him up and he protested vociferously. An attempt to catch the snake made him disgorge the toad whose hind legs lay stretched out behind her. I did not examine her very closely, but I believe she was dead. Two more *piscator* were seen in a morning's walk, a large one swimming across the stream, apparently carrying a toad (or frog), and a small 10" youngster which hopped off the ground several times, in a vigorous attempt to escape. The monsoon had just broken.

This was in north Salsette, along the Dahisar Nadi.

BOMBAY, HUMAYUN ABDULALI.
June 11, 1941.

XIII.—SUPPOSED CANNIBALISM AMONG SPIDERS IN HIGH ALTITUDES.

In the 'Comity of Spiders' p. 118, Bristowe quotes Hingston as saying that the spiders found on Mt. Everest at 22,000 feet are the highest existing animals on earth . . . . and for food they eat one another. Bristowe doubts this cannibalistic regime, and suggests that thorough search would reveal springtails and other small insects under stones. This receives confirmation from Eric Shipton who told me last year (August 1940) that in July 1935 he found fish insects under rocks collected to build a cairn at the summit of a peak of the Mt. Everest group, height 22,580 feet. (Lat. N. 28° 04′ Long. E. 86° 54′). These and probably other forms of *Aptera* evidently provide food for the spiders on Mt. Everest.

The same solution of the food problem for spiders is to be found in caves. *Collembola*, and rarely *Campodea*, are to be found in Indian lime stone caves. Cave spiders are present remote from the entrances in caves on Moila Tibba near Chakrata. The large adults make webs and apparently depend for food on hatches of fungus gnats, and the chance arrival of insects for hibernation. They live in a very sluggish and semi-comatose state. The immature spiders are however very active, and are to be found running about the cave floor in those situations where *Collembola* (and millepedes) occur.

GEODETIC BRANCH OFFICE,
SURVEY OF INDIA,
DEHRA DUN, U. P.
March 19, 1941.

E. A. GLENNIE,
Colonel,
Regional Recorder (India & Burma),
British Speleological Association.

XIV.—EXTENSION OF THE KNOWN RANGE OF THE BEETLE *ALLOMYRINA DICHOTOMUS* INTO ASSAM.

While I was in Darjeeling during the summer of 1940 I made a small collection of stag beetles for Mr. Gilbert Arrow, F.R.E.S., of the British Museum (Natural History) and sent them to him. As I do not know very much about beetles, a number of Dynastidae were sent along with the stag beetles (Lucanidae). He has just sent me a list of identifications, as follows, of the 15 specimens sent:—

Lucanidae:

Nos. 1-4 *Calcodes castanopterus*, ♂ and ♀.
5 *Dorcus fulvonotalus*, ♂.
6 *Dorcus reichei*, ♂.
7 *Dorcus curvidens*, ♀.
8 *Dorcus antaeus*, ♀.
9-11 *Calcodes baladeva*, ♂ and ♀.

Dynastidae:

12 *Eupatorus hardwickei*, ♂.
13 *Dynastes gideon*, ♂.
14 *Allomyrina dichotomus*, ♀.
15 *Eupatonus hardwickei* var *cantori*, ♂.

Speaking of the specimens of *Allomyrina dichotomus* ♀, he writes: 'No. 14 is of very particular interest to me, as it has never been recorded as an Indian species. . . . . It is known only as a Chinese and Japanese insect and its discovery in Darjeeling is surprising. . . . . The male of *Allomyrina dichotomus* is an extraordinary insect with an enormous head-horn, broad at the end, with four points. I should very much like to see an Indian example. It may prove to differ to some extent from the typical form.'

There is no possibility of any mistake over this addition to the Indian Coleoptera for all the specimens were caught alive and killed personally by me.

DIBRUGARH,
LAKHIMPUR DISTRICT,
ASSAM.
April 12, 1941.

R. E. PARSONS,
F.R.E.S.,
Indian Police.

XV.—A NOTE ON THE ROOT-PARASITISM OF *CENTRANTHERA HUMIFUSA* WALL.

Centranthera belongs to the family *Scrophulariaceae*, and is allied to the genera *Striga* and *Sopubia*, most species of which are known to be root-parasites. The members of the genus *Centranthera* are described in the *Flora of the Presidency of Madras* as 'probably

more or less parasitic', but little or no definite information appears to be available about the parasitism of the South Indian species.

Centranthera humifusa Wall. is not uncommon on the margins of ponds and in other marshy places in the Chingleput District, flowering during the N.-E. monsoon season. It is a small, more or less prostrate herb with stems and leaves rather like those of a striga, but the calyx is spathaceous, and the corolla is funnel-shaped, about .6 in. long, with yellow lobes and reddish-brown striated tube. There are several rather stout main branches to the root system; these branches may be several inches long, are orange in colour, and their surface is finely ridged longitudinally. From these main branches numerous white or almost white thread-like secondary branches spread. These when they come in contact with the slender rootlets of certain other plants attach themselves by small roundish suckers. These suckers are not terminal, as in some root-parasites, for the thread-like rootlet continues and may attach itself to a whole series of rootlets of other plants. Much less frequently a main branch of the root system may be found attached to the root of another plant by a larger haustoria. No root hairs were found on the rootlets of this plant, and so the root-system appears to be entirely parasitic in function. This plant grows in marshy places where the ground is densely occupied by grasses, sedges and other marsh plants, and where the soft wet soil is consequently traversed by a tangled network of rootlets. The fine rootlets carrying the suckers are brittle and the suckers usually separate easily from the host. Consequently, it is difficult to trace the host plant with certainty. Connection was, however, traced to two sedges (*Fimbristylis dichotoma* Vahl and *F. polytrichoides* R. Br.) and to two grasses, one of which was *Iseilema laxum* Hack. The haustoria were also found attached to the nitrifying nodules on the roots of *Desmodium triflorum* DC.

This plant does not appear to be sufficiently common in this district nor sufficiently large to be harmful to crops.

MADRAS CHRISTIAN COLLEGE, E. BARNES.
TAMBARAM,
CHINGLEPUT DIST.,
S. INDIA.

January 25, 1941.

PROCEEDINGS OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

The Annual General Meeting of the Members of the Bombay Natural History Society was held on Wednesday evening, the 25th June 1941, at 6-15 p.m. at the B.E.S.T. Lecture Hall, Electric House, Fort, Bombay, Rt. Revd. R. D. Acland, Lord Bishop of Bombay, presiding.

AGENDA.

1. Reading of the Annual Report of the Committee.
2. Presentation of the Balance Sheet and Statement of Accounts for the past year.
3. Election of the Committee.
4. Such other business as may be properly brought before the Meeting.

The Honorary Secretary announced the election of 57 new members since the last meeting held on 18th April 1940 :—

Mr. A. H. Baker, Bombay; Mr. F. Hessling, Bombay; Rev. R. A. Wilson, Kolhapur; Mr. John H. S. Rawson, North Perak, F.M.S.; Mr. F. J. Connell, Bombay; Mr. F. R. E. Malden, Khaur, Punjab; Mr. C. F. Hoey, Darjeeling; Mr. B. D. Mirchandani, I.C.S., Nadiad; The Superintendent, Municipal Gardens, Byculla, Bombay; The Honorary Secretary, East Indian Railway European Institute, Allahabad; Mr. W. P. Keelan, Dehra Dun; Mr. J. D. Michael, Simla; The Principal, V. V. Training College, Sandhurst Road, Bombay; The Principal, Bengal Agricultural Institute, Tejgaon, Dacca; Mr. B. A. Buckwell, R.A., R.A. Mess, Meerut; Mrs. A. B. M. Way, Jullundur Cantt., Punjab; Shrimant Raja Saheb N. T. Patwardhan of Miraj State; H. H. Sri Jayachamaraja Wadiyar Bahadur, Mysore State; The Commissioner of Agriculture, Baroda State; Mr. W. Meiklejohn, I.F.S., Darjeeling; Major E. J. Palairet, Quetta; Dr. S. Kamesam, B.E., Bangalore; The Director, Tawaza Department, Srinagar, Kashmir; The Conservator of Forests, Orissa, Angul; Major W. E. Merrill, I.A., Dehra Dun; The Director, Indian Forest Ranger College, Dehra Dun; Mr. Madhavlal M. Bhatt, J.P., Bombay; The Conservator of Forests, Holkar State, Indore; Mr. Antonio Vieira Velho, Nova Goa; The Conservator of Forests, N.W.F.P., Abbottabad; Mr. J. A. Douglas, Dehra Dun; Miss A Avdall, Calcutta; The Secretary, Bengal Club, Ltd. Calcutta; The Biology Teacher, Woodstock School, Mussoorie, U.P.; Mr. E. Lehner, M.A., Ph.D., Khodaung, Upper Burma; Mr. E. P. Wiltshire, Shiraz; Mr. E. B. Glenn, Calcutta; The University Librarian, University Library, Mysore, S.I., Mr. D. D. Belayew, Baghdad; The Conservator of Forests, Baroda State; The Station Executive Officer, Kharagpur; Mr. T. R. Stobart, B.Sc., Bombay; Mr. H. B. Gabb, Darjeeling; The Registrar, University of Travancore, Trivandrum; H. E. General Sir Claude Auchinleck, Simla; Kumar Sures Singh Kalakankar, Oudh; H. H. Shri Bhimsinghji Sahib Bahadur, Maharao of Kotah; Mr. R. V. E. Hodson, I.P.S., Government House, Peshawar; The Director, Bose Institute, Calcutta; Mr. James McFarlane, Calcutta; H. H. Maharaja Anandrao Puar Sahib Bahadur, Dhar, C.I.; Mr. M. T. Bam, Meerut; H. E. The Governor of Sind, Karachi; Mrs. S. F. Jarman, Bombay; Mr. J. S. Ker, Calcutta; Miss Maud E. Wolfe Murray, Nilgiris; The Honorary Secretary, Allahabad Club, Ltd., Allahabad.

BOMBAY NATURAL HISTORY SOCIETY.

Office Bearers—1941.

The following gentlemen were elected to serve on the Managing Committee for the ensuing year :—

President.—H. E. Sir Roger Lumley, G.C.I.E., D.L.

Vice Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. Father J. F. Caius, S.J., F.L.S.; Rt. Revd. R. D. Acland, M.A.

Executive Committee.—Mr. Farrokh E. Bharucha; Mr. A. Forrington; Mr. J. B. Greaves, C.B.E., M.L.A., J.P.; Mr. M. J. Hackney; Mr. R. E. Hawkins; Mr. D. H. Hill, F.R.G.S., J.P.; Dr. M. Sharif, D.SC., PH.D., F.N.I.; Lt.-Col. S. S. Sokhey, I.M.S.; Mr. F. Wadia; Mr. H. M. McGusty (*Hon. Sec. and Treasurer*).

Advisory Committee.—Mr. Salim A. Ali; Dr. C. F. C. Beeson, D.SC., M.A., I.F.S.; Lt.-Col. R. W. Burton, I.A. (*Retd.*); Mr. C. H. Donald, F.Z.S.; Dr. F. H. Gravely, D.SC., Mr. C. M. Inglis, B.E.M.E.O.U., F.Z.S.; Mr. R. C. Morris, F.R.G.S., F.Z.S.; Major E. G. Phythian Adams, F.Z.S., I.A.; Dr. Baini Prashad, D.SC.; Mr. H. C. Smith, I.F.S.; Lt.-Col. C. G. Toogood, C.I.E., D.S.O.; Mr. J. H. Williams.

Staff.—S. H. Prater, M.L.A., J.P., C.M.Z.S. (*Curator*); and C. McCann, F.L.S. (*Assistant curator*).

The proceedings concluded with an interesting lecture by Mr. S. H. Prater on 'The Region of Perpetual Night'.

The lecturer developed his theme very interestingly describing first the various factors which affected animal life in the depths of the sea. Prominent among these is the absence of the sunlight and the consequent absence of plant food, the terrific pressure from the weight and volume of water, freezing cold and diminished supplies of oxygen. The lecturer showed how deep sea animals had adapted themselves to life under these adverse conditions. The lecture was illustrated by an interesting series of Lantern Slides and of models of deep sea fishes prepared in the Museum laboratories.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER, 1940.

ADMINISTRATION.

President.—H. E. Sir Roger Lumley, G.C.I.E., D.L.

Vice-Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. Fr. J. F. Caius, S.J., F.L.S.; Rt. Revd. R. D. Acland, M.A.

Executive Committee.—Mr. Farrokh E. Bharucha; Mr. A. Forrington; Mr. J. B. Greaves, C.B.E., M.L.A., J.P.; Mr. M. J. Hackney; Mr. R. E. Hawkins; Mr. D. G. Hill, F.R.G.S., J.P.; Dr. M. Sharif, D.SC., PH.D., F.N.I.; Lt.-Col. S. S. Sokhey, I.M.S.; Lt.-Col. W. C. Spackman, I.M.S.; Mr. F. Wadia; Mr. H. M. McGusty (*Hon. Secretary and Treasurer*)—Bombay.

Advisory Committee.—Mr. Salim Ali, Dehra Dun; Dr. C. F. C. Beeson, D.SC., M.A., I.F.S., Dehra Dun; Lt.-Col. R. W. Burton, I.A., (Retd.), Bangalore; Mr. C. H. Donald, F.Z.S., Dharamsala; Dr. F. H. Gravely, D.SC., Kodaikanal; Mr. C. M. Inglis, B.E.M.B.O.U., F.Z.S., Darjeeling; Capt. R. C. Morris, F.R.G.S., F.Z.S., Coimbatore; Major E. G. Phythian Adams, F.Z.S., I.A., Nilgiris; Dr. Baini Prashad, D.SC., Calcutta; Mr. H. C. Smith, I.F.S., Maymyo; Lt.-Col. C. G. Toogood, C.I.E., D.S.O., Dehra Dun; Mr. J. H. Williams, Coimbatore.

Staff.—S. H. Prater, M.L.A., J.P., C.M.Z.S. (*Curator*); C. McCann, F.L.S. (*Assistant Curator*).

THE HONORARY SECRETARY'S REPORT FOR THE YEAR 1940.

The Society's Journal. The forty-first Volume of the Journal was completed during the year and the first number of Volume XLII was published.

MAMMALS.

The large collections obtained during the Society's Mammal Survey have provided the basis for numerous papers leading to the

revision of Blanford's standard work on Indian Mammals in the Fauna of British India Series. The first volume of the revised edition dealing with the Primates and the Carnivores was published in 1939, under the authorship of Mr. R. I. Pocock. The author now continues his preliminary studies, and during the year we published two papers by him dealing with the Hogbadgers and Otters of British India. Hogbadgers, whose name aptly describe their curious appearance, are not found in Peninsular India, but are fairly widely distributed to the north and east of the Bay of Bengal. There has been considerable difference of opinion about the status and correct nomenclature of the many forms and species, described by various authors. Blanford, accepting the views of certain previous writers, recognized two Indian species—The Large Indian Hogbadger (*Arctonyx collaris*), found in the Eastern Himalayas and Burma, and a smaller animal (*A. taxoides*), confined more or less to Assam and Arrakan. Pocock, accepting the verdict of recent American authorities, recognizes but a single species, represented in the various areas of its wide range by racial forms. His conclusion is based on a study of examples of practically all the hitherto described forms, which, though they do not provide complete evidence of intergradation, yet offer sufficient evidence to support his view. Two races of the Hogbadger occur in India—the typical form (*A. collaris collaris*), which inhabits the Sikkim Terai, the Bhutan Duars and Assam, and a second form, with a larger head and body, which Pocock describes as a new sub-species under the name *A. collaris consul.* It is found in Assam, Burma, and Tenasserim.

Pocock's paper on Indian Otters is again an attempt to clear the confusion around this group of animals. It is almost impossible, from the plethora of names and vagueness of descriptions, to fix the identity of the various species. The three Indian species included in Blanford's work under the genus *Lutra* are now separated under three distinct genera: *Lutra,* the so-called Common Otter, *Lutrogale,* the Smooth Otter, and *Amblonyx,* the Clawless Otter. An interesting point connected with the distribution of otters in India has been brought to light as a result of the study of the material collected by the Society's Mammal Survey. It has been discovered that the distribution of the Common Otter and the Clawless Otter is parallel to the discontinuous distribution of the Thar and the Pine Marten, which are found in the Himalayas and nowhere else in India, except in the hill ranges of the south. Similarly, these two otters occur both in northern and southern India, but are absent from the central area of the Peninsula. Mr. Pocock in his paper describes two new races—the South Indian form of the Clawless Otter (*Amblonyx cinerea nirnai*), and a desert race of the Smooth Otter (*Lutrogale perspicillata sindica*) from Sind.

The pages of the Society's *Journal* where sportsmen and naturalists for half-a-century have recorded their observations have become an encyclopaedia from which one may now write the natural history of many Indian animals. Such is Col. R. W. Burton's paper on the Indian Wild Dog. It is a *resumé* of all that has been recorded

in the *Journal,* over the space of 50 years or so, on these interesting animals. Among other matters discussed, is the old question, so often raised by sportsmen, as to whether there is a large and small race of wild dog in India. Packs of females, which are slighter in build, with their young, have probably given rise to the notion. Fresh evidence that wild dogs can be tamed, if taken in hand very young, is provided. The subject was first raised in our *Journal* some 40 years ago, when a writer, who made the experiment, said that for 'gameness, staunchness and invincible tenacity', he was convinced that there was no breed of domestic dog to compare with his domesticated wild ones.

Questions put to the Society often lead to investigations which produce interesting results. Some time ago we received an enquiry from the Editors of the *Encyclopaedia Britannica* as to the number of tigers shot annually in India. While there are no reliable means of ascertaining the numbers of tigers killed in open forests, reasonably correct data can be obtained relative to forests under State control. The figures made available by the Chief Conservators of Forests with the various Provincial Governments and States, show that approximately 650 tigers were killed in controlled forests in India, in the year 1937-8. The enquiry also shows that tigers are more numerous in the forests of northern India, particularly in the United Provinces. The numbers are well maintained in the Central Provinces, but, as one goes farther south, there is a distinct decrease in the tiger population. Another interesting point is that there appears to be a far larger number of males than females. In Northern and Central India, the proportion averages at about 2 to 1. A similar predominance in the number of males was revealed by actual censuses taken some years ago in Palamau Division of Behar. Lastly it has been shown that the granting of rewards for shooting tigers or their withdrawal has had little effect on the numbers shot in British India. The whole subject is discussed in a note by Mr. Prater, the Society's Curator, published during the year under review.

Mr. McCann's contributions to the *Journal* are always interesting. His papers include one on the Fulvous Fruit Bat (*Rousettus leschenaulti*) in which he discusses the life history and habits of a species, which is not an uncommon pest in orchards and fruit gardens in Western India. His study of the feeding habits of this bat supports the discovery he made a few years ago when investigating the food of the flying-fox. His conclusion is that these large fruit bats do not absorb solid food. All that passes into their stomachs is nectar, or the juices of fruit masticated by them. Solid pulp, seeds and skins are rejected through the mouth. The litter under a tree where fruit bats have been feeding is this rejected matter. There is after all a substratum of truth in the popular Indian belief that flying-foxes and bats excrete through their mouths.

Birds.

The Ornithological Survey of Mysore State was completed during the year. The work was undertaken with the co-operation

of the American Museum of Natural History, New York, which paid part of the costs. Financial assistance was also received from the Mysore Government. Reports embodying the results of the Survey will shortly be published in the *Journal*. Of the many bird surveys carried out by the Society, this was perhaps one of the most successful. Our thanks are due to Mr. Salim Ali, who had charge of the work, and to various officials and friends in Mysore who assisted him. In the course of the last ten years or so the Society's Ornithological Surveys have covered the greater part of India. They have been directed particularly to areas which were little known ornithologically. They have helped substantially to provide a truer picture of the status and distribution of Indian birds. Like the Mammal Survey for mammals, these Bird Surveys undertaken by the Society have made more imperative a revision of the standard work on the Indian avifauna. During the year under review we published Part II of the Birds of Central India, being reports of surveys carried out by Mr. Ali in Bhopal, Gwalior, Indore, and Dhar.

Burmese birds feature in notes on the Birds of Nattaung, Karenni District, contributed by Messrs. H. C. Smith, P. F. Garthwaite, and B. E. Smythies, Burma Forest Service. The birds of the Karen Hills have been the subject of scattered notes and observations, and the present paper provides the first connected account of the bird life of this interesting zone. We should like to take this opportunity to congratulate the writers of this paper on their recently published book on *The Birds of Burma*—an excellent work which summarizes the present day knowledge of Burmese birds, and gives in simple language an account of the ways and habits of the various species. Coloured illustrations of 290 species, excellently done, quite apart from their attractiveness, supply exactly what is wanted by laymen. The people of Burma are indeed fortunate in having this well written and well illustrated work on the bird life of their Province, which serves as an attractive guide and is well directed to increase interest in and knowledge of Burmese birds.

A feature of our *Journal* during recent years has been Mr. E. H. Lowther's well written and beautifully illustrated notes on Indian Birds. Mr. Lowther's enthusiasm as a camera hunter and his enjoyment of birds and their ways enlivens what he writes. We are glad indeed that we have been able to persuade him to publish his notes and fine pictures—a thing he was at first very reluctant to do. His 'Sportsman's Gallery' which we published during the year gives charming pictures of some of our commoner game birds. A second article by Mr. Lowther is associated with many happy memories of camera hunting in the Manbhum District, revived here in vivid description and in excellent pictures.

Fishes.

Three parts of Dr. Hora's serial on the Game Fishes of India were published. They deal with the Mahseers. The Large-scaled

Barbels collectively known as 'Mahseer' include a number of species and forms about whose status and correct distribution there is little exact knowledge. All anglers know of the mighty Mahseer, *Barbus tor*. But which particular species answers to its description, and where is this true Mahseer found? In the present state of our knowledge it is not possible to be precise as to the range of *Barbus tor* in the rivers of India. All that can be said is that this particular species is widely distributed in the rivers and streams debouching from the Himalayan foot hills into the adjoining plains. A second species *Barbus* (*tor*) *mosal* appears to be commoner in Burma than in the Himalayan streams. A third north Indian species dealt with by Hora is the Bokar of the Eastern Himalayas and Assam, *Barbus l. hexagonolepis*. Coloured illustrations and descriptions of these species are included in Dr. Hora's papers.

The intensive development of irrigation in the Punjab, involving the construction of masonry dams and weirs across its rivers, has had an adverse effect on its inland fisheries. Many species of food fishes living in those rivers are migratory. During the breeding season, they ascend to the higher reaches for spawning. The dams and weirs constructed for irrigation purposes have become serious obstacles to the spawning movements of the fishes. It is true, that the weirs are provided with fish ladders to permit the upward passage of fish, but Dr. Hamid Khan's investigations have shown that most of the ladders, from their faulty construction, serve little practical purpose. The weirs and dams remain a serious obstacle to spawning movements. The effect is increasingly demonstrated in the very considerable reduction in the stock of fishes in the upper reaches of the rivers. Barriers to spawning movements, ineffective provision for surmounting them, and last but not least the whole-sale indiscriminate slaughter of fishes in the canals during the close season, are all factors responsible for the steady deterioration of the inland fisheries of the Province. While the supply of water for the development of irrigation is supremely important, there is little reason for the needless sacrifice of a valuable source of food supply. In his paper Dr. Hamid Khan shows what is wrong with the existing fish-ladders, and what should be done to make them serve the purpose for which they were constructed. His recommendations deserve the serious consideration of the Government.

Detailed information of the life history of larvicidal fishes, particularly of species of proved utility in the destruction of mosquito larvae are essential to the practical use of these natural agents. A paper published under the joint authorship of Messrs. S. Jones and T. Job describes the earlier stages in the development of the Deccan Killifish (*Apolcheilus lineatus*), a species reported to be of special value in mosquito control. The habits of a second larvicidal species (*Horaichthys setnai*) are discussed in a second paper by T. Job, from observations made on fry collected in the backwaters of Cochin and Travancore. The author's conclusion is that this species is suitable for use in malarious coastal areas and that it is particularly effective in destroying mosquito larvae in the earlier stages of development.

Reptiles.

Mr. McCann's reptile and amphibian miscellany contains a wealth of notes and observations on crocodiles, lizards, and frogs. You might quite easily come upon Mr. McCann prowling around his house in the dead of night looking for lizards with an electric torch. For many months, a pet crocodile occupied the damp quarters behind his bath tub, tortoises make free use of his garden, while frogs and toads in homely aquaria, not to mention crowded jars of pickled reptiles, are prominent in the decorative scheme of his house. But of such stuff are naturalists made and from such enthusiasm is derived the intimate knowledge that Mr. McCann has brought to his very interesting paper. His notes on the food, breeding habits, and development of common Indian reptiles form the substance of his miscellany. They add much to the little that is known about even the commonest species.

Worli Hill, one of the seven Islands which went into the making of our fair city of Bombay, has been the subject of study by various geologists, most recently by the late Mr. J. Rebeiro, who published the results of his work in our *Journal*. Below the thick mass of morum and trap which make up the dome of the hill lie highly interesting sedimentary deposits in which the most persistent fossil is the frog. The presence of these frogs indicate that the deposits were originally laid in freshwater, suggesting that what subsequently became an island was once part of the mainland. The frogs have been described by various authors, and, because of their toad-like characters, were included by Noble in a special genus, *Indobatrachus*. Specimens collected by Mr. G. W. Chiplonker of the Hindu University, Benares, are described by him as a new species under the name *Indobatrachus trivialis*.

Invertebrates.

Butterflies and Moths.—Part II of Major-General Sir Harry Tytler's Notes on New and Interesting Butterflies from Burma was published during the year. Owing to the death of the author the manuscript of this part was edited by Mr. G. Talbot, who also corrected the proofs of both parts. The present part deals with the *Nymphalidae*, *Erycinidae* and *Lycaenidae*, and contains descriptions of 32 new races. Capt. W. C. Carrott continued his notes on the butterflies of the Shan States and added supplementary data to his original paper published during the previous year. In 1931, we published an account of the butterflies of the Simla hills by Mr. G. W. De Rhe-Phillipe, much fresh information made available subsequently has made revision of the original paper necessary. This work was undertaken by Mr. M. A. Wynter-Blyth with the assistance of Mr. A. E. Jones. The present paper covers an area roughly corresponding with the Simla Hill States and records some 277 species. Reference is also made to species known from the surrounding territory, which are likely to be met within the area—in all the paper provides a very useful and up-to-date working list. The authors acknowledge their indebtedness to Brigadier

Evans for his help in identifying many of the species listed by them. Students and collectors in India, studying the earlier stages of Indian butterflies and moths are frequently handicapped by the lack of any information about the food plants of caterpillars. Mr. D. G. Sevastopulo's informative article on the food plants of Indian Bombyces is therefore welcome. It summarizes such information as the author has been able to find on the food plants of the caterpillars, adds supplementary information from personal experience and makes suggestions from what is known of the feeding habits of allied species in other countries.

Mr. G. C. Bhattacharya wrote an interesting account of what he describes as the 'Death March of the Hibiscus Caterpillars.' An orderly procession of caterpillars was seen moving in single file—their objective a mimosa plant growing in an earthen pot. The procession climbed the wall of the pot and arrived on its circular rim. Following the circle, the leading caterpillar soon found itself at the tail-end of the procession. Its ingrained instinct to follow in the wake of the preceding caterpillar compelled it to follow the procession. In a persistent circle the procession travelled day and night, till one by one its members dropped dead from exhaustion, the last survivors of the interminable journey succumbing on the 6th day. The processionary instinct, highly effective in bringing the caterpillars to their destination proved disastrous in the novel circumstances in which they found themselves. They were unable to deviate by a hair's breadth from an instinctive mode of behaviour. They followed its tyrannical urge even unto their own destruction.

Economic Entomology is represented by a paper on the Wax Moth (*Achroia grisella*), a pest of honeycombs. The authors, Messrs. M. C. Cherian and S. Ramachandra, discuss the status of the moth as a pest in the Coimbatore District and suggest control measures. The distribution, life history, and habits of *Galerucida bicolor,* a minor pest of cultivated yam, were recorded by Dr. T. V. Ramakrishna Ayyar.

Much has been written on the courting habits of spiders. The perils braved by the male in courting the female, usually his superior in physique and prowess, has no parallel in the animal kingdom. Not infrequently the too presumptuous male meets his death and is added to the larder of his mistress. Such tragic courtship is however not as universal among spiders as is generally stated. Among some tribes, the relation between the sexes is more pacific and may even approach domesticity. Among the Leaping Spiders (*Attidae*) courtship takes the form of a love dance. Professor Montgomery in his interpretation of this dance believes that even this apparently nonchalant behaviour of the male is prompted by fear and that the antics of the dance are for the most part exaggerations of the spider's ordinary reaction to fear and timidity. Mr. Mathew, in his interesting study of the courtship of an Attid Spider (*M. plataleoides*), shows that in this species the antics of the male are the ordinary 'on guard' movements which the spider carries out normally in the face of any suspected danger. The female is not immediately recognized, as the eyes of the male give it, at any distance, but a vague impression of what confronts it.

But, in circumstances where the male is sure that it is dealing with a female of its own species, such as when it takes a female in its nest, or is familiarized with her presence as co-captives in a cage, the dance is dispensed with. The partners come to terms without the preliminary demonstration. The male of this spider is stronger and more powerfully built than the female and has no special reason to fear her, but nevertheless he adopts his defensive attitude till recognition is completed by actual contact with his desired partner.

Botany.

The three parts of Father Caius's serial on Medicinal and Poisonous Plants published during the year deal with the very large family of Composites and with the Flaxworts. It has been said that there is no plant drug used in medicine the world over which cannot be grown and produced in India, and yet India continues to be largely dependent on external supplies for her needs. The exigencies of war have however given a great impetus to the development of local products. Such data as the author is now providing in his papers on local medicinal plants is a timely and valuable contribution to the development of Indian plant products.

Mr. N. L. Bor continues his serial on Beautiful Indian Climbers and Shrubs. When completed these articles will be produced as a companion volume to the book by Blatter and Millard on *Beautiful Indian Trees*. The last named work is now out of print and we are unfortunately unable to meet the many demands made on us for copies. A second edition under present conditions would mean a considerably enhanced cost. We must wait for better times. We anticipate the same demand for Mr. Bor's work when it appears in book form and the question of expediting publication of the serial in the *Journal* by issuing a larger number of parts is now being considered. Another serial in course of publication in the *Journal* is M. Sayeedud-din's work on Common Indian Herbs. Parts 3, 4 and 5 were published. We also commenced publication of a work on the Flora of the Punjab by Dr. T. A. Sabnis. The work is based on the author's study of the plant collections in the Herbarium of the Forest Research Institute, Dehra Dun, and incorporates notes made by the various collectors.

Ecological methods can be applied to many different branches of animal or plant biology. This is a wide and almost virgin field in India both for zoologists and botanists, we therefore welcome Mr. S. V. Ganapati's study of the conditions in a temple tank which are conducive to the development of an algal pest, *Microcystis aeruginosa*, which is found in permanent bloom in many tanks in Madras City. The death and decay of these plants not only affect the taste of the water, but also give it a characteristic foul odour. The author discusses the physical and chemical conditions which favour the development of these algal growths. In the particular tank studied, the most important factors favouring development were the high temperature of the water, absence of movement, and the high content of phosphates and organic manurial elements. Parallel studies of the physical, chemical, and biological conditions

of the many ponds in Madras, which contain this pest, would help to disclose the reasons for its permanent productivity and for the periodically malodorous condition of the water. Apart from its scientific interest, such a study would be of decided significance from the health point of view.

Shooting and Fishing.

Shikaris who have never bagged a rogue elephant and would like to, are recommended by Mr. Hall to go to Assam as the most likely spot for realizing the ambition. In his very entertaining and vigorous style Mr. Hall describes his adventures with rogue elephants in Assam, down to the grand *finale* enacted in a village, at night in pyjamas and slippers. The meeting of Mr. Hall and the elephant in the pitch blackness of a rainy night amid a frantic chorus of screaming, panic-stricken men, women and children, and the subsequent happenings have all the spice of adventure that the most exacting could wish for. In the same number we published Major Phythian-Adams' account of small game shooting in Mysore. Particularly interesting are the author's records of game shot over a number of years. They reveal that Pintail Snipe occur in far larger numbers than Fantail in Southern India; among duck, the Spot-bill is the commonest, Shoveller and Pintail making a bad second and third; among the migratory Teal, the Garganey appears in much the larger numbers, while among the resident species, the Cotton Teal is the most common. In all, the State affords quite good opportunities for small game shooting, and the author shows what these opportunities are, and how they can best be enjoyed.

Col. R. W. Burton, to whose account of the ways of wild dogs we have already referred, contributed three other articles to the *Journal*. These deal with fish and fishing. His Mahseer River of Southern India is the beautiful Bhavani, or rather, that stretch of it, some 10 miles above Mettupalaiyam where the river debouches from a rocky gorge into an open valley and, for 25 miles or more, becomes wonderful fishing water. August and September is the time of the year for fishing in it. Col. Burton writes as one who knows our streams and forests, as well he may, having taken, for so many years, so much of his pleasure from them. The story of his visit to the Laccadive Islands makes equally delightful reading and provides those who would like to spend a holiday off the beaten track with useful and interesting information. There are coral reefs to explore, blue lagoons to fish in, *barracouda* and other tough game fish in the seas around, and friendly islanders and skilled fishermen for company. Col. Burton's last article has to do with Sword fish in the seas off New Zealand. It is a far cry from the coasts of India; but big-game fishing is one of the many attractions that New Zealand has to offer to its visitors. We take this opportunity of thanking Col. Burton for his effort to provide popular reading in the *Journal*. Col. Burton is one of the Society's 'old guard,' his first contribution to our pages was written 35 years ago. During all the intervening years he has frequently shared his varied reminiscences of sport in the Indian jungles with our readers.

We have constantly expressed the hope that more of our members would do this. It is true we are living in much more rigid times when leisure hours are fewer. But the charms of the jungle and the wild will always remain and those who enjoy them may yet share their good fortune with the many who cannot. Accounts of shooting, fishing, and travel are always welcome in our *Journal*. If you have experiences to write about, please send them to us.

Publications.

Snake charts.

During the year we brought out a new edition of the Snake Chart. It has since been made available to most of the Hospitals and Dispensaries in India, and to many Schools and Colleges.

Poisonous Land Snakes of India.

A book on the Poisonous Land Snakes of India is in course of preparation and we hope to publish it during the present year. Part I of this work which contains descriptions of our poisonous snakes has been written by Dr. Malcolm Smith of the British Museum. Part II, which has to do with snake poisoning and its treatment will be the work of Dr. Burgess Barnett, the author of recent discoveries relative to the use of Russell's Viper's venom as a blood coagulant in surgery. Wall's Poisonous Terrestrial Snakes, which was published by the Society and which ran into four editions has long been out of print. The new book will provide a modern standard work on a subject of much interest both to doctors and laymen in India.

The Book of Indian Birds.

This year will also see the fulfilment of a long cherished plan to provide a moderately priced and well illustrated book on Indian Birds. The Book of Indian Birds by Salim Ali exactly supplies this need. It contains 171 full page picture plates in colour, numerous photographs and simple readable accounts of the habits, food, and nesting of the common birds seen about towns and villages in the plains of India and around our coasts. People have always wanted a book like this. The Society has now provided it.

Birds of Bombay and Salsette.

Of more local interest is the work on the Birds of Bombay and Salsette which appeared in the *Journal* in serial form and which has now been issued as a Museum Pamphlet with the series of other pamphlets dealing with the Fauna of Bombay and Salsette.

Nature Calendar.

In 1941, for the first time, the Society published a Natural History Calendar. It was an eleventh hour decision, but in spite of this the 1,300 copies which we issued were sold out almost as soon as they appeared, and many late applications had to be turned down. The illustrations, for which we are indebted to Major R. S. P. Bates, Mr. E. H. N. Lowther, Mr. T. R. Hubback, and Major C. L. Boyle were of course the making of the calendar,

and we hope we may rely on the support of these gentlemen in the production of future efforts along similar lines. The 1942 Calendar is already in course of preparation, and there is every reason to believe that this will prove an increasingly popular innovation.

Revenue Account.

Our total income for the year was Rs. 29,340-10-6 as against Rs. 27,091-9-0 in 1939, an increase of Rs. 2,249-1-6, but even so we failed to meet expenses by Rs. 3,548-10-4. Fortunately we carried forward a surplus of Rs. 5,000 from the last balance sheet, and enquiries received to date indicate that Salim Ali's Bird Book is going to be a marked success. The Society's Calendar was also very well received, and I think we can view the coming year without any misgivings.

Membership.

4 members died during the year. Only 25 members resigned as against 44 new members who joined; but we have written off 41 members who have not paid their subscriptions for some years. Total membership is 810 compared with 836 at the end of 1939.

Acknowledgments.

The Council of the Society would like to record its appreciation of the continuous help which the Society has received from Mr. W. S. Millard. Ever since he left India in 1919, and relinquished his post as Honorary Secretary, Mr. Millard has continued his interest in the Society and has given it invaluable assistance particularly in connection with printing of plates and publications issued by the Society in London. On behalf of the members of the Society we offer him our sincere thanks.

Our sincere thanks are also due to Mr. Theodore Hubback for the generous contributions he has made to cover the cost of plates issued with his interesting articles on Malayan Wild Life. Mr. Hubback's interest in the work of the Society and the assistance that he has repeatedly given us is deeply appreciated.

Staff.

The Committee wish to record their appreciation of the good work done by the Curator and his staff during the past year.

15th April, 1941.

H. M. McGUSTY,
Honorary Secretary.

Dr. *Cr.*

INCOME AND EXPENDITURE ACCOUNT OF DONATIONS FOR SPECIFIC PURPOSES FOR THE YEAR ENDED 31st DECEMBER, 1940.

	Rs A P	Rs A P		Rs A P	Rs A P
Fund No. 1					
To Expenditure on Fish Gallery, etc. ...	95 0 0		By Unexpended Balance as per last Balance Sheet		336 10 7
,, Balance carried to Balance Sheet ...	241 10 7	336 10 7			
Show Cases Fund No. 2					
,, Balance carried to Balance Sheet ...		145 15 11	,, Unexpended Balance for Show Cases in New Building as per last Balance Sheet		145 15 11
Special Journal Fund					
,, Expenditure on Journals	2,215 6 6		,, Unexpended balance (Special Journal Fund) as per last Balance Sheet ...		2,885 5 4
,, Balance carried to Balance Sheet ...	669 14 10	2,885 5 4			
Ornithological Survey					
,, Expenditure on Ornithological Survey ...	1,058 3 0		,, Unexpended balance as per last Balance Sheet		2,546 8 0
,, Balance carried to Balance Sheet ...	1,488 5 0	2,546 8 0			

BOMBAY, *15th March, 1941.*

Examined and found correct.
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants, Auditors.

(Sd.) H. M. McGUSTY,
Honorary Treasurer.

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Large-flowered Thunbergia
THUNBERGIA GRANDIFLORA Roxb.
(½ nat. Size.)

JOURNAL
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1941. VOL. XLII. No. 4.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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PARTS VIII AND IX.

(*Continued from Vol.* xlii, No. 3 (1941), p. 471).

PART VIII.

(*With* 1 *coloured and* 5 *black and white plates and* 10 *text-figures*).

Thunbergia Retzius.

The genus *Thunbergia* was erected by Retzius in honour of Karl Peter Thunberg, professor of Botany at Upsala, who died in 1828.

The species of *Thunbergia* (family Acanthaceae) are mostly tall perennial climbers which are favourite garden plants on account of the beauty and profusion of their flowers. They are extensively cultivated in all parts of the world and in India, where several are indigenous. A good many species are hardy out of doors and are extremely decorative if grown to the best advantage.

CHARACTERS OF THE GENUS.

The leaves are opposite, petiolate (sessile in *Thunbergia natalensis*) on the usually swollen joints of the stems, rarely subentire, more usually lobed or toothed in various ways; the nerves are, in

most cases, palmate, i.e. they arise and spread from the top of the petiole. The flowers are large and showy and are arranged in terminal pendulous racemes or solitary or in pairs in the axils of ordinary leaves. Each flower is temporarily enclosed in a spathe consisting of two large bracteoles cohering along the margins. The calyx is very short, sometimes a mere rim, or, more often, crowned by 10 to 15 teeth. The corolla has a narrow or widely infundibuliform, often curved, tube ending in five sub-orbicular lobes all spreading, or a campanulate and strongly curved tube arising from the short cylindrical or conical base ending in five lobes of which the upper two are erect. The stamens are four in number usually in pairs with filaments of different lengths, inserted in the lower portion of the tube and included. The anthers are two-lobed and are glabrous or with a fringe of hairs along the margins, or the lobes bearded at the base or furnished with a crest of hairs; sometimes one or both lobes spurred. The ovary is seated upon a large annular disk, which is often larger than the ovary. The ovary is 2-celled with 2 collateral ovules in each cell; style straight or curved, surmounted by a stigma which may be obconical in shape or, more often, distinctly 2-lipped, with the upper lip erect and the lower spreading. The pollen grains are globose, without germ pores, but with one or more often spirally twisted grooves. The fruit is shaped rather like a bird's head and consists of a globose 2-celled capsule crowned by a stout beak. On dehiscence the beak splits violently from apex to base and the seeds are flung out. The seed is semiglobose in shape with a large pit on the inner side.

The brightly coloured flowers of the species of *Thunbergia* are an indication that the process of fertilisation is carried out through the agency of insects. The construction of the flowers however is such that only insects with certain characteristics are suitable for the purpose.

Taking the flower of *Thunbergia grandiflora* as an example, it will be observed that it can be divided into three portions; a lower conical portion which directly surrounds the ovary and nectary, a tubular-ventricose portion which carries the four stamens in a groove on its upper surface, and the spreading lobes. The spreading lobes are usually brightly coloured and their function is merely to attract an insect. The tubular portion is important as the transference of pollen must take place within it. As already stated the four stamens lie together in a groove on the upper surface of the corolla tube. On the lower surface of the tube inside is a bulge corresponding to a groove on the outside. This bulge ensures that the back of any visitor is pressed well up against the anthers on the roof. The anthers of the upper pair of stamens are pressed closely together and form a convenient groove in which lies the style. The anthers of the lower pair lie on either side of the upper pair. The style itself expands into the cup-shaped stigma a little in advance of the stamens. The filaments of the stamens though compressed are swollen at the base and the four of them are so placed that they practically block the entrance to the chamber in which the ovary is situated. A small foramen is left

through which passes the style. The anthers are bearded with long thin hairs and bear one or two horny hooks on their posterior margins. The nectary which secretes the honey is a fleshy disk surrounding the ovary.

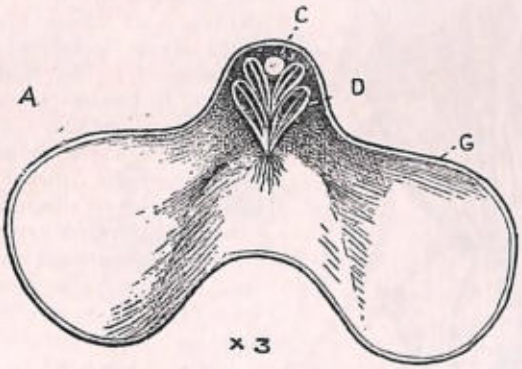
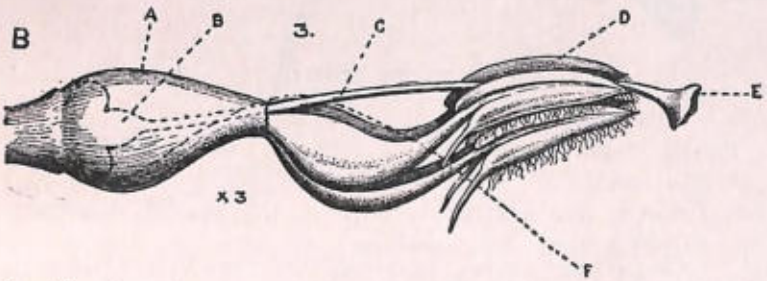


Fig. 1. A.—Cross section of corolla showing position of style and stamens; note the curvature of the corolla which ensures that the insect will touch the stamens.



B.—Side view of stamens ovary and style; corolla tube removed. A, base of corolla; B, ovary-seated on nectary disc; C, style; D, stamens; E, stigma; F, path to honey which must be followed by proboscis of insect; G, corolla.

The first thing that happens when an insect visits the flower is that its dorsal surface touches the viscous lower lip of the stigma which is pressed down and any pollen which the insect is carrying is transferred. The insect pushes on still further and comes into contact with the hooks on the anther, which results in pollen being shaken down upon its back and thorax. Owing to the smallness of the hole at the base of the stamens and its distance from the honey only insects with a long proboscis can reach the booty. The proboscis must be passed upwards over

the style and then downwards to reach the honey. As the insect retreats its pollen-dusted back presses up the lower non-viscous edge of the stigma and prevents self-fertilisation.

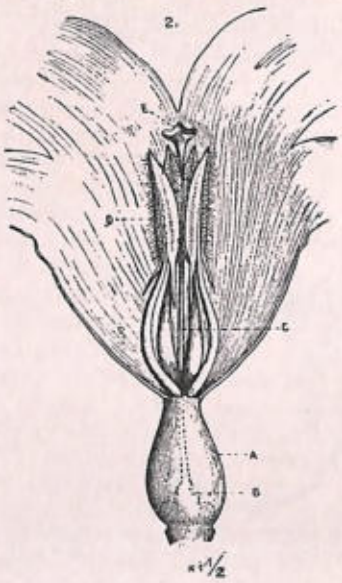


Fig. 2.—Front view of stamens ovary and stigma with portion of the corolla cut away. (See Fig. 1. for explanation of lettering.)

Burkill[1] observed the process of cross-fertilisation in this species in Calcutta and discovered that the agents were *Xylocopa latipes* and *X. aestuans*. The bodies of these bees just fit the antrum of the flower and the proboscis is sufficiently long to reach the honey. He observed that the dorsal surfaces of the insects were dusted with pollen on their emergence from the flower. A further refinement in the mechanism of pollination is when the stigma has two lips the lower of which is non-receptive. This lip touches the back of the insect and drags down the upper receptive lobe which duly collects the pollen from the back of the visitor without any danger of self-fertilisation.

Key to the Species.

Flowers axillary, solitary.
- Petioles winged. ... ... *T. alata.*
- Petioles wingless.
  - Colour of flowers white ... ... *T. fragrans.*
  - Colour of flowers blue or purple.
    - Plant erect.
      - Leaves petiolate ... ... *T. erecta.*
      - Leaves sessile ... ... *T. natalensis.*
    - Plant climbing. ... ... *T. grandiflora.*

Flowers in terminal or axillary racemes.
- Flowers blue.
  - Leaves broadly ovate, cordate at the base. ... *T. grandiflora.*
  - Leaves ovate oblong to lanceolate-oblong, rounded at the base. ... ... *T. laurifolia.*
- Flowers yellow. ... ... *T. mysorensis.*
- Flowers scarlet. ... ... *T. coccinea.*

---

[1] Burkill, I. H., *J.A.S.B.* (1906) 511-14.

Thunbergia alata Boj.

BLACK-EYED SUSAN.

(*alata* is a Latin word meaning winged and refers to the wings on the petiole).

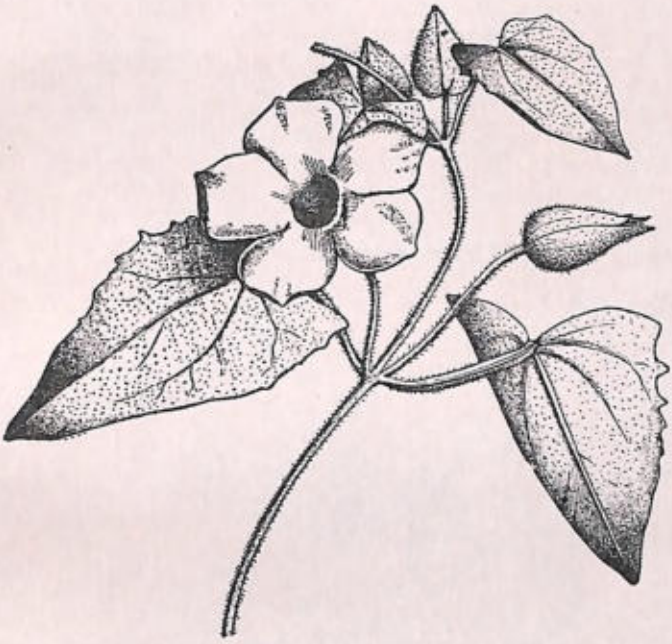


Fig. 3.—*Thunbergia alata* Boj. ×¾.

Description.—A slender herbaceous twiner with very hairy shoots. Leaves opposite, seated on a narrowly winged petiole which is often as long as the blade, sagittate in shape, up to 2 in. long by 1.75 in. wide, acuminate, pubescent on both surfaces and hirsute on the nerves beneath; margin entire, undulate, with one or two broad teeth on either side. Flowers axillary, seated on peduncles which are shorter than the subtending leaves. Bracteoles spathe-like, ovate, apiculate, pubescent on both surfaces and hirsute on the margins, persistent, about 0.5 in. long. Calyx very short, bowl-shaped, surmounted by 10 subulate lobes, covered with glandular hairs. Corolla tube infundibuliform, 0.75 in. long and 0.2 in. wide in the throat, ending in five yellow, orange or rarely white lobes, deep claret coloured in the throat. Stamens four, one pair of filaments shorter than the other; anthers of the lower pair with two spurs, those of the upper with only one spur, densely fringed along the margin and at the base with long club-shaped hairs. Ovary seated in a cup-shaped disk; style 0.5 in. long; stigmas 2-lipped, the upper lip about twice as long as the lower but much narrower.

Flowers.—September-November. Fruits cold season.

Distribution.—Native of south-east Africa. Cultivated or naturalised throughout India.

Gardening.—This twiner closely resembles *Thunbergia fragrans*, but is softly villous and has winged petioles and usually yellow flowers with a brown or purple eye or sometimes shades of buff or orange or even white. It is well suited for a small trellis-work. Propagated usually by seeds. There are several varieties but the following are commonly seen in cultivation:—

Thunbergia alata Boj. var. *alba* Paxt. has white flowers with a blackish centre.

Thunbergia alata Boj. var. *aurantiaca* Kuntze is a variety with bright orange flowers having a dark centre.

Medicinal use.—In Malaya the leaves are made into poultices which are applied to the head to relieve headaches.

Thunbergia fragrans Roxb.

(*fragrans* is Latin for fragrant. Why this epithet should have been applied to this plant, which has odourless flowers, is not known).

Description.—A slender herbaceous twiner with scabrid, or more or less glabrescent, shoots. Leaves opposite on slender

Fig. 4.—*Thunbergia fragrans* Roxb. ×1/1.

wingless petioles which are usually shorter than the blade, lanceolate, or triangular-ovate, cordate or subcordate at the base, almost hastate, up to 2.5 in. long by 1 in. wide, toothed on both sides

Photo by *M. N. Bakshi*

Thunbergia fragrans Roxb.
New Forest, Dehra Dun.

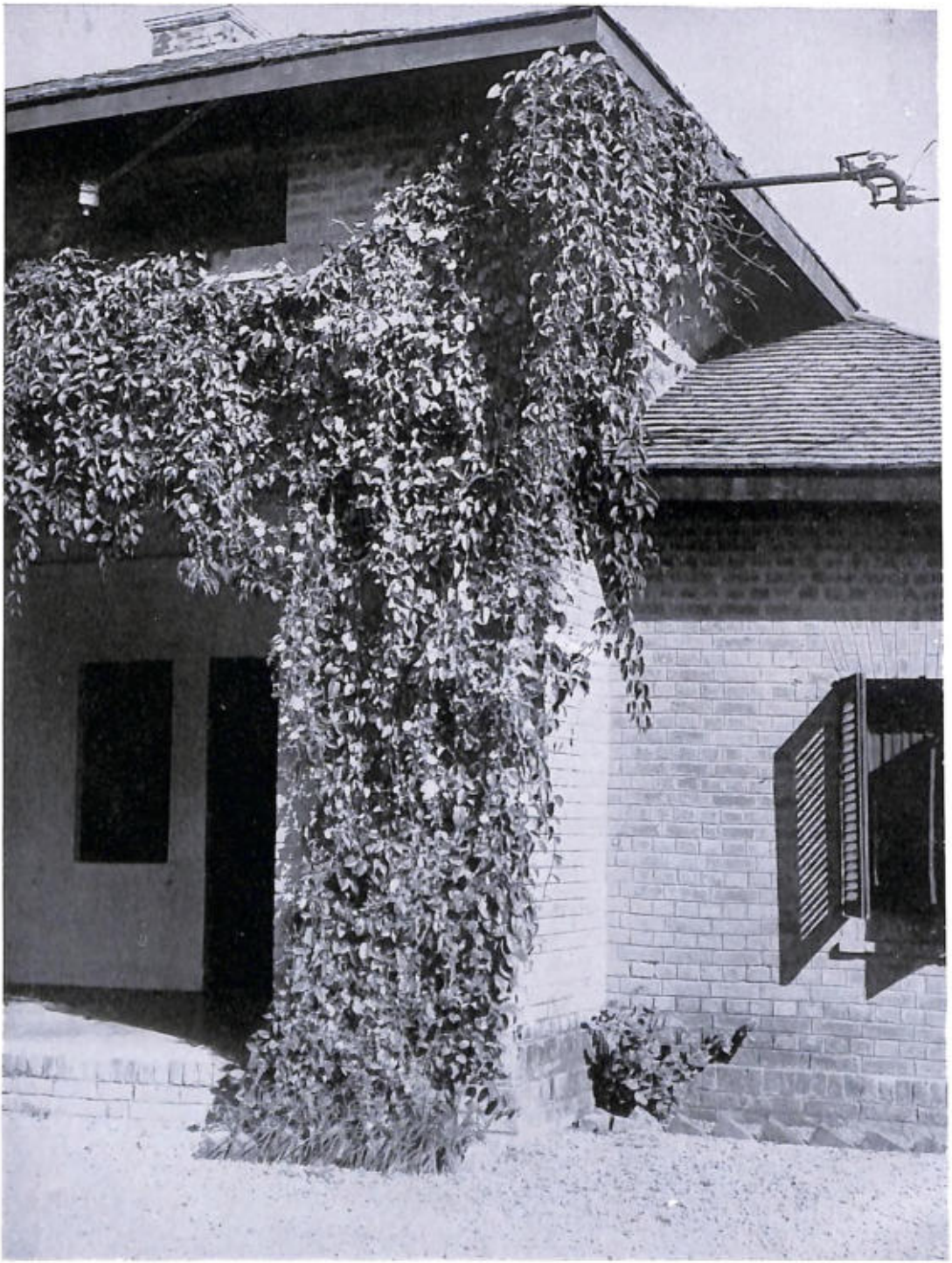


Photo by *M. N. Bakshi*

Thunbergia fragrans Roxb.
New Forest, Dehra Dun.

at the base, more or less rough on both surfaces, palmately 5-nerved. Flowers axillary on peduncles which are usually longer than the subtending leaf. Bracteoles spathe-like, ovate or ovate-lanceolate in shape, less than 0.75 in. long, persistent. Calyx bowl-shaped, very short, surmounted by 15 subulate teeth, glandular-pubescent. Corolla tube infundibuliform, about 1 in. long, white and without fragrance, lobes spreading about 0.75 in. in diameter. Stamens in pairs, the filaments of one pair as long as those of the other which are about 0.5 in. long; anthers entirely glabrous and without spurs. Ovary seated in a disk; style nearly 1 in. long; stigma 2-lipped, the upper lip slightly longer and narrower than the lower lip. Capsule scabrid. Seeds reticulate.

Flowers.—September-November. Fruits cold season.

Distribution.—Throughout India and Malaya.

Gardening.—A herbaceous climber with beautiful snow-white flowers. Easily propagated by seed which it produces abundantly. It is suitable for growing over a screen. Contrary to what the specific name would seem to denote, the flowers are not fragrant.

Thunbergia erecta (Benth.) T. Anderson

(*erecta* is Latin for upright and refers to the habit of the species).

Description.—This species is a small shrub which in Indian gardens reaches a height of about 4 feet. The shoots are quadrangular in section and each angle bears a narrow wing, glabrous when old but the younger are covered with a mantle of short crisp hairs near the nodes; buds in the axils of the leaves densely covered with short golden or reddish hairs. Leaves opposite, exstipulate, but connected at the base by a raised ridge across the node, petiolate (petiole 0.1 in. long), ovate-elliptic, acute and apiculate, subacute at the base, glabrous, penninerved but the first pair often arise near the base; margin entire, undulate, or occasionally with a broad triangular tooth above the middle. Flowers axillary, solitary or paired, seated on peduncles up to 1.5 in. long, usually much less. At the top of the peduncle are a pair of greenish white bracteoles, spathe-like, early or tardily deciduous. Calyx very short, bowl-shaped, surmounted by 15 subulate calyx-teeth, densely covered with gland-tipped hairs. Corolla tube 1.5-2.5 in. long, glandular outside, slightly conical at

Fig. 5.—*Thunbergia erecta* (Benth.) T. Anderson × ½

the base swelling above, infundibuliform, curved, ending in five subequal lobes; yellowish white at the base, central portion cream shading into the dense violet lobes and mouth, ochre-coloured in the throat. Stamens four, in pairs, the filaments of one pair 0.5 in. long, of the other 0.4 in. long, covered with short gland-tipped hairs. Anthers shortly awned or mucronate, with a thick fringe of hairs along the margins. Ovary seated in an annular disk. Style up to 1.5 in. long; upper lip of the stigma erect and folded, the lower spreading and very broad.

Flowers.—Chiefly during the cold weather.

Distribution.—Native of west tropical Africa, but is a very common cultivated plant in gardens throughout India.

Gardening.—A hardy shrub, very pretty when in full bloom during the cold season. It thrives best in bright sunshine and is well adapted to the topiarist's art. Easily propagated by cuttings during the rains. It was introduced into India from Kew in 1859.

Thunbergia erecta (Benth.) T. And. var. *alba* is a variety with white flowers, but it is by no means as beautiful as the type.

Thunbergia natalensis Hook.

(The specific name refers to the home of the plant).

Fig. 6.—*Thunbergia natalensis* Hook. × ½

Description.—An erect shrub, 2 ft. or more high, with four-angled stems, which are almost hirsute in specimens grown at Dehra Dun but are stated by Hooker, Bailey and others to be glabrous except at the internodes. Leaves opposite, somewhat crowded, sessile or very shortly petiolate, ovate-acute or acuminate, sinuate-dentate, cordate at the base, palmately 3-nerved, slightly scabrous on both surfaces, glabrous above, hairy on the nerves below, 4 in. long by 2 in. broad. The axillary solitary flowers are seated on peduncles which are shorter than the subtending leaf-blade. Bracteoles at the top of the peduncles herbaceous, 3-nerved, hirsute on the nerves, ovate, spathaceous, nearly as long as the corolla tube, to which it is closely appressed. Calyx bowl-shaped with six blunt teeth. Corolla 2 in. long, shortly conical below swelling above into an infundibuliform curved tube and ending in five obcordate, nearly equal, horizontally spreading lobes. Stamens four; filaments nearly equal, filiform, thickened towards the base; connective bluntly apiculate, anther cells shortly spurred and bearded below. Ovary seated in

Photo by *M. N. Bakshi*

Thunbergia erecta (Benth.) T. And.
New Forest, Dehra Dun.

Photo by *N. L. Bor*

Thunbergia erecta (Benth.) T. And.
New Forest, Dehra Dun.

a fleshy disk. Style as long as the corolla tube, obconic, supporting a concave stigma, glandular-hairy and bearded below the stigma. Capsule 1.25 in. long, densely hairy or glabrous.

Flowers.—April-May. Does not fruit in Dehra.

Distribution.—Native of Natal; but now cultivated in gardens throughout India.

Gardening.—An undershrub up to 2 ft. high with handsome pale blue flowers; the corolla tube yellow, 2 in. long. Propagated by cuttings.

Thunbergia grandiflora Roxb.

(*grandiflora* means large-flowered in Latin).

Description.—A large woody climber reaching a height of 20 feet or more. Shoots four-angled or -ribbed, shortly hairy, rough, becoming smoother and glabrous with age. Leaves opposite on the swollen nodes, petiolate, (petioles up to half the length of the blade, twisted at the base and scabrid) cordate at the base, palmately 7-nerved, coarsely toothed or lobed, 4 in. long by 3-4 in. broad, ovate-acute or ovate-acuminate in shape, very rough on both surfaces. Flowers sometimes solitary in the axils of ordinary leaves, but more often, appearing as terminal pendulous racemes, pedunculate (penduncles up to 2 in. long). At the top of the peduncle will be found two velvety, obliquely obovate or oblong bracteoles which are persistent. The calyx is reduced to a velvety rim. Corolla tube shortly conical at the base, then very widely and obliquely campanulate, up to 2.5 in. long, ending in five lobes, the upper two of which are erect and the others spreading. The upper surface of the corolla tube is grooved to take the stamens and style. Corolla whitish in the lower half shading into the blue lobes; yellow inside with blue stripes in the throat. Stamens subequal; filaments about 0.4 in. long, flattened and corrugated at the base where they almost occlude the entrance to the lower conical portion of the tube. Anthers of the lower stamens 0.3 in. long, both cells spurred; those of the upper 0.4 in. long with only one cell spurred; margins densely fringed with long thin hairs. Style 1 in. long; upper lip of the stigma folded and erect, the lower spreading. Capsule shaped like a bird's head 1-2 in. long.

Flowers.—March-November. Fruits cold season.

Distribution.—Native of Eastern Bengal. Commonly grown in gardens in the plains throughout the country.

Gardening.—A very extensive climber with pendent branches, and dark, green, heart-shaped leaves. It bears large bluish flowers from March right through the rains. It is of a very luxuriant growth, and if allowed to climb a lofty tree will cover it with a dense green curtain of foliage. It can, however, be made to flower when small, by judicious close pruning. Easily propagated by cuttings or layers during the rains.

Medicinal use.—A decoction of the leaves is said to be used in Malaya for stomach complaints. The leaves are used as a poultice.

Thunbergia laurifolia Lindl.

(*laurifolius* means having leaves like a laurel).

Fig. 7.—*Thunbergia laurifolia* Lindl. ×⅔.

Description.—A shrubby climber with terete, smooth and glabrous stems. Leaves opposite, petiolate, oblong-lanceolate, acuminate, rounded at the base, glabrous and smooth or slightly rough on both surfaces, palmately 3-nerved at the base, reticulation prominent below, up to 7 in. long, 2 in. broad; margins entire or distantly toothed; petioles up to 3 in. long, thickened at the apex and base. Inflorescence in pendulous axillary or terminal racemes. Individual flowers pedicellate. Bracteoles spathaceous, cohering along the upper margin, herbaceous. Calyx very small, cup-shaped; margin crenulate. Corolla tube cylindrical or broadly conical at the base, swelling above, obliquely funnel-shaped, very wide at the mouth. Lobes five, rotundate, emarginate, spreading. Stamens four, inserted near the base of the tube; filaments broad subulate curved. Anthers oblong, apiculate with two subulate spurs at the base; margins fringed. Ovary globose, sunk in the crenately-margined, fleshy disk. Style long, included; stigma two-lobed; lobes channelled.

Flowers and Fruits.—Cold season.

Photo by *M. N. Bakshi*

Thunbergia grandiflora Roxb.
New Forest, Dehra Dun.

Distribution.—Upper and Lower Burma, Andamans and the Malay Peninsula, now common in gardens throughout the country.

Gardening.—A large climber which bears during the cold season large lavender-blue flowers in profusion. It is suitable for growing over walls or strong trellis work. Yields seeds abundantly. Propagated by seed or layers.

Medicinal use.—In Malaya the juice of the leaves is said to be efficacious in cases of menorrhagea. It is also applied to the ears for deafness.

Thunbergia mysorensis T. Anderson.

(*mysorensis* refers to the home of the plant).

Fig. 8.—*Thunbergia mysorensis* T. Anderson ×½.

Description.—A glabrous twining shrub with slender glabrous, often twisted, stems. Leaves opposite, ovate-lanceolate or narrowly elliptic-acuminate in shape, 4-6 in. long by 1.25-2 in. broad, broadly cuneate at the base, sinuate, entire or toothed on the margins; basal nerves 3, prominent with conspicuous venation between; petioles .5-1.5 in. long. Flowers large, in long pendulous interrupted racemes. Bracteoles spathaceous enclosing the corolla tube, ovate-oblong, 1 in. long, parallel-nerved, margins cohering in the bud. Calyx very shallow, salver-shaped; margins obscurely lobed or crenulate. Corolla tube purple, 2 in. long, shortly conical below, swelling above and ending in four lobes, the upper lobe erect with reflexed side lobes, the lower lip of 3 subequal spreading lobes. Lobes bright yellow or maroon, spotted with yellow or brown. Stamens four; filaments hairy at the base; anthers bearded with

a short spur at the base of each cell. Ovary immersed in the thick fleshy disk; style long; stigma cup-shaped. Capsule 1.25 in. long, glabrous, seeds rugose.

Flowers.—Cold season. Seldom fruits in Dehra Dun.

Distribution.—South India in the Western Ghats, South Canara and Mysore to Travancore and Tinnevelly up to 3,000 ft. Cultivated in the plains throughout India.

Gardening.—An extensive glabrous climber with long slender branches; flowers in long pendent racemes bright yellow or orange, or maroon with a purplish tube. Usually shy of seeding and has to be propagated by layering.

Thunbergia coccinea Wall.

(*coccineus* is a Latin word meaning scarlet-coloured, and refers to the bright scarlet flowers of this species).

Fig. 9.—*Thunbergia coccinea* Wall. ×¾.

Description.—A slender climbing and widely spreading twiner. Stems and shoots 4-angled, the angles shortly winged, smooth

and glabrous. Leaves opposite, shortly petioled (petiole twisted), cordate at the base, ovate-lanceolate or ovate, acuminate, the lower variously toothed, the upper entire on the margin, undulate, palmately 5-nerved, smooth and glabrous, green above, somewhat glaucous beneath, up to 5 in. long, 3 in. broad; nerves prominent on the lower surface.

Flowers in terminal or axillary pendulous racemes, up to 3 feet long. Individual flowers shortly or long-pedicelled. Bracteoles 0.5-0.75 in. long, large, spathaceous, cohering along the margins, concave, ovate-acuminate in shape, including the whole flower except the lobes which are reflexed back over them, brown in colour. Calyx bowl-shaped surmounted by 10 or more blunt triangular teeth. Corolla tube infundibuliform, orange in the throat, enclosed in the bracteoles, 5-lobed, emarginate, scarlet, lobes being reflexed over the exterior margins of the spathe. Stamens four, in pairs, the filament dilated at the base; anther cells spurred, the lower with two spurs, the upper with one only. Ovary seated in a disk. Capsule globular; beak short, blunt.

Flowers.—December-March. Fruits March-April.

Distribution.—Outer Himalayas from Kumaon eastwards, Khasia hills, Tenasserim, commonly cultivated in gardens throughout India.

Gardening.—A widely spreading climber with long pendent branches. It bears during the cold weather scarlet or orange flowers in lax pendulous racemes about a foot or more in length. Usually multiplied by layers during the rains.

Part IX.

(*With* 1 *coloured and* 4 *black and white plates and* 3 *text-figures*).

Sophora Linn.

(The generic name is derived from the Arabic name, Sophera, for *Cassia sophera* Linn.).

Sophora belongs to the sweet-pea family (Papilionaceae) which is so well known as to obviate the necessity of a description. The genus itself comprises trees and shrubs with alternate, stipulate, odd-pinnate leaves. The flowers are arranged in racemes or panicles and are yellow or violet-purple in colour. The calyx is gamosepalous, oblique, broadly campanulate in shape, surmounted at the top by short, deltoid teeth. The corolla consists of five clawed petals. The upper petal is broad, erect and is termed the standard or vexillum; the two side petals are narrower and are called the wings or alae; the 2 lower petals loosely connate by their lower margins are the narrowest and form the so-called keel or carina. The stamens are 10 in number, free or obscurely joined at the very base; the anthers are versatile. The ovary is shortly stalked, with many ovules on the ventral suture. The pod is constricted between the seeds and is termed moniliform, that is, somewhat like the beads on a necklace.

The species of this genus are valued for their pretty often fragrant flowers, and for their handsome foliage and curious pods. They are inhabitants of the warmer countries of the world but mainly at high altitudes, and therefore some of them have been introduced with success into Europe. *Sophora japonica* L. was introduced into France by Jussieu in 1747, and is common in that country and in Germany. It has been found that it is capable of withstanding the smoke-vitiated atmosphere of towns especially in the neighbourhood of railway stations.

The brightly coloured and fragrant flowers indicate that these plants are cross-pollinated through the agency of insects.

As has already been said the leaves of *Sophora* are odd-pinnate, that is, they are composed of an odd number of leaflets arranged on either side of a central rhachis. The leaflets can be distinguished from ordinary leaves by the fact that they do not possess a bud in the axil of the stalklet or pulvinus. During the night some of these species arrange their leaves in the sleep-position. Towards nightfall the pulvini move and the leaves drop downwards and their under surfaces are pressed together. This is one of the ways in which a plant avoids loss of heat and water through excessive transpiration.

Several Sophoras are well known for their poisonous properties. This is due to the presence of an alkaloid which is variously known as sophorine or cytisine. It is a very dangerous drug causing convulsions and death. The seeds and roots of *Sophora tomentosa* Linn. contain cytisine, and are used as remedies in small doses for cholera and diarrhoea.

SOPHORA TOMENTOSA Linn.
(nat. Size.)

The unopened flower buds and pods of several species give a yellow dye; when used in conjunction with the indigo plant (*Indigofera flaccidifolius*) the resultant colour is green. In Baden, Germany, the unopened flower buds are used to colour Easter eggs. In Japan this yellow dye is said to be used exclusively to dye the garments of the Royal House.

The wood being extremely hard is of use in joinery and parquetry.

KEY TO THE SPECIES.

Flowers yellow.

Leaflets up to .5 in. long ... ... *S. Griffithii.*
Leaflets 1 in. long or over ... ... *S. tomentosa.*

Flowers blue to violet.

Leaflets leathery, over 1 in. long ... ... *S. secundiflora.*
Leaflets soft, up to .5 in. long ... ... *S. viciifolia.*

Sophora Griffithii Stocks

(The specific epithet commemorates the name of William Griffith (1811-1845) one of that noble band who did so much for Indian Botany in the early nineteenth century).

Description.—A small, erect deciduous shrub. Young twigs densely hoary. Stipules minute, villous, often persistent after the fall of the rhachis. Leaves alternate, compound, odd-pinnate, 4-8 in. long. Leaflets 21-41, opposite or alternate, .25-.5 in. long, ovate, oblong or obovate in shape, thick, rigid, glabrous above when mature, densely appressed silvery-velvety beneath.

Inflorescence of pedunculate racemes from old leaf scars, 1.5-5 in. long; peduncle usually leaf-bearing. Flowers .7 in. long, yellow, appearing with the young leaves; pedicels silvery hoary, .1-.2 in. long, in the axils of hoary buds. Calyx gamosepalous, very oblique, .2 in. long, densely appressed hoary, ending in 5 shorter triangular teeth. Petals 5, yellow; standard longer than the keel, markedly veined, almost orbicular in shape, emarginate at the top, ending below in a long strap-shaped claw; wings obliquely oblong-obtuse, clawed below, toothed on either side above the claw; keel of two petals loosely connate along the lower margins, upper margin toothed above the claw. Stamens ten; filaments free to the base.

Fig. 1.—*Sophora Griffithii* Stocks. × ½.

Ovary hirsute with appressed white hairs; style slender, incurved; stigma capitate. Pod up to 4 in. long, with four winged ridges, constricted between the ellipsoid seeds, hairy.

Flowers.—March-April. Fruits hot season.

Distribution.—Salt Range and trans-Indus hills, Baluchistan, Afghanistan and Persia. Occasionally cultivated in gardens in India.

Gardening.—A small shrub with velvety, silvery grey leaves and large bright yellow flowers appearing shortly before or with the leaves. Usually propagated by seed.

Sophora tomentosa Linn.

(*tomentosus* means hairy in Latin).

Description.—A large shrub or small tree, the whole plant being covered with a soft grey-velvety pubescence. Leaves alternate, odd-pinnate, 6-10 in. long, with 15-19 leaflets; rhachis terete, tumid at the base; leaflets often alternate on the rhachis, shortly stalked, 1-1.5 in. long, broadly elliptic in shape, rounded or obtuse at both ends, dull grey-green in colour, thinly downy above, the lower surface covered with a dense pubescence; margins somewhat reflexed.

Inflorescence a terminal raceme up to 6 in. long. Individual flowers pedicellate, often crowded; pedicels densely silky, bracteate, .25-.3 in. long, jointed just below the calyx. Calyx tube broadly campanulate, almost truncate with 5 very small obscure lobes, minutely silky, oblique, .25-.4 in. long. Corolla yellow, of 5 petals. Standard long clawed, .6-.75 in long; blade orbicular or elliptic, slightly emarginate. Wings oblong-obtuse, narrow, clawed. Keels of two narrow, clawed petals. Stamens 10; filaments free to the base or nearly so. Ovary shortly stalked, linear, tapering at the apex, densely hairy; style straight; stigma capitate. Pod long-stalked, issuing from the persistent calyx, moniliform, the joints being separated by narrow necks as long as themselves, pointed, covered with a brown velvety down; seeds 1-8 in each pod, .35 in. in diameter, nearly globular, pale brown.

Flowers.—Rainy season with a second flush in the cold weather. Fruits cold season.

Distribution.—Cosmopolitan in the tropics on the sea coast. Widely cultivated in gardens throughout the plains of India.

Gardening.—The shining, dark green, handsome foliage of this shrub contrasting with its bright yellow flowers, render it a very ornamental plant. Unfortunately in Dehra it is liable to be infested by a caterpillar which at times strips it of all its leaves and beauty. Easily raised from seed during the rains. It is apt to be damaged by frost in northern India.

Medicinal and Economical uses.—The seeds and roots of this plant contain the alkaloid cytisine and are considered medicinal in Malaya. Small doses of it are used as remedies in cases of cholera and diarrhoea. According to Heyne pounded leaves are applied on wounds caused by certain poisonous fish.

Burkill says that the timber is hard and heavy, but is not much used.

Photo by *M. N. Bakshi*

Sophora griffithii Stocks
New Forest, Dehra Dun.

Photo by *M. N. Bakshi*

Sophora griffithii Stocks
New Forest, Dehra Dun.

Photo by *M. N. Bakshi*

Sophora tomentosa Linn.
New Forest, Dehra Dun.

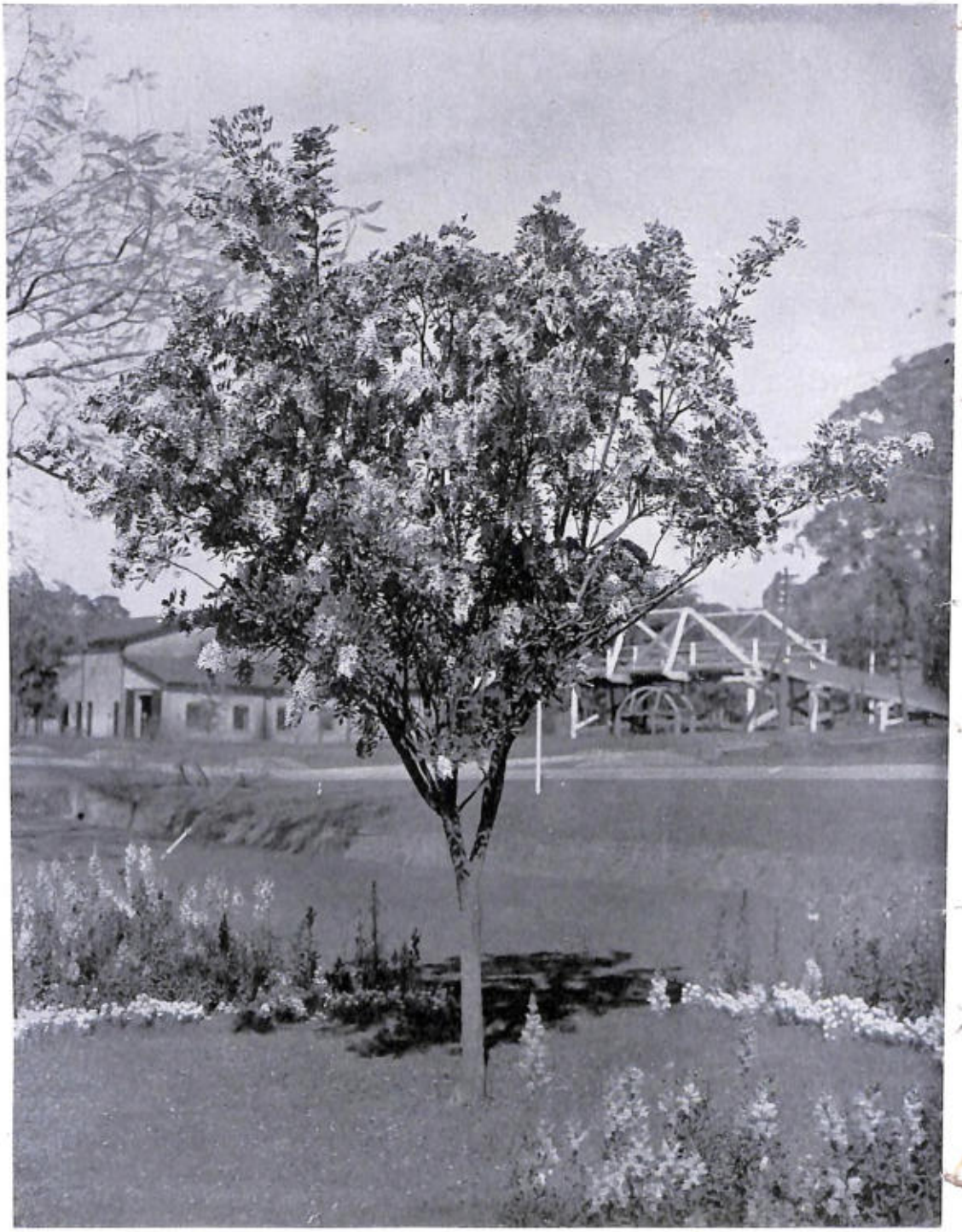


Photo by *M. N. Bakshi*

Sophora secundiflora DC.
New Forest, Dehra Dun.

Sophora secundiflora Dc.

(*secundiflora* is a Latin word meaning flowering to one side, from the fact that the flowers are arranged in one-sided racemes).

Fig. 2.—*Sophora secundiflora* Dc. ×½.

Description.—An evergreen shrub or a small tree, which may reach 35 ft. in height, with smooth bark and young shoots covered with an appressed silvery pubescence. Buds ovoid, densely covered with short hairs. Leaves compound, alternate, odd-pinnate, 4-6 in. long, with 7-9 leaflets; rhachis glabrous or hairy, grooved on the upper surface; leaflets opposite, dark green and shining, rather leathery, evergreen, oblanceolate or obovate in shape, with swollen pulvini, 1.25 in. long, emarginate at the apex; nervation reticulate, very prominent below.

Inflorescence of one-sided, terminal racemes, 2-3 in. long. Individual flowers very fragrant, about, 1 in. long, pedicelled; pedicels .3 in. long, supported by a bract and bearing two small bracteoles halfway up, covered with silvery, appressed pubescence. Calyx gamosepalous, .3 in. long, including the lobes, brown in colour, covered with appressed pubescence, lobes 5, the upper broadly obtuse, the lower four deltoid in shape. Petals five; standard oblong, .5 in. long, .5 in. wide, cordate at the apex, contracted into a strap-shaped claw below; wings and keel obliquely oblong, rounded at the tip, sagittate at the base, with a strap-shaped claw. The petals

are violet-blue or pale blue in colour, and the standard has a few darker spots near the base. Stamens 10, equal; filaments slightly connate at the base, inserted on the hypanthium. Ovary narrowly elliptic-oblong, stipitate, covered with coarse hairs, .3 in. long; style slender, curved, glabrous; stigma small, capitate. Pod 1-7 in. long, ·5-·75 in. in diameter covered with white hairs, constricted between the seeds. Seeds bright scarlet.

Flowers.—March-April. Fruits rainy season.

Distribution.—Indigenous to the Southern United States and North Mexico; now frequently cultivated in gardens throughout the plains of India.

Gardening.—A shrub or a small tree with short slender trunk and upright branches forming a narrow head. Flowers fragrant, handsome, violet-blue. It is a very free flowering and ornamental plant but its growth is slow. Raised from seed sown during the rains.

Medicinal and economic uses.—The seeds of this species are poisonous due to the presence of the alkaloid cytisine or sophorine. This alkaloid if taken in big doses causes nausea, then convulsions and finally death by asphyxia.

Sophora viciifolia Hance

(*viciifolius* expresses in Latin the similarity of the leaves of this species to those of Vicia (the Vetch), another genus of the family).

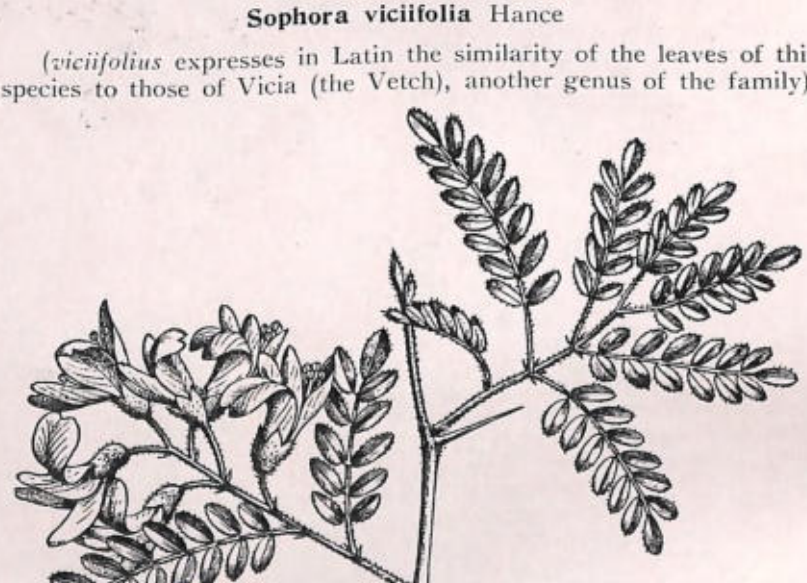


Fig. 3.—*Sophora viciifolia* Hance ×½.

Description.—A small shrub reaching 6 ft. in height with striate stems. Lateral branches covered with short white hairs, often

arrested and then appearing as spines. Stipules spinescent. Leaves alternate, compound, odd-pinnate, up to 2 in. long; rhachis cylindrical, covered with short appressed silvery pubescence; leaflets 11-15, almost sessile, .25-.5 in. long, oblong or elliptic, obtuse, mucronulate, glabrous above, covered with white pubescence beneath; nervation, apart from the mid-rib, obscure.

Inflorescence of short axillary or terminal 6-12-flowered racemes. Individual flowers seated on hairy pedicels .3 in. long, bluish violet or nearly white in colour. Calyx gamosepalous, violet in colour, membranous, shortly 5-toothed, cylindrical in shape, somewhat oblique, covered with appressed pubescence. Petals 5; standard spathulate-obovate, reflexed, clawed; wings oblong-obtuse, with a tooth on one side; keel-petals clawed, oblique. Stamens 10; filaments free or slightly connate at the base. Ovary stipitate, oblong, pointed at both ends, covered with coarse hairs; style curved, glabrous, slender; stigma capitate, small. Pod 2 in. long, slender, long-beaked.

Flowers.—March-April. Has so far not fruited in Dehra.

Distribution.—Indigenous to Central and Western China, now cultivated in various parts of India.

Gardening.—The violet calyx makes an attractive contrast to the milky white corolla of this hardy graceful shrub. It was introduced into the Royal Gardens, Kew, in 1898, where it flowered for the first time in July 1902. Easily grown from seed.

(*To be continued*)

THE BIRDS OF BAHĀWALPŪR (PUNJĀB)

BY

SÁLIM ALI.

(*With a map and 4 plates*).

Thanks to facilities afforded by H. H. The Nawab's Government it became possible to undertake the much-desired survey of the bird life of Bahāwalpūr State in the early part of 1939. During the period from 27 January to 24 March 331 specimens, representing some 115 forms, were collected in addition to a considerable amount of field notes and ecological data. Unfortunately the time was far too short for any but the most superficial study of some of the problems peculiar to desert conditions; the aim of this paper is mainly to place on record the present position of the avifauna so as to provide a basis for comparison at some future date when irrigation and colonisation will have altered the face of the country still further.

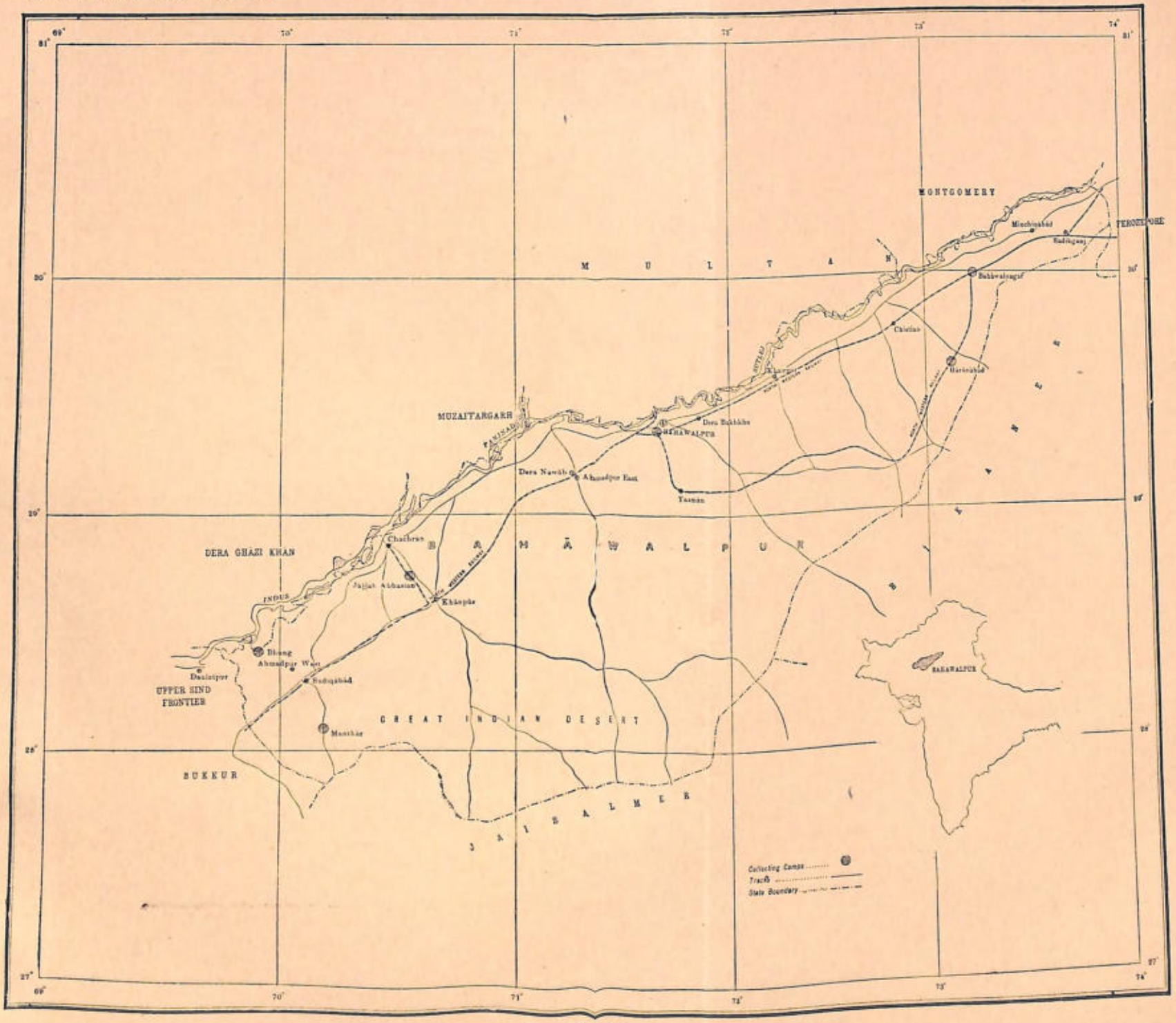
Bahāwalpūr State in its present phase is a particularly promising venue for the study of plant and animal successions since, like other similar canal-irrigated tracts in the Punjāb and Sind, it is undergoing a process of profound physical changes, before our eyes as it were. The vast system of irrigation canals originating in the Sutlej River, which has been completed and brought into operation within the last 30 years, is responsible for this magical transformation. Arid, sun-scorched sandy wastes, broken only by a dreary succession of shifting sand-dunes and dotted with a sparse and scanty growth of desert plants, are being rapidly converted into a prosperous, green and intensively cultivated region punctuated by large leafy Banyan, Peepal, Neem and other trees sheltering the newly sprung homesteads of the colonists, and by thriving forest plantations of Shisham trees (*Dalbergia Sissoo*).

I must again record my thanks to Mr. Hugh Whistler for the precise determination of the material collected and for his useful taxonomical notes (in square brackets) thereon. Also for his many helpful suggestions from time to time before, during and after the work in the field. For we were then still at that happy period of our civilisation, now alas in total eclipse, when aeroplanes did not mainly signify bombers or fighters, but were the means of that speedy and peaceful concourse between the ends of the earth which enabled our close and constant collaboration in dealing with various problems as they arose in the field.

PHYSIOGRAPHY.

Bahāwalpūr State, covering an area of 15,918 square miles, lies in the extreme south-west of the Punjāb between 27° 42′ and 30° 25′ N. and 69° 31′ and 74° 1′ E. Its northern boundary runs along the Sutlej, Chenāb and Indus rivers. In the south-west the Sukkur District of Sind abuts on to it, while south and south-east

80°
81°
30°
25°
23°
17°
69°



MAP OF BAHAWALPUR STATE

Scale approx. 1" = 32 miles.

31° 69'
30°
29°
28°
27° 69'

it is bordered by the Rājpūtāna desert States of Jaisalmēr and Bikanēr. The greatest length of the area from N.-E. to S.-W. is about 300 miles, the mean breadth being about 40.

Devoid of hills and streams except the pools and backwaters of the great rivers on its northern boundary, e.g. the duck-shooting *dhands* at Jajjāh-Abbāsiān, the State is divided lengthwise into three great strips. Of these the first—the southernmost and broadest—is a slice of the Great Indian Desert, largely with rolling sand-dunes and known as Rōhi or Chōlistān. It is separated from the adjacent tract by a depression known as the Hakra, the ancient bed of some bygone river and variously ascribed to the Sutlej, the Ghaggar and the Jumna.

The central tract is chiefly flat desert or *pat* country a large portion of which has recently been brought under cultivation by means of canals. The third is a fertile, irrigated, narrow, alluvial tract in the river valley, called the 'Sind'. In the ecological notes that follow these three tracts will be referred to as I, II and III respectively.

The elaborate network of irrigation canals and the colonisation of erstwhile wastelands, is tending more and more to alter the character of the landscape and to obscure the demarcation between these three longitudinal belts. The central belt and the riverain are fast losing—or have already lost in many parts—their distinctive characters and are often difficult to distinguish. The canals have not stopped at the central belt, but in many sectors have made considerable inroads into the Chōlistān itself, thus depriving large areas of their truly desert character. But the desert still holds sway over much of its pristine domain and any vast change in the hinterland is unlikely, at least for a considerable time.

The climate is characterized by excessive drought. Rainfall is scanty and irregular, the annual precipitation for the State as a whole rarely exceeding 5″. Most of this falls during the S.-W. monsoon season, but some also in winter. From April to the middle or end of June the mean shade temperature is 103°F. The air is dry and the wind scorching, so that the growth of vegetation is imperceptible. But with only 1″ of rain a miraculous transformation takes place and the country becomes fresh and green. After November the mean temperature falls to 60° or 65°F with frosty nights.

Vegetation corresponds with the physical aspects of the three divisions. The scenery of the fertile riverain with its countless date palms especially lining the inundation canals, is almost Egyptian or Mesopotamian in character. A belt of tamarisk jungle stretches for miles along the river. In the other two tracts (II and I) wherever irrigation canals have not altered the aspect, sparse desert scrub—characteristic of so much of the Punjāb and Sind—holds sway. Most prominent among the species here met with are the Kandi (*Prosopis spicigera*), the Ak (*Calotropis gigantea*), the Wild Caper (*Capparis aphylla*), *Salvadora oleoides*, the Lāni and Lāna (species of *Salsola*), and *Suaeda* spp. In Chōlistān there are, moreover, stretches of Khar (*Haloxylon Griffithii*).

The desert areas worked by the survey are mainly (1) Yazmān (20 miles south of Bahāwalpūr town), (2) Manthār (14 miles south

of Ahmadpūr Lamma) and (3) Hārūnābād (at the eastern end of the State). Of these three localities more or less pure desert conditions now prevail only at Yazmān. In the proximity of the newly introduced canals there are scanty fields of sirsūn (mustard), wheat and gram. Immediately beyond stretches a succession of sand-dunes with their typical shrubs, interspersed with extensive *pats* of firm level ground. The sand-dunes in places are hard crusted, but for the most part they consist of loose, rippled, wind-blown sand. Amongst the scanty xerophytic vegetation, the two species of *Salsola*, locally known as Lāni and Lāna, predominate.

Manthār, while in general retaining its typically desert character, represents a further stage in the evolution of the canal colonies. The desert is here encroached upon to a greater extent than at Yazmān since this area was canalised and opened up to cultivation some years earlier. The soil has, however, proved to be poor and subject to water-logging, and large patches are *kallar* and covered with a deposit of salt. The usual desert shrubs are in evidence around the 'island' of cultivation and on and about the abandoned crusty-surfaced fallow land. Beyond succeeds an infinity of sand-dune wastes.

Hārūnābād is what may be termed the climax of canal-irrigated desert cultivation in Bahāwalpūr State. Pure desert until a few years ago, it is at the present time an extensive, fertile, green and intensively cultivated tract. Striking development has taken place within the last twelve years during which has sprung up the flourishing town of Hārūnābād with a large and important *mandi* or grain market. Shīsham (*Dalbergia Sissoo*) and Babūl (*Acacia arabica*) trees of respectable size lining the canal banks, dotted about the cultivation or growing in well-tended forest plantations, impart to the country a refreshingly green and wooded appearance. The numerous minor water channels that intersect the area are lined on both banks with Ak (*Calotropis gigantea*) and clumps of the tall coarse *Sar* grass (*Saccharum*). Beyond the island of cultivation and with incongruous suddenness comes the desert—an undisturbed succession of hummocky sand-dunes with *pats* interspersed, as if in constant watchfulness, ready to sweep in and reclaim lost territory should the vigilance and industry of Man show the least relaxation.

Desert Colouration.

A great deal has been written concerning the 'effacing' colouration of desert animals. The various problems in this connection were constantly borne in mind but although a quantity of factual and suggestive data was obtained, no nearer approach to a solution of any of them can be claimed. The investigator in the desert is early beset by curious anomalies, but the general truth is sufficiently obvious that the majority of animals here are in fact coloured strikingly like the soil upon which they live. He is naturally led to the conclusion that this close colour resemblance, by rendering the animal inconspicuous in its environment, gives it a degree of protection from its enemies, or if a predator it confers advantage in capturing its prey. A little observation, however,

soon convinces him that for the colouration to achieve this end effectively one vital condition *must* be fulfilled, and that condition is complete immobility. Movement at once betrays an animal howsoever obliteratingly coloured. One variety of *pat* commonly met with in the desert, is pinkish and of a hue strikingly like that seen in the wings and tail of the Desert Finch-Lark (*Ammomanes deserti*). I frequently observed that a scattered group of 3 or 4 of these birds feeding on such soil only a few yards away could become completely obliterated from view. But the effacement lasted only up till such time as the birds remained perfectly motionless. The slightest movement on their part sufficed to dispel all illusion of their invisibility.

It is a well-known habit of birds frequenting bare open spaces—like bustard and stone-curlew—to squat down and stretch out their necks, lying 'doggo' on the approach of an enemy as if conscious of their natural camouflage. But under normal conditions it must be only rarely that they receive sufficient warning of impending danger to enable them to resort successfully to this ruse. In nine cases out of ten the predator's attention has, in the first instance, been drawn to its quarry by its movements while in search of food. In such cases it is difficult to believe that obliterating colouration even helped by such a manoeuvre can and does give them adequate protection.

There seems no doubt, however, that effacing or obliterative colouration *may* (and in fact does) at times serve to protect an animal from a *chance* predator. For example, no seed- or fruit-eating bird will fail to seize a juicy insect or spider if accidentally come upon. But if that insect or spider happens to be effacingly or unobtrusively coloured—and what is still more important, if it remains motionless—it may stand a fair chance of being passed by. Not so, however, from an insectivorous bird that *habitually* preys upon such quarry. In that case the colouration alone will not save its possessor. In other words it seems unreasonable to suppose that effacing colouration by itself can give adequate protection to an animal against a predator who has been habituated and trained from infancy to hunt effacingly coloured prey, often to the exclusion of other prey not so coloured.

Apart from other considerations it is by no means certain that the faculty of colour-perception in animals is sufficiently developed for them to differentiate so keenly between colours, and even between shades of the same colour, as to have evolved through Natural Selection—as some still hold—the remarkable similarity in the colouration of desert animals to their sandy environment. Experiments suggest that a bird's vision and man's are practically the same towards the orange-yellow end of the spectrum (long-wave lengths), but that birds cannot perceive blues and violets at all. Colour sense in mammals seems to be considerably poorer. A dog, for example, is said to see objects only in monotones, something like a sepia-toned photograph, and the proverbial red rag to a bull probably means no more than a rag of any other dark colour. This being the case it seems futile to speculate on the true merits of what we call the effacing colouration of a desert animal to its possessor.

Whatever the benefits derived from desert colouration by its possessors, to my mind at least it appears highly improbable that the presence of such colouration is the direct result of Natural Selection, i.e. that it came about by the gradual elimination of such organisms as did not conform with the colouration of their sandy environment. It seems more reasonable to suppose that the same factors as are responsible for making the desert desert-coloured are also responsible for making the majority of its animals, both diurnal and nocturnal, desert-coloured: that the similarity is thus primarily the result of some purely mechanical and extraneous process or processes. That humidity has something to do with it, and may even be the principal controlling factor, seems clearly established. Animal forms living in moist evergreen forest biotope are invariably darker pigmented than their representatives inhabiting a more arid environment. Animals are palest coloured in the desert where humidity is lowest, and darkest coloured in areas where it is highest.

An attractive theory, that has stood the empirical test, is advanced by Col. R. Meinertzhagen (*Ibis*, 1940, p. 120). This authority who has had considerable experience of deserts in Africa and Asia and has made a special study of desert birds and life conditions, suggests that the density of humidity (ozone?) in the atmosphere controls the amount of ultra-violet radiation that gets through to the earth and therefore to the life upon the earth. In the very low humidity of the desert a very high percentage of the ultra-violet rays get through, whereas in heavily saturated air their penetration is greatly impeded. According to him wherever a large amount of ultra-violet radiation gets through one finds comparatively lightly pigmented plumage or fur among the resident animals, and wherever the radiation is obstructed and reduced by atmospheric humidity comparatively darkly pigmented plumage or fur is met. In a discussion on the relation between plumage and environment (*Ibis*, 1934, p. 54) Meinertzhagen pointed out that in the Red Sea littoral which enjoys brighter sunshine than Sinai, Egypt or Palestine and where rain is practically unknown, is found the darkest form of the Sand-Partridge (*Ammoperdix hayi cholmleyi*). This seeming anomaly is explained by the fact that the humidity in this region is double in density to that of the Sahara and much greater than that of Sinai, Egypt or Palestine in all of which countries paler forms of this partridge occur. In spite of the cloudless dazzling skies of the Red Sea littoral, the suspended water vapour in the air reduces the force and effect of the ultra-violet rays getting through to the earth and brings about the same darkening of the plumage of birds as it does in humid forested regions.

A suggestive fact noted by me in the course of the Bahāwalpūr Survey was how after being drenched in a shower of rain the colouration of desert birds, e.g. *Ammomanes deserti* and *Cursorius cursor*, darkened to exactly the same shade of brown as that of the sodden soil upon which they found themselves. These very birds whose pale sandy colouration was of some obliterative value to them in an environment of pale dry desert sand now enjoyed the same advantage when the soil was rain-sodden and rendered considerably darker. Here is a suggestion that it may in reality be

Fig. 1.—Tamarisk and kandi (*Prosopis*) scrub on flood-inundated land, as in Tracts II and III. (Haunts of *Dryobates scindianus, Molpastes leucogenys Cyanosylvia suecica, Phoenicurus ochruros* and several *Phylloscopus*).

Photos : *the late F. H. Hallberg.*

Fig. 2.—An aspect of the desert in Tract II-I.

Fig. 1.—An aspect of the desert as in Tract I—Hārūnābād environs.

Photos : *the late F. H. Hallberg.*

Fig. 2.—Cultivation in desert canal colony interspersed with sand-dunes, as about Yazmān and Manthār (Tract I). (Haunts of *Chamydotis u. macqueeni, Sylvia curruca* and *nana, Œnanthe xanthoprymna, Œ. capistrata, Argya candata* etc.).

the same common factor (or set of factors) that is directly responsible for the similarity in the colouration of desert animals and of their environment. In this case that common factor was moisture.

I had also frequent occasion to remark how the slanting evening sun, shortly before set, imparted to the desert the same pinkish or vinaceous flush as is to be seen in the plumages of such desert birds as *Ammomanes deserti*, *Lanius phoenicuroides* and *L. minor*. This may only be a coincidence, but the similarity is such that no observant person can fail to be struck with it.

Itinerary.

27 January-11 February; 8-11 March: Bahāwalpūr Town & Environs (III)
12-19 February: Bhūng (III)
20-27 February: Manthār (I)
28 February-7 March: Jajjah-Abbāsiān (III)
12-17 March: Hārūnābād (I-II)
18-24 March: Bahāwalnagar (III)

In the course of the Survey over 1000 miles were covered by motor car within the State, and every type of country visited. Public roads as such are few in number and poor in quality, but the excellent roads maintained by the Irrigation Department, running along the canal bunds throughout the vast network that now spreads over all but the remotest desert tracts, are open to private motor traffic. They afford a speedy and fruitful access to distantly outlying localities, to explore which it would otherwise necessitate tedious days on camel back and elaborate camping arrangements. Thus collected, the specimens are naturally representative of a much wider area than indicated by their labels. For convenience in placing the localities on ordinary maps, obscure place-names have been avoided and those of better known landmarks nearby substituted in their stead.

During the limited time at the disposal of the Survey it was naturally impossible to determine the correct status of the various species met with, i.e. whether a species is a winter, summer or rains visitor, and whether it breeds in the locality or not. In many cases, as with most of the wildfowl, the status is of course well-known, but the deficiency remains where resident birds and local migrants are concerned. In the notes that follow, therefore, it must be understood that such remarks as 'Common', 'Occasional' and others, apply only to the period covered by the Survey.

SYSTEMATIC LIST[1].

Corvus corax laurencei Hume. The Raven.

Specimens collected: 39♂, 40♀ 2-2-39 Bahāwalpūr Town environs (II-III). Elsewhere noted: Yazmān, Manihār, Hārūnābād (I).

[1] I=Desert (Chōlistān or Rōhi); II=Semi-desert (central belt); III=Riverain tract (the Sind).

[Measurements :

	Bill	Wing	Tail
1 ♂ ad.	78	448	242 mm.
1 ♀ ad.	74	413	220 mm.—H. W.]

Fairly common in small numbers. Usually pairs, but sometimes small parties of 4 or 5 (once 15) about colonists' homesteads in the canal-cultivated desert areas (I and II). Has a bell-like call which in the distance sounds rather like bits of a Barred Owlet's (*Glaucidium*).

Some of the birds on the outskirts of Hārūnābād town—where they largely fed on offal—were evidently *ruficollis*.

The survey specimens were sexually mature and apparently breeding. Testes 22 × 15; largest ovarian follicle 5 mm.

Corvus splendens zugmayeri Laub. The Sind House-Crow.

Specimens collected: 146♂, 147♀ 18-2-39 Bhūng (II-III).
Elsewhere noted: Hārūnābād town (I); Bahāwalpūr town and environs, Bahāwalnagar town and environs (III).

[Measurements :

	Bill	Wing	Tail
1 ♂ ad.	52	264	163.5 mm.
1 ♀ imm.	44	243	149 mm. —H. W.]

Very common and abundant in towns and villages in III, and also in the fairly well established canal colonies in I as in Hārūnābād and its environs. It has not yet penetrated to the more recent colonies in I, e.g. Yazmān and Manthār, but its extension there is no doubt only a matter of time.

Within the village of Bhūng stand some large Banyan and Peepal trees which are the nightly roost of hundreds upon hundreds of House-Crows. The birds flight in every evening before sunset in straggling parties and flocks over long distances and from all points of the compass. Although there are other large trees in neighbouring villages the crows concentrate only upon this particular grove in Bhūng. This preference is, I think, explainable by the historical fact that Bhūng is the oldest village in the locality. Its trees have been used by the crow population since long before the outlying villages became sufficiently established to provide similar amenities. The Bhūng roosts therefore continue to function as community centres to this day. Another very large roost was seen in a shisham plantation on the outskirts of Bahāwalnagar town. Mangled and partly desiccated remains of several crows, one here another there, were found lying on the ground under the roost trees. Two of these had their heads completely wrenched off. Who was the culprit?

The gonads of the specimens were inactive.

No Jungle Crows were met with in Bahāwalpūr State.

Dendrocitta vagabunda pallida (Blyth). The N.-W. Indian Tree-Pie.

Specimen collected: 83 ♀ 7-2-39. Bahāwalpūr town environs (III).
Elsewhere noted: Bhūng, Jajjah-Abbāsiān, Chāchrān (II-III).

[Measurements :

	Bill	Wing	Tail
1 ♀ ad.	34	162	277 mm. —H. W.]

Not common. The first example seen in Bahāwalpūr town or its environs was only after a whole week's working in the locality, during which I had specifically noted it as absent.

Met with singly or in pairs—occasional—in trees in Inspection Bungalow compounds, well-grown shisham plantations and the like.

On 5 March (Chāchrān) a nest was found 30 ft. up in a Babūl tree in the Inspection Bungalow compound. One of the owners visited it several times and sat in momentarily, but on examination it was empty!

Remiz coronatus (Severtz.). The Penduline Tit.

Specimens collected: 68 o?, 69 ♀ 7-2-39. Bahāwalpūr town environs (III-II); 281 o?, 282 ♀, 283 ♀ 14-3-39. Hārūnābād (I); 303 ♂, 304 ♀ 19-9-39, 320 ♂ 20-3-39. Bahāwalnagar (III-II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	10	52-53.5	43-44 mm.
6 ♀♀	10-11	52-54	39-43.5 mm.

This species had not previously been known to extend into N.-W. India below the line Lahore, Mozaffargarh and Upper Sind about Ruk Junction so its occurrence in some numbers in Bahāwalpūr State is a slight but interesting extension of range.—H. W.]

The Penduline Tit was not uncommon in the localities where the specimens were obtained. It was inseparable from shisham trees (*Dalbergia*) whether planted along the boundary of Inspection Bungalow compounds, along canal banks or in the various plantations of the Forest Department.

Small flocks were met with hunting insects in the foliage of these, especially amongst the freshly sprouting sprigs. They have the typical tit habits of clinging upside down and sideways to the leaf clusters in quest of food. The birds utter mousy cheeping notes as they move about—*swee . . . swee* etc.—rather like those of *Dumetia*, but feebler.

Whether the birds here were merely winter visitors or had some other status could not be ascertained.

Turdoides somervillei sindianus (Ticeh.). The Sind Jungle Babbler.

Specimens collected: 128 ♂ 16-2-39 Bhūng (III-II).
Elsewhere noted: Bahāwalpūr town and environs, Jajjah-Abbāsiān, Bahāwalnagar (III-II); Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	24.5	105	111 mm. —H. W.]

Patchily and locally distributed. Both in Bhūng and in Rahīmābād—two villages about 3 miles apart isolated from each other by canal cultivation—situated in the midst of semi-desert country, a single flock each of these Jungle Babblers was observed within the small walled-in mango gardens belonging to their respective zamindars. No others were seen, nor did the country around seem a likely habitat.

In other localities the birds frequented tamarisk jungle on the margin of *dhands*, and groves of trees about villages. In shisham plantations with tall coarse grass and thickets the terrain of the Jungle Babbler overlapped that of *Argya earlii*.

At Hārūnābād the species was met with in the wooded Inspection Bungalow compound and in other similarly wooded patches. It has as yet not spread to the younger desert canal colonies of Yazmān and Manthār since the requisite habitat has not developed there.

Argya earlii (Blyth). The Striated Babbler.

Specimen collected: 314 ♂ 19-3-39 Bahāwalnagar (III-II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
1 ♂	22	95	worn —H. W.]

Two flocks were observed in a dense patch of tall *sarkan* grass on the edge of a shisham plantation, and a third amongst a bed of bulrushes in a *dhand*. It inhabits better wooded, moister localities than *A. caudata*.

The specimen, with testes enlarged to 16×8 mm., was probably breeding.

Argya caudata caudata (Dumont). The Common Babbler.

Specimens collected: 67 ♂ 6-2-39 Bahāwalpūr town environs (III-II); 136 ♂ 17-2-39 Bhūng (III-II).
Elsewhere noted: Yazmān, Manthār (I); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	20.5	81.5-84.5	123-128 mm.

Both these birds have remarkably long tails 123 and 128 mm., the length usually associated with *A.c. eclipes*, but their colour and the identity of other specimens from neighbouring areas in the S.-W. and S.-E. Punjab shows that one is safe in calling them *caudata caudata*. Length of tail is very variable in this species—for instance 2 ♂♂ collected at Dandot 2000′ in the Salt Range within a month of each other, have tails of 113 and 130 mm. and I could quote similar examples in other districts.—H. W.]

Common on the fringe of desert cultivation and on the banks of dry sandy canals in a mixed growth of tall coarse *sarkan* grass and kandi (*Prosopis*) bushes, scuttling about like rats from one clump to another. Also in II about *pats* with *Salvadora* and *Capparis* bushes. Flocks were also met with far out in the desert amongst sparsely scrubbed sand-dunes. In this biotope, along with *Sylvia c. blythii* and *S. minula* it was the commonest bird species to be met.

At Bahāwalnagar the edge of its terrain overlapped the edge of that of *A. earlii* so that frequently both species could be seen side by side in a circumscribed area.

The gonads of No. 136 (17 February) were enlarged to 12×5 mm., and the bird was evidently preparing to breed shortly.

Chrysomma sinensis hypoleucus (Frankl.). The Sind Yellow-eyed Babbler.

Specimens collected: 220 ♀, 221 ♂ 4-3-39 Jajjah-Abbāsiān (III-II); 327 ♂, 328 ♀ 22-3-39 Bahāwalnagar (III-II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	14-14.5	67-67.5	95 mm.
2 ♀♀	13-13.5	64.5-67.5	99 mm.—H. W.]

Not common. Frequents date scrub along dry canal banks and tall *sarkan* grass intermingled with thorn thickets, on the edge of young Shisham plantations. Two of the specimens were obtained from a flock which kept to heavy tamarisk scrub standing partially submerged in a *dhand*.

A careful look-out was kept for *Chrysomma altirostris* but without success.

Molpastes leucogenys leucotis (Gould). The White-eared Bulbul.

Specimen collected: 116 ♂ 15-2-39 Bhūng (III-II).
Elsewhere noted: Bahāwalpūr town environs (III); Manthār, Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	17	87	81 mm.—H. W.]

Fairly common—usually in pairs or small parties—and generally distributed in all three tracts. In I it is found for considerable distances in the interior, but is absent in the most outlying and sandy desert portions. Partial to riverain jungle subjected to annual flood inundation where tamarisk and kandi (*Prosopis*) abound. On one occasion a gathering of over 30 birds was observed feeding on black ants on the ground. In desert and semi-desert areas the fruit of *Capparis* and *Salvadora* form the main attraction for this bulbul.

Molpastes cafer [pallidus (Baker)]. The Central Indian Red-vented Bulbul.

No specimens.

A single example (or pair?) was observed in the garden of the Guest House (Abbās Manzil) on 10-2-39. Escaped cage bird?

Certhia himalayana limes. The Tree-Creeper.

Specimens collected: 81 ♀ 7-2-39 Bahāwalpūr town environs (III-II); 129 ♀ 16-2-39 Bhūng (III-II); 230 ♂ 5-3-39 Chāchrān (III); 311 ♀ 19-3-39 Bahāwalnagar (III-II).

Elsewhere noted: Hārūnābād (I); Bahāwalpūr town (III).

[Measurements:

	Bill	Wing	Tail
1 ♂	23	73	68 mm.
3 ♀♀	20.5-21	66-69	60.5-64 mm.—H. W.]

Obviously winter visitor. Common. Invariably present on shisham trees in forest plantations, in groves about villages and in Inspection Bungalow compounds even where these are isolated by miles of inhospitable semi-desert or treeless cultivated tracts. The birds were met with singly working their way up the tree-trunks and along the boughs in short spurts like a nuthatch and extracting tiny insects from the crevices of the bark.

Saxicola caprata bicolor Sykes. The North-Indian Pied Bush-Chat.

Specimens collected: 17 ♂ 29-1-39 Bahāwalpūr town environs (III); 86 ♂ 8-2-39 Dera Bakha (Bwp. town environs), (II); 141 ♀ 18-2-39 Daulatpūr (Sukkur Dist. Frontier), (III-II).

Elsewhere noted: Jajjah-Abbāsiān, Bahāwalnagar (III-II); Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	13-14.5	71-73.5	50-55 mm.
1 ♀	13.3	71.5	50.5 mm. —H. W.]

Rather rare in the environs of Bahāwalpūr town, but common elsewhere in III and II as well as in the colonised parts of I. Noted as paired off, with males in full song, from about the first week of March. Partial to the tamarisk growth in the neighbourhood of *dhands*, canals and cultivation, commonly perching on the tips of the long, coarse grass clumps (*Saccharum*) growing on and about the margins and *bands*.

The white in the wings of the male is displayed prominently while he is singing, with tail depressed and wings partly drooping at the sides. The tail is nervously twitched open now and again. In this race the white underparts of the male extend in life well up to the lower breast, reminiscent rather of *Œnanthe picata*. Its extent can be very considerably diminished in a badly made-up skin.

As early already as 8 February the testes of a specimen had commenced to mature. They measured 4×3 mm.

Saxicola torquata indica (Blyth). The Collared Bush-Chat.

Specimens collected: 16 ♂ 29-1-39 Bahāwalpūr town environs (III-II); 105 ♂ 13-2-39 Bhūng (III-II); 265 ♀ 13-3-39 Hārūnābād (I).

Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	14-14.5	69-73	48-50.5 mm.
1 ♀	13.5	70	50 mm.

According to the criteria given by Ticehurst (*Ibis* 1938, pp. 338-341) No. 16 would pass as *S. t. maura* as it has a wing measurement of 73 mm. and the white on the base of the tail feathers is more extensive than in No. 105 (wing 69 mm.), but the difference between the two forms is exceedingly slight and

I am not sure how far they are worth recognition. No. 265, the female with wing of 70 mm., would also seem to be *maura* as it is larger than a large series of Himālayan breeding birds—H. W.]

Evidently winter visitor. Not common. Met with singly about fallow canal cultivation, the edge of tamarisk beds in the riverain, and dry reed-beds on the margins of *dhands*.

Œnanthe picata (Blyth). The Indian Pied Chat.

Specimens collected: 23 ♀, 37 ♂ 1-2-39 Bahāwalpūr town environs (II); 122 ♂ 15-2-39 Bhūng (III-II); 189 ♂ 27-2-39 Manthār (I).

Elsewhere noted: Yazmān (I); Between Jajjah-Abbāsiān and Khānpūr (II-III).

[Measurements:

	Bill	Wing	Tail
3 ♂♂	17·5	90·5-93	62-66·5 mm.
1 ♀	17	88·5	62·5

No. 23 is a typical female of the type in which the lower throat and upper breast are a sooty black, almost but not quite so dark and pure as in the male.—H. W.]

Numerically not abundant but generally distributed in its accustomed biotope —stony semi-desert, and desert with sparsely scrubbed sand-dunes. The males (which appeared to predominate) can be told from other confusing black-and-white chats by their black head, crown, back and breast and white rump, tail and underparts. The tail has a subterminal black band.

Met with singly perched on desert bushes, dipping forward violently from time to time like the Redstart or the Brown Rock-Chat (*Cercomela*), especially when alarmed. Usually very wild. Among the sand-dunes in the remoter portions of the desert this chat was, along with *Sylvia nana*, about the only bird species found.

These desert-haunting black-and-white chats present some of the most glaring anomalies in the colouration of desert animals. Their diurnal habits make them conspicuous (at least they are by no means inconspicuous) in an environment of pale coloured sand, yet we have no evidence to show that they are handicapped in any way. The desert is as much their habitat as of the most effacingly coloured species.

Œnanthe capistrata (Gould). The White-headed Chat.

Specimens collected: 20 ♀ 29-1-39 Bahāwalpūr town environs (II); 273 ♀ 13-3-39, 297 ♂ 16-3-39 Hārūnābād (I).

Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
1 ♂	18	98	69 mm.
2 ♀♀	16-16·5	88-90	60-66 mm.

These females are of the rather pale brown type with hair-brown ear coverts which are usually recognisable without difficulty as the females of this species.—H. W.]

Rare in Bahāwalpūr State. Frequents semi-desert and fallow land in desert canal cultivation. Biotope same as that of *Œ. picata*. Usually seen singly. Shy. The male is coloured like *Œ. picata*, but has a whitish grey-buff cap.

The specimen of 16 March was very fat and evidently preparing to emigrate.

Œnanthe deserti atrogularis (Blyth). The Desert Wheatear or Gould's Desert Chat.

Specimens collected: 15 ♂ 29-1-39, 46 ♀ 3-2-39 Bahāwalpūr town environs (II); 52 ♂ 4-2-39, 87 o? 8-2-39 Dera Bakha (II).

Elsewhere noted: Bhūng (III-II); Manthār, Yazmān (I).

[Measurements:

	Bill	Wing	Tail
3 ♂♂	16	93·5-96·5	60·5-64 mm.
1 ♀	17	94	64·5 mm. —H. W.]

Fairly common. Met with singly in semi-desert, and amongst rippled sand-dunes covered with half-buried scanty bushes.

Œnanthe xanthoprymna chrysopygia (De Fil.). The Red-tailed Chat.

Specimens collected: 42 ♀, 43 ♀ 3-2-39 Bahāwalpūr town environs (II); 88 ♂ 8-2-39 Dera Bakha (II); 92 ♀ 10-2-39 Yazmān (I); 190 ♂, 191 ♀ 21-2-39 Manthār (I).

Elsewhere not noted.

[Measurements:

	Tail	Wing	Bill
2 ♂♂	19.5	94.5-96.5	61.5-63 mm.
4 ♀♀	18.5-19.5	91-95	58.5-63 mm. —H. W.]

The Red-tailed Chat was not uncommon in the sand-dune facies of the desert, and was occasionally also observed on the outskirts of desert canal cultivation. It was met with singly perched on low bushes or running on the ground, often far out in the dreary rolling expanses of desert where, besides an occasional *Œ. picata* and a stray *Sylvia nana*, no other bird life was visible. In Sind, according to Ticehurst, it is associated chiefly with rocky ground and rocky hills. The birds were always inordinately shy, for some unaccountable reason even more so than the other species of chats. Two specimens, when winged, ran swiftly and made straight for gerbille holes in a seemingly premeditated manner and disappeared deep down the maze of subterranean tunnels.

Phœnicurus ochruros phoenicuroides (Moore). The Kashmir Redstart.

Specimens collected: 10 ♂ 28-1-39 Bahāwalpūr town environs (III); 133 ♂, 134 o? 16-2-39 Bhūng (III-II); 155 ♀ 21-2-39, 182 o? 25-2-39 (Manthār (I); 235 ♀ 5-3-39 Chāchrān (III).

Elsewhere noted: Hārūnābād (I); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
3 ♂♂	15-15.5	83-86	62.5-63 mm.
2 ♀♀	15-15.5	77-81.5	56.5-60 mm. —H. W.]

Common in riverain tamarisk jungle and babool trees along the canals. Also about villages and cultivation. The notes commonly uttered (by the male!) are a mousy *whit . . . whit . . . whit* etc. like an unoiled, squeaking bicycle wheel. The interval between one *whit* and the next is just about the time taken by one revolution of the wheel when ridden at an easy pace.

Cyanosylvia suecicia ssp? . The Bluethroat.

Specimens collected: 27 ♂ 1-2-39 Bahāwalpūr town environs (III); 104 ♂ 13-2-39 Bhūng (III-II); 195 o? 1-3-39 Jajjah-Abbāsiān (III-II); 237 ♂ 5-3-39 Chachran (III); 277 ♂ 14-3-39 Hārūnābād (I).

[No. 195 (Bill 16, Wing 71, Tail 58 mm.) is clearly *pallidogularis*. The remainder (4 ♂♂ Bill 15.5-17; Wing 72-78; Tail 55-56 mm.) are either in winter dress or heavy moult on chin and throat, and I am unable to identify them with certainty but they evidently are not *pallidogularis*.—H.W.]

Not numerically abundant anywhere, but fairly common and generally distributed in the better watered portions of the State. Riverain tamarisk beds, and tamarisk scrub growing on the edge of wheat cultivation or *dhands* are favourite resorts.

Ticehurst found the prevailing race in Sind to be *pallidogularis*. (*Ibis*, 1922, p. 638).

Saxicoloides fulicata cambaiensis (Lath.). The Brown-backed Indian Robin.

No specimens collected.

Noted in the environs of Bahāwalpūr town, at Bhūng and Jajjah-Abbāsiān. Uncommon. Met with sporadically about the canals, in scrub country dotted with clumps of tall grass. It has not as yet penetrated to Hārūnābād.

Copsychus saularis saularis (Linn.). The Indian Magpie Robin.

The only example seen during the entire Survey was in the Inspection Bungalow compound at Bahāwalnagar on 21 March. No others were met with even in this locality.

It is of doubtful or exceptional occurrence in Sind also, although the *Fauna* 'Distribution' implies that it is common.

Turdus atrogularis Temm. The Black-throated Thrush.

Specimen collected: 28 ♂ 1-2-39 Bahāwalpūr town environs (III).
Elsewhere noted: Chāchrān (III).

The specimen was shot from a scattered party of 4 birds, hopping about and feeding on the ground in young gram, mustard and vetch crops and on sparsely scrubbed-fallow fields in the Sutlej riverain. The only other example seen (5 March—Chāchrān) was in identical facies near the Chenāb river.

Prunella atrogularis atrogularis (Brandt). The Black-throated Hedge-Sparrow.

Specimen collected: 49 ♂ 3-2-39 Bahāwalpūr town environs (III-II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
1 ♂	—	76	64.5 mm.

The races of this species are hard to discriminate, but the paler and more lightly streaked back and the paler 'halo' round the black throat-patch seem to distinguish the specimen from the race *huttoni* which is the common form in N.-W. India. The typical race is only a straggler to N.-W. India. There is a female in the British Museum from Gilgit 5000' 9 Jan. 1879, and Mr. H. W. Waite obtained another female at Jhelum on 17 Feb. 1926. A male in my own collection (Mochiwala, Jhang, 25 Jan. 1919) may well also belong to the typical form.—H. W.]

The specimen was obtained from a small party feeding on the ground at the edge of canal cultivation in sandy semi-desert. It was fat.

Muscicapa parva parva (Bechstein). The European Red-breasted Flycatcher.

Specimens collected: 78 ♀ 7-2-39 Bahāwalpūr town environs (III); 288 ♂, 289 ♂, 290 ♂ 15-3-39 Hārūnābād (I); 315 ♂ 19-3-39 Bahāwalnagar (III).

[Measurements:

	Bill	Wing	Tail
4 ♂♂	13.5-14	67.5-72.5	49.5-54 mm.
1 ♀	13.5	71	54 mm.

It may be of interest to remark for the benefit of Indian ornithologists that in May 1936 I was on the breeding ground of this species in Eastern Poland near Tarnopol and Zaliszczyki and collected a series of males which by their organs were all clearly breeding. Half of these birds were red-breasted and of the type familiar to us in India (e.g. Nos. 288, 290 and 315 above). Other breeding males were, however, of two types, and these by their more worn wings and tails were evidently first year birds though the distinctive juvenile spotting had been worn off the tertiaries and coverts. One of these types was indistinguishable from the adult female. The second was very similar to the female but the throat and breast were washed with reddish-fulvous, though not so rich in tint as in the adult male. The grey border was absent. No. 289 represents this type.—H. W.]

This flycatcher was not uncommon in the better wooded portions of the State. It was particularly partial to shisham trees whether growing in groves about villages and cultivation, in the compounds of Inspection Bungalows or in forest plantations, both in the riverain as well as the colonised desert tracts. The birds were noted as having become more abundant from about the middle of March.

Three of the March specimens, as also the majority of males observed in the second half of that month, were in freshly moulted, perfect red-breasted plumage.

The specimen of 19 March moreover, was very fat suggesting that the birds were preparing to emigrate.

Leucocirca aureola aureola (Less.). The White-browed Fantail Flycatcher.

Specimens collected: 130 ♂, 131 ♀ 16-2-39 Bhūng (III-II).
Elsewhere noted: Manthār (I), Jajjah-Abbāsiān (II-III), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	15	84	98 mm.
1 ♀	—	80.5	97 mm. —H. W.]

Not common, but a pair or so usually met with in the walled-in fruit gardens in villages even where these are isolated by miles of semi-desert and inhospitable treeless country from its next likely habitat. It frequents tamarisk jungle by canals and bordering the *dhands* formed by seepage from these or from the backwaters of the great rivers. It was less uncommon about Bahāwalnagar where the Forest Department's shisham plantations were its favourite haunts. Here, on 19 and 20 March respectively two nests under construction, nearly completed, were observed both about 15 ft. up in shisham trees.

The male shot on 16 February had testes measuring 8×4 mm., therefore with gonad development considerably more advanced than its mate whose ovaries were merely granular. This pair was evidently preparing to breed.

Lanius excubitor lahtora (Sykes). The Indian Grey Shrike.

Specimens collected: 14 ♀ 29-1-39 Bahāwalpūr town environs (II); 218 ♂ 3-3-39. Jajjah-Abbāsiān (II).
Elsewhere noted: Yazmān (I), Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	24.5	115	117.5 mm.
1 ♀	24	111	110.5 mm. —H. W.]

Fairly common, but not abundant. Solitary examples occasional or frequent in desert or semi-desert facies. The specimen of 3 March had maturing gonads measuring 10×6 mm.

Lanius vittatus Valenciennes. The Bay-backed Shrike.

Specimen collected: 262 ♀ 13-3-39 Hārūnābād (I).
Elsewhere noted: Jajjah-Abbāsiān (II-III).

[Measurements:

	Bill	Wing	Tail
1 ♀		87	90 mm. —H. W.]

Uncommon. Only 5 solos observed during the entire Survey. Usually in babool trees about semi-desert canal cultivation.

Lanius schach erythronotus (Vigors). The Rufous-backed Shrike.

Specimen collected: 259 ♂ 9-3-39 Lāl Sohāra (II).

[Measurements:

	Bill	Wing	Tail
1 ♂	21	94	115 mm. —H. W.]

Rare. The specimen was the first and only shrike of this species met with in Bahāwalpūr State. It was among young date palms lining a canal. Testes 3×2 mm.

Lanius isabellinus Hempr. & Ehr. The Pale Brown Shrike.

Specimens collected: 13 ♂ 29-1-39, 22 ♀ 1-2-39, 66 ♀ 6-2-39 Bahāwalpūr town environs (III-II); 96 ♀ 10-2-39 Yazmān (I); 137 ♂ 17-2-39 (Bhūng (III-II); 258 ♀ 9-3-39 Lāl Sohāra (II); 275 ♀ 14-3-39 Hārūnābād (I).

[Measurements :

	Bill	Wing	Tail
2 ♂♂	19-5-20	91-93	80-82 mm.
5 ♀♀	18-19.5	89.5-92	74-82 mm. —H. W.]

Common. Occasional solos alternating with or in the same facies as *L. e. lahtora*, i.e. on the edge of canal cultivation and fallow fields in desert and semi-desert. The specimen of 14 March was very fat.

Pericrocotus brevirostris brevirostris (Vigors). The Indian Short-billed Minivet.

Specimens collected : 196 ♂, 197 ♀, 198 ♀, 199 ♀ 1-3-39 Jajjah-Abbāsiān (II-III); 305 ♀, 306 o? 19-3-39 Bahāwalnagar (III-II).
Elsewhere noted : Bahāwalpūr town and environs (III-II).

[Measurements :

	Bill	Wing	Tail
1 ♂	14.5	93	114.5 mm.
4 ♀♀	14.5-15.5	89.5-94	100-114 mm.

No. 196 is in female-like plumage, but it was sexed by Mr. Sálim Ali personally and the correctness of this determination is confirmed by the pinkish-red tinge on odd feathers both of the forehead and of the chin and throat—a tinge of colour which is found in none of the rest of the series; yet various new feathers which are coming in quill on the chin and throat will evidently be yellow and not red. Yellow males of this type are usually and naturally described as 1st year birds, but the possibility should be borne in mind that they are males which will always retain the female type of plumage, i.e., that males in this species may be to a limited extent dimorphic.—H. W.]

Not uncommon in the better wooded portions such as among the shishams in compounds and forest plantations, and in tamarisk jungle by *dhands* and back-waters of rivers. Mixed flocks of red and yellow birds were met with busily hunting for insects among the foliage or flying from tree to tree uttering a quick-repeated musical *wee-twee?*

Its status in Bahāwalpūr is uncertain. In Sind, according to Ticehurst, it is a winter straggler from the Himālayas. (*Ibis*, 1922, p. 612.)
Specimen No. 305 (19 March) was very fat.

Pericrocotus peregrinus pallidus Stuart Baker. The Sind Small Minivet.

Specimen collected : 82 ♂ 7-2-39 Bahāwalpūr town environs (III).
Elsewhere noted : Hārūnābād (I).

[Measurements :

	Bill	Wing	Tail
1 ♂	12.5	69	76 mm.—H.W.]

Rare. Small parties were seen on a few occasions only, in Shisham plantations and in groves of trees and wooded compounds.

Dicrurus macrocercus albirictus (Hodgson). The Himalayan Black Drongo.

Specimen collected : 47 ♂ 3-2-39 Bahāwalpūr town environs (II-III).
Elsewhere noted : Yazmān (I); Bhūng (III-II); Hārūnābād (I); Bahāwalnagar (II-III).

[Measurements :

	Bill	Wing	Tail
1 ♂	23	153	106 mm.—H. W.]

The Black Drongo was noted as practically absent in Bahāwalpūr town and environs between 29 January and 7 February. Indeed, during these 9 or 10 days the specimen (very fat!) was the only example seen. After the latter date it was somewhat more in evidence—singly or in twos and threes by canal cultivation—but still far from common. The same proved to be the case over the rest of the State also, though in the neighbourhood of Bahāwalnagar it was perhaps slightly

more numerous than elsewhere. The scarcity of this species, so plentiful in cultivated areas over the greater part of India needs explaining. The more so as in the adjoining province of Sind Ticehurst found it 'very common everywhere except in the hills and barest deserts.' (*Ibis*, 1922, p. 546.)

Acrocephalus agricola (Jerdon). The Paddy-field Warbler.

Specimen collected: 268 ♂ 13-3-39 Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	15·5	59	56 mm.—H. W.]

A solo, flushed in oat field.

Orthotomus sutorius guzurata (Latham). The Tailor-Bird.

Specimen collected: 239 ♂ 5-3-39 Chāchrān (III).
Elsewhere noted: Bahāwalpūr town (III), Bhūng (III-II), Jajjah-Abbāsiān (III-II), Hārūnābād (I), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	16	53	— mm.—H. W.]

On the whole rather scarce, but a pair or two were usually met with wherever green shrubbery was present as in gardens in towns and villages, shisham plantations and Inspection Bungalow compounds in canal colonies even where these were isolated by miles of semi-desert.
The gonads of the specimen were maturing. They measured 4×3 mm.

Hippolais caligata rama (Sykes). Sykes's Tree Warbler.

Specimen collected: 148 ♂ 21-2-39 Manthār (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	16	60	51 mm.—H. W.]

Shot in babool tree by tributary canal. I have no other specific sight records, but feel that it may be less uncommon than this circumstance would indicate.

Cettia cettia cettioides Hume. The Eastern Bush-Warbler.

Specimens collected: 215 ♂, 216 ♂ 3-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere not noted.
The specimens were obtained at Tatar *dhand* where they kept hidden amongst the partially submerged reeds and thickets at the edge of the inundated tamarisk jungle. They are great skulkers and best secured by patient waiting and watching when the restless bird will present momentary glimpses as it hops amongst the stems. Snatches of a loud, clear song were uttered by the males.

Lusciniola melanopogon mimica Madarász. The Eastern Moustached Sedge-Warbler.

Specimens collected: 210 ♀ 2-3-39, 211 ♂, 212 ♀, 213 ♀, 214 ♂ 3-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere noted: Bahāwalnagar-Minchinābād (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	16	64·5-65	54-57 mm.
3 ♀♀	16	60·5-62	49·5-55 mm.—H. W.]

Not uncommon at *dhands* amongst partly submerged tamarisk thickets. It picks its food from the surface of the water or the squelchy mud, clinging sideways to the reed stems or hopping amongst the root stocks with cocked tail.

Laticilla burnesi (Blyth). The Long-tailed Grass-Warbler.

Specimens collected: 307 ♀, 308 ♂, 309 ♂, 310 ♂ 19-3-39; 329 ♂, 330 ♂ 22-3-39 Bahāwalnagar (II-III).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
5 ♂♂	14-14.5	55-58	102-110 mm.
1 ♀		54.5	105.5 mm.—H. W.]

The Long-tailed Grass-Warbler was only met with in the environs of Bahāwalnagar. Here it frequented an open clearing in a shisham plantation littered with faggots, dry branches and stacks of firewood and interspersed with sprawling clumps of the coarse saw-edged *sarkan* grass. The species appeared to be common in this locality, but always kept to more or less identical facies. In general effect and habits this warbler seems to be midway between *Prinia sylvatica* and *Trochalopteron lineatum* now reminiscent of the one now of the other. It is a great skulker, hopping with agility in and out of the scrub and thickets and can be flushed only with difficulty. When it finally does so it is merely to fly feebly for a few yards and dive into cover again. It has a loud song which, curiously enough, is again between those of the two species mentioned.

The specimens of 19 March were breeding; they all had fully mature gonads (testes 10×8 mm., ovaries granular with largest follicle 2 mm diam.) On the same date an individual was observed carrying a caterpillar in its bill, but no nest was found.

The 2 males of 22 March had testes 5×4 mm.

Franklinia buchanani (Blyth). The Rufous-fronted Wren-Warbler.

Specimens collected: 269 ♂ 13-3-39, 276 ♂ 14-3-39 Hārūnābād (I).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	13.5	52.5-53.5	61-64 mm.—H. W.]

Uncommon. Met with in sparse semi-desert scrub about canal cultivation. Males in full song, and breeding evidently in progress. Testes of specimens 10×6 and 5×4 respectively.

Sylvia curruca blythi Ticeh. & Whistler. The Indian Lesser Whitethroat.

Specimens collected: 18 ♂ 29-1-39, 25 o? 1-2-39 Bahāwalpūr town environs (III-II); 135 o? 16-2-39 Bhūng (II-III); 192 ♀ 27-2-39 Manthār (I); 238 ♀ 5-3-39 Chāchrān (III); 246 ♂ 6-3-39 Jajjah-Abbāsiān (III-II); 319 ♂ 20-3-39 Bahāwalnagar (III-II).
Elsewhere noted: Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	13-13.5	64-66.5	61 mm.
3 ♀♀	12.5-13	67-67.5	54.5-59 mm.—H. W.]

A very common winter visitor. Found in tamarisk. *Capparis* and kandi (*Prosopis*) jungle and scrub, usually on the margin of *dhands* amidst semi-desert. Also amongst the partially submerged tamarisks and scrub. No. 319 was very fat. It was moulting all its rectrices simultaneously and had a fresh, partly grown stub tail.

Sylvia curruca halimodendri Suschkin. The Central Asian Lesser Whitethroat.

Specimen collected: 193 o? 27-2-39 Manthār (I).
Elsewhere not differentiated.

[Measurements:

Bill	Wing	Tail
12	69.5	59.5 mm.

It is not surprising that this race should have been obtained in Bahāwalpūr

as Mr. Waite has procured a number of examples of it in the Jhelum Salt Range and in the Shahpur and the Dera Ghazi Khan Districts.—H. W.]

This pale form of the Lesser Whitethroat, first obtained by me within the limits of India proper at Phūlji, Larkana Dist., Sind, in 1926 (*J.B.N.H.S.*, xxxii, p. 376) is evidently less rare in this part of N.-W. India than it appears to be, no doubt on account of possible confusion with *blythi* with which it corresponds both in measurements and wing formula. It is, however, much paler than *blythi* being the same in colour as *minula*.

Whitethroats, along with *Argya caudata*, were the commonest bird species in the desert about Manthār. On 27 February (when this specimen was secured) the weather was heavily overcast and there had been rain throughout the previous night. Whitethroats—especially *blythi* and *minula*—were literally swarming!

The specimen was very fat.

Sylvia curruca minula Hume. The Small Whitethroat.

Specimens collected: 26 o? 1-2-39 Bahāwalpūr town environs (III-II); 53 ♀ 4-2-39 89 o? 8-2-39 Dera Bakha (II); 120 ♀ 15-2-39 Bhūng (II-III); 145 o? 18-2-39 Daulatpur (Sukkur Dist. frontier, III); 152 ♀ 21-2-39, 165 ♀ 22-2-39 Manthār (I).

[Measurements:

	Bill	Wing	Tail
4 ♀♀	10.5-12	60-63	52.5-55 mm.—H. W.]

A common and abundant species. Met with singly amongst *Capparis*, tamarisk and kandi (*Prosopis*) scrub in I, II and III. It is frequently found miles out in absolute sand-dune desert amongst the sparse stunted *Capparis* bushes half buried in mounds of wind-blown sand. It is easily differentiated in the field form *blythi* by its smaller size and markedly paler colouration.

Sylvia nana nana (Hempr. & Ehren.). The Desert Warbler.

Specimens collected: 32 ♂, 33 ♀ 2-2-39 Bahāwalpūr town environs (II); 101 ♂, 102 ♂ 13-2-39 Bhūng (II); 163 ♂, 164 ♂ 22-2-39 Manthār (I).

Colours of soft parts: Iris bright lemon-yellow; legs and feet yellowish flesh colour; bill same but with upper mandible brown.

[Measurements:

	Wing	Bill	Tail
5 ♂♂	11-11.5	59-60.5	47.5 mm.—H. W.]
1 ♀	11	57	46-51 mm.

Common in I and II. Seen singly hopping about on the sand amongst the bases of scanty *Salsola*, *Capparis* and *Prosopis* bushes growing on the sand-dunes and mounds. Its movements are somewhat reminiscent of *Scotocerca*. Often met with miles out in the desert where the only other birds were perhaps a stray *Œnanthe capistrata* or a Small Whitethroat.

Phylloscopus griseolus Blyth. The Olivaceous Tree-Warbler.

Specimen collected: 318 ♂ 20-3-39 Bahāwalnagar (III).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
1 ♂	14	67	52 mm.—H. W.]

The first and only example met with in Bahāwalpūr State. Very fat and evidently on passage. Its habits differed from those of other Phylloscopi in that it kept to tree-trunks more than to the foliage, running up and down them rather like a Tree-Creeper.

Phylloscopus collybita tristis Blyth. The Brown Willow-Warbler or Siberian Chiffchaff.

Specimens collected: 79 ♂ 7-2-39 Bahāwalpūr town environs (III); 112 ♂, 113 ♀ 14-2-39, 121 ♂ 15-2-39 Bhūng (III-II); 166 ♂ 22-2-39, 186 ♀ 26-2-39

Manthār (I); 222 ♀ 4-3-39 Jajjah-Abbāsiān (III-II); 252 ♀, 253 ♀ 9-3-39 Lāl Sohāra (II); 270 ♂ 13-3-39, 286 ♀ 14-3-39 Hārūnābad (I); 312 ♂ 19-3-39 Bāhāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
6 ♂♂	11-12	62-65	49-52 mm.
6 ♀♀	11-12	57-62	44-48 mm.—H. W.]

Very common. Singly or twos and threes amongst roadside shisham or babool trees, in tamarisk and kandi riverain jungle, and in wheat and cotton fields. In the latter, especially after the crop had been picked, quite large scattered gatherings were occasionally observed hunting insects on the bare stalks. The birds were also plentiful on the dry lotus stalks and other partially submerged vegetation in the *dhands* at Jajjah-Abbāsiān and elsewhere.

Four of the specimens obtained between 15 February and 9 March were very fat and evidently getting ready to emigrate. According to Ticehurst, most birds have left Sind by the last week in March. (*Ibis*., 1922, p. 563).

Phylloscopus neglectus neglectus Hume. The Plain Willow-Warbler.

Specimens collected: 1 ♂, 4 ♀ 28-1-39. 80 ♂ 7-2-39 Bahāwalpūr town environs (III).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	10-10.5	52.5-53	40.5-41 mm.
1 ♀	10.5	49	38 mm.—H. W.]

Not uncommon in the environs of Bahāwalpūr town, but curiously enough not noted elsewhere within the State. Single birds were seen in tamarisk beds along the Sutlej River, and in shisham plantations.

Specimen No. 313 o? 19-3-39 Bahāwalnagar, of a Phylloscopus smaller than *tristis* more olive above with a faint coronal band, appears somehow to have gone astray and Mr. Whistler evidently never received it. It was a solo shot in a shisham plantation.

Prinia gracilis lepida Blyth. The Indian Streaked Wren-Warbler

Specimens collected: 2 ♀, 3 ♂ 28-1-39, 38 ♂ 2-2-39 Bahāwalpūr town environs (III-II); 90 ♂ 8-2-39 Dera Bakha (II); 142 ♂ 18-2-39 Daulatpūr (Sukkur Dist. frontier III); 156 o? 21-2-39 Manthār (I); 260 ♂ 9-3-39 Lāl Sohāra (II); 266 ♀ 13-3-39 Hārūnābād (I)

[Measurements:

	Bill	Wing	Tail
5 ♂♂	10.5-11	43-46	67.5-72 mm.
3 ♀♀	10-10.5	40.5-45	58.5-66 mm.—H. W.]

Common in scrub and grass bordering canals and canal cultivation. Its call (song) is almost indistinguishable from that of *Prinia inornata*, and in habits also the two species are very similar. In appearance it is a small replica of *Argya caudata*.

As early as 2 February breeding seemed imminent. The gonads of No. 38 were enlarged to 3×2 mm. No. 260 (9 March) as well as 266 (13 March) were evidently breeding birds. The testes of the former measured 6×4 mm.; the ovary of the latter coarsely granular. About this period the birds had paired off, with the males constanly warbling excitedly from exposed perches such as the top of a bush.

A nest was found on 13 March (Hārūnābād). It was a small oval pouch of grass strips, bound with vegetable down, with a lateral opening near the top, wedged into the base of a clipped clump of saw-edged *sarkan* grass (*Saccharum*) growing on the bank of a minor canal. Both parents were busy feeding the 2 (or 3?) partly fledged chicks within.

Prinia inornata terricolor (Hume). The Indian Wren-Warbler.

Specimens collected: 126 ♀, 127 ♂ 16-2-39 Bhūng (III-II); 143 ♂ 18-2-39 Daulatpūr (Sukkur Dist. frontier, III); 267 ♀ 13-3-39 Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	13-14	50-53	76 mm.
2 ♀♀	13	48.5	75 mm.—H. W.]

Fairly common and found in the same facies as *Prinia gracilis* viz. wheat, gram and oat fields, especially about minor canals, and with the bordering tamarisk scrub intermingled with clumps of *sarkan* grass. The two species were frequently met with in the same patch. Nos. 126 and 127, in fresh pre-nuptial plumage, were strikingly yellow on the underparts when freshly killed.

The gonads of specimen No. 143 (18 February) were enlarging preparatory to breeding. They measured 4×3 mm.

Cisticola juncidis [cursitans (Frankl.)]. The Rufous Fantail Warbler.

No specimens. The unmistakable *chip . . . chip . . . chip* uttered by this warbler in its wandering, zig-zag overhead flight was heard above standing wheat crops in the Chenab riverain at Chāchrān on 5 March.

Ticehurst (*Ibis*, 1922, p. 552) describes this warbler as a common resident in Lower Sind but apparently scarcer in Central and Upper Sind. In the last, T. R. Bell found it breeding in February.

Prinia socialis or **Prinia flaviventris sindiana** Ticeh.?

I have a record of a fleeting glimpse of a warbler which may be either one or the other of the above, in some clumps of tall *sarkan* grass by cultivation at Jajjah-Abbāsiān (III-II) 6-3-39.

Pastor roseus Linn. The Rosy Pastor.

During the entire period the Survey was in the field (27 January to 24 March) no Rosy Pastors were seen in Bahāwalpūr State. I can only account for this absence on the assumption that the Pastor is purely a passage migrant in Bahāwalpūr and that the end of March was naturally too early for its spring northward movement.

According to Ticehurst (*Ibis*, 1922, p. 616) the Pastor leaves Lower Sind regularly about 6 May. A week later it has gone from Upper Sind returning again to its Indian winter quarters as early as the second or third week of July. The last date recorded by Mr. Whistler in the almost adjacent Jhang District of the Punjab is 14 May.

Sturnus vulgaris poltaratzskyi Finsch. Finsch's Starling.

Specimens collected: 12 ♀ 29-1-39 Bahāwalpūr town environs (III); 103 ♀ 13-2-39 Bhūng (III-II).

Elsewhere noted: Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♀♀	29-30.5	126-131	61-66 mm.—H. W.]

Not very common, but small flocks were frequent in suitable terrain. The birds sauntered about and dug with their bills on the moist grassy edges of the drying-up *dhands*.

A grove of shisham trees in Bhūng village was the community roost of the starling population for miles around. Flock upon flock flighted in from all quarters at sunset every evening till the bare tree-tops were thick and black with their multitudes. For the size of the assemblages, however, and contrary to the case with roosting mynas, the birds produced surprisingly little noise.

Acridotheres tristis tristis (Linn.). The Common Myna.

No specimens.

Noted: Bahāwalpūr town and environs (III-II); Bhūng (III-II); Manthār (I); Jajjah-Abbāsiān (III-II); Hārūnābād (I); Bahāwalnagar, Minchinābād (III-II).

The myna is common in and about the older and well established towns, villages and cultivated tracts of the State, and is steadily advancing into the 'hinterland' with the opening up and colonisation of desert and semi-desert areas. It has, as yet, not penetrated to Yazmān, the youngest of the desert colonies investigated by the Survey. At Manthār, which represents the secondary stage of this evolution of the desert, it was met with in small numbers about the outlying homesteads of the settlers. At Hārūnābād, which may be considered the climax of desert colonisation under the new irrigation schemes, it has already fairly established itself though as yet only in small numbers.

Acridotheres ginginianus (Latham). The Bank Myna.

No specimens.

Noted: Dera Bakha (II); Bahāwalpūr town environs (III-II).

Sparsely and locally distributed. Small numbers were observed in attendance on grazing cattle around the outskirts of villages, or following the plough on fallow land on the margins of *dhands*.

Ploceus philippinus philippinus (Linn.). The Baya or Common Weaver-Bird.

No specimens.

I saw no Bayas at all during the time I was in Bahāwalpūr State, but evidence of their presence in small numbers at other seasons was not wanting. For instance on 16 February (Bhūng) two or three old nests were observed hanging on a babool by a dry sandy canal. These nests were examined and found to be made of strips of paddy leaf. Enquiry showed that water is let into this canal between April and October and that paddy is cultivated on the adjoining land during that time.

At Daulatpūr (Sukkur District frontier—Indus riverain), a colony of 20 old nests was noted on a shisham tree. No Bayas were about, but local information that small numbers were still present in the locality was confirmed by a partly desiccated specimen killed by the local zamindar's falcon which I found lying on top of his falcon shed. Evidently the baya is a marked local migrant in Bahāwalpūr as elsewhere, its movements—at least at nesting time—being largely controlled by the incidence of paddy cultivation.

Ploceus manyar flaviceps (Lesson). The Streaked Weaver-Bird.

Specimens collected: 321 ♂, 322 ♂, 323 ♀ 21-3-39 Bahāwalnagar (III-II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	18.5-19.5	72-72.5	45-47 mm.
1 ♀	18	68.5	42 mm.—H. W.]

Several small flocks observed frequenting extensive bulrush beds in a *dhand*. The breeding season was evidently at hand. The males had acquired breeding plumage and the gonads of the 2 specimens showed indications of enlargement, measuring 2×1 mm.

The difference in the breeding seasons of the 2 species of Baya, due to their respective ecological requirements—paddy leaf for nest material in *philippinus* and reeds and bulrushes for nest sites in *manyar*—is noteworthy.

Uroloncha malabarica (Linn.). The White-throated Munia.

Specimen collected: 278 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Bahāwalpūr town environs (III).

[Measurements:

	Wing	Bill	Tail
1 ♂	11	58	50.5 mm.—H. W.]

Uncommon. Small flocks.

The testes of the specimen were enlarged to 4×3 mm. On 16 March a pair was observed nest-building about 6 ft. up in a small ber tree (*Zizyphus*) near the Inspection Bungalow at Hārūnābād.

Amandava amandava amandava (Linn.). The Indian Red Munia.

Specimens collected: 224 ♀, 225 ♀, 226 ♀ Jajjah-Abbāsiān (III-II); 324 ♂ 21-3-39 Bahāwalnagar (III-II).
Elsewhere noted: Manthār (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	10.5	49	38.5 mm.
3 ♀♀	10	48.5-49.5	36-36.5 mm.—H. W.]

Occasional small flocks seen amongst reeds and bulrushes at *dhands*, or among clumps of *sarkan* grass lining the minor tributary canals through cultivation and semi-desert country. Towards the end of February and in the early part of March most males were in the intermediate plumage, i.e. rather like the female but with a crimson band down centre of abdomen. By the 3rd week of March the males had acquired breeding plumage and were observed singing from the tips of reed stalks.
The Yellow-throated Sparrow *Gymnorhis xanthocollis* a marked local migrant elsewhere, was definitely absent in Bahāwalpūr State during the period of the Survey.

Passer domesticus indicus Jardine & Selby. The Indian House-Sparrow.

Specimen collected: 50 ♂ 4-2-39 Dera Bakha (II). [Bill 13.5; Wing 78.5; Tail 56.5 mm.].

Passer domesticus parkini Whistler. The Kashmir House-Sparrow.

Specimens collected: 51 ♀ 4-2-39 Dera Bakha (II); 153 ♀, 154 ♀ 21-2-39 Manthār (I); 256 ♀, 257 ♂, 9-3-39 Lāl Sohāra (II).

[Measurements:

	Bill	Wing	Tail
1 ♂	14.5	80.5	59 mm.
4 ♀♀	13.5-15	74-5-76	52-57 mm.

It is difficult to be certain of identifying these females in the absence of any guide as to whether they belonged to the resident population or were migrants, but on the whole they appear to be *parkini*.—H. W.]
Elsewhere noted (subspecies?): Bahāwalpūr town; Yazmān (I); Bahāwalnagar town.
Common in towns and villages in all the three tracts. Also seen about outlying homesteads in the canal colonies and in the country surrounding cultivation, often miles out in desert facies. Flocks of 20 to 100 or more, often intermixed with *Passer hispaniolensis*.
At Manthār large flocks of sparrows gathered every evening to roost among *Capparis* bushes growing on sand-dunes. The din they set up sounded in the distance rather like that of a building Baya colony.
Commencement of gonadal development was noticeable in the specimens of 9 March: testes 3×2 mm.; ovary granular.
As no specimens were actually collected within the towns or villages I am unable to say definitely that the resident race is *indicus*, which is presumably the case.

Passer pyrrhonotus Blyth. The Sind Jungle-Sparrow.

Specimens collected: 29 ♂, 30 ♂ 1-2-39, 74 ♀, 75 ♀ 7-2-39 Bahāwalpūr town environs (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	12	67-70	49-55 mm.
2 ♀♀	12	63-65	48-49 mm.—H. W.]

Very locally distributed. Not uncommon in the environs of Bahāwalpūr town. Flocks among *Capparis* and *Salvadora* bushes and jungle in semi-desert.

Passer hispaniolensis transcaspicus Tschusi. Tschusi's Sparrow.

Specimens collected: 84 ♂, 85 ♂ 8-2-39 Dera Bakha (II); 254 ♂, 255 ♂ 9-3-39 Lāl Sohāra (II).
Elsewhere noted: Yazmān (I).

[Measurements:

	Bill	Wing	Tail
4 ♂♂	15	80-83	57-62 mm.—H. W.]

Not uncommon. In small flocks as well as large ones of a hundred or more, frequently in association with *P. d. parkini*, in the proximity of canal cultivation in desert and semi-desert.
Gonads of the specimens of 9 March had commenced to enlarge. In both cases they measured 4×3 mm.

Emberiza cia par Hartert. The Transcaspian Meadow Bunting.

Specimens collected: 48 ♂ 3-2-39 Bahāwalpūr town environs (III-II); 158 ♀ 21-2-39, 183 ♀ 25-2-39 Manthar (I); 240 ♂ 5-3-39 Chāchrān (III-II); 249 ♀ 9-3-39 Lāl Sohāra (II); 271 ♂ 13-3-39 Hārūnābād (I).
Elsewere noted: Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Wing
3 ♂♂	13-13.5	80-81.5	79-81 mm.
3 ♀♀	13.5-14	85-89	72.5-77 mm.—H. W.]

Generally distributed, but not abundant numerically. Single birds, pairs or small parties were sparingly met with in semi-desert, and in the neighbourhood of desert canal cultivation. As a rule the birds were very shy.
The only instance of any departure in the gonads from the absolute quiescent condition was No. 240 (5 March) with testes measuring 2×1 mm.

Emberiza striolata striolata (Licht.). The Striolated Bunting.

Specimens collected: 184 ♂ 25-2-39 Manthār (I); 247 ♂, 248 ♂ 9-3-39 Lāl Sohāra (II).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
3 ♂♂	11.5	77-80.5	59-63 mm.—H. W.]

The specimens, with the addition of one example that was with No. 184, represent all I saw of the Striolated Bunting in Bahāwalpūr State. On both occasions the birds were observed in the vicinity of canals with tamarisk scrub and *sarkan* grass clumps at hand. In flight, and at a distance, the rufous wings and general effect are very reminiscent of the female Crested Bunting (*Melophus*), minus crest.
The testes of the 9 March specimens measured 2×1 mm., therefore indicating the commencement of maturity.

Riparia paludicola brevicauda Horsfield. The Indian Sand Martin.

Specimens collected: 227 ♀, 228 ♀ 4-3-39 Jajjah-Abbāsiān (III-II); 236 ♂ 5-3-39 Chāchrān (III).
Elsewhere noted: Bahāwalpūr town environs (III).

[Measurements:

	Bill	Wing	Tail
1 ♂	8	93.5	38 mm.
2 ♀♀	8-8.5	92.5-96	36.5-40 mm.—H. W.]

Common in the riverain tract. A colony of some 30 to 50 nest tunnels was observed in the vertical face of a sandbank in the Sutlej river near Bahāwalpūr town on 28 January, with the birds flying about and entering and leaving their holes.

Sp. No. 227 had a soft ovarian egg. The largest ovum in 228 was 3 mm. in diameter and its distended oviduct indicated that it had laid. Both these specimens were very fat. No. 236 (5 March), with testes 6×4 mm., was obviously also breeding. It was shot in the vicinity of the sandy bank of the Chenab River containing a number of holes occupied by the birds.

Hirundo rustica rustica Linn. The Common Swallow.

Specimens collected: 178 ♀ 23-2-39 Manthār (I); 229 ♂ 4-3-39 Jajjah-Abbāsiān (III-II).

Elsewhere noted: Bhūng (III-II).

[Measurements:

	Bill	Wing	Centr. Tail feathers	Outer tail feathers
1 ♀	12	124	44	104.5 mm.—H. W.]
1 ♂	—	121	42	107 mm.

Not abundant, but small numbers were frequently met with hawking insects about the *dhands*, cultivation, and along the larger canals.

The first meeting was not until 17 February after the Survey had been in the field for over 3 weeks.

Both the specimens were fat. In the male the first signs of gonadal development were discernible (2×1 mm.).

Motacilla alba dukhunensis Sykes. The White Wagtail.

Specimens collected: 11 ♂ 28-1-39 Bahāwalpūr town environs (III); 232 ♂ 5-3-39 Chāchrān (III).

Elsewhere noted: Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	16	89-92.5	86-87.5 mm.—H. W.]

Fairly common in the riverains of the Sutlej and Chenab, and also found sparingly about the canal colonies.

The specimen of 5 March was fat and evidently preparing to emigrate.

Motacilla alba personata Gould. The Masked Wagtail.

Specimen collected: 65 ♂ 6-2-39 Bahāwalpūr town environs (III).

[Measurements:

	Bill	Wing	Tail
1 ♂	18	94	93 mm.—H. W.]

This wagtail was observed in much smaller numbers than *dukhunensis*, also in the riverains of the Sutlej and Chenab rivers.

Motacilla flava subsp.? The Blue-headed Wagtail.

Several birds with a bluish-grey head—presumably *beema*—were seen on ploughed land bordering a *dhand* between Bahāwalnagar and Minchinābād (21 March).

Motacilla feldegg melanogriseus (Homeyer). The Turkestan Black-headed Wagtail.

Specimens collected: 171 o?, 17 o?, 173 o? 23-2-39 Manthār (I).

[Measurements:

	Bill	Wing	Tail
3 apparently 1st. year ♂♂	16-16.5	80-81	70-71.5 mm.—H. W.]

A flock of about 20 birds in a young vetch field, muddy and waterlogged by rain overnight. All the specimens in heavy moult.

Motacilla citreola calcaratus (Hodgs.). Hodgson's Yellow-headed Wagtail.

Specimen collected: 331 ♂ 22-3-39 Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	19.5	87	76—H. W.]

Several on the margin of a *dhand*.

Anthus trivialis haringtoni Witherby. Witherby's Tree-Pipit.

Specimens collected: 125 ♂ 16-2-39 Bhūng (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	15	88	60 mm.—H. W.]

These birds appeared plentifully among gram fields and other cultivation on the morning of 16 February. Passage?

The testes of the specimen were beginning to enlarge. They measured 2×1 mm.

Anthus similis decaptus Meinertzhagen. The Persian Rock-Pipit.

Specimens collected: 123 ♀, 124 o? 16-2-39 Bhūng (III-II); 167 ♂ 22-2-39 Manthār (I); 223 ♂ 4-3-39 Jajjah-Abbāsiān (III-II); 250 ♀ 9-3-39 Lāl Sohāra (II)

Elsewhere noted: Bahāwalpūr town environs (III)

[Measurements:

	Bill	Wing	Tail
2 ♂♂	20.5	103-104	83.5-91 mm.
2 ♀♀	20-23	98-101	86.5-87 mm.—H. W.]

Not uncommon. Single birds (almost invariably) were met with in among young gram and mustard crops, on fallow land about canal cultivation or on grassy canal banks. The specimens of 22 February and 9 March were very fat, the former having testes 4×2.5 mm. and the latter a coarsely granular ovary. In 223 (4 March) the testes measured 5×4 mm.

Anthus campestris griseus Nicoll. The Eastern Tawny Pipit.

Specimens collected: 24 ♂ 1-2-39 Bahāwalpūr town environs (III-II); 117 ♂, 118 ♀ 15-2-39 Bhūng (III-II); 174 ♂ 23-2-39 Manthār (I); 251 ♂ 9-3-39 Lāl Sohāra (II); 263 ♂, 264 ♂ 13-3-39 Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
6 ♂♂	17-18.5	90-94	68-77 mm.
1 ♀	17	88.5	70 mm.—H. W.]

Abundant in gram and vetch crops on sandy soil and in fallow fields of cotton, among the dry bare stalks. Specimens 263 and 264 (13 March) in freshly moulted summer plumage were bright yellow underneath and their gonads were beginning to develop. In either case the testes measured 2×1 mm.

Anthus roseatus Hodgs. Hodgson's Pipit.

Specimens collected: 242 ♂, 243 ♂ 6-3-39 Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	15-16	89-89.5	66.5-68 mm.—H. W.]

Several seen on a snipe marsh on the edge of a *dhand*. 242 had gonads 2×1 mm., while in 243 they were in a quiescent condition. The latter bird was fat.

Anthus spinoletta blakistonii Swinh. The Chinese Water-Pipit.

Specimens collected: 19 ♂ 2-2-39, 63 ♀ 5-2-39 Bahāwalpūr town environs (III); 108 ♂, 109 ♀ 14-2-39 Bhūng (III); 233 ♂ 5-3-39 Chāchrān (III).

[Measurements:

	Bill	Wing	Tail
3 ♂♂	16-17	92-93	66.5-68.5 mm.—H. W.]

Common. Was usually seen in loose scattered flocks on the wet grassy margins of *dhands*, and among mustard and other crops in the Indus and Chenab riverains.

This pipit utters a characteristic monosyllabic *si . . . si* &c. In freshly moulted summer plumage its vinous-grey and dark-streaked underparts are diagnostic in the field.

Alaemon alaudipes doriae (Salvadori). The Persian Desert-Lark.

Specimens collected: 97 ♂, 98 ♀ 10-2-39 Yazmān (I); 292 ♂ 16-3-39 Hārūnābād (I).

Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	33-5-34	136-139	94-97 mm.
1 ♀	28	120	81.5 mm.—H. W.]

A pair on the first occasion and a solitary example on the second represent my only meetings with the Desert-Lark in Bahāwalpūr State. It was found on extensive *pats* among the sand-dunes in pure desert facies, with a sparse sprinkling of *Suaeda* and *Salsola* bushes half buried in wind-swept sand. The birds had no others of their kind within a radius of at least 2 miles. Probably even in localities where they are commoner each pair inhabits a very wide stretch of country.

In general effect this Desert-Lark is remarkably midway between the Crested Lark (*Galerida cristata*) and the Cream-coloured Courser (*Cursorius cursor*). The black and white in the wings is conspicuous in flight. In life, and when freshly killed, the hind-crown is a delicate (almost pinkish) dove grey, as curiously enough it also is in the Cream-coloured Courser. This colour is lost in both species a few hours after death. In the china-white colouration of its legs and feet, in the colour and shape of its bill and in the black and white colour pattern in its wings, this lark bears a close similarity to the desert courser.

In specimen No. 97 (10 February) the testes had commenced enlarging (5×3 mm.). In 292 (16 March) they appeared to be mature (10×8 mm.). This bird was singing and displaying, and I feel almost certain that he had his mate (on eggs?) in the neighbourhood although owing to a dust storm in progress we failed to locate her. The male has a clear beautiful song of three mellow whistling notes *tee-tee-tee* followed by a prolonged note like that uttered by *Ammomanes phoenicurus* on the downward grade of its song flight. From the top of the bush on which it was perched the bird sprang about 5 feet up in the air every little while and nose-dived in the familiar manner of *Eremopterix*, at the same time singing and displaying the black and white of its wings and tail to greatest advantage.

Mr. R. C. Bolster found a nest of this Desert-Lark with c/3 on 18 April 1922 west of Dera Nawab, and has given a good description of it on p. 1132 of Vol. xxviii of the *Journal*.

It is a particularly fast runner, and I found to my cost both in Bahāwalpūr and previously in Sind that when merely winged it needs all-out sprinting to get level with the bird!

Alauda arvensis intermedia Swinhoe. The Transbaikal Skylark.

Specimens collected: 110 ♂, 111 ♀ 14-2-39 Bhūng (III).

[Measurements :

	Bill	Wing	Tail
1 ♂	15	115-5	70-5 mm.
1 ♀	14-5	108	67 mm.—H. W.]

Several observed in association with Water-Pipits in mustard fields on banks of the Indus. Gonads indicated the first beginnings of maturity. Testes 2×1 mm: ovary granular.

Alauda gulgula punjaubi Whistler. The Small Punjab Skylark.

Specimens collected: 99 ♂ 13-2-39 Bhūng (III-II); 139 ♂, 140 ♀ 18-2-39 Daulatpūr (III, Sukkur District frontier); 234 ♂ 5-3-39 Chāchrān (III).
Elsewhere noted: Bahāwalpūr town environs (III).

[Measurements :

	Bill	Wing	Tail
3 ♂♂	14-5-17	92-5-98	54-56 mm.
1 ♀	16	87-5	55 mm.—H. W.]

Common in the riverains of the great rivers, in and about wheat and vetch cultivation. Males soaring and singing aloft, often several together. By mid-February the birds had paired off. The specimens of 18 February had mature gonads and they were evidently breeding: testes 7×5 mm.; largest ovum 3 mm. diam. Testes of No. 234 (5 March) 5×4 mm.

Calandrella brachydactyla longipennis (Eversm.). The Yarkand Short-toed Lark.

Specimens collected: 93 ♂, 94 ♂, 95 ♀ 10-2-39 Yazmān (I); 132 ♀ 16-2-39 Bhūng (III-II); 179 ♂, 180 o?, 181 ♂ 25-2-39 Manthār (I); 241 ♂ 5-3-39 Chachrān (III); 296 o? 16-3-39 Hārūnābād (I).

[Measurements :

	Bill	Wing	Tail
7 ♂♂	13-14	92-5-100	59-62 mm.
2 ♀♀	13	92-5-94	55-57 mm.—H. W.]

Common and abundant. Often in large flocks on *pats* and fallow land about desert and semi-desert canal cultivation, and in the riverains.
A specimen of 25 February and another of 5 March were the only ones in which any departure from the absolute quiescent state of the gonads was discernible. In both cases the testes measured 2×1 mm. The last specimen—16 March—was very fat. and by that date also the flocks had coalesced into very large concentrations indicating that the birds were preparing to emigrate.

Calandrella rufescens persica (Sharpe). Sharpe's Sand-Lark.

Specimens collected: 34 ♀, 35 ♂ Bahāwalpūr town environs (II).

[Measurements :

	Bill	Wing	Tail
1 ♂	11	100	64 mm.
1 ♀	13	96	60 mm.

This form is doubtless often overlooked amongst the numbers of the last few. There are several Punjab records.—H. W.]
A flock of about 8 was seen feeding among sand-dunes with scanty bushes—typical *Sylvia nana* facies.

Calandrella raytal adamsi (Hume). The Indus Sand-Lark.

Specimens collected: 5 ♂, 6 o?, 7 ♂ 28-1-39, 64 ♂ 6-2-39 Bahāwalpūr town environs (III).

[Measurements :

	Bill	Wing	Tail
4 ♂♂	12.5-14	84.5-87	48.5-52 mm.—H. W.]

Abundant on the sandy beds of the Sutlej and the other large rivers, running about and feeding on the sand in twos and threes, or soaring and flying about aimlessly overhead. Also met with in the sandy environs of semi-desert canal cultivation. Two out of the 4 specimens were infested by endoparasitic worms—in the body cavity of one, and in the intestine of the other. The specimen of 6 February had testes 4×3 mm.

Galerida cristata chendoola (Frankl.). Franklin's Crested Lark.

Specimens collected: 9 ♂ 28-1-39, 21 ♂ 29-1-39 Bahāwalpūr town environs (III-II); 100 ♀ 13-2-39 Bhūng (III-II); 293 ♀, 294 ♂, 295 ♂ 16-3-39 Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
4 ♂♂	19-20	102-104	56-63 mm.—H. W.]

Common and abundant on dry sandy soil in the riverain, and also about semi-desert canal cultivation. In song and evidently breeding by mid-March. In No. 293 (16 March) the largest ovum measured 6 mm. diam. but the bird had evidently not commenced laying. In both Nos. 294 and 295 the testes were 10×6 mm.

Ammomanes deserti phoenicuroides (Blyth). The Indian Desert Finch-Lark.

Specimens collected: 44 ♀, 45 o? 3-2-39 Bahāwalpūr town environs (II); 149 ♀, 150 ♂ 151 ♀ 21-2-39, 185 ♂ 25-2-39, 194 ♂ 27-2-39 Manthār (I).

[Measurements:

	Bill	Wing	Tail
3 ♂♂	15-16	98.5-107	65-70 mm.
3 ♀♀	15-15.5	96-101	62-66 mm.—H. W.]

Common on *pats* in desert, and on fallow land in semi-desert canal cultivation, in twos and threes or loose flocks of up to 20. I found them drinking at a puddle regularly (on 3 successive mornings) at about 9-30 not in flocks like sandgrouse but in irregular relays of two or three at a time. Whether these larks also have fixed drinking times or drink at all hours of the day I was unable to ascertain.

The only departure from non-breeding condition of the gonads was noted in No. 150; testes 4×3 mm.

Eremopterix grisea siccata Ticeh. The Black-bellied Finch-Lark.

Specimens collected: 114 ♂ 14-2-39, 138 ♀ [illegible]-2-39 Bhūng (III-II).
Elsewhere noted: Bahāwalpūr town environs (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	12	77	42 mm.
1 ♀	12.5	77.5	41 mm.—H. W.]

Rather uncommon and patchily distributed. It was met with on sandy fallow land in riverain cultivation, usually on more hard-crusted soil than that preferred by *Galerida cristata*. Testes 3×2, largest ovum 2 mm.

Eremopterix albifrons affinis (Blyth). The Indian Black-crowned Finch-Lark.

Specimens collected: 279 ♂, 280 ♂ 14-3-39 Hārūnābād (I).
Not noted elsewhere.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	12	82	50-51 mm.—H. W.]

A party of 5 or 6 (of both sexes) in a fallow field. Testes of both 4×3 mm.

Zosterops palpebrosa occidentis Ticeh. The N.-W. Indian White-eye.

Specimens collected: 284 ♂, 285 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Bhūng (III-II); Chāchrān (III).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	12-5	55-56	38-39 mm.—. H. W.]

Uncommon. The specimens were shot among some shisham (*Dalbergia*) trees in the compound of the Inspection Bungalow. They were in association with *Remiz coronatus* and *Phylloscopus c. tristis*.

The White-eye furnishes a good example of a sedentary and thoroughly arboreal bird of wooded country and gardens creeping in to what was until quite recently pure desert, consequent upon suitable conditions produced by canal irrigation. It is more than likely that the birds breed here now. The testes of both the examples were enlarging. They measured 3×2 mm.; No. 285 was very fat.

Cinnyris asiatica brevirostris (Blanf.). The Sind Purple Sunbird.

Specimen collected: 287 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Jajjah-Abbāsiān (III-II); Chāchrān (III); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	19·5	57	38 mm.—H. W.]

Between 27 January and 4 March this species appeared to be completely absent. The first example—a single male in breeding plumage—was observed on the latter date. At Hārūnābād only one other individual besides the specimen was noted, also in full summer dress. None at all were present on the *Calotropis* flowers, so beloved of the species, which were out in profusion about the canal cultivation in this locality. In the third week of March (Bahāwalnagar) it was less scarce than heretofore, though still only occasional and singly. Curiously enough all the individuals seen during the survey were males and in full summer dress. Not till the third week in March, however, were they heard in song. The Purple Sunbird is no doubt a local migrant as it is in Upper Sind, and likewise absent also from Bahāwalpūr during winter. The Survey records presumably represent return arrivals for the hot weather and breeding.

Dryobates scindeanus (Horsf. and Moore). The Sind Pied Woodpecker.

Specimens collected: 70 ♀, 71 ♀ 7-2-39 Bahāwalpūr town environs (III-II); 144 ♀ 18-2-39 Daulatpur (III, Sukkur District frontier); 169 ♂, 170 ♀ 23-2-39 Manthār (I).
Elsewhere noted: Bhūng (III-II); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	28	116	71 mm.
4 ♀♀	24-26	111-115	65-70 mm.

This name would seem to be antedated by *Dryobates assimilis* Blyth. See Ticehurst *J.B.N.H.S.*, xxxiv, p. 468.—H. W.]

Not uncommon. A couple or so usually present in shisham plantations and tamarisk jungle growing both in the riverain and on seasonally inundated land by canals. At Manthār one such tamarisk jungle stood right in the midst of sand-dunes, and the specimens were secured in this. Where trees are scarce I have observed these woodpeckers clinging to the thin stems of tamarisk bushes and once even to a stake near a cultivator's hut used for tethering his cattle. The specimens of 23 February were beginning to show gonadal development: testes 3×2 mm., ovary coarsely granular.

Brachypternus benghalensis ssp. The Golden-backed Woodpecker.

Specimen collected: 231 ♂ 5-3-39 Chāchrān (III).
Elsewhere noted: Bhung (III-II); Jajjah-Abbāsiān (III-II); Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	41·5	146.5	87 mm.

This specimen is an intermediate between *benghalensis* and *diluins* agreeing with the birds that one finds throughout the Western Punjab.—H. W.]

Not common. Occasional pairs in roadside babool trees, date groves along canals and shisham trees planted about villages and in Inspection Bungalow compounds. Testes of the specimen measured 10×6 mm.

Iynx torquilla torquilla Linn. The European Wryneck.

Specimens collected: 175 ♀ 23-2-39 Manthār (I); 317 ♂ 20-3-39 Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	17·5	90	68.5 mm.
1 ♀	18	92	72 mm.—H. W.]

The only two examples met with in Bahāwalpūr State. No. 175 was feeding on the ground like a finch, the other on a low branch in a shisham plantation.

No Barbets were heard or seen in Bahāwalpūr territory between end January and end March.

Centropus sinensis sinensis (Stephen). The Common Crow-Pheasant or Coucal.

Specimen collected: 206 ♀ 2-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere noted: Bahāwalpūr town environs; Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	45	239	284 mm.—H. W.]

Uncommon. Single birds were occasionally met with chiefly in III. Several examples were seen amongst the partially submerged tamarisk thickets in Gagree *dhand* where the specimen was obtained.

The bird was found caught in a fish hook, one of many suspended by the local fishermen from a rope stretched a few inches above the surface of the water across a narrow inlet in the *dhand*. It had evidently perched on the rope, pulled up the line and swallowed the bait together with the hook, the point of which had pierced the gullet and was sticking outside. The stomach of this specimen contained exclusively remains of small fish such as those with which the hooks were baited, and the fish no doubt were the main attraction to the crow-pheasants here. I do not remember to have seen the fish-eating propensities of the crow-pheasant recorded before.

Psittacula eupatria nipalensis (Hodgs.). The Large Indian Paroquet.

Specimens collected: 76 ♀, 77 ♂ 7-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted: Daulatpur (Sukkur Dist. frontiér, III); Jajjah-Abbāsiān (III-II); Bahāwalnagar (III-II).

[Measurements:

	Bill from cere	Wing	Tail	
1 ♂	38	230	353	19 mm.
1 ♀	33	221	325	19 mm.—H. W.]

The Large Paroquet was common and plentiful in Bahāwalpūr town and its immediate environs, but scarce elsewhere. To Yazmān and Manthār it does not as yet seem to have penetrated, no doubt owing to the absence of

Zosterops palpebrosa occidentis Ticeh. The N.-W. Indian White-eye.

Specimens collected: 284 ♂, 285 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Bhūng (III-II); Chāchrān (III).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	12.5	55-56	38-39 mm.—. H. W.]

Uncommon. The specimens were shot among some shisham (*Dalbergia*) trees in the compound of the Inspection Bungalow. They were in association with *Remiz coronatus* and *Phylloscopus c. tristis*.

The White-eye furnishes a good example of a sedentary and thoroughly arboreal bird of wooded country and gardens creeping in to what was until quite recently pure desert, consequent upon suitable conditions produced by canal irrigation. It is more than likely that the birds breed here now. The testes of both the examples were enlarging. They measured 3×2 mm.; No. 285 was very fat.

Cinnyris asiatica brevirostris (Blanf.). The Sind Purple Sunbird.

Specimen collected: 287 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Jajjah-Abbāsiān (III-II); Chāchrān (III); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	19-5	57	38 mm.—H. W.]

Between 27 January and 4 March this species appeared to be completely absent. The first example—a single male in breeding plumage—was observed on the latter date. At Hārūnābād only one other individual besides the specimen was noted, also in full summer dress. None at all were present on the *Calotropis* flowers, so beloved of the species, which were out in profusion about the canal cultivation in this locality. In the third week of March (Bahāwalnagar) it was less scarce than heretofore, though still only occasional and singly. Curiously enough all the individuals seen during the survey were males and in full summer dress. Not till the third week in March, however, were they heard in song. The Purple Sunbird is no doubt a local migrant as it is in Upper Sind, and likewise absent also from Bahāwalpūr during winter. The Survey records presumably represent return arrivals for the hot weather and breeding.

Dryobates scindeanus (Horsf. and Moore). The Sind Pied Woodpecker.

Specimens collected: 70 ♀, 71 ♀ 7-2-39 Bahāwalpūr town environs (III-II); 144 ♀ 18-2-39 Daulatpur (III, Sukkur District frontier); 169 ♂, 170 ♀ 23-2-39 Manthār (I).
Elsewhere noted: Bhūng (III-II); Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	28	116	71 mm.
4 ♀♀	24-26	111-115	65-70 mm.

This name would seem to be antedated by *Dryobates assimilis* Blyth. See Ticehurst *J.B.N.H.S.*, xxxiv, p. 468.—H. W.]

Not uncommon. A couple or so usually present in shisham plantations and tamarisk jungle growing both in the riverain and on seasonally inundated land by canals. At Manthār one such tamarisk jungle stood right in the midst of sand-dunes, and the specimens were secured in this. Where trees are scarce I have observed these woodpeckers clinging to the thin stems of tamarisk bushes and once even to a stake near a cultivator's hut used for tethering his cattle. The specimens of 23 February were beginning to show gonadal development: testes 3×2 mm., ovary coarsely granular.

Brachypternus benghalensis ssp. The Golden-backed Woodpecker.

Specimen collected: 231 ♂ 5-3-39 Chāchrān (III).
Elsewhere noted: Bhung (III-II); Jajjah-Abbāsiān (III-II); Hārūnābād (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	41.5	146.5	87 mm.

This specimen is an intermediate between *benghalensis* and *dilutus* agreeing with the birds that one finds throughout the Western Punjab.—H. W.]

Not common. Occasional pairs in roadside babool trees, date groves along canals and shisham-trees planted about villages and in Inspection Bungalow compounds. Testes of the specimen measured 10×6 mm.

Iynx torquilla torquilla Linn. The European Wryneck.

Specimens collected: 175 ♀ 23-2-39 Manthār (I); 317 ♂ 20-3-39 Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	17.5	90	68.5 mm.
1 ♀	18	92	72 mm.—H. W.]

The only two examples met with in Bahāwalpūr State. No. 175 was feeding on the ground like a finch, the other on a low branch in a shisham plantation.

No Barbets were heard or seen in Bahāwalpūr territory between end January and end March.

Centropus sinensis sinensis (Stephen). The Common Crow-Pheasant or Coucal.

Specimen collected: 206 ♀ 2-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere noted: Bahāwalpūr town environs; Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	45	239	284 mm.—H. W.]

Uncommon. Single birds were occasionally met with chiefly in III. Several examples were seen amongst the partially submerged tamarisk thickets in Gagree *dhand* where the specimen was obtained.

The bird was found caught in a fish hook, one of many suspended by the local fishermen from a rope stretched a few inches above the surface of the water across a narrow inlet in the *dhand*. It had evidently perched on the rope, pulled up the line and swallowed the bait together with the hook, the point of which had pierced the gullet and was sticking outside. The stomach of this specimen contained exclusively remains of small fish such as those with which the hooks were baited, and the fish no doubt were the main attraction to the crow-pheasants here. I do not remember to have seen the fish-eating propensities of the crow-pheasant recorded before.

Psittacula eupatria nipalensis (Hodgs.). The Large Indian Paroquet.

Specimens collected: 76 ♀, 77 ♂ 7-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted: Daulatpur (Sukkur Dist. frontier, III); Jajjah-Abbāsiān (III-II); Bahāwalnagar (III-II).

[Measurements:

	Bill from cere	Wing	Tail	
1 ♂	38	230	353	19 mm.
1 ♀	33	221	325	19 mm.—H. W.]

The Large Paroquet was common and plentiful in Bahāwalpūr town and its immediate environs, but scarce elsewhere. To Yazmān and Manthār it does not as yet seem to have penetrated, no doubt owing to the absence of

suitable trees. Or it may be that it visits these localities after the breeding season is over when tree-holes are no longer an indispensable requisite.

In Bahāwalpūr town breeding was noted in full swing between end January and mid February. Holes in the trunks of *Albizzia lebbek* and *Tamarix gallica* trees were in general occupation by the birds. 3 or 4 holes close to one another in the trunk of a large *Albizzia* tree in the Prime Minister's garden were tenanted by as many pairs.

The gonads of the specimens were in breeding condition: testes 22×16 mm., largest ovarian follicle 6 mm. diam. with oviduct distended.

Psittacula krameri manillensis (Bechst.). The Rose-ringed Paroquet.

Specimens not collected.

Noted: Bahāwalpūr town, Daulatpūr, Jajjah-Abbāsiān, Hārūnābād, Bahāwalnagar.

Except in and about Bahāwalpūr town, where the numbers of the two species are about equal, this paroquet is commoner in the State than its larger relative. In the tamarisk jungles about the *dhands* at Jajjah-Abbāsiān (1-7 March) pairs were observed occupying all available holes, and breeding was in progress. This paroquet seems to have established itself in the Hārūnābād canal colony by this time.

Coracias benghalensis benghalensis Linn. The Indian Roller.

Specimen collected: 200 ♀ 1-3-39 Jajja-Abbāsiān (III-II).

Elsewhere noted: Bahāwalpūr town and environs (III-II); Bhūng (III-II), Hārūnābād (I), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	44	188	126.5 mm.—H. W.]

The Roller was found in small numbers, usually singly, about cultivation. The specimen was a sickly emaciated bird and killed with a stick by a mohana (boatman). No outward injury was apparent. Its plumage was in perfect condition and ectoparasites were completely absent. At Bahāwalnagar, a locality in which the species was commoner than elsewhere, competition for tree holes and the noisy aerobatic displays, indicative of imminent breeding, were noted in progress between 21 and 24 March.

Merops orientalis orientalis Lath. The Common Indian Bee-eater.

Specimen collected: 36 ♂ 2-2-39 Bahāwalpūr town environs (III-II).

Elsewhere noted: Bahāwalpūr town (III), Bhūng (III-II), Manthār (I), Jajjah-Abbāsiān (III-II). Hārūnābād (I), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	31	92.5	126.6 mm.—H. W.]

Evidently a migrant and absent from the area in winter. None were observed in Bahāwalpūr town and environs between 27 January and 2 February. The specimen (2 Feb.) was the first encountered; it was fat and there were only two other individuals with it. Their increase thereafter from day to day was marked, and when Bahāwalpūr town was re-visited on 10 March the species was found to have become quite common. It was then busy excavating nest tunnels in sand mounds, earth banks etc. as was also the case at Hārūnābād on 12 March and onwards.

In other portions of the State it was likewise noted as much scarcer at the beginning of the Survey than towards the end, by which time most birds had evidently returned to their breeding grounds.

Ceryle rudis [leucomelanura Reichenb.]. The Indian Pied Kingfisher.

No specimen collected.

Noted: Bahāwalpūr town environs (III-II), Manthār (I), Jajjah-Abbāsiān (III-II).

Fairly common on *dhands* and about the rivers and larger canals. At Manthār one was observed on a canal through pure sandy desert.

Alcedo atthis pallasi Reichenb. The Central Asian Kingfisher.

Specimen collected: 201 ♀ 1-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere noted: Manthār (I).

[Measurements:

	Bill	Wing	Tail
1 ♀	43·5	77·5	37 mm.

This is one of those indefinite specimens whose identity it is impossible to establish satisfactorily, but it seems most likely to be this.—H. W.]

Not common. Occasional solos at *dhands* and canals—once on one through pure desert!

Halcyon smyrnensis [smyrnensis (Linn.)]. The White-breasted Kingfisher.

No specimen collected.
Noted: Bahāwalpūr town and environs (III-II), Manthār (I), Jajjah-Abbāsiān (III-II).
Not common. Occasional solos at *dhands*, rivers, canals and also about gardens and plantations. Once on a canal through pure desert country.

Upupa epops epops Linn. The European Hoopoe.

Specimens collected: 115 ♂ 14-2-39 Bhūng (III-II); 272 ♀ 13-3-39 Hārūnābād (I).
Elsewhere noted: Bahāwalpūr town and environs (III-II), Jajjah-Abbāsiān (III-II), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	64	143	97·5 mm.
1 ♀	57	143·5	94·5 mm.—H. W.]

Not common but generally distributed in the riverain, and about canal cultivation in both the other tracts also. It loves to feed in and on the sides of dry sandy canals lined with date scrub and tall sarkan grass.
At Hārūnābād an example was observed flying about like mad in and out among the trunks of roadside shisham trees, crest and tail fully expanded, and turning and twisting in the air like a butterfly!
Both the specimens were very fat. Testes of No. 115 (14 Feb.) 3×2 mm.

Caprimulgus mahrattensis Sykes. Sykes's Nightjar.

Specimen collected: 168 ♀ 22-2-39 Manthār (I).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
1 ♀	19·5	170	99·5 mm.—H. W.]

The specimen—the only seen during the Survey—was obtained in a stretch of rolling sand-dunes, far out in the desert. At the report of the gun fired at a Desert Warbler it suddenly slithered at top speed half way down a bare sand-dune on the summit of which it had been lying under a half-buried *Capparis* bush, completely unnoticed and unsuspected: Ovary granular.

Otus bakkamœna. ssp. The Collared Scops Owl.

Specimens collected: 316 ♂ 19-3-39, 326 o? 22-3-39 Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	20	170	92 mm.
1 o?	22	177	87 mm.

I have compared these 2 specimens with a series of *O.b.gangeticus* and 3

specimens of *O.b.deserticolor* in the British Museum. If these two forms are really separable these specimens agree best with *gangeticus*, but there is a certain amount of individual variation in these small owls and I am not certain—on the material before me—that *gangeticus* and *deserticolor* are separable. If they are not, the name *deserticolor* of course takes precedence.—H. W.]

The Scops Owl was met with only at Bahāwalnagar where both the specimens were shot on different nights off the identical stump of a babool tree in the Inspection Bunglow compound. The birds advertised their presence soon after dusk by their mellow *wut . . . wut . . . wut* calls repeated monotonously every 5 seconds or so, sometimes for over 10 minutes at a stretch.

The testes of No. 316 had enlarged to 10×8 mm.

Bubo coromandus (or **bubo**). The Dusky (or Rock?) Horned Owl.

Heard at a distance in a shisham plantation on the Dera Nawab road (Bahāwalpūr town environs) on 7 February, and again at Bhūng on 19 February.

Athene brama indica (Frankl.). The Northern Spotted Owlet.

Specimens collected: 219 ♀ 3-3-39 Jajjah-Abbāsiān (III-II).
Elsewhere noted: Bahāwālpūr town environs, Bhūng.

[Measurements:

	Bill	Wing	Tail
1 ♀	20	165	82 mm.—H. W.]

Not uncommon, but less abundant than it usually is in most parts of continental or peninsular India. Hollows in ancient tamarisk trees near villages usually held a pair, and it was also partial to groves of date palms growing about the canals. My notebook records that its voice and notes sounded slightly sharper and different from those of the South Indian race *brama*. This same difference in voice I have noticed in the case of the northern and southern races of several other well known birds as well.

The specimen was preparing to lay shortly. It had a mature ovary with the largest follicle over 5 mm. in diameter.

Pandion haliaëtus haliaëtus (Linn.). The Osprey.

Specimen collected: 205 ♂ 2-3-39 Jajjah-Abbāsiān.

[Measurements:

	Bill	Wing	Tail
1 ♂	41	481	201 mm.—H. W.].

Shot at a *dhand* where this was the only example.

Torgos calvus (Scop.). The Black or King Vulture.

Noted only at Bahawalnagar, where it was uncommon.

Gyps fulvus ssp? The Griffon Vulture.

Several were observed at the remains of a carcase at Yazmān in pure desert on the outskirts of the canal colony (10 February).

Pseudogyps bengalensis (Gmelin). The White-backed Vulture.

Commonly nesting (end January) in large roadside shisham trees along the road from Lahore through Montgomery and Islam Headworks to Bahāwalpūr.

Neophron percnopterus [percnopterus (Linn.)]. The White Scavenger Vulture.

Noted in small numbers in Bahāwalpūr town environs, Yazmān, Manthār, Hārūnābād Bahāwalnagar and the intervening country, feeding on offal on the outskirts of villages and canal colony homesteads.

On 21 March a nest was nearing completion—both birds working—about 15 feet up in a babool tree close to a village between Bahāwalnagar and Minchinābād.

Falco peregrinus subsp.? The Peregrine Falcon.

No specimen.
Noted: Jajjah-Abbāsiān, Bahāwalpūr town environs.
One or two examples were usually to be seen in the vicinity of the duck-shooting *dhands*. One stooped on a wounded *Chettusia* struggling in the water, and so intense was its concentration upon the quarry that it stooped again and again regardless of 3 charges of dust shot at fairly close range which sent its feathers flying and blood could be seen on its underside. Another bird was observed to dive with lightning speed at an angle of 45° at a coot that had separated from its herd and to strike it in mid-air and bear it away, all in its stride.

Falco jugger J. E. Gray. The Laggar Falcon.

Specimens collected: 106 ♂, 107 ♀ 13-2-39 Bhūng (III-II).
Elsewhere noted: Hārūnābād (at edge of cultivation).

[Measurements:

	Bill	Wing	Tail
1 ♂	29	316	164 mm.
1 ♀	33	359	198 mm.—H. W.]

In these specimens—obviously a pair—the development of the gonads was much more advanced in the female than in the male. The testes measured only 10×6 mm. whereas the largest ovarian follicle was already over 4 mm. in diameter. Similar discrepancy in the maturity of the gonads of paired birds has been observed by me in several other instances before.

Falco tinnunculus tinnunculus (Linn.). The European Kestrel.

Specimens collected: 274 ♂ 14-3-39 Hārūnābād (I).
Elsewhere noted: Dera Bakha (II), Bhūng (III-II), Daulatpūr (III), Manthār (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	20	258	173 mm.—H. W.]

Not common. Only occasional solos in semi-desert and in the vicinity of canal cultivation. The specimen, with testes 5×4 mm., was very fat.

Aquila rapax vindhiana Frankl. The Indian Tawny Eagle.

Specimen collected: 31 ♀ 1-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted. Bhūng.

[Measurements:

	Bill	Wing	Tail
1 ♀	55·5	534	258 mm.—H. W.]

Generally distributed but not abundant. The specimen was shot off a large stick platform nest at the top of a kikar tree (*Acacia arabica*) containing one hardest egg, unspotted greyish-white measuring 67×51 mm.

Aquila nipalensis nipalensis (Hodgs.). The Eastern Steppe Eagle.

No specimen.
Three examples were observed on the ground at Yazmān in semi-desert facies (10 Feby.).
Another large solitary eagle was seen on a canal bank at Manthār. It was blackish with a broad white subterminal band to the tail and grey patches under the wings visible in flight. As it was past dusk and the bird was very shy I did not get a satisfactory view, but as far as could be told it was not *Haliaëtus leucoryphus*.

Aquila clanga Pallas. The Greater Spotted Eagle.

Specimens collected: 203 ♂, 204 ♀ 2-3-39 Jajjah-Abbāsiān (III-II).

[Measurements :

	Bill	Wing	Tail
1 ♂	53	500	227
1 ♀	54	514	242 mm.—H. W.]

Several of these fine eagles were to be seen any day on the large duck-shooting *dhands* in the Jajjah-Abbāsiān area : Gagree, Tatar, Bakkūvāla and others.

Both the specimens were very fat. The stomach of one was empty ; the other contained a leg, bill and feathers of an adult tree-pie.

Hieraëtus fasciatus fasciatus (Vieill.). Bonelli's Eagle.

Specimens collected : 55 ♂, 56 ♀ 5-2-39 Bahāwalpūr town environs (Kāli *dhand*).

[Measurements :

	Bill	Wing	Tail
1 ♂	46	466	252 mm.
1 ♀	50	483	258 mm.—H. W.]

Presumably a pair since they were both in the same tree and no others of the species were about. Shot near a small *dhand* by the Sutlej river. Testes of ♂ (adult plumage) 17×12 mm. ; largest ovarian follicle of ♀ (sub-adult brown plumage) over 2 mm. in diam. At 9.30 a.m. the male's stomach was found to be empty ; the female's contained remains of a Grey Partridge, the leg with the spur being intact.

Haliaëtus leucoryphus (Pallas). Pallas's Fishing-Eagle.

Specimen collected : 202 ♂ 1-3-39 Jajjah-Abbāsiān (III-H).
Elsewhere noted: Bahāwalpūr town environs, at Kāli *dhand* and Sutlej river.

[Measurements :

	Bill	Wing	Tail
1 ♂	59·5	559	262 mm.—H. W.]

A pair or so usually present on *dhands* and the large rivers. Its loud screaming call is unmistakable. I liken it to the creaking on an unoiled wooden pulley of the water lifting gear at a village well. Coots seem to form an important item of its food. Its hunting tactics are to stampede a herd of coots and isolate an individual before it drives the attack home, stooping upon it as the bird patters along the surface of the water, and bearing it away in its claws.

A pair of these eagles had a nest ca. 40 ft. up in an old peepal tree near the Empress Bridge over the Sutlej (Bahāwalpūr town environs). The owners constantly kept to its proximity, but when climbed up to on 5 February it was found to be empty. The testes of the specimen measured 7×5 mm. and it was not clear if breeding was over or had not yet commenced.

Haliastur indus indus (Boddaert). The Brahminy Kite.

No specimen.
Noted : Bahāwalpūr town environs, Bhūng, Daulatpūr, Jajjah-Abbāsiān.
Fairly common by the large rivers and about *dhands* in the riverain tract.

Milvus migrans govinda Sykes. The Common Pariah Kite.

No specimen.
Noted : Bahāwalpūr town and environs, Dera Nawab, Bhūng, Jajjah-Abbāsiān, Hārūnābād and elsewhere.

Common in and about towns and villages. Breeding was in full swing throughout the duration of the Survey and many nests were observed in shisham trees with the birds brooding. As late as 4 March two pairs were noted in copula.

Elanus coeruleus vociferus (Lath.). The Black-winged Kite.

Specimen collected: 119 ♂ 15-2-39 Bhūng (III-II).
Elsewhere noted: Jajjah-Abbāsiān (III-II).
Only two examples seen during the entire Survey. In tamarisk and kandi (*Prosopis*) riverain jungle with clumps of tall coarse *sar* grass.

Circus macrourus (S. G. Gmelin). The Pale Harrier.

No specimen.
Rare. One or two noted at Yazmān, Bhūng and Hārūnābād about the wheat crops, but owing to possible confusion with *pygargus* these records should be taken with reserve.

Circus æruginosus æruginosus (Linn.). The Marsh Harrier.

No specimen.
Noted: Bahāwalpūr town environs, Manthār, Jajjah-Abbāsiān.
Not common but one or two frequently present about *dhands* and occasionally also canals. The Marsh Harrier was most in evidence at the various duck-shooting *dhands* at Jajjah-Abbasian. One was observed persistently harrying a moorhen (*Gallinula*), pouncing upon it repeatedly from the air into the reeds.

Buteo rufinus rufinus (Cretzschmar). The Long-legged Buzzard.

Specimen collected: 73 ♂ 7-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted: Bhūng (III-II), Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	42·5	412	224 mm.—H. W.]

Fairly common and frequent. Usually met with singly near canals and cultivation. Once far out amongst desert sand-dunes.

Butastur teesa (Frankl.). The White-eyed Buzzard-Eagle.

No specimen.
Noted: Bhūng and environs, Jajjah-Abbāsiān, Lāl Sohāra.
Not common. Occasional solos by cultivation and in the surrounding semi-desert.

Astur badius cenchroides Severtzof. The Sind Shikra.

Specimen collected: 261 ♀ 13-3-39 Hārūnābād (I).
Elsewhere noted: Bhūng (III-II), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	22	218	174 mm.

This is one of those specimens which it is difficult to be certain about and the plumage is not paler than some specimens of *dussumieri*, but I identify it as *cenchroides* on the large wing which I cannot equal with a large series of *dussumieri*.—H. W.]
Uncommon. Met with singly in fruit gardens and shisham plantations about cultivation. The specimen had coarsely granular ovary with the largest follicle 2 mm. in diam. so it was evidently preparing to breed shortly.

Astur gentilis subsp.? The Goshawk.

Among the falcons kept by zamindar Sardar Khan of Daulatpur I saw a female Goshawk said to have been captured locally. It is said to be a rather scarce winter visitor to these parts. This statement was confirmed soon afterwards by 2 solos (or the same bird?) seen on 20 and 22 March in the environs of Bahāwalnagar. One of these made an unsuccessful stoop on a flock of Jungle Babblers.
According to the zamindar's falconer the colour of the female Goshawk's iris which is lemon yellow at 3 years age, changes to 'red' when the bird reaches 7 or 8 years.

Pernis ptilorhynchus ruficollis Lesson. The Indian Crested Honey-Buzzard.

Specimen collected: 72 ♀ 7-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted: Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	44	425	263 mm.—H. W.]

Rare. Solos met with in shisham plantations on two occasions only. Ovary of specimen coarsely granular.

Columba livia neglecta Hume. Hume's Blue Rock Pigeon.

Specimens collected: 299 ♂, 300 ♀ 16-3-39 Hārūnābād (I).
Elsewhere noted: Yazmān (I), Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	25	231	120 mm.
1 ♀	24·5	214	110 mm.—H.W.]

Flocks—sometimes of up to 50 or more—gleaning in harvested or newly sown fields. At Jajjah a colony roosted amongst a grove of date palms along a dry canal. The specimens were breeding: testes 21×10 mm.; largest ovum 10 mm.; oviduct greatly distended.

Columba eversmanni Bonaparte. The Eastern Stock-Pigeon.

Specimens collected: 301 ♂, 302 ♂ 17-3-39 Hārūnābād (I).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	21.5-22	201-211	98-105 mm.—H. W.]

A grove of babool trees standing amidst wheat fields was the roost of a colony of 100-200 of these pigeons. Parties and flocks flighted in every evening to this spot from the surrounding cultivation, and provided excellent sport. They are fast fliers and when thoroughly disturbed they turn and twist in the air with great agility offering a variety of shots. In fading light when silhouetted against the sky it is possible to confuse this species with the Ring-Dove, but the relatively shorter tail of the pigeon is always diagnostic.

The gonads of the specimens showed only a slight departure from the quiescent state. They measured 10×4 and 7×3 mm. respectively.

Streptopelia senegalensis cambayensis (Gmelin). The Little Brown Dove.

No specimen.
Noted: Bahāwalpūr town and environs (III-II), Bhūng (III-II), Manthār (I), Jajjah-Abbāsiān (III-II), Hārūnābād (I), Bahāwalnagar (III-I).
Common. Usually in the same semi-desert canal cultivation facies as the Ring-Dove. On 20 March one was observed carrying nesting material.

Streptopelia decaocto decaocto Frivalszky. The Ring-Dove.

Specimens collected: 176 ♂, 177 ♀ 23-2-39 Manthār (I)
Elsewhere noted: Bahāwalpūr town and environs (III-II), Yazmān (I), Bhūng (III-II), Jajjah-Abbāsiān (III-II), Hārūnābād (I), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	22	160	117 mm.
1 ♀	21	168	125 mm—H. W.]

Common in the desert and semi-desert canal colonies. At Yazmān it was the only dove species, but in the other localities usually side by side with the Little Brown Dove. The gonads of the specimens gave no indication of breeding,

but on 20 March (Bahāwalnagar) a nest was found 12 ft. up in a babool tree with the bird brooding.

The Spotted Dove (*Streptopelia chinensis suratensis*), which inhabits more wooded country, was not met with in Bahāwalpūr State at all.

Œnopopelia tranquebarica tranquebarica (Herm.). The Indian Red Turtle Dove.

No specimen.

Uncommon. Only observed in the environs of Bahāwalpūr town (28 January).

Pterocles orientalis (Linn.). The Large Imperial, or Black-bellied Sandgrouse.

Specimens collected: 41 ♂ 2-2-39 Bahāwalpūr town environs (II); 54 ♂ 4-2-39 Dera Bakha (II).

Elsewhere noted: Yazmān (I), Manthār (I).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	20-21	235-236	99-100 mm.—H. W.]

A fairly common and well-known winter visitor to Bahāwalpūr. Flocks of 20 to 40 and occasionally larger, usually seen on fallow fields about desert and semi-desert canal cultivation. Smaller parties were also met with on *pats* far out in the interior of the desert. Very wary. In flight the large size, black belly and white underside of wings are diagnostic of this species.

The specimen of 4 February was very fat. After 26 February the birds were not seen again, and by that date the majority had evidently left.

Pterocles alchata [**caudacutus** (Gmelin)]. The Large Pintail Sandgrouse.

A specimen was shot at Yazmān (10 February), but the shikari in his zeal had not only all but severed the neck in the name of Allah, but plucked off handfuls of its feathers before I could intervene!

Several small flocks of this sandgrouse were observed on *pats* and fallow fields in semi-desert in this locality but not elsewhere, so it is evidently an uncommon species.

Pterocles exustus ellioti Bogdanov. The Common Indian Sandgrouse.

Specimens collected: 159 ♂, 160 ♀, 161 ♂, 162 ♂ 22-2-39, 188 ♂ 26-2-39 Manthār (I).

Elsewhere noted: Bahāwalpūr town environs (II).

[Measurements:

	Bill	Wing	Tail
4 ♂♂	18.5-20	179-185	108-142 mm.
1 ♀	18.5	171	103 mm.—H. W.]

This sandgrouse seems to be much less common in Bahāwalpūr State than the Imperial. Beyond occasional small parties of from 3 to 12 in the localities mentioned, it was not met with.

Pterocles senegallus (Linn.). The Spotted Sandgrouse.

Speciment collected: 91 ♂ 10-2-39 Yazmān (I).

[Measurements:

	Bill	Wing	Tail
1 ♂	18	195	130 mm.—H. W.]

Several small flocks were observed on *pats* on the outskirts of canal cultivation in this locality.

R. C. Bolster (*J.B.N.H.S.*, xxvii, 867) records the Spotted Sandgrouse breeding 10 miles west of Ahmadpur East in 1922 (?). On 7 April he found 2 downy chicks a few days old, and remarks that one of them who distinctly larger than the other. As brooding in the open scrapes in sand in which the sandgrouse lay their eggs must necessarily begin with the first egg in order that it may not get baked by the fierce desert sun, this discrepancy in the age and size of the chicks is not what one would expect.

Pernis ptilorhynchus ruficollis Lesson. The Indian Crested Honey-Buzzard.

Specimen collected: 72 ♀ 7-2-39 Bahāwalpūr town environs (III-II).
Elsewhere noted: Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♀	44	425	263 mm.—H. W.]

Rare. Solos met with in shisham plantations on two occasions only. Ovary of specimen coarsely granular.

Columba livia neglecta Hume. Hume's Blue Rock Pigeon.

Specimens collected: 299 ♂, 300 ♀ 16-3-39 Hārūnābād (I).
Elsewhere noted: Yazmān (I), Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
1 ♂	25	231	120 mm.
1 ♀	24·5	214	110 mm.—H.W.]

Flocks—sometimes of up to 50 or more—gleaning in harvested or newly sown fields. At Jajjah a colony roosted amongst a grove of date palms along a dry canal. The specimens were breeding: testes 21×10 mm.; largest ovum 10 mm.; oviduct greatly distended.

Columba eversmanni Bonaparte. The Eastern Stock-Pigeon.

Specimens collected: 301 ♂, 302 ♂ 17-3-39 Hārūnābād (I).
Elsewhere not noted.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	21·5-22	201-211	98-105 mm.—H. W.]

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No specimen.
Noted: Bahāwalpūr town and environs (III-II), Bhūng (III-II), Manthār (I), Jajjah-Abbāsiān (III-II), Hārūnābād (I), Bahāwalnagar (III-I).
Common. Usually in the same semi-desert canal cultivation facies as the Ring-Dove. On 20 March one was observed carrying nesting material.

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The specimen of 4 February was very fat. After 26 February the birds were not seen again, and by that date the majority had evidently left.

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Elsewhere noted: Bahāwalpūr town environs (II).

[Measurements:

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Speciment collected: 91 ♂ 10-2-39 Yazmān (I).

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Coturnix coturnix coturnix (Linn.). The Common or Grey Quail.

Specimen collected : 187 ♀ 26-2-39 Manthār (I)
Elsewhere noted : Bhūng (III-II)

[Measurements :

	Bill	Wing	Tail
1 ♀	15·5	107	36 mm.—H. W.]

The Survey found the Grey Quail scarce. It may be more plentiful when on actual passage in spring and autumn. Occasional pairs or loose parties of 3 or 4 birds were flushed in young gram and wheat fields.

Francolinus francolinus henrici Bonap. The South Persian Black Partridge.

Specimens collected : 157 ♂ 21-2-39 Manthār (I)
Elsewhere noted : Bahāwalpūr town environs (III), Bhūng (III-II)

[Measurements :

	Bill	Wing	Tail
1 ♂	25	163	94 mm.—H. W.]

Frequents tamarisk scrub and tall *sarkan* grass patches in the riverain tract and by *dhands* and canals. Not abundant now and steadily growing scarcer. Almost completely wiped out from certain localities.

From what I gathered, this species and the Grey Partridge are very largely netted in Bahāwalpūr by professional bird catchers although of late the shikar department has been making an effort to check the ravages. For a recent official shooting camp and for the banquetting of high and mighty State guests I was informed that each of several tahsildars had orders to supply 500 birds. It is not difficult to conceive that many more birds must actually be captured for the required number to filter through to the other end! Thus extermination proceeds apace and unless stringent protection is enforced and professional snaring and netting completely banned—and that without delay—it is not improbable that soon partridges may have to be looked for in vain.

Francolinus pondicerianus interpositus Hartert. The Northern Grey Partridge.

No specimen preserved.
Noted : Bahāwalpūr town environs (III-II), Yazmān (I), Bhūng (III-II), Hārūnābād (I) and elsewhere.

More abundant than the Black Partridge but equally persecuted. Frequents riverain cultivation as well as canal colonies in desert and semi-desert.

Rallus aquaticus korejewi Sarudny. The Turkestan Water-Rail

Specimens collected : 244 ♂, 245 ♂ 6-3-39 Jajjah-Abbāsiān (III-II).

[Measurements :

	Bill (from feathers)	Wing	Tail
2 ♂♂	41·5-42·5	121-122	49·5-53·5 mm.—H. W.]

Shot in a reed-bed bordering Gagree *dhand*.

Porzana pusilla pusilla (Pallas). The Eastern Baillon's Crake.

Specimens collected: 217 ♀ 3-3-39 Jajjah-Abbāsiān (III-II)

[Measurements :

	Bill (from feathers)	Wing	Tail
1 ♀	17	91	45 mm.—H. W.]

Shot in a reed-bed at Tatār *dhand*.

Amaurornis phoenicurus subsp.? The White-breasted Waterhen.

No specimen.
Noted on Baggah and Tatār *dhands*, Jajjah-Abbāsiān.

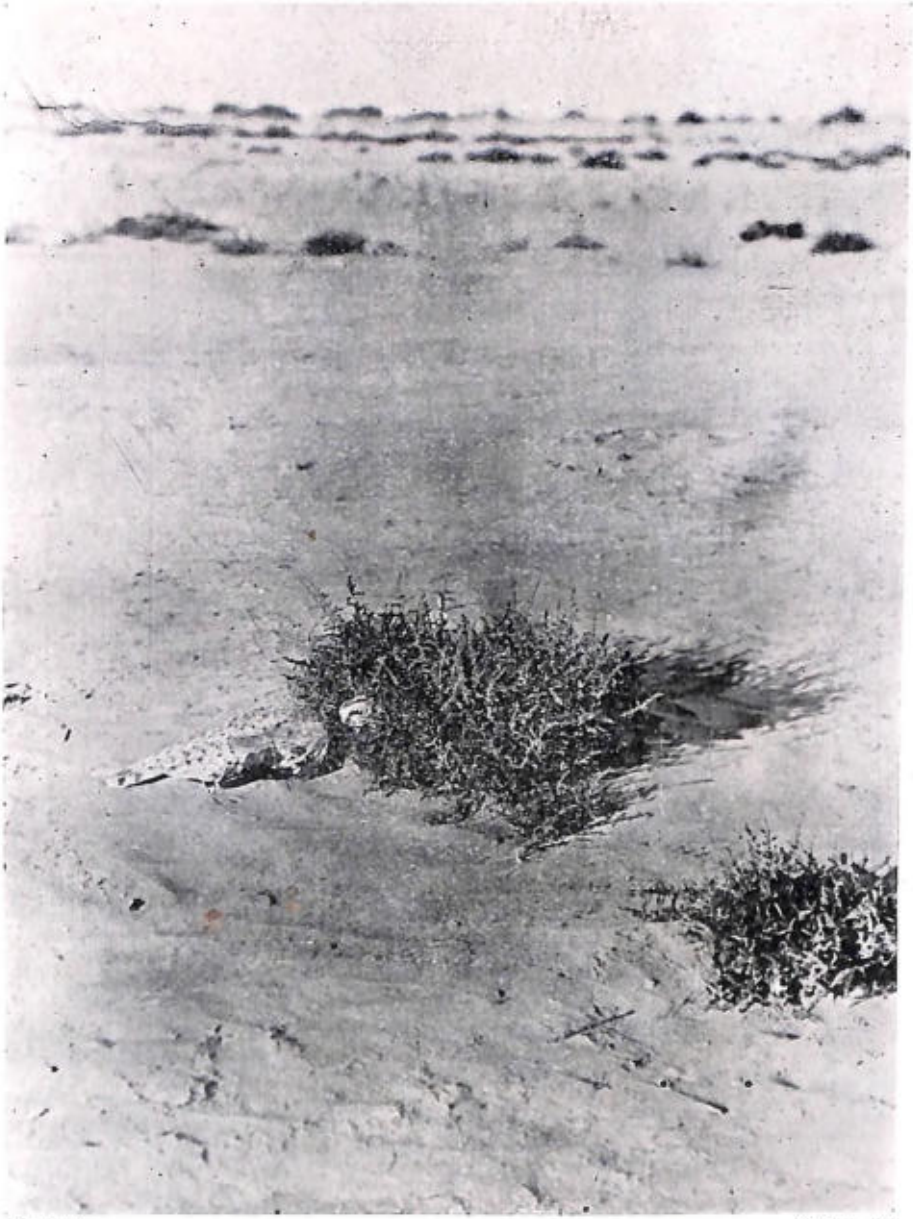

Photo : *Sálim Ali.*

A winged Houbara taking cover behind a diminutive bush.

Photo : *Sálim Ali.*

The Houbara (*Chlamydotis undulata macqueeni*) when lying 'doggo' is a perfect example of obliterative desert colouration.

Gallinula chloropus subsp.? The Moorhen.

No specimen
Fairly common on Baggah, Tatār, Gagree and other *dhands* at Jajjah-Abbāsiān, and also at Bahāwalnagar.

Porphyrio poliocephalus subsp.? The Purple Moorhen.

No specimen.
Noted: Jajjah-Abbāsiān.

Common on Gagree and other *dhands* with reed-beds, on the edge of which it occasionally showed itself. It is much prized by the mohanas (boatmen) as food.

Fulica atra atra Linn. The Coot.

No specimens. Abundant on *dhands* at Jajjah-Abbāsiān, Bahāwalnagar and and elsewhere.

Anthropodes virgo (Linn.). The Demoiselle Crane.

No specimen. Noted at Yazmān (I), Chāchrān (III) and Hārūnābād (I).
Said to be unusually scarce this season (1938/39). Only small occasional flocks of 4 or 5 and up to 10 birds met with among young wheat fields in the riverain tract or canal cultivation in desert.
On 16 March on a loose sandy *pat* among low hummocky sand-dunes in the desert some 2 miles from the edge of cultivation, were observed recent foot-prints of an enormous congregation of some hundreds of large crane-like birds, possibly this species. Had they massed here prior to emigration?

Choriotes nigriceps (Vigors). The Great Indian Bustard.

No specimen. A pair was observed at Manthār on some abandoned fallow land bordering on sand-dune desert. The birds were excessively shy and difficult to approach even within fair rifle shot. Once on the wing, they flew steadily on for miles and were finally lost to view. Said to be rare in Bahāwalpūr.

Chlamydotis undulata macqueeni (Gray). The Houbara.

No specimen.
Noted: Bahāwalpūr town environs (III), Yazmān (I), Dera Bakha (II), Manthār(I)
Common and plentiful among the sandy mustard fields and low tamarisk scrub on the banks of the Sutlej river. Also in sparsely scrubbed desert and semi-desert country, often on the outskirts of cultivation especially of *sirsūn* (mustard) crops. Flocks of 4 to 7 birds were commonly met with.
The Houbara, at all times alert and swift on its legs, is well nigh unapproachable on a cool cloudy day. It is apparently not much hunted by the Punjabi settlers in the desert canal colonies, and it was difficult to find anybody with a proper idea of manoeuvring a camel round the bird in ever-narrowing circles as is the normal method of circumventing it in Sind. When pressed the Houbara surreptitiously lies 'doggo' behind a bush or mound, and it must be seen to be believed how thoroughly inconspicuous such a large bird can thus become in its sandy environment. In flight the white underparts and the round white patches near the wing tips are prominent. The flight, seemingly heavy with slow wing beats, head and neck extended as in the Stone-curlew, is in reality considerably swifter than it appears.

Cursorius cursor cursor (Lath.). The Cream-coloured Courser.

Specimens collected: 29i ♀ 15-3-39, 29s ♂ 16-3-39 Hārūnābād (I)
Elsewhere noted: Yazmān (I)

[Measurements:

	Bill	Wing	Tail
1 ♂	32	167	67 mm.
1 ♀	33	165	64 mm.—H. W.]

Patchily and locally distributed but apparently not uncommon in desert areas

on *pats* among sand-dunes, the facies common also to the Desert Lark (*Alaemon*). In colour scheme and general effect it is but an enlarged edition of the Desert Lark. In overhead flight the bird is strongly reminiscent of the Pratincole or Swallow Plover.

No. 291 was evidently ready to breed. Its largest ovarian follicle was over 3 mm. in diam. No. 298, less sexually mature (testes 6×4 mm.), was very fat.

Chettusia leucura (Licht.). The White-tailed Lapwing.

Specimens collected: 57 ♂, 58 ♂ 5-2-39 Bahāwalpūr town environs (III).
Elsewhere noted: Jajjah-Abbāsiān.

[Measurements:

	Bill	Wing	Tail
2 ♂♂	35-35·5	173-179	71-73 mm.—H. W.]

Not uncommon. Small flocks of 6 to 8 birds were usually met with on the marshy margins of *dhands*. The gonads of the specimens showed signs of enlargement. They measured 4×2 and 3×1.5 respectively.

Lobivanellus indicus subsp? The Red-wattled Lapwing.

No specimen.
Noted: Yazmān (I), Jajjah-Abbāsiān (III-II), Bahāwalpūr town environs (III-II).
Fairly common but not abundant. Pairs or small parties about irrigated ploughed and fallow land in semi-desert canal areas. Also at *dhands*.

The Yellow-watted Laping [*Lobipluvia malabarica* (Bodd.)] was not met with by the Survey between January and April. There is no information for other seasons of the year, but it is not unlikely that it may be a hot weather breeding visitor to Bahāwalpūr territory as it is in Sind and elsewhere.

Charadrius dubius jerdoni (Legge). Jerdon's Little-Ringed Plover.

Specimen collected: 8 ♂ 28-1-39 Bahāwalpūr town environs (III).
Elsewhere noted: Bahāwalnagar (subspecies?).

[Measurements:

	Bill	Wing	Tail
1 ♂	15·5	114	60 mm.—H. W.]

Not common. Small parties of 3 or 4 were occasionally seen on sandy river beds and at *dhands*. Left testis of specimen 6×3 mm., right 3×2 mm.

Tringa totanus eurhinus (Oberh.). The Redshank.

Specimens collected: 59 ♀, 60 ♂, 61 ♂, 62 ♀ 5-2-39 Bahāwalpūr town environs (III).
Elsewhere noted: Bhūng (III-II), Bahāwalnagar (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	49-51	160-161	66-72 mm.
2 ♀♀	51-53·5	162-165	66.5-67 mm.

These birds belong to the grey eastern race for which I prefer to use the name *eurhinus* and not *terrignotae*. There has, however, been considerable controversy about the matter and for this consult *Ibis* 1934, p. 115, 1936 p. 826 and 1938 p. 525.—H. W.]

Redshanks were seen in large flocks of 40 to 50 each at *dhands* in the environs of Bahāwalpūr town. They were common here in early February. Elsewhere solitaries or small parties of 3 or 4 were met with. The last date recorded is 21 March, by which time most birds had certainly left. There was of course no development as such in the gonads of the specimens though in both sexes a slight departure from the absolute quiescent condition was discernible. The testes of No. 60 measured 3×1.5 mm.

All the birds were infested with flukes in the posterior body cavity. One had 28 of the parasites clinging in a mass to the ceiling of the lumbar region. Outwardly the birds appeared perfectly healthy, and they were in good condition.

Philomachus pugnax (Linn.). The Ruff and Reeve.

Specimen collected: 325 ♂ 21-3-39 Bahāwalnagar (HH.)

[Measurements:

	Bill	Wing	Tail
1 ♂	43·5	181	69 mm.—H. W.]

One of a pair at a *dhand*. Testes 3×2 mm. Very fat.

Tringa ochropus Linn. The Green Sandpiper.

Fairly common at *dhands* and puddles.

Tringa glareola Linn. The Wood Sandpiper.

Noted at a *dhand* between Bahāwalnagar and Minchinābād.

Tringa hypoleucos Linn. The Common Sandpiper.

Not common. Noted singly on margins of *dhands*.

Glottis nebularia (Gunnerus). The Greenshank.

Noted Bhūng 16 February. Solo on a small open pond.

Erolia temminckii (Leisler). Temminck's Stint.

Noted: Bahāwalpur town environs, Bhūng, Jajjah-Abbāsiān, Bahāwalnagar. Fairly common on damp grassy margins of tanks whence the water has receded. In small parties of 3 or 4 and flocks of up to 20 individuals.

Capella gallinago gallinago (Linn.). The Common or Fantail Snipe.

Common. Shot around the *dhands* at Jajjah, Bahāwalnagar and elsewhere.

Lymnocryptes minima Brunnich. The Jack Snipe.

Fairly common. Shot at Jajjah-Abbāsiān.

Larus ridibundus (or **brunicephalus ?**). The Black- (or Brown-?) headed Gull.

Two gulls in winter plumage were observed on Gagree *dhand* at Jajjah-Abbāsiān on 2 and 6 March. They were extremely wild and impossible to approach within gunshot.

Sterna aurantia Gray. The Indian River Tern.

Common on the larger rivers—Indus, Sutlej, Chenab.

Sterna melanogaster Temm. The Black-bellied Tern.

Noted in Bahāwalpūr town environs and near Bhūng, on the Sutlej and Indus rivers.

Phalacrocorax niger (Vieill.). The Little Cormorant.

Noted at Gagree *dhand*, Jajjah-Abbāsiān, 2-6 March.

Phalacrocorax carbo sinensis (Shaw & Nodder). The Indian Large Cormorant.

Fairly abundant on Gagree *dhand*, Jajjah-Abbāsiān, 2-6 March.

Phalacrocorax fuscicollis Stephen. The Indian Shag.

Several on Gagree *dhand*, Jajjah-Abbāsiān, 2-6 March.

Anhinga melanogaster Pennant. The Indian Darter or Snake-Bird.

Noted: Bahāwalpūr town environs, Jajjah-Abbāsiān, Bahāwalnagar. Common at *dhands*.

Ciconia nigra (Linn.). The Black Stork.

Noted only in Bahāwalpūr town environs in Sutlej river bed. Three on 28 January; solo 29 Jan.

Ardea purpurea (manillensis Meyen). The Eastern Purple Heron.

Two or 3 solos seen at Gagree *dhand*, Jajjah-Abbāsiān, 2 March.

Ardea cinerea subsp.? The Grey Heron.

Occasional solos observed at *dhands* in Bahāwalpūr town environs and at Jajjah.

Egretta alba subsp.? The Large Egret.

Noted: Bahāwalpūr town environs, Jajjah-Abbāsiān. Solos at *dhands*.

Egretta intermedia (Wagler). The Indian Smaller Egret.

Observed at Gagree *dhand*, Jajjah-Abbāsiān, 2-6 March.

Egretta garzetta (Linn.). The Little Egret.

Observed at Gagree *dhand*, Jajjah-Abbāsiān, 2-6 March.

Ardeola grayii (Sykes). The Indian Pond Heron.

Noted: Bhūng.
Apparently uncommon in Bahāwalpūr State.

Nycticorax nycticorax nycticorax (Linn.). The Night Heron.

Noted: Jajjah-Abbāsiān (Gagree *dhand*) 4 March.

Butorides striatus javanicus (Horsf.). The Indian Little Green Heron.

Specimen collected: 209 ♀ 2-3-39 Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill (from feathers)	Wing	Tail
1 ♀	64	170.5	60 mm.—H. W.]

One of a pair amongst partially submerged tamarisk tangles in Gagree *dhand*.

Anas platyrhyncha Linn. The Mallard.

Evidently the most abundant wintering duck in Bahāwalpūr. Out of about 1000 duck killed during one of the big shoots at Jajjah-Abbāsiān between 26 and 29 January (1939) about 800, i.e. about 80% were Mallards. By the beginning of March most birds of this species had left.

Spatula clypeata Linn. The Shoveller.

Common on *dhands*, Jajjah, 2-6 March.

Anas streperus Linn. The Gadwall.

Common on *dhands*, Jajjah, 2-6 March.

Anas penelope Linn. The Wigeon.

Common on *dhands*, Jajjah, 2-6 March.

Dafila acuta (Linn.). The Pintail.

Fairly common on *dhands*, Bahāwalpūr town environs & Jajjah.

Nettion crecca (Linn.). The Common Teal.

Common on *dhands* everywhere.

Casarca ferruginea (Vroeg.). The Ruddy Sheldrake or Brahminy Duck.

A couple were observed on a mudbank in the Indus at Daulatpūr (Sukkur Dist. frontier) 18 February.

Netta rufina (Pallas). The Red-crested Pochard.

Common. By the end of the first week of March mostly this species, *Aythya rufa* and *Nettion crecca* were left on the various *dhands* at Jajjah-Abbāsiān.

Marmaronetta angustirostris (Ménétriés). The Marbled Teal.

I examined 2 specimens killed during the big shoot at Jajjah between 26 and 29 Jan.

Aythya fuligula fuligula (Linn.). The Tufted Pochard.

Observed on Baggah and Tatār *dhands*, Jajjah-Abbāsiān, 2-6 March.

Aythya rufa rufa Linn. The White-eyed Pochard.

Common on *dhands* throughout the area. One of the last ducks to leave for their breeding grounds.

Podiceps nigricollis nigricollis Brehm. The Black-necked Grebe.

I examined a specimen killed during the big shoot at Jajjah between 26 and 29 January. No others were seen.

Podiceps ruficollis capensis (Salvadori). The Indian Little Grebe.

Specimens collected: 207 ♂, 208 ♂ 2-3-39 Jajjah-Abbāsiān (III-II).

[Measurements:

	Bill	Wing	Tail
2 ♂♂	26.5-27	99.5-102.5	27-34 mm.—H. W.]

Common and abundant on all *dhands*. No. 207 was very fat with testes 6×4 mm. Testes of 208 4×3 mm.

THE EARLY STAGES OF INDIAN *LEPIDOPTERA*.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART VIII.

(*Continued from Vol.* xlii, *No.* 3 (1941), p. 517).

RHOPALOCERA.

PIERIDAE.

Delias berinda Moore, *berinda*.

Pupa looking very like a large bird dropping. Cephalic snout slightly bifid with the points upturned. Two small spines immediately above the eyes. Thorax slightly keeled. A series of very small dorsal tubercles decreasing in size towards the cremaster. A dentate ridge on the abdomen subdorsally above the edge of the wing case. Ground colour olive brown. The sides of the mesathorax, a triangular patch on the wing case, its apex, a lateral abdominal stripe, wider just before the cremaster, and a ventral stripe on the anterior portion of the abdomen white. A ventral stripe and the dorsum of the last two abdominal somites and the centre tooth of the ridge above the wing case black. A lateral tubercle on the mesathorax and the rest of the dentate ridge above the wing case yellowish. Suspended by a girdle and tail pad of white silk.

A number of pupae were found attached to rootlets under the over-hang of a bank beside a path through woods. One was found about six feet from the ground attached to a bamboo.

Described from a number of pupae found in Shillong, from one of which a male emerged 6-v-41.

NYMPHALIDAE.

Precis orithya L., *ocyale* Hbn.

de Nice., *Butt. Ind.*, ii, 73. 1886.
Moore, *Lep. Ceyl.*, i, 41, pl. 22, fig. 1b. 1881.
Moore, *Lep. Ind.*, iv, 69, pl. 311, figs. 1, 1a-1c. 1899-1900.
Bingham, *Fauna Brit. Ind.*, Butterflies, i, 358. 1905.

Head black, the clypeus filled in with orange, hairy and with each lobe ending above in a short branched spine. Body black, a paler double dorsal stripe, the area between sprinkled with white dots, a very broken yellowish lateral line from the 4th somite backward and a yellow subspiracular line. 1st somite with a pale orange collar. The lateral area with occasional minute white dots arranged in transverse lines. 1st somite with a short subdorsal black branched spine, a double sublateral branched spine, the upper deep yellow, the lower black. 2nd and 3rd somites with longer

subdorsal and lateral black branched spines and a double shorter sublateral one. 4th to 10th somites with dorsal, subdorsal and lateral black branched spines (five in all) and a double sublateral, the upper with a deep yellow base. 11th somite similar but with two dorsal spines, one before the other. 12th and 13th somites with subdorsal black spines only. Two small branched black spines at the base of each proleg. Legs black. Prolegs deep yellow banded with black. Venter blackish grey.

Pupa suspended by the cremaster. Shape rather short and stout, thorax hardly keeled. Colour dark brownish black, the dorsum with a series of small subdorsal tubercles marked with pale pinkish grey, and with a transverse pinkish grey band before the cremaster. Traces of a pinkish grey dorsal line. Wing cases more olive brown in colour.

Described from a full fed larva found in Shillong 24-iv-41, pupated 27-iv-41 and a female emerged 15-v-41.

Bingham, quoting de Niceville, writes:—'Larva head and body of a very dark shining black shading into brown . . . head on a short neck, latter of an orange colour for a short distance; caudal extremity also tipped with orange. Body covered with perpendicular spines armed with strong radial hairs . . . Head bifurcated, reddish spot in centre of face, a small spinous process in the angle of each eye. Pupa suspended by tail, naked; wing-covers of a muddy yellow; rest of body of a purplish colour variegated by lines of a dull creamy white. Slight projections of an angular nature along the abdomen.' Moore describes the Ceylon form, now known as ssp. *swinhoei* Btlr., as follows:—'Larva dark purple-brown, each somite with short branched spines, two lateral rows of small yellow spots. Pupa ochreous, speckled and lined with dark brown. Feeds on Acanthads.' His figure shews a black larva with a double lateral row of white elongated spots.

Vanessa cardui L.

Moore, *Lep. Ceyl.*, i, 50, pl. 27, fig. 1a. 1881.
Bingham, *Fauna Brit. Ind.*, Butterflies, i, 366. 1905.

Head black with short bristly pubescence. Body dull black clothed with short erect white hairs. An indistinct double yellow dorsal line, traces of a transverse yellow line intersegmentally and a broad yellow sublateral stripe. 1st somite with a minute subdorsal black tubercle and with a lateral and two sublateral yellow ones. 2nd and 3rd somites with a subdorsal, lateral and two sublateral short branched spines, pinkish basally and yellowish apically. 4th to 11th somites with similar spines dorsally, subdorsally and laterally (five in all) and two yellowish spines sublaterally. 12th and 13th somites with the subdorsal spines only. Legs and prolegs brown. Venter grey speckled with whitish.

Pupa suspended by the cremaster. Pale pinkish buff with a darker subdorsal and lateral stripe. Wing cases darker and mottled. A series of nine short stout golden spines subdorsally on thorax and abdomen. Traces of a gold tinged dorsal abdominal stripe, the keel of the thorax slightly golden. Shape, thorax slightly

keeled, wing cases slightly angled, head truncate, very slightly bifid.

Food-plant—Thistles.

Described from a full fed larva found in Shillong 8-v-41, pupated 12-v-41 and a male emerged 29-v-41.

Moore's description, which is quoted by Bingham, is 'Larva blackish-brown, with a longitudinal pale interrupted line on each side; the segments armed with short branched spines. Feeds on *Artemisia*. Pupa tuberculate head bluntly cleft, pale ochreous or brown, more or less spotted with yellow.' The figure shews a black larva with greyish intersegmental stripes.

Vanessa canace L., *canace*.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 372. 1905.

Head black, hairy, with an inverted reddish Y-shaped mark. 1st somite reddish spotted with black, rest of the body with a bright rust-red black-spotted transverse band across the centre of each somite, the intersegmental area black transversely lined with whitish. 1st somite spineless. 2nd and 3rd somites each with a subdorsal and lateral white branched spine, the apical branches black. 4th to 11th somites each with a similar dorsal, subdorsal, lateral and sublateral spine (seven in all). 12th and 13th somites each with a pair of subdorsal spines only. Anal plate black. Legs black. Prolegs black banded with rust-red. Venter black transversely lined with whitish.

The young larva is similar but the rust-red is replaced by bright cadmium yellow. The rust-red colour develops after the last ecdysis.

Pupa suspended by the cremaster. Colour dark purple brown mottled with darker and paler and varying considerably in depth. The abdomen with a pale dorsal line, a double pale ventral line and a pale lateral stripe from the edge of the wing case to the cremaster. Wing cases with a central triangular dark mark. Metathorax and 1st abdominal somite with paired subdorsal golden spots. 2nd and 3rd abdominal somites tinged with metallic copper colour. Shape longer than the usual Vanessid pupa. The head bifid and the cephalic horns long and curved inward. Thorax keeled. Wing cases angled. Abdomen with a series of seven subdorsal and five dorsal spines. Cremaster very long, the edges pale.

Food-plant—*Smilax*.

Described from a full fed larva found in Shillong 21-iv-41, pupated 25-iv-41 and a male emerged 11-v-41.

Bingham, quoting a description by Hampson, writes:—'Larva segments alternately orange and white, with numerous black spots on the orange segments and black streaks on the white; seven white, branching, black-tipped spines on each orange segment. Pupa variegated reddish brown, with frontal gold and silver spots; head produced and bifid.' Moore (*Lep. Ceyl.*, i, 49, pl. 25, fig. 2*a*. 1881) describes and figures the larva and pupa of the Ceylon subspecies *haronica* Moore. The description is 'Larva light red, spotted wth black, the segments divided by black and purple lines, armed with eight longitudinal rows of delicate branched spines; anal

segment slightly humped. Feeds on *Smilax*. Pupa reddish-brown, abdominal segments tubercular, thorax angular, head produced and bifid.' He further mentions that the larva also feeds on Wild Yam. The figure shews a bright yellow larva spotted with black and with the intersegmental areas streaked with black and purplish. The pupa is too short and the shape of the cephalic horns is incorrect. Bingham quotes another very similar description from Moore (*Lep. Ind.*, iv, 94, pl. 315, fig. 2. 1899-1900) which gives the spines as yellow and mentions that the head and legs of the larva are black and that the pupa has two dorsal rows of small reddish pointed tubercles on the abdomen.

Argynnis hyperbius L., *hyperbius*
de Nice., *Butt. Ind.*, ii, 131. 1886.
Bingham, *Fauna Brit. Ind.*, Butterflies, i, 440. 1905.

Head dull black. Body velvety black with a broad dull orange dorsal stripe. 1st somite anteriorly with a long subdorsal and posteriorly with a shorter lateral black branched spine. 2nd somite similar. 3rd somite with the subdorsal spines only. 4th to 11th somites with a series of subdorsal, lateral and sublateral branched spines, the subdorsal series longest, those on the 4th somite black, on the others with the apical third black, the basal two-thirds pink. 12th somite with a subdorsal and a lateral pink and black spine. Legs black. Prolegs black, the feet yellow. Venter black.

Pupa dark blackish brown, the wing cases slightly mottled with paler. Dorsum with traces of a median stripe composed of chestnut specks, the thoracic keel chestnut. The thorax with three and the abdomen with two subdorsal golden spots. Shape head bifid and produced into two short horns, wing cases angled, thorax keeled. A small black spine in each of the thoracic and abdominal gold spots and a series of six subdorsal outwardly curved spines, of which the first is the largest. Suspended by the cremaster.

Food-plant—Garden Pansy.

Described from a full fed larva found in Shillong 5-v-41, pupated 8-v-41 and a male emerged 18-v-41.

Bingham quotes de Niceville as follows:—'Larva head and legs black; body black, this colour, however, obscured by orange-tawny markings. A broad orange-tawny dorsal stripe. Four straight horizontal simple black spines on head; spines on pectoral segments black; on abdominal segments pink tipped with black; on caudal segments pink faintly black-tipped. Pupa head and wing-cases pale Indian red; ten pale metallic spots on back; abdomen dark pink; spines faintly black-tipped. The head ends in two well-separated blunt points; there are a pair of spines anteriorly, another in the middle, and a third smallest pair posteriorly on the thorax, the latter being hunched and keeled, on the abdominal segments there are eight pairs of spines, the third anterior pair the largest.' Moore, in *Lep. Ceyl.*, i, pl. 31, fig. 2b. 1881, figures the larva and pupa of the Ceylon subspecies *taprobana* Moore, he gives no description but mentions Wild Violet as the food-plant. The figure shews a dull black larva with a dull tawny dorsal stripe. The shape of the pupa is not very accurate.

Cethosia biblis Drury, *tisamena* Fruhs.

Head black. Body with the intersegmental areas black, each somite with a transverse white, purple and white stripe, a black stripe dividing the colours. An interrupted sublateral white stripe. Lateral area and venter black. Legs and prolegs black, the feet of the latter grey. Spiracles black ringed with white. Head with a pair of long thin tuberculate black spines. 1st somite with an anterior subdorsal and a posterior lateral similar but shorter spine. 2nd somite with similar but slightly longer spines. 3rd somite with the subdorsal spine only, but rather longer. 4th to 11th somites with a subdorsal, lateral and sublateral spine. 12th somite with subdorsal and lateral only. On all the somites the subdorsal spine is longest, the sublateral shortest, and, except for the 1st and 2nd somites' lateral spines, all arise from the purple stripe.

Pupa suspended by the cremaster. Shape—head truncate and projecting laterally into a slightly upturned tubercle. Pro- and mesothorax with a subdorsal spine, wing cases with two lateral projections above, abdomen with three pairs of subdorsal spines, then a rounded lobe terminating in a spine and then a further four spines decreasing in size from front to rear. A lateral series of four spines on the abdomen, the first fairly long, the fourth little more than a tubercle. A pupa formed in captivity was ivory white with a subdorsal and lateral series of small olive brown blotches. The wing cases also blotched centrally with olive brown. Cremaster black, last three abdominal somites marked with black dorsally and ventrally. A double dorsal golden spot on the prothorax and two on the anterior somites of the abdomen. A wild caught pupa of similar shape, which unfortunately died but was almost undoubtedly of this species, had a rich deep golden brown ground colour.

Food-plant—A small creeper with heart-shaped leaves. The larvae refused to eat the ordinary cultivated Passion Flower.

Described from a full fed larva found in Shillong 7-v-41, pupated 16-v-41 and a female emerged 23-v-41.

Pareba vesta F., *vesta*.

Moore, *Lep. Ind.*, v, 31, pl. 387, figs. 1, 1a-1f. 1901-03.
Bingham, *Fauna Brit. Ind.*, Butterflies, i, 470. 1905.

Head yellowish brown, a pale inverted Y-shaped mark, the arms filled in with black and edged with black externally. Ground colour of body creamy-white, a chocolate brown dorsal, lateral and sublateral stripe and with two transverse chocolate brown stripes across each somite posterior to the spines and another on the intersegmental area. Armed with the following slightly branched spines, basally yellow brown and apically black and arising from yellowish warts between the longitudinal stripes, 1st somite with a subdorsal spine, 2nd and 3rd with a subdorsal and lateral, 4th to 11th with a subdorsal, lateral and sublateral, and 12th somite with a subdorsal and lateral. Legs and prolegs black. Venter whitish with a purplish brown lateral stripe.

Pupa suspended by the cremaster. Shape long, not prominently angled, a series of short black spines subdorsally on thorax and abdomen. Colour white. Abdomen with a black subdorsal,

lateral and a median ventral stripe, the subdorsal and lateral bearing seven and four deep yellow spots respectively, the ventral with an interrupted yellow internal stripe. Wing cases veined with black. Thorax with a central yellow stripe edged with black. Antenna cases yellow outlined with black. Head and leg cases marked with black.

Described from a full fed larva found in Shillong 21-iv-41, pupated 25-iv-41 and a male emerged 14-v-41.

Bingham, quoting Moore, gives the following description :— 'Larva elongated; head unarmed; segments armed with a subdorsal and a sublateral row of long, sharp-pointed, branched spines and a lateral row of shorter naked spines. Head reddish ochraceous, black-spotted, front with a white stripe; segments dark purplish violet, with longitudinal rows of short transverse white bars; spines ochreous with black tips; legs ochreous with black bands. Pupa suspended. Elongated, narrow; head with two short frontal points; thorax convex and uneven; abdominal segments with a dorsal and two lateral rows of short tubercular points. Colour white, tubercles and streaks on wing-cases ochreous.'

LYCAENIDAE.

Rapala nissa Koll., *rectivitta* Moore.

Head small, black and retractile. 1st somite hood-shaped. 2nd to 9th somite each with a subdorsal and sublateral fleshy tooth ending in a few black bristles. 10th somite with two sublateral teeth but no subdorsal. 11th somite with one sublateral tooth. Colour yellowish green with a darker dorsal line, the teeth somewhat paler and with an oblique triangular pale lateral mark on each somite. Legs, prolegs and venter paler green. Ant gland and tubercles inconspicuous.

Pupa of the usual Lycaenid shape. Pale pinkish grey, the sides of the thorax and wing cases suffused with blackish. Formed in captivity on a slight mat of silk on the bottom of the tin and covered by a leaf, and secured by a slight girdle and the cremaster.

Described from a full fed larva found in Shillong 21-iv-41, pupated 27-iv-41 and a female emerged 15-v-41.

HETEROCERA.

LYMANTRIIDAE.

Porthesia scintillans Wlk., *limbata* Btlr.

Head black. Ground colour of body black. A double orange-red dorsal line on the 1st to 3rd somite, the lines divide and become subdorsal on the 4th and 5th somites and then join again and continue dorsally very indistinctly to the 10th somite. 4th and 5th somites with small dorsal humps tufted with short black hair. 6th to 10th somites with round subdorsal patches of white scale-like hairs, 4th and 5th somites with smaller patches below

the dorsal humps. 11th somite slightly humped and with a few of the white scale-like hairs laterally. An orange-red sublateral line with a series of crimson warts bearing white hairs, the warts continuing across the 12th somite. 1st somite with red subdorsal tubercles tufted with blackish hairs. A few white hairs. Dorsal glands pale lilac. Legs and prolegs yellowish grey. Venter black streaked transversely with orange-red.

Cocoon of dark brown silk mixed with larval hairs. Pupa olive brown, the abdomen tinged posteriorly with yellow, the wing-cases with green.

Described from a full fed larva found in Shillong 23-iv-41, spun 27-iv-41 and a female emerged 17-v-41.

A larva found at Peshoke (2,500 ft. Darjeeling District) in December 1937 on Tea was similar to the larva of *P. scintillans scintillans* (mihi, *Journ. Bomb. Nat. Hist. Soc.*, xl, 406), but unfortunately failed to emerge so that it was impossible to be certain whether it was of ssp. *limbata* or not.

LASIOCAMPIDAE.

Metanastria lidderdalii Btlr.

Head pale grey, striped with darker. Ground colour of body whitish, overlaid with minute specks and streaks of grey, black, pink, brown and green and giving a general greyish appearance tinged, in some examples, with brown, pink or green. 1st somite with deep crimson subdorsal blotches marked externally with dark blue and with a broad dark dorsal stripe, which continues onto the 2nd somite where it is lost in the dense hair. A dark zig-zag subdorsal line from the 4th to 11th somite enclosing a dorsal series of dark shield-shaped marks. A constant feature is a pale grey shield-shaped mark on the posterior portion of the 7th and anterior portion of the 8th somite. 5th to 11th somites with oblique pale lateral stripes. Some larvae with deep cherry red blotches laterally. 2nd and 3rd somites clothed dorsally with a dense mass of short purple-blue hairs intermixed with a few longer white-tipped hairs and with five transverse bands of short white spatulate hairs running through them. A sublateral series of large tubercles bearing fringes of grey hair. 4th to 10th somites with subdorsal pencils of a few longish black hairs. 11th somite slightly humped and it and the 12th somite with a few single longish black hairs. Venter pale grey with a deep pink central stripe. Legs deep pink. Prolegs greyish. Spiracles dark grey ringed with whitish. When at rest the hairs on the 2nd and 3rd somites are not very noticeable, but when alarmed the head and 1st somite are doubled underneath the body, erecting a dense fuzz of sharp hairs, and the whole of the forepart of the body is lashed from side to side.

Cocoon boat-shaped of tough greyish silk, shaded with yellow, and studded with the sharp larval hairs projecting point outwards. Usually spun along a twig. Pupa brownish black, the intersegmental areas dark olive brown. The abdominal somites with a

few very short hairs. Cremaster a bunch of short reddish brown hooked spines.

Food-plant—Pine.

Described from a number of full fed larvae found in Shillong, one of which spun 18-iv-41 and a male emerged 20-v-41.

LIMACODIDAE.

Mambarilla narosides Hering.

Head blackish, small, retractile. 1st somite pale purplish brown, retractile. Shape almost flat, very nearly diamond-shaped, the lateral edges scalloped. 2nd somite cut straight across and in four scallops. 8th somite broadest. 12th somite ending in two blunt points. Colour dull dark purplish, a dark rust-coloured broad dorsal stripe on 2nd to 4th somites, a dull whitish lateral mark on the 6th somite, the lateral area of the 9th to 11th somites dull whitish, 10th somite with a white dorsal bar with rounded ends and a paler dorsal blotch on the 12th somite. The lateral scallops ending in a few short bristles, white on the 9th to 11th somites, brown on the others. Venter whitish.

Cocoon small, almost spherical, of the usual hard Limacodid type. Colour silvery white with a slightly curved deep chocolate brown stripe on the top and an incomplete circle of the same colour at one end. Some have more than one stripe on top and may be marked at both ends.

Food-plant—Pear.

Described from a number of full fed larvae and cocoons found in Shillong 1-v-41, from one of which a female emerged 19-v-41.

NOCTUIDAE.

Acronicta indica Moore.

Head deep reddish chestnut or black, with an inverted V-shaped paler mark. Ground colour black, the intersegmental areas transversely lined with yellow. 3rd to 10th somites with an orange dorsal streak on the anterior portion of each somite and an oblique white stripe subdorsally. A zig-zag creamy subspiracular stripe with an erect pinkish-chestnut dash behind each spiracle. 1st somite with single longish pale hairs. 2nd somite with a double subdorsal tuft of white hair, 3rd somite with a triple subdorsal tuft of black hair, 4th to 8th somites with triple subdorsal tufts of white hair. All somites with single longish hairs. Legs chestnut. Prolegs pinkish-chestnut. Venter blackish. Spiracles white. One larva had the ground colour deep brown instead of black, the subdorsal tufts of hair pinkish brown instead of white and the subdorsal stripes reddish orange instead of white.

Cocoon spun, in captivity, among leaves and of golden brown silk. Pupa very dark purple brown, minutely punctate. Cremaster broad, a short point on either side and clothed with short straight dark brown bristles.

Food-plant—*Plantago* sp.

Described from a full fed larva found in Shillong 12-v-41; spun 16-v-41 and a female emerged 27-v-41.

The larva is very similar to that of the European *A. rumicis* L., with which the present species was formerly considered synonymous.

GEOMETRIDAE.

Terpna ornataria Moore.

Head grey green, triangular and produced into a long point, bifid at the extreme tip. Body grey green, a yellow subdorsal line which ends by edging the anal flap, which is produced into a longish point. The dorsum, under a lens, minutely speckled with dull red, with larger dull crimson speck on the anterior portion of each somite dorsally and another subdorsally just external to the subdorsal line. A sublateral line, consisting of a white, a yellow and a brown line, starting from the posterior pair of legs and terminating on the 11th somite. Venter frosted green with a white median stripe, joined by dark-edged whitish oblique stripes with a dull red speck at the point of junction. Legs green, the 1st pair very small, the 3rd marked with red posteriorly. Prolegs green, the anal claspers with the apex dull reddish. Rests with the legs tucked in and the projection on the head forming a line with the dorsum, position slightly curved.

Pupa in a folded leaf spun together and lined with silk. Colour pale watery yellow-green, the head and prothorax pale olive-brown and with a pale spot ringed with chestnut enclosing the spiracle on the 9th somite. In all pupae found wild, the leaf had a hole bitten through it, through which this spot shewed.

Described from a full fed larva found in Shillong 24-iv-41, spun 26-iv-41 and a female emerged 17-v-41.

Anisodes obrinaria Guen.

Pupa shape triangular. Head truncate, thorax with the front produced into a pair of horns. Thorax not keeled. Colour pale green. Front edge of the thorax blackish brown, a dorsal red brown line. Abdomen with a red brown line on the posterior half, the line originating from a red brown spot. Formed on the surface of a leaf without any cocoon, the cremaster being fixed into a few strands of silk.

Described from a pupa found in Shillong 26-iv-41, from which a female emerged 30-iv-41.

(To be continued).

ON THE BANKS OF THE NARBADA.

BY

LIEUT.-COL. R. W. BURTON, I.A. (*Retd.*).

PART I.

(*With 4 plates*).

'Narbada Mai', or Mother Narbada as it is also reverently named, is considered by many Hindus to be the most sacred of all the rivers of India. It rises to the east of the Central Provinces, at Amarkantak on the borders of the State of Rewah, and enters the Arabian Sea near the town of Broach after a course of some seven hundred miles.

In earlier years it formed, with the forests and hills along its course, one of the main barriers which then shut off the peoples of Northern India from those of the Deccan. At the close of the triumphant career of Samudragupta, the second king of the Gupta dynasty, the Narbada was his southern frontier. He did not attempt to retain conquests made south of the river, and returned about the year A.D. 330 past the fortress of Asirgarh which is nowadays seen by railway passengers between the stations of Burhanpur and Khandwa.

The Narbada (Sanskrit, *Nar-Mada*, 'causing delight') is rightly named for it is a beautiful river through most of its long course, and to camp on its banks during the cold season is truly a delight. In the hotter months of the year the pleasure may be somewhat abated; but tiger and panther are more readily come by, and at certain places the fishing is good.

If one's stay is leisurely suitable swims can be baited with parched gram by means of which excellent sport is obtained. This gram fishing is a method peculiar to the Central Provinces, and an art in itself. Suitable equipment is a fly rod for fish up to 10 lbs. or so, a gut cast as fine as you dare use, and size 8 'model perfect' hooks. 'Fine and far off' is the maxim to bear in mind, and the threaded pellet must swim naturally with the other grains thrown in to accompany it down the stream; for any 'drag' will be fatal to success. And unless there is a ripple on the water it is likely that *all* the pellets will be sucked down *except* that to which one is expectantly attached! It is expert angling, can be most disappointing at times, and is not so simple as the chapter on the subject in the '*Rod in India*' by the immortal Thomas would lead one to suppose. Anglers wishing to have the fullest possible information and guidance as to gram fishing should refer to the excellent article on the subject entitled 'Fishing in the Rivers of the C.P.' by Maj. W. B. Trevenen which was published in the *Journal of the Bombay Natural History Society*, Vol. xxxiv, No. 3, p. 700 *et seq.*

Where there are boisterous falls in the river, as at Dhariaghat, there is excellent sport, using natural bait, with mahseer and a number of other predaceous fish both for a period when the water is subsiding after the rains and in the hot weather—March being the best month if the intense heat is not objected to. To hit off the former some considerable margin of time is necessary, or there may be disappointment due to late floods. The waiting days can be passed in pursuit of tiger and panther, in natural history observations, or just walks through an always interesting forest country.

One day three large stones had to be moved to one side of a forest track to clear the way for the cart. Under one stone was a snake, beneath the next a centipede quite eight inches long, and the third harboured a scorpion! Trails of large pythons are occasionally seen in sandy places; huge spider's webs are stretched from bush to bush; the night's tracks of all the jungle animals and birds are along the paths: so jungle strolls can be full of surprises to an inquisitive and observant eye.

There is much life on the river and along its sand banks and islands. We see a crocodile on a sand-spit, and perched on the near-by jutting branch of a submerged snag is a 'snake bird', as the Indian Darter is called by Europeans, and very snake-like he appears when his lean head and neck are protruded above the surface of the water after a dive. The specimen we see has his wings spread out to dry and looks like a bird on a lectern—or the German Eagle! At a respectful distance from the seemingly sleeping saurian are two brahminy ducks—Ruddy Sheldrake, to give them their other name. Wary birds they are, and without good reason, as they are not sought after by European sportsmen and are protected by Hindus, who do not like them being shot. Graceful river terns are seen sweeping over the water with light and airy flight, and kingfishers of three varieties are noticed; the black and white species ('The pied fish-tiger hung above the pool') being less common on this river than the larger and smaller coloured ones—the common Indian kingfisher, with appearance and habits of the one so familiar to us in the British Isles; and the Indian white-breasted kingfisher, with large, conspicuous red beak.

Cormorants are common, and that curious bird, the Indian Stone-Curlew, or Goggle-eyed Plover, is often flushed as we float silently in the dug-out past the islets of the river. Among the bright green foliage of the dwarf jamun bushes many small birds, bulbuls, warblers, sparrows and the like are seen and heard; while the ubiquitous king crows and their larger and more ornate relatives the racket-tailed drongos, are seen hawking the air from selected vantage points. Screeching paroquets weave emerald skeins among the tree-tops; egrets show dazzling white amid the dark foliage of the trees; there is the occasional splash of fish; and a wide ripple is caused by a crocodile having slipped silently into the stream from a sloping bank.

Troops of monkeys and lungoors, an occasional otter: all these and many other sights are the ordinary daily happenings; but all that is to be seen and noticed would fill a volume. Indeed this river is a delight not only on account of the many forms of life to be observed, but because of the changing forest scenery; the

gracefully waving bamboos, grasses and tamarisks; the lovely lights and shadows on the water; and the beauty of the crimson sunsets followed by the softening light of the risen moon which makes the wide river bed with the dark brooding forests on either bank a fairy land of magic and mystery.

The rainy season in the north-western part of the Central Provinces is frequently prolonged into October, so when setting out late in September we knew there might be some unpleasant weather and cart tracks in a bad state. However, after two marches to cover the twenty-four miles from the small wayside station we pitch camp within sight and hearing of the falls under the scanty shade of small teak trees from which the leaf has mostly fallen.

Above the basaltic barrier the river is now some four hundred yards in width, narrows to a hundred and fifty, and tumbles in separate cascades of varying volume over the rocks through which it has cut its way during countless centuries. It is a fine sight.

Below the falls the perpendicular rocks confine the river in a gorge eighty to a hundred yards wide, to open out and again contract, and so make its way for twenty miles to Mandhata, where are famous temples and a cliff from the summit of which human sacrifices took place up to the year 1824, when the country came under British dominion at the close of the Third Mahratta War. It is plain to the eye that the falls we now see were, ages ago, some eight hundred yards further down; and aeons before that again, several miles below.

By the side of the path approaching the sacred river is a small temple dedicated to Mahadeo, from within which issues the almost unceasing chant of the solitary priest. All through the day and night, with but short intervals for rest and food, he drones away; and so passes the monotonous days of his earthly existence in contemplation and hope of the Nirvana he aims eventually to attain. He is one of the really earnest devotees and has been here three years, alone in the tiger-haunted forest, with no human dwelling within miles of him on this side of the river.

In earlier days similar devotees were carried off from the jungle temples at Amarkantak by man-eating tigers: and that may be so occasionally even at the present time.

Early on the 4th October we are on the rocky bank below the nearest fall. The water is beginning to clear; so a good sized murral is seen cruising about. With us is a *dhimar*, a man of the fisherman caste summoned from the Dhar State on the further bank. Having lived much of his life with the roar of the falls in his ears he has acquired a habit of conversing by signs, so interprets his meaning by taking off his loin cloth which he fashions by means of pieces of driftwood into a sufficiently serviceable net. Squatting at the edge of the rough water he has in a few moments bait for the undoing of *Ophiocephalus striatus*—and whitebait for our dinner! He then takes the small rod set aside for his use, attaches a treble hook to the line, and, stalking the place, quietly drops his bunch of wriggling fry into the rushing stream ten feet below. In less than no time the reel is singing a merry tune. 4 lbs. and 24 inches long: one of the best eating freshwater fish of India. But all murral are not so simple as that.

On the other side of the river, where the rapids from the main fall sweep in rushing eddies along the rugged rocks, are two men with sixteen-foot bamboos and twenty feet of cord. Using dead bait they search the likely places with perpendicular lines and we see three large murral unceremoniously lifted out of the water. 'Sometimes,' says our henchman, 'they catch as much as three maunds of fish in a morning'. It is mahseer we want and not these coarser fish. The water is too coloured for spinning and we try live bait without result, for the river is rising fast and there must have been heavy rain higher up.

In the evening we go to see the reported tracks of a tiger. A fine fellow he is by his footprints, of which we see both old and new, so know that the sandy ravine is where he passes regularly on his rounds. A tree for a machan chair is selected. There being no suitable root or stump to which the young buffalo can be picketted, a trench eight feet in length and a foot wide is dug, with a further length tunnelled at each end, so that a ten-foot log can be sunk two feet below ground level. Round the log is passed a flexible wire rope with a loop at the surface to take a similar rope for attachment to the poor boda's foreleg. The loop round the animal's leg is carefully padded. The sand being filled in and well rammed down over stones, adding to the weight, all is secure. No tiger can move such a fixture.

A tiger killing at this prepared dinner table should be as good as bagged. There must be no wounding; for, the jungle, apart from any other consideration, is so thick at this season that the following up of a wounded beast would almost amount to suicide: yet it would have to be undertaken for such are the ethics of the game.

Next day a thunderstorm makes everything damp and uncomfortable, but on the following morning a cloudless sky evidences more settled weather. The water is now less coloured and a 3-lb. mahseer is secured on a spinning dead bait, and in the afternoon another of the same size on the further side of the river. Next morning two mahseer of 5 and 6 lbs. are taken, also on spinning tackle, and then the uncertain weather brings the river down in heavy spate. The rain to cause this six-foot rise must have been a long way off and very heavy: probably it was around the head waters on the Rewah border. Here is a cloudless sky, hot sun, and chilly nights. At 6 a.m. it is 66° and 96° at 2 p.m.

For twelve days the river continues in flood. Neither we nor the locals take many fish, and none of them are mahseer. For days our desultory efforts produce only *tengra* of one to three pounds weight. These scaleless fish afford no sport, but are good to eat. Several *perrun*, also of the family *Siluridae*, are caught on live bait, the largest 8 lbs.—ugly fish having enormous mouths full of rows of sharp teeth. All fish of this 'cat-fish' family are voracious feeders, and some of them grow to a great size—six feet in length, and 200 lbs. and more in weight.

In 1891 I hooked one quite six feet long, from the stern of an Irrawaddy paddle-wheel steamer lying at anchor for the night below Katha. A lascar foolishly touched the taut line with the boat-hook so the monster escaped. A *wallago-attu*—perrun—of 23 lbs. seized a *rohu* (carp) of seven pounds while the smaller fish was being

ON THE BANKS OF THE NARBADA

Fig. 1.—Dasara Festival at Dhariaghat.

Fig. 2.—Dhariaghat Falls on the Narbada: tiger and mahseer, both are here.

ON THE BANKS OF THE NARBADA

Fig. 1.—A 20 lb. Mahseer.

Fig. 2.—Perrun, 14 lbs.

played in the lake at Mahoba; after he let go a 2-lb. *rohu* fished as live bait brought about his speedy capture.

Sometimes we sit and watch the leaping fish. Gallant efforts they make to ascend the foaming falls and cataracts; some must succeed, but most appear to fail. Our greatest admiration is gained by the tiny heroes which leap from the foaming torrent against the slippery sides of the rocky walls. There they cling, panting, with down-pressed pectoral and ventral fins; wriggle up a little, take a rest, wriggle again, and so, by difficult inches, climb five feet of rock—mostly perpendicular and sometimes overhanging—until they meet the water trickling over at an edge. Then a final effort is made and the gallant mite rushes into the flood to be instantly borne away down the fall he has been instinctively endeavouring to surmount.

It is only very wee minnows which attempt the ascent in this manner. The others are ceaselessly leaping, leaping, mostly without avail: and the loin cloths are busy all the time.

On the 13th October there was a great gathering of people from far and near, the occasion being the annual Dasara festival—the Durga-Puja of the Bengal Presidency. On this day there will have been similar gatherings at all the ghats and temples throughout the course of this sacred river.

It is a gay scene we look upon. The rugged, rocky shores of the river are crowded on both banks with gaily apparelled men, women and children, for this is a universal Hindu outing similar to a British bank holiday. Bullock carts, palanquins, ponies, are scattered among the throng, and the smoke from many fires rises in the air. There is a great washing of clothes, performing of various ceremonies, and offering of coconuts. Below the falls are several large boats which have brought people from Mandhata, and the boatmen are reaping a rich harvest of the nuts from the stream, vieing with each other in racing down the flood to secure them. By evening all these thousands of people have left to return to their homes.

Next day there is news of a large cow buffalo having been killed by a tigress five miles upstream. We hasten to the place with a young companion who is in camp with us for a week or so. Mr. Verdant Green—for so we may name him concerning all that pertains to shikar, is full of hope, but it is not until 5-30 p.m.—much too late for such an affair—that we leave him perched in a machan chair for this first experience of sitting up for a tiger.

In the morning we find tracks of the tigress all around the kill, and learn she was heard sniffing under the machan early in the night but gave no other sign of her presence. She may have been within hearing when the machan was being made ready, or suspicious because the kill had perforce been dragged some twenty feet; or, more likely, had detected the occupant. Another all night vigil by our young friend afforded him the further experience of seeing five hyaenas at their loathly repast, for the weather was warm, and the poor buffalo hastening towards dissolution.

On the way back to camp we see tracks of other tigers, and a bear, along the sandy banks of the river, and at a village talk to an old man—eighty he says he is, perhaps he is sixty. A couple

of months ago he heard a disturbance in the calf-shed near his hut. Entering with a man holding a lantern he found a large male panther had seized a calf by the throat. Graphically he illustrates how he severed the marauder's spine with one stroke of his axe and wholly disabled it with further blows, the final stroke almost cutting its head in two. Such killing of panthers with axes is not uncommon: even tigers have been slain in like manner by plucky herdsmen.

In the evening we take our first large mahseer of the trip, large for this river. He seized the spinning dead bait in a small eddy just off the main rapid along the further bank so was into the flood and eighty yards below in no time. The fish then reached more placid water at the entrance to a bay, but the clamber along the rocks took some time and there was a loose line now and then; a fall would have been painful, and dangerous in places. However all was well and the fish duly played out and netted. 20 lbs., 31 ins. long, girth 22 inches; a handsome mahseer with dark blue back and portly outline.

The sky is dark and lowering as we take the photograph. The *dhimar*, picking up his rod, hurriedly laid down when he heard our yell above the roaring of the waters, finds his minnow has been pouched by a mottled green snake and the line in a fine tangle. The light is now too bad for a photograph and we are eager for another fish. Several are seen to leap in the tumbled turmoil of the rapids; there is one savage tug at the bait but no hold taken; so we put up our tackle, trudge up the bank to the boat, and cross the river after the most gorgeous sunset it is possible to imagine.

This sudden activity of fish, and the flaming sky, was a sure presage of the storm which gathered next day to burst upon us from 3 p.m. to midnight. Every day we take coarse fish: *tengra, perrun, bekri*, eels, and realize, as indeed we well know, that this month of October is too uncertain for mahseer fishing in this river. March is the month. Then are golden days and silver nights, mahseer, tiger, all delights! The days more red-hot than golden, but sport would compensate and risk of fever be less.

On the 25th October two small mahseer taken on spinning tackle are returned to grow larger, and the twin brother of our acquaintance of last Sunday is seen rolling like a porpoise in the swirling foam. Now the water is clearing, and there will be no more rain. Early in the month there were flights of duck and teal moving up and down, but none have been seen lately. Daily we see the three varieties of kingfisher, fish hawks, kites, ubiquitous crow, and blue rock pigeons. On only one day was a mugger seen and he, a monster of his kind, cruising down the flood like a Thames steamer.

When asked if any of the villagers are ever taken by muggers the *dhimar* relates a wonderful tale. 'It was,' he says, 'about the time of the great upheaval (meaning the Indian Mutiny) that a boy took two bullocks to the river to drink. A mugger seized the lad by the leg; he held on to the head ropes. The saurian would not let go, nor did the boy, but the bullocks were strong and dragged both boy and crocodile to the village where the latter

ON THE BANKS OF THE NARBADA

Fig. 1.—A Narbada Priest.

Fig. 2.—The *Dhobi* at work.

ON THE BANKS OF THE NARBADA

Fig. 1.—A centre cataract.

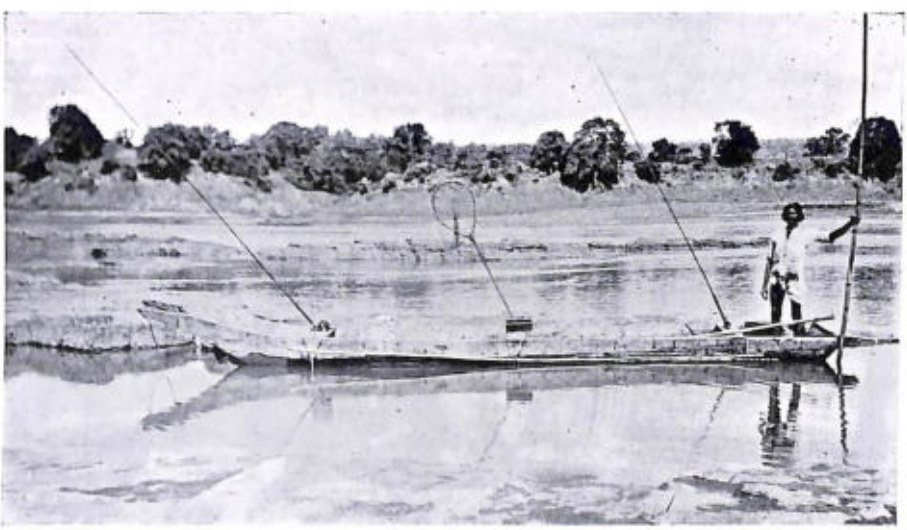

Fig. 2.—My fishing boat.

was despatched and the boy released'. A stout-hearted, also strong-armed village boy!

On the night of the 26th the tiger again took a stroll along the sandy shore of the river, passing between the two *bodas* without getting into touch with either of them. Yet the baits are tethered in carefully selected places where tigers have passed, and always do pass, on their nightly prowls. It is sheer bad luck and only two nights remain, for this outing must come to an end on the 30th October.

Now that the impetuous flow of the river has somewhat abated, the *dhimar* accedes to the suggestion that we can venture to the several falls and cascades accessible from the rocks in the centre of the rocky barrier. We go there in the afternoon and observe much of surpassing interest. Plain to the understanding are demonstrated the methods slow and sure by which the mighty force of the water continues to erode a way through the rocks and gradually destroy them. Very evident it is that during the ages to come the falls will recede further and further upstream.

First there is a small irregularity in the rock surface; a little sand whirled round and round forms a slight circular depression; then a few small pebbles continue the work; the boil becomes deeper, the pebbles larger: then arrive pebbles to size of a football and a large 'well' is formed. All of these processes are seen at work in the various stages. The result is that two wells are formed in proximity to one another. As they grow larger the sides give way and an arch is formed. Gradually the arch is weakened at the summit and worn away; then the rocks are tumbled into the irresistible flood to be eventually ground into sand. So it is that the relentless power of Nature is ever at work and 'grinds exceeding small'. As the various processes of formation of these 'boils' and 'wells' can only take place during the few months of the year when the river is in flood, and then works intermittently and at various levels, ages indeed must have gone to the making of the great gorge that we see.

We go to the principal cascade, where the two branches of it meet beneath an arch which will eventually collapse, and see two fat murral busily at work among the fry; and a large mottled-green snake—similar to he of the tangled line—is on a rock at the water's edge making quick lunges at the small fish leaping out of the stream as they essay ascent of the tumbled water. We see him catch one, and watch him dispose of it. Many he misses, and is not such a skilful fisherman as the 'pied fish-tiger' which hovers over a placid in-curving bay of the river further down.

At these centre cascades there is a great assembly of fish of all sizes, from minnows an inch long to fish of two or more pounds in weight: all of these in their countless millions are attempting the ascent, and adding the glitter of their silvery forms to the beauty of the foaming water.

The *dhoti* arrangement is soon at work to procure live bait, and in a few minutes a ten-pound mahseer, seizing it deep down under the arch, makes off down the further channel. The movement has been foreseen as, should the fish be able to turn the corner, all is lost for the line will be cut on the rocks and in any case the

fish cannot be landed. So no line is allowed and the struggler hauled back by brute force, the hook-hold being fortunately sound, and directed into the nearer rapid. Once in the swirl of that he could not be denied and is fifty yards downstream in a moment; then he is played out and brought to net in a small bay close by.

A six-pound mahseer is caught, and two much heavier ones lost by the hook-hold not being good enough to withstand the drastic methods necessary to prevent them going down the further flood. As the day draws to a close a 14-lb. perrun is landed after a good fight in the heavier water of another fall, and then we reluctantly pack up to clamber over the rocks to the boat.

We have stayed overlong, and it is nearly dark when we commence to pole upstream. Soon it is realized that it is not possible either to see the rocks below the surface, or which way the currents set, or to pole against the current. To be swept down either of the main falls a descent of forty feet—as must happen if the boat gets into the heavy force of the stream—means certain disaster; so we perforce return to the rocks resigned to the necessity of remaining marooned for the rest of the night.

No food, shorts and shirt! But the sky is clear, the moon will be up in half an hour, and a cleft in the rocks is found which will afford some shelter from the chilly wind to be expected after midnight. The *dhimar* collects driftwood; so has a fire and his evil-smelling tobacco to comfort him.

Soon the familiar star patterns and constellations are pricked clear upon a stainless sky shortly to be dimmed by the rising moon which sheds silver radiance over the upstream placid reaches of the river and enhances the magnificence of the wild turmoil of the falls and cascades. The night is very beautiful.

We wander about the rocks and watch the cascades and the leaping fish doubly silvered in the rays of the moon, a sight which will always live in the memory. The *dhimar* slaps his tummy to indicate it is time to roast some fish over the embers, so we are soon full-fed and ready for slumber which is somewhat slow to arrive owing to the vibration of the tortured rocks. The sun hat makes a sufficient pillow. The fisherman settles down close to the fire which he takes care to keep going through the hours.

Shortly after daybreak the friendly moon sets behind a giant mango tree on the further bank, the stars fade out in the pale blue sky, and the sun springs above the forest tree-tops to shed welcome rays on the scene. The fisherman sets about making arrangements to get the boat away. A long rope is signalled for from camp. He wades and swims to the bank to fetch it and a man to help. At the head of the rapid the man is left near a rock, and the *dhimar* returns to the boat which we pole to a place near the edge of the difficult water. Then the rope is fetched by the otter-like native, and fastened to the boat; it is nervous work to watch him, hampered by the long rope, swept in an instant some twenty yards down before he obtains a footing.

The boat is taken as far upstream as can be managed, to whirl rapidly down when let loose, but be pulled with success to the eddy below the rock. At last the adventure is safely ended. As we arrive the swollen bulk of a defunct bullock comes floating

down the river to be carried over one of the centre cataracts and be wholly disintegrated in the process. It is glad we are to have had a drink of river water before *that* came along!

In the afternoon we go again to the same place and have further success with mahseer and perrun, but take care to stop fishing in time to come away under similar arrangements to those of the morning. This is the end of the October outing. Six miles takes us to the forest rest house, near which is a sandstone fort about 150 years old in which European officials, ladies, children, refugees from Indore, were sheltered for some weeks during the troublous times of 1857, before they were moved for greater security to the Asirgarh Fort. The remaining eighteen miles to the railway station is done in a bullock cart during the cool hours of the night, and train taken at an early hour on the last day of October.

(*To be continued*).

A STUDY OF THE REAPPEARANCE OF TROUT FOOD IN TROUT WATERS IN THE KULU VALLEY (PUNJAB).

BY

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(*With 2 plates*).

In 1937 study of the food of Brown Trout (*Salmo fario* L.) in the Kulu Valley by examination of its stomach contents, had shown that during the months of July and August the monsoon rains caused heavy floods and produced disturbance in the supply of available trout food in the river (Hamid Khan, 1938). The Brown Trout in the Kulu Valley mostly feeds on insects and aquatic larvae clinging to the stones, and during the heavy floods most of the trout's food is washed off the stones. But as soon as the floods subside, it is found that the fauna of the stream has again made its appearance on the stones lying submerged under water. Investigations were, therefore, started in 1938-39 to study reappearance of fauna in the trout waters. No previous record of such a study is available in India, and its importance cannot be minimised. The results of such investigations are of the greatest practical utility to pisciculturist and can be utilized by him to develop the fisheries to their utmost capacity with due consideration to food available in the streams.

METHODS AND APPARATUS.

The commonest type of substratum in the Kulu Valley is stony and it is not practicable to use any dredging or grabbing method for collection of stream fauna. In addition to the fauna adhering to the stones, there is a swimming fauna and fauna lying in the sand and shingle under the stones. It would, therefore, not suffice to raise the stones over a given area for qualitative and quantitative study of stream fauna.

In order to overcome these difficulties, the apparatus, used for collection of fauna from selected areas in the trout waters in the Kulu Valley, was a modified form of the scoop recommended by Moon (1935) for an 'Investigation of the Littoral region of Oligotrophic Lakes'. The body of the scoop consists of a four-sided square box like structure, made of galvanized iron sheet, measuring 12 inches by 12 inches and with angle iron frame. Anteriorly, there are two iron hooks on either side of the frame for attachment of ropes and at its anterior ventral edge, the frame has an iron blade of two inches width. The iron blade is slightly inclined downwards. Posteriorly and situated dorsally, there is an iron socket for a five feet long wooden pole. To the posterior face of the

Fig. 1.—Scoop used for collection of fauna from streams.

Fig. 2.—The scoop in use.

Fig. 1.—Washing organisms from stones.

Fig. 2.—Washing organisms from stones.

scoop is fitted a three feet long bag of strong coarse cloth, which is open at the bottom end, but closed tightly when the scoop is in use (Plate I, fig. 1).

To use the scoop, an area of six square feet is measured, the scoop is placed in shallow water near the bank with its face against the current of water (Plate I, fig. 2), the handle is pushed forward and the scoop is dragged slowly by means of the ropes. The blade of the scoop is pressed gently under a stone which is raised slowly and placed in the bag of the scoop. All the stones lying within the measured area are thus collected, washed carefully in a bucket with a soft deck brush so as to collect all the organisms on the stones, with due care so as not to damage them (Plate II, figs. 1 and 2). The swimming fauna, i.e. the fauna floating on the surface of water, which falls on it from overhanging trees or from other sources, within the measured area, is collected in the bag of the scoop.

When all the stones have been collected, the scoop is then dragged along the bottom, with its iron blade dug deeply into the substratum; collecting the last traces of the fauna present. The fauna, thus obtained in the bucket and net, is strained in muslin cloth and preserved in 70 per cent. alcohol for study.

The scoop has been found to work satisfactorily for collection of practically all the available fauna from the measured area.

Material.

The collection of the fauna was made from selected areas on either bank of the river Beas in the Kulu Valley between Sultanpur and Dramdhag—a distance of twenty-eight miles. The fauna clinging to the stones, lying within the measured area of six square feet, and totally or partially submerged in water, was collected, the stones were cleaned, and replaced in water and kept under observation.

The fauna collected from the stones was classified as 'rich', 'average' or 'poor' according to the quantity collected. The observations were taken twice a day. The period of time required for the fauna to reappear on the stones almost to its normal condition was recorded, and it was found to vary with the different collections made in different months.

The fauna collected from the stones mostly consisted of insect larvae belonging to the orders Trichoptera (Caddis fly), Ephemeroptera (May fly), Diptera, Coleoptera, Hymenoptera, Lepidoptera, Plecoptera and Neuroptera. Trichoptera included the sub-families *Sericostomatidae, Hydropsychidae, Philoptomatidae,* and *Rhyacophilidae.* The May fly larvae belonged to *Ecdyurus* (Hepata geniidae) and *Cloen* (Baetidae). Coleoptera, Hymenoptera and Lepidoptera were meagerly represented. Neuroptera was represented by Sialitidae. Of all the insect larvae, Trichoptera and Ephemeroptera were the commonest.

It is thus evident that Trout's food, studied previously by examination of stomach contents (Hamid Khan, 1938) corresponded to a large extent to the fauna collected from the stones.

The total number of collections of fauna and number of

observations on reappearance of fauna on the stones from July 1938 to October, 1939, was 337 in each case, on an average of about 30 collections every month. No observations were recorded during winter months i.e. from November, 1938 to February, 1939.

Table I shows the average time taken in each month by the fauna to reappear on the stones almost to its normal condition. During the rains and just after the rains the fauna seems to take a longer period to reappear than that it takes before the rains. It may, however, be noted that such a comparison cannot be taken too far as the time taken by the fauna to reappear also varies according to its nature and its density. It is but natural that the time required for the 'rich' fauna to reappear on stones to its original condition is longer than the time that a 'poor' fauna takes to reappear even under normal conditions. During the rains, however, heavy floods cause a great disturbance in the fauna available in the streams, and it is very likely that the organisms clinging to the stones are washed off and get scattered in the stream. Consequently the reappearance of fauna on the stones takes a longer time.

Comparative Study of Fauna.

When the fauna had again made its appearance on the stones almost to its original condition, it was recollected from the stones lying in the measured area and compared with the original collection of fauna made before the stones were cleaned, marked and replaced in water for observations. Altogether eighteen such collections were made.

Table II gives the comparison of collections of fauna from the stones '*before cleaned*' and '*after cleaned*' stages. '*Before cleaned*' stage means the original collections and '*after cleaned*' implies the collection made after reappearance of fauna. It is to be remembered that the observations recorded in Table II were made mostly on collections from stones where fauna was 'rich'. Consequently the average period in Table I taken by the fauna to reappear during various months of the year is different from that given in Table II.

From the observations recorded in Table II it appears that the difference between fauna collected from the stones before they were cleaned, and the fauna when it had reappeared is negligible. In some cases Caddis and May fly larvae have appeared in excess and in other cases the difference is not very great. But in almost all cases the fauna[1] had reappeared to almost to its original strength.

Conclusion.

It has been interesting to find out from these observations that the trout food on an average reappeared after four days' time on the stones which had been cleaned and replaced in the stream. It can, therefore, safely be vouched that the disturbance caused by the floods in the fauna of the trout streams is of a temporary nature, and that the food resources of trout streams in the Kulu seem to be inexhaustible.

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[1] 'Fauna' implies animal fauna. Plant life which was found on the stones along with the insect larvae in the collection is not included.

SUMMARY.

1. Reappearance of fauna on stones submerged in water in River Beas in the Kulu Valley was studied in 1938-39.

2. Scoop used for collection of material from large stones, gravel and sandy substratum is described.

3. The fauna was collected from six square feet area from selected areas on either bank of river Beas.

4. The stones from which the fauna was collected were cleaned, marked, replaced in water and kept under observation.

5. Average period taken by fauna to reappear varies from 63 hours in March to 138 in October.

6. The fauna collected originally did not differ much from the fauna collected after its reappearance.

7. The results of the investigations show that food resources of trout streams in the Kulu Valley seem to be inexhaustible.

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TABLE I.

Showing the average time for the reappearance of the fauna on the stones.

Year	Month	Average time taken for reappearance of the fauna on stones	Remarks
1938	July ...	125 hours	
,,	August ...	90 ,,	105 hours average. (During and after rains.)
,,	September ...	100 ,,	
,,	October ...	85 ,,	
1939	March ...	63 ,,	
,,	April ...	80 ,,	78 hours average. (Before rains.)
,,	May ...	91 ,,	
,,	June ...	79 ,,	
,,	July ...	No observations taken.	
,,	August ...	120 hours	122 hours average. (During and after rains.)
,,	September ...	125 ,,	
,,	October ...	138 ,,	

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From the observations recorded in Table II it appears that the difference between fauna collected from the stones before they were cleaned, and the fauna when it had reappeared is negligible. In some cases Caddis and May fly larvae have appeared in excess and in other cases the difference is not very great. But in almost all cases the fauna[1] had reappeared to almost to its original strength.

Conclusion.

It has been interesting to find out from these observations that the trout food on an average reappeared after four days' time on the stones which had been cleaned and replaced in the stream. It can, therefore, safely be vouched that the disturbance caused by the floods in the fauna of the trout streams is of a temporary nature, and that the food resources of trout streams in the Kulu seem to be inexhaustible.

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[1] 'Fauna' implies animal fauna. Plant life which was found on the stones along with the insect larvae in the collection is not included.

SUMMARY.

1. Reappearance of fauna on stones submerged in water in River Beas in the Kulu Valley was studied in 1938-39.

2. Scoop used for collection of material from large stones, gravel and sandy substratum is described.

3. The fauna was collected from six square feet area from selected areas on either bank of river Beas.

4. The stones from which the fauna was collected were cleaned, marked, replaced in water and kept under observation.

5. Average period taken by fauna to reappear varies from 63 hours in March to 138 in October.

6. The fauna collected originally did not differ much from the fauna collected after its reappearance.

7. The results of the investigations show that food resources of trout streams in the Kulu Valley seem to be inexhaustible.

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TABLE I.

Showing the average time for the reappearance of the fauna on the stones.

Year	Month	Average time taken for reappearance of the fauna on stones	Remarks
1938	July ...	125 hours	
,,	August ...	90 ,,	105 hours average. (During and after rains.)
,,	September ...	100 ,,	
,,	October ...	85 ,,	
1939	March ...	63 ,,	
,,	April ...	80 ,,	78 hours average. (Before rains.)
,,	May ...	91 ,,	
,,	June ...	79 ,,	
,,	July ...	No observations taken.	
,,	August ...	120 hours	122 hours average. (During and after rains.)
,,	September ...	125 ,,	
,,	October ...	138 ,,	

8	May 1939	140 hours 30 minutes	6 sq. ft.	56°F 53°F	49 32	17 23	1 ...	... ...	... ...	... ...	1 8	... ...	... ...	... ...	... ...	68 63	Before cleaned. After cleaned.
9	May 1939	71 hours 45 minutes	6 sq. ft.	56°F 56°F	34 10	21 47	1 4	... ...	... ...	1 ...	... 2	... 1	... ...	... ...	... ...	57 64	Before cleaned. After cleaned.
10	May 1939	141 hours 45 minutes	6 sq. ft.	52°F 52°F	42 38	30 28	4 ...	... ...	... ...	... ...	... 2	... ...	... ...	... ...	... ...	76 68	Before cleaned. After cleaned.
11	May 1939	168 hours 40 minutes	6 sq. ft.	56°F 56°F	142 74	27 38	... ...	... ...	... ...	... ...	... ...	3 ...	... ...	... ...	... ...	172 112	Before cleaned. After cleaned.
12	June 1939	119 hours 20 minutes	6 sq. ft.	53°F 53°F	30 ...	15 43	6 ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	51 43	Before cleaned. After cleaned.
13	June 1939	70 hours 35 minutes	6 sq. ft.	58°F 56°F	26 8	7 16	... ...	... 2	... ...	... ...	... ...	... ...	... ...	... ...	... ...	33 26	Before cleaned. After cleaned.
14	June 1939	119 hours 10 minutes	6 sq. ft.	72°F 70°F	34 14	12 30	... ...	... ...	... ...	... ...	1 ...	... ...	... ...	... ...	... ...	47 44	Before cleaned. After cleaned.
15	August 1939	118 hours 15 minutes	6 sq. ft.	63°F 68°F	37 23	8 18	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	45 41	Before cleaned. After cleaned.
16	Sept. 1939	103 hours 50 minutes	6 sq. ft.	52°F 51°F	8 ...	52 72	... ...	... ...	... ...	1 ...	... ...	... ...	... ...	... ...	... ...	61 72	Before cleaned. After cleaned.
17	Oct. 1939	194 hours 30 minutes	6 sq. ft.	56°F 50°F	85 79	72 78	... ...	2 ...	... ...	... ...	3 1	1 ...	... ...	... ...	... ...	163 158	Before cleaned. After cleaned.
18	Oct. 1939	189 hours 30 minutes	6 sq. ft.	54°F 45°F	90 72	44 53	... ...	... ...	... ...	... ...	3 1	... ...	... 2	... ...	... ...	137 128	Before cleaned. After cleaned.

TABLE II

Showing the comparison of the Fauna at *Before Cleaned* and *After Cleaned* Stages.

Set of observations	Month	Time of reappearance of the fauna	Area of collections	Temperature	Kind of Fauna											Total of individuals	Remarks
					Trichoptera	Ephemeroptera	Diptera	Coleoptera	Hymenoptera	Lepidoptera	Plecoptera	Neuroptera	Insect Larvae unidentified	Mollusca	Pisces		
1	March 1939	146 hours	6 sq. ft.	50°F	129	4	...	...	...	...	...	...	...	...	...	133	Before cleaned.
				54°F	39	50	5	...	...	...	2	...	...	...	...	96	After cleaned.
2	March 1939	141 hours 50 minutes	6 sq. ft.	50°F	13	50	...	...	...	...	...	...	...	...	...	63	Before cleaned.
				50°F	32	25	...	...	...	...	...	...	...	...	...	57	After cleaned.
3	March 1939	122 hours 55 minutes	6 sq. ft.	51°F	28	26	...	...	...	...	...	...	...	...	...	54	Before cleaned.
				53°F	48	15	...	...	...	...	...	...	...	...	...	63	After cleaned.
4	April 1939	117 hours 30 minutes	6 sq. ft.	51°F	102	15	...	...	...	...	...	...	...	...	...	117	Before cleaned.
				49°F	118	12	2	...	...	...	...	...	...	...	...	132	After cleaned.
5	April 1939	119 hours 15 minutes	6 sq. ft.	50°F	62	25	2	...	...	4	...	1	...	.	...	94	Before cleaned.
				49°F	49	34	2	...	...	...	...	...	...	1	...	86	After cleaned.
6	April 1939	170 hours 30 minutes	6 sq. ft.	53°F	72	6	...	...	...	...	3	1	...	...	...	82	Before cleaned.
				54°F	70	16	...	...	...	...	...	...	...	1	...	87	After cleaned.
7	April 1939	91 hours 30 minutes	6 sq. ft.	53°F	48	17	...	...	1	...	...	...	1	5	...	72	Before cleaned.
				51°F	36	30	...	...	...	...	...	...	...	...	...	66	After cleaned.

THE INDIAN CADDIS FLIES (*TRICHOPTERA*).

BY

MARTIN E. MOSELY, F.R.E.S., F.Z.S.

(*With twelve plates*).

PART VIII.

(*Continued from page* 339 *of Volume* xli, No. 2, 1939).

SERICOSTOMATIDAE McLACHLAN. (*Contd.*).

LEPIDOSTOMATINAE Ulmer (*Contd.*).

Dinarthrum latum Martynov. Pl. 1. Figs. 1-4.

Dinarthrum (*Indodinarthrum*) *latum* Mart., Rec. Ind. Mus., 38, pp. 283-284, figs. 53-54, a-c, 1936.

Martynov describes the species as follows:—

'♂. Punjab. Punj-pul Nullah, about a couple of miles from Dalhousie, on the Dalhousie-Bakloh Road, 6,500 ft., v-27, S. L. Hora.'

'♂. Eastern Himalayas, Darjeeling, 11-vi-14, F. H. Gravely (defective specimen).'

'Similar and related to the foregoing species. Basal joint of the antennae nearly as long as the whole body, armed with two processes in the basal part. Anterior wings as in *D.* (*I*) *punjabicum* Mart., but discoidal cell is longer, the cell between M_3+CuA_1 and CuA_2 much longer, cell CuA_2-CuP, on the contrary, not as extended; anal stripe with spinules and scales, a little shorter and somewhat arcuate.'

'♂. Dorsal plate of the 10th segment short, with irregular hind margin; from the side, the 10th segment is higher than in *D. punjabicum*. Basal joint of the pedes genitales more elongated, second joint more dilated at its end; titillators also curved to the right.'

'Length of body 5-5·3 mm.'

Cotypes in the collection of the Indian Museum, Calcutta, I am unacquainted with this species.

Dinarthrum punjabicum Martynov. Pl. 2. Figs. 1-4.

Dinarthrum (*Indodinarthrum*) *punjabicum* Mart., Rec. Ind. Mus., 38, pp. 282-283, fig. 51, a-b, 52, a-c, 1936.

Martynov describes the species as follows:—

'11♂, 6♀. Punjab, Punj-pul Nullah, about a couple of miles from Dalhousie, on Dalhousie-Bakloh Road, 6,500 ft., v. 27, S. L. Hora.'

'♂. Head and thorax brown above, head transverse. Basal joint of ♂ antennae brown, nearly as long as the thorax and abdomen,

curved, directed forwards and clothed with rufescent hairs and outstanding thickened hairs; it bears at its inner side two processes, the basal long and curved and the second shorter, thread-like, yellowish, annulated with brown. 1st joint of ♂ maxillary palpi long, second shorter, slender. Coxae brownish, legs yellow, or somewhat brownish; tarsal joints darker at their ends. Anterior wings greyish-brown, clothed with yellowish rufous hairs and with black scales before and behind the longitudinal subdiscoidal groove; whitish spots of hairs at the end of SC, somewhat nearer to the base and at the end of M. Venation somewhat resembling that in *D. ferox* McLach.; discoidal cell rather short, but somewhat variable. M weak dividing at the base of discoidal cell into the fore branch, reaching the end of wing, and the weak hind branch soon uniting with CuA to form a common vein, then separating and forming probably M_3+CuA_1. Anal groove or stripe straight, distinct and extending a little beyond the end of DC; basal portions of CuP and of A_1 present; fork 5 (between M_3+CuA_1 and Cu_2) somewhat variable, but usually rather short; apical cell between the ends of CuA_2 and CuP extended, elongated; in the posterior wings discoidal cell sometimes closed by a cross-vein; sparse blackish scales present. In females DC in the anterior wings is also short, CuP, A_1, A_2 and A_3 connected behind by a post-costal vein, running near the hind edge of the wing; forks 1, 2, 3 and 5 present; basal joint of ♀ antennae twice shorter than in ♂, without processes.'

'Abdomen dark brownish.'

'♂. Side pieces of 9th segment with concave hind margins; 9th tergite almost triangular, with dark hind edge; 10th dorsal segment not entire, but divided by a median fissure into two portions, which, from above, are band-shaped, with hind margins nearly parallel to the hind edge of 9th tergite; side portions not projecting above. Second joint of pedes genitales elongated, slightly thickened in its distal portion; end part sub-divided by a small incision above into two small lobes.'

'Penis curved downwards; titillators originating from the left side of the penis; they are rather thick and curved to the right.'

'In ♀ anterior wings DC is also short, forks 1, 2 and 3 beginning at the same level.'

'Length of body 4 mm.'

'Remarks.—This species resembles *D.* (*Paradinarthrum*) *longiplicatum* Mart. and *D.* (*P.*) *mesoplicatum* Mart. but differs somewhat in the structure of ♂ genitalia, as also in the venation of anterior wings in ♂.'

Cotypes in the collection of the Indian Museum, Calcutta. I am unacquainted with this species.

Dinarthrena gen. n.

Spurs, 2, 4, 4. In the ♂, the basal joint of the antenna is armed with either one or two processes. Wings clothed with hairs and scales; in the anterior, the post-costal fold varies in length; discoidal cell long and narrow; in the posterior wing, the discoidal

cell is sometimes wanting, possibly aberrantly. Penis-sheaths present. Inferior appendages branched or unbranched; no upright branch at the base.

Genotype.—*D. shanta* sp. n.

Dinarthrena shanta sp. n. Pl. 3. Figs. 1-5.

Insect dark brown. In the ♂, basal joint of the antenna rather short and stout with a claw-shaped, angular branch at the base, somewhat transparent in the type; palpi short, probably two-jointed but obscured under the thick clothing of hairs; anterior wing rather narrow with an acute apex, both wings clothed with hairs and scales; post-costal fold slightly more than half the length of the wing, terminating in a wide cellule and with only one large and rather shallow cellule between it and the posterior margin.

Genitalia ♂.—The apical margin of the ninth tergite produced in a wide triangle with a rounded apex; the dorsal plate is replaced by a pair of strongly chitinized and asymmetric spines arising from bulbose bases, that on the left with a basal spur arising on its upper margin; that on the right, with a small spur before its apex; penis short and curved; sheaths asymmetric, of unequal length; inferior appendages unbranched and terminating in a long, trumpet-shaped, narrow-stemmed, from above, extension arising from a broader basal part armed with various projecting processes; from the side, the extension terminates in a diamond-shaped dilatation.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna ·84 mm.

S. Shan States: Road 40 km. E. of Taunggyi, 13-x-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Dinarthrena steelae sp. n. Pl. 4. Figs. 1-6.

Insects brownish; in the ♂, the anterior wings are clothed with hairs and scales; there is a scale-lined, longitudinal groove through the centre and the usual fold in the post-costal area; all forks sessile and two large cells in the post-costal region; in the posterior wing, fork No. 1 with a footstalk in both sexes; an additional fork in both wings in the ♀; in the ♂, basal joint of the antenna of medium length, elbowed about midway; in the unique type, membranous with two membranous processes at the base but the remaining joints normal in texture; maxillary palpi two-jointed, basal joint long, terminal joint short; labial palpi, basal joint very short, second shorter than the third; spurs 2, 4, 4.

Genitalia ♂.—Dorsal plate from above, with the centre of the apical margin rounded, margin somewhat serrate, outer angles strongly produced; from the side, tapering to narrow, obliquely truncate apices, with a pair of triangular plates, directed downwards, arising from the centre of the dorsal plate, on the under surface; penis slender, arching downwards; sheaths symmetrically directed tailwards; inferior appendages perhaps two-jointed, stout

at the base, terminal joint partly welded to the basal joint with the apex produced in a small, inwardly directed plate.

Length of the anterior wing ♂ 6.5 mm.

Length of the basal joint of the antenna ♂ 1·9 mm.

Burma: Mishmi Hills, Chhaglon, 5,350 ft., 25—26-ii-1935, M. Steele.

Type ♂ and paratype ♀(?) in the collection of the British Museum.

These two insects, ♂ and ♀, belonging to the same genus and taken in the same locality on two successive days, probably belong to the same species but there is no direct evidence that they have been correctly associated.

I have pleasure in dedicating the species to Miss M. Steele who has devoted much time to collecting insects of many Orders in Burma and Assam.

Agoerodella gen. n.

Spurs, 1, 4, 4. In the ♂, basal joint of the antenna without processes. Maxillary palpi, basal joint very long, terminal short, almost rudimentary. Wings covered with hairs and scales; in the anterior, post-costal fold short, less than half the length of the wing; discoidal cell narrow. Penis-sheathes wanting. Inferior appendages single-jointed and unbranched.

Genotype.—*A. punkata* sp. n.

Agoerodella punkata sp. n. Pl. 5. Figs. 1-6.

Insect yellowish; in the ♂, wings covered with hairs and scales; anterior, discoidal cell rather short and narrow, shorter than its footstalk; post-costal fold short, cell between it and the posterior border long and narrow; seventh apical cellule closed with a broad cross-vein just beyond the termination of the post-costal fold; neuration of the posterior wing irregular, no discoidal cell, only fork No. 1 present; basal joint of the antenna about as long as the width of the head with the oculi, shrouded in dense hair which, when removed reveals a close row of stout spines of varying length; the inner surface of the joint is excavated to leave a ridged hollow darkly pigmented towards its distal half; maxillary palpi two-jointed, basal joint long, stout and curved, terminal joint very small; spurs 1, 4, 4, anterior tibiae considerably dilated; femur in the type, notched on its inner surface towards its distal end.

Genitalia ♂.—The apical margin of the ninth tergite produced at its centre; beyond is a dorsal plate forming a pair of long, finger-like, parallel and adjacent processes arising above the centre of a broad, triangular plate; penis broad and short, slightly arched, apex excised; inferior appendages single-jointed and unbranched, tapering from broad bases to much produced and rounded apices.

Length of the anterior wing ♂ 7·5 mm.

Length of the basal joints of the antenna 1.25 mm.

N.-E. Burma: Punkataung, 16-iii-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Adinarthrella gen. n.

Spurs, 2, 4, 4, or 1, 4, 4. In the ♂, the basal joint of the antenna rather short and without processes. Maxillary palpi two-jointed, basal joint abnormally bent and thickened before the apex, terminal joint normal. Wings covered with hairs and scales; in the anterior, costa folded over the wing towards its base; post-costal fold varying in length. Inferior appendages with the apices branched but without an upwardly directed process at its base.

Genotype.—*A. brunnea* sp. n.

Adinarthrella brunnea sp. n. Pl. 6. Figs. 1-5.

Insect dark brown; in the ♂, basal joint of the antenna not very long, without any basal processes and slightly elbowed before the apex; it is furnished with the usual hairs and scales; maxillary palpi two-jointed, basal joint elbowed in the basal half and enormously dilated at the bend, then the joint is narrow to the apex, second joint slender, about the same length or slightly longer than the narrow part of the basal joint; wings clothed with hairs and scales, the latter mainly confined to the veins; anterior, costal margin rounded, the costa at its base, doubled over the sub-costa, enclosing a pencil of hairs; discoidal cell long and narrow; no median groove; post-costal fold rather long; in the posterior wing, the 4th apical cellule extending not so far inward as the basal angle of the discoidal cell; spurs 1, 4, 4.

Genitalia ♂.—9th tergite produced at its centre in two long, slender, triangles separated from each other by a narrow excision; penis rather long and straight, apex excised, a pair of very slender sheaths along the upper surface but the structure is difficult to make out; inferior appendages single-jointed, branched with a broad base extending for about half its length; seen from the side, there is a somewhat slender branch arising from the apex of the broadened half, apex inturned, from above; the apical portion of the appendage is thickened with a convex lower margin; the upper margin of the appendage along the basal half, is strongly sinuate or S shaped; from above, the apices are dilated and rounded, particularly in the inner margins.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna ♂ 1.5 mm.

Assam: Shillong, 5,000 ft., 20-31-x-1934, Fletcher coll.

Type ♂ and paratypes ♂ and ♀ in the collection of the British Museum.

Adinarthrella inconspicua sp. n. Pl. 7. Figs. 1-7.

Insect brown; in the ♂ wings clothed with hair and scales, much denuded in the type, broad and rounded; anterior with the costa bent over along the basal third and there bearing long, stiff hairs; discoidal cell long and narrow; a faintly indicated fold in the post-costal area terminating on the margin of a rather large and somewhat round cell; posterior wing with the nervure closing the discoidal cell very weak, perhaps absent in one wing; fork No. 1 sessile; basal joint of the antenna about as long as the width

of the head with the oculi; maxillary palpi two-jointed, basal joint very stout and rather short, slightly curved, terminal joint slender and inconspicuous; basal joint of the labial palpi short and stout slightly curved; spurs 2, 4, 4, those of the anterior tibiae conspicuous.

Genitalia ♂.—The apical margin of the ninth tergite produced in a large, bifid process with a minute, triangular process at its base; penis short and straight, apex slightly excised; sheaths long with very acute apices; inferior appendages apparently two-jointed, from beneath, broad at the base and produced in a slender process of about the same length as the basal part; from the side this produced portion has a small projection on each side of its base, the lower bearing a peg-like tooth; from beneath, the appendages are widely separated with a slight projection at the centre of each inner margin.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna 0.86 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 11-v-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Adinarthrella kimsa sp. n. Pl. 8. Figs. 1-5.

Description of the male; head fuscous, clothed with dense fuscous hairs; oculi black; basal joint of the antenna rather short, fuscous, densely clothed with fuscous hairs, remaining joints very pale ochraceous or golden with dark fuscous annulations; maxillary palpi two-jointed, basal joint bent at right angles about midway, terminal joint short; labial palpi, basal joint, as long as the second but shorter than the third; wings ochraceous, anterior with the costa doubled over at the base and enclosing a pencil of hairs; there is a central, curved groove lined with dark scales and a fold parallel with the post-costa; pubescence short and golden, excepting in the folds where it is darker; fringes dark; legs ochraceous, spurs 2, 4, 4.

Genitalia ♂.—Ninth segment produced in the centre of its dorsal margin in two long processes divided from each other by a narrow excision; from the side, the process is broad at the base with a deep, angular excision on the under surface before the apex which is stout and downwardly directed; penis short and arched, the sheaths as in *Dinarthrum*, directed asymmetrically to one side but perhaps aberrant; inferior appendages single-jointed, stout, from the side, a small process arising from the upper margin towards the base, apex bifurcate, the forks lying one above the other, the upper more strongly chitinized than the lower which arises from a somewhat swollen basal portion; from beneath, the lower fork is constricted before the apex which is triangular, its obliquely truncate margin covered with strong spines; the lower margins of the appendages are fringed with strong hairs.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna 1·2 mm.

Sikkim: Kurseong, 18-30-iv-1922. Fletcher collection. Type ♂ in the collection of the British Museum.

Adinarthrella gen. n.

Spurs, 2, 4, 4, or 1, 4, 4. In the ♂, the basal joint of the antenna rather short and without processes. Maxillary palpi two-jointed, basal joint abnormally bent and thickened before the apex, terminal joint normal. Wings covered with hairs and scales; in the anterior, costa folded over the wing towards its base; post-costal fold varying in length. Inferior appendages with the apices branched but without an upwardly directed process at its base.

Genotype.—*A. brunnea* sp. n.

Adinarthrella brunnea sp. n. Pl. 6. Figs. 1-5.

Insect dark brown; in the ♂, basal joint of the antenna not very long, without any basal processes and slightly elbowed before the apex; it is furnished with the usual hairs and scales; maxillary palpi two-jointed, basal joint elbowed in the basal half and enormously dilated at the bend, then the joint is narrow to the apex, second joint slender, about the same length or slightly longer than the narrow part of the basal joint; wings clothed with hairs and scales, the latter mainly confined to the veins; anterior, costal margin rounded, the costa at its base, doubled over the sub-costa, enclosing a pencil of hairs; discoidal cell long and narrow; no median groove; post-costal fold rather long; in the posterior wing, the 4th apical cellule extending not so far inward as the basal angle of the discoidal cell; spurs 1, 4, 4.

Genitalia ♂.—9th tergite produced at its centre in two long, slender, triangles separated from each other by a narrow excision; penis rather long and straight, apex excised, a pair of very slender sheaths along the upper surface but the structure is difficult to make out; inferior appendages single-jointed, branched with a broad base extending for about half its length; seen from the side, there is a somewhat slender branch arising from the apex of the broadened half, apex inturned, from above; the apical portion of the appendage is thickened with a convex lower margin; the upper margin of the appendage along the basal half, is strongly sinuate or S shaped; from above, the apices are dilated and rounded, particularly in the inner margins.

Length of the anterior wing ♂ 7 mm.

Length of the basal joint of the antenna ♂ 1.5 mm.

Assam: Shillong, 5,000 ft., 20-31-x-1934, Fletcher coll.

Type ♂ and paratypes ♂ and ♀ in the collection of the British Museum.

Adinarthrella inconspicua sp. n. Pl. 7. Figs. 1-7.

Insect brown; in the ♂ wings clothed with hair and scales, much denuded in the type, broad and rounded; anterior with the costa bent over along the basal third and there bearing long, stiff hairs; discoidal cell long and narrow; a faintly indicated fold in the post-costal area terminating on the margin of a rather large and somewhat round cell; posterior wing with the nervure closing the discoidal cell very weak, perhaps absent in one wing; fork No. 1 sessile; basal joint of the antenna about as long as the width

of the head with the oculi; maxillary palpi two-jointed, basal joint very stout and rather short, slightly curved, terminal joint slender and inconspicuous; basal joint of the labial palpi short and stout slightly curved; spurs 2, 4, 4, those of the anterior tibiae conspicuous.

Genitalia ♂.—The apical margin of the ninth tergite produced in a large, bifid process with a minute, triangular process at its base; penis short and straight, apex slightly excised; sheaths long with very acute apices; inferior appendages apparently two-jointed, from beneath, broad at the base and produced in a slender process of about the same length as the basal part; from the side this produced portion has a small projection on each side of its base, the lower bearing a peg-like tooth; from beneath, the appendages are widely separated with a slight projection at the centre of each inner margin.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna 0.86 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 11-v-1934, R. Malaise.

Type ♂ in the collection of the Stockholm Museum.

Adinarthrella kimsa sp. n. Pl. 8. Figs. 1-5.

Description of the male; head fuscous, clothed with dense fuscous hairs; oculi black; basal joint of the antenna rather short, fuscous, densely clothed with fuscous hairs, remaining joints very pale ochraceous or golden with dark fuscous annulations; maxillary palpi two-jointed, basal joint bent at right angles about midway, terminal joint short; labial palpi, basal joint, as long as the second but shorter than the third; wings ochraceous, anterior with the costa doubled over at the base and enclosing a pencil of hairs; there is a central, curved groove lined with dark scales and a fold parallel with the post-costa; pubescence short and golden, excepting in the folds where it is darker; fringes dark; legs ochraceous, spurs 2, 4, 4.

Genitalia ♂.—Ninth segment produced in the centre of its dorsal margin in two long processes divided from each other by a narrow excision; from the side, the process is broad at the base with a deep, angular excision on the under surface before the apex which is stout and downwardly directed; penis short and arched, the sheaths as in *Dinarthrum,* directed asymmetrically to one side but perhaps aberrant; inferior appendages single-jointed, stout, from the side, a small process arising from the upper margin towards the base, apex bifurcate, the forks lying one above the other, the upper more strongly chitinized than the lower which arises from a somewhat swollen basal portion; from beneath, the lower fork is constricted before the apex which is triangular, its obliquely truncate margin covered with strong spines; the lower margins of the appendages are fringed with strong hairs.

Length of the anterior wing ♂ 6 mm.

Length of the basal joint of the antenna 1·2 mm.

Sikkim: Kurseong, 18-30-iv-1922. Fletcher collection. Type ♂ in the collection of the British Museum.

Adinarthrella parva sp. n. Pl. 9. Figs. 1-7.

Insects small and yellowish. Anterior wing ♂ with the costa folded along rather more than its basal half; post-costal fold long, extending nearly to the border of the wing; four large cellules between it and the posterior margin, the two nearest the apex about equal in size, the next the largest, basal cellule small; wings covered with hairs and scales. There are additional forks in both wings in the ♀. Basal joint of the antenna in the ♂, rather longer than the width of the head together with the oculi, no processes at the base; maxillary palpi membranous, possibly two-jointed, basal joint stout and elbowed, terminal, slender and straight; spurs, 1, 4, 4.

Genitalia ♂.—Dorsal plate produced in a long triangle with an excised apex; from the side, the plate is deep at its base, tapering to a rounded apex, lower margin straight, upper sloping downward; penis short and stout with a pair of short, slender sheaths; inferior appendages bifurcate towards the apex, no basal branch but a slight, hooked projection of the upper margin about midway; upper fork, from the side, slightly shorter and more slender than the lower.

Length of the anterior wing ♂ 6 mm., ♀ 7 mm.

Length of the basal joint of the antenna ♂ ·86 mm.

N.-E. Burma: Kambaiti, 7,000 ft., 28-v-1934; 1-v-1934.

Type ♂ in the collection of the Stockholm Museum. Paratypes of both sexes in the Stockholm and the British Museums.

Goerodes Ulmer.

Goerodes Ulm., Coll. Selys, Fasc. 6(1), pp. 37-38, 1907.
Goerinella Ulm., Deut. ent. Zeit, **1915**, p. 67, 1915.
Crunobiodes Mart., Ann. Mus. Zool. Acad. Sci. U.R.S.S., 28, p. 471, 1927.

Spurs, 2, 4, 4. In the ♂, basal joint of the antenna without processes. Maxillary palpi one- or two-jointed. Wings with a clothing of either hairs or scales or both; costa sometimes folded over the wing, sometimes normal; post-costal fold varying in length. Penis-sheaths absent. Inferior appendages branched, always with an upwardly directed branch at the base. Dorsal plate generally in the form of a pair of spine-like processes but sometimes the processes are fused together to make a plate of varying shape.

Genotype.—*G. cornigera* Ulmer.

Goerodes indica Martynov. Pl. 10. Figs. 1-7.

Maniconeura indica Mart., Rec. Ind. Mus., xxxviii, pp. 289-291, figs. 60-62, 1936.

Insect brown generally; in the ♂, basal joint of the antenna about as long as the breadth of the basal part of the head without the oculi; second joint short, third longer than the second or succeeding joints; maxillary palpi two jointed, basal joint darkly pigmented and pressed closely in front of the face, terminal joint small

and membranous, transparent; wings clothed with hairs only; there are no intermingled scales; a fold in the post-costal region of the anterior wing in which the discoidal cell is long and narrow; neuration in the post-costal region slightly aberrant in the type; in the posterior wing, the base of the fourth apical cellule extends very slightly further inwards than the basal angle of the discoidal cell; spurs 2, 4, 4.

Genitalia ♂.—9th dorsal segment with a triangular production of the centre of its margin; beyond it extends a dorsal plate dilating immediately beyond the base, constricted again before the truncated and excised apex; the upper surface of this plate is set with peg-like spines or teeth; penis short, curved, with a dilated and excised apex; no penis sheaths, inferior appendages possibly two-jointed, branched; terminal joint welded to the apex of the basal joint; this terminal joint forms a plate with a broadened, obliquely truncate apex and carries two minute finger-like processes on its inner surface, one of which is furcate; from the side, there is the usual short, upwardly directed branch arising from the upper surface of the appendage towards the base, and from beneath, each appendage has a short, stout branch arising towards its base along its inner margin.

Length of the anterior wing ♂ 5 mm.

Type ♂ and paratypes ♂ and ♀ in the British Museum and in the collection of the Indian Museum, Calcutta, from Peninsular India, Castle Rock, N. Kanara District, ×.16; S. W. Kemp.

Ceylon: Matale, 4-i-24; Pundaloya, vii-98.

Goerodes inequalis Martynov. Pl. 11. Figs. 1-4.

Dinarthrodes inequalis Mart., Rec. Ind. Mus., 38, pp. 284-286, figs. 55-56 a-c, 1936.

Martynov describes the species as follows:—

'2♂, ♀. Western Himalayas, Kumaon Hills, Bhowali, bushes and trees, 12-v-30, H. S. Pruthi.'

'Head and thorax brown; head transverse; basal joint in ♂ antennae long, but shorter than the body, curved inwards, without any spines. Maxillary palpi densely clothed with greyish and black elongated scales, apparent basal joint probably represents an outgrowth of the palpiger; second (first) joint slender and directed upwards, third (second) joint slender, shorter than the foregoing. Labial palpi pale, fairly long, as usual three-jointed.'

'♂. Anterior wings greyish-yellow; DC elongated, but shorter than its pedicel; M dividing into two branches at the middle of DC, M_3+_4 near its base connected with a short cross-vein with CuA; this vein is long and curved at its end backwards and then prolonged with CuA_2; CuA_1 absent; cross-vein between CuA_2 and CuP long; before CuP and the basal part of A_1 is the anal groove with hairs, concealing the venation in the basal part. Posterior wings greyish, DC subelliptical; cross-vein rs-m connecting basal parts of RS_3+_4 and M_1+_2.'

'♂. 9th segment broad, narrowed above; side pieces with convex hind margins; sternite provided with two brownish lateral, straight,

chitinous thickenings. Median portion of 10th segment elongated, with a narrow cleft divided into two portions, bearing short erect hairs; seen from the side this portion of the 10th segment is narrow at base, gradually thickening to its end. Side portions of 10th segment (morphologically they probably represent preanal appendages) extended as two long sinuate processes of unequal length, the left being considerably shorter than the right. The right process is directed backwards, then curved upwards and outwards; acute end portion is turned backwards; the left process is curved in a similar manner, but its end portion is directed somewhat inwards. Basal joint of the pedes genitales brown, thick, straight, bearing on its end portion a tuft of long bristles; second joint pale, almost twice shorter, slender in its middle, at base uniting with first joint; internally from it originates the inner slender branch, and from the base of the first joint arises on each side another pale slender process directed rather upwards. Penis slender, arcuately curved downwards (titillators invisible, probably shortened or absent).'

'♀. Anterior wings brownish, venation as usual in females; forks 1, 2 and 5 present. Basal joint of antennae somewhat longer than the head with eyes.'

'Length of body about 5-5.5 mm.'

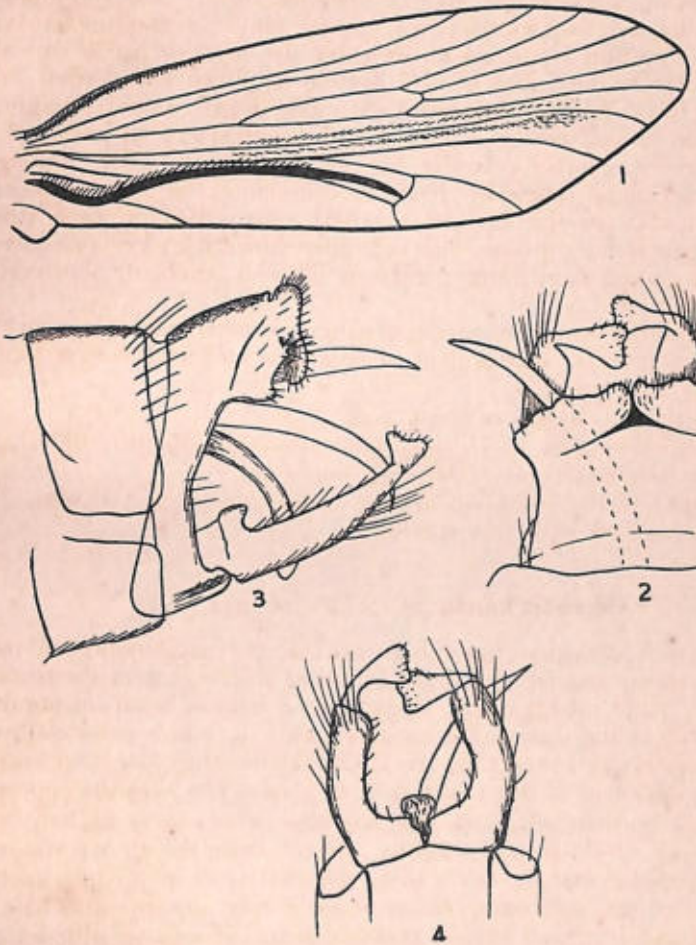
'Remarks.—Allied to *D. albardana* Ulm. but distinct, differing mainly in the structure of the 10th segment.'

Co-types in the collection of the India Museum, Calcutta. I am unacquainted with this species.

Goerodes kanda sp. n. Pl. 12 figs. 1-5.

Insects brownish; description of the ♂; basal joint of the antenna rather shorter than the breadth of the head with the oculi; maxillary palpi membranous, single-jointed with a small membranous nodule at the base and a sinuous apex; the whole palpi clothed with short broad scales with the lower half bearing long stiff hairs as well; the effect of this vestiture is to give to the joint the appearance of a bottle-brush; labial palpi, basal joint nearly as long as the second which is only slightly shorter than the third; wings, anterior, costal margin much more rounded than in *piscina*, costa folded over the sub-costa, rather more deeply towards the base; discoidal cell long and broad; post-costal fold extending practically the whole length of the wing, slightly dilated at the base; in the posterior wing, the fourth apical cellule extending further inwards than the basal angle of the discoidal cell; both wings clothed with scales as well as hairs; spurs 2, 4, 4.

Genitalia ♂.—The margin of the ninth dorsal segment produced in two pairs of processes, the outer, which are the longer, slightly asymmetric, stout at their bases, strongly chitinised, gradually tapering to acute apices; the inner are also strongly chitinised with broad bases side by side and touching each other in the lower half, then diverging widely; penis short, arching downward deeply



Dinarthrum latum sp. n. ♂. Fig. 1, Anterior wing. Fig. 2, genitalia dorsal. Fig. 3, lateral. Fig. 4, ventral.
(After Martynov.)

chitinous thickenings. Median portion of 10th segment elongated, with a narrow cleft divided into two portions, bearing short erect hairs; seen from the side this portion of the 10th segment is narrow at base, gradually thickening to its end. Side portions of 10th segment (morphologically they probably represent preanal appendages) extended as two long sinuate processes of unequal length, the left being considerably shorter than the right. The right process is directed backwards, then curved upwards and outwards; acute end portion is turned backwards; the left process is curved in a similar manner, but its end portion is directed somewhat inwards. Basal joint of the pedes genitales brown, thick, straight, bearing on its end portion a tuft of long bristles; second joint pale, almost twice shorter, slender in its middle, at base uniting with first joint; internally from it originates the inner slender branch, and from the base of the first joint arises on each side another pale slender process directed rather upwards. Penis slender, arcuately curved downwards (titillators invisible, probably shortened or absent).'

'♀. Anterior wings brownish, venation as usual in females; forks 1, 2 and 5 present. Basal joint of antennae somewhat longer than the head with eyes.'

'Length of body about 5-5.5 mm.'

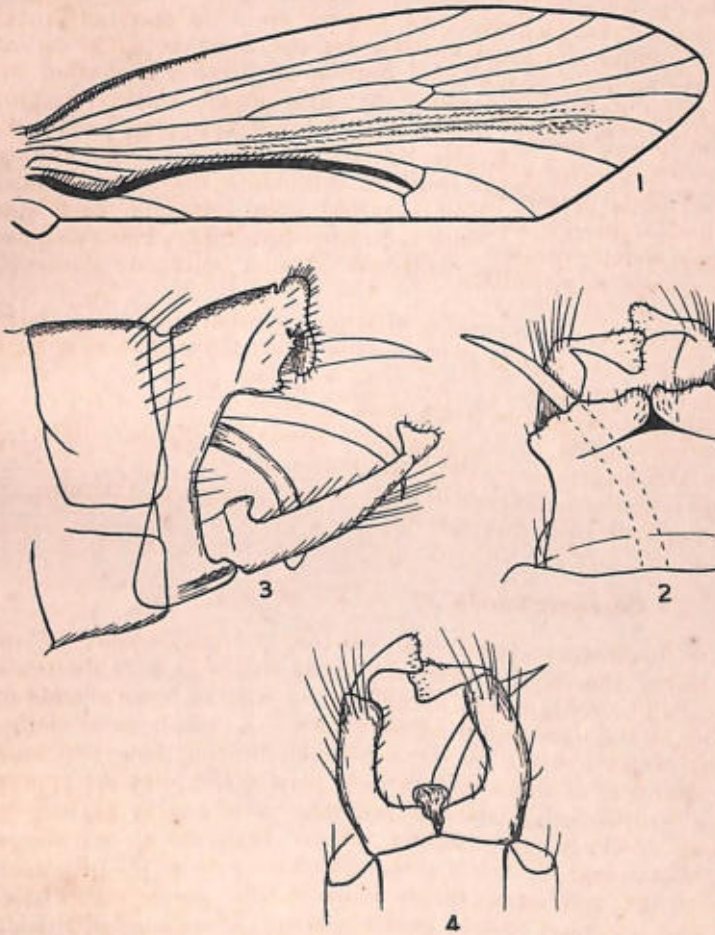
'Remarks.—Allied to *D. albardana* Ulm. but distinct, differing mainly in the structure of the 10th segment.'

Co-types in the collection of the India Museum, Calcutta. I am unacquainted with this species.

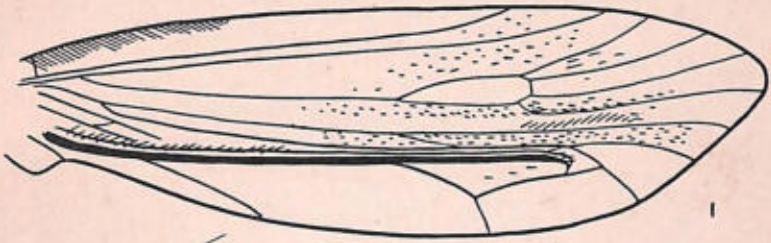
Goerodes kanda sp. n. Pl. 12 figs. 1-5.

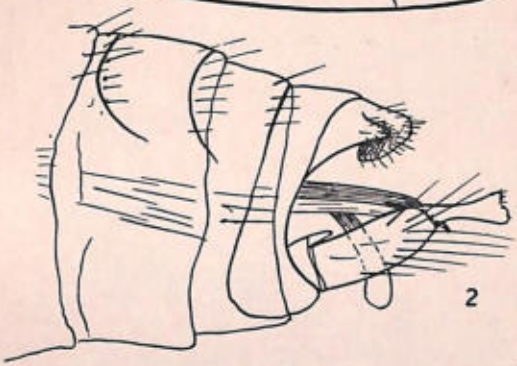
Insects brownish; description of the ♂; basal joint of the antenna rather shorter than the breadth of the head with the oculi; maxillary palpi membranous, single-jointed with a small membranous nodule at the base and a sinuous apex; the whole palpi clothed with short broad scales with the lower half bearing long stiff hairs as well; the effect of this vestiture is to give to the joint the appearance of a bottle-brush; labial palpi, basal joint nearly as long as the second which is only slightly shorter than the third; wings, anterior, costal margin much more rounded than in *piscina*, costa folded over the sub-costa, rather more deeply towards the base; discoidal cell long and broad; post-costal fold extending practically the whole length of the wing, slightly dilated at the base; in the posterior wing, the fourth apical cellule extending further inwards than the basal angle of the discoidal cell; both wings clothed with scales as well as hairs; spurs 2, 4, 4.

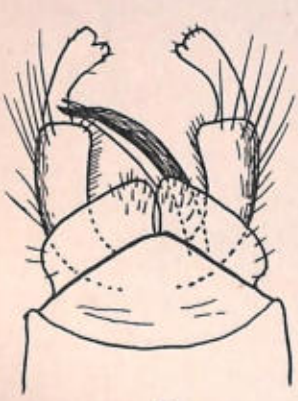
Genitalia ♂.—The margin of the ninth dorsal segment produced in two pairs of processes, the outer, which are the longer, slightly asymmetric, stout at their bases, strongly chitinised, gradually tapering to acute apices; the inner are also strongly chitinised with broad bases side by side and touching each other in the lower half, then diverging widely; penis short, arching downward deeply

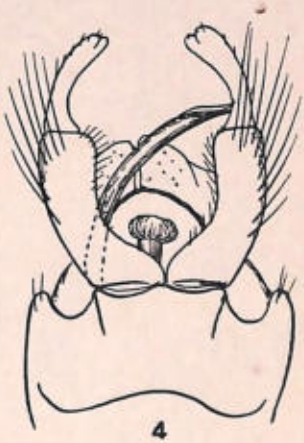


Dinarthrum latum sp. n. ♂. Fig. 1, Anterior wing. Fig. 2, genitalia dorsal. Fig. 3, lateral. Fig. 4, ventral.
(After Martynov.)

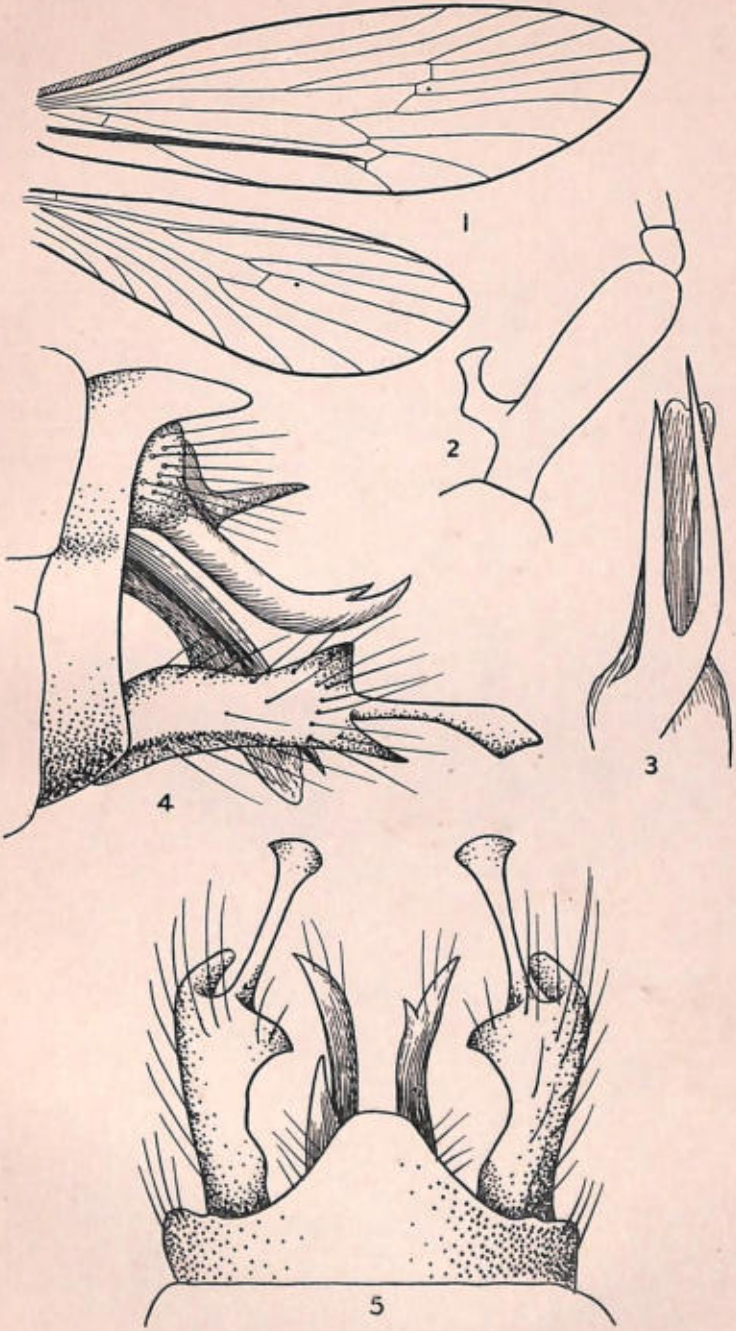




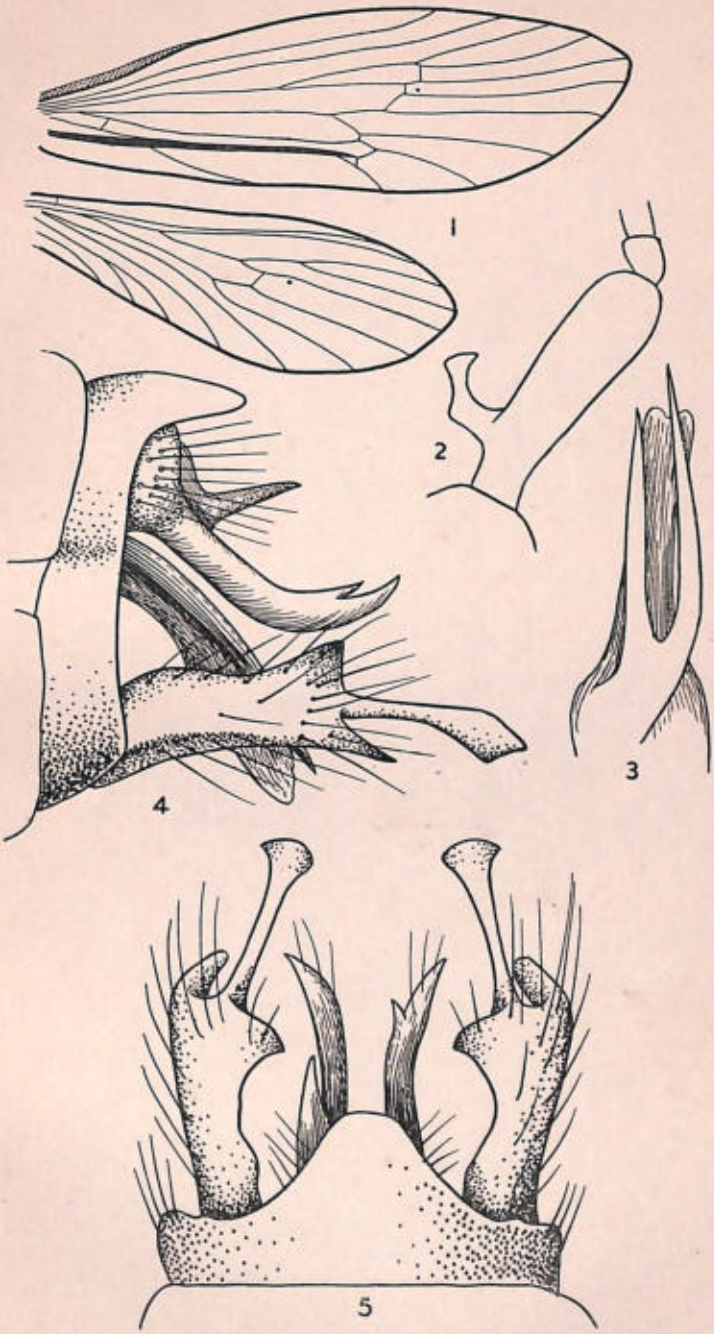




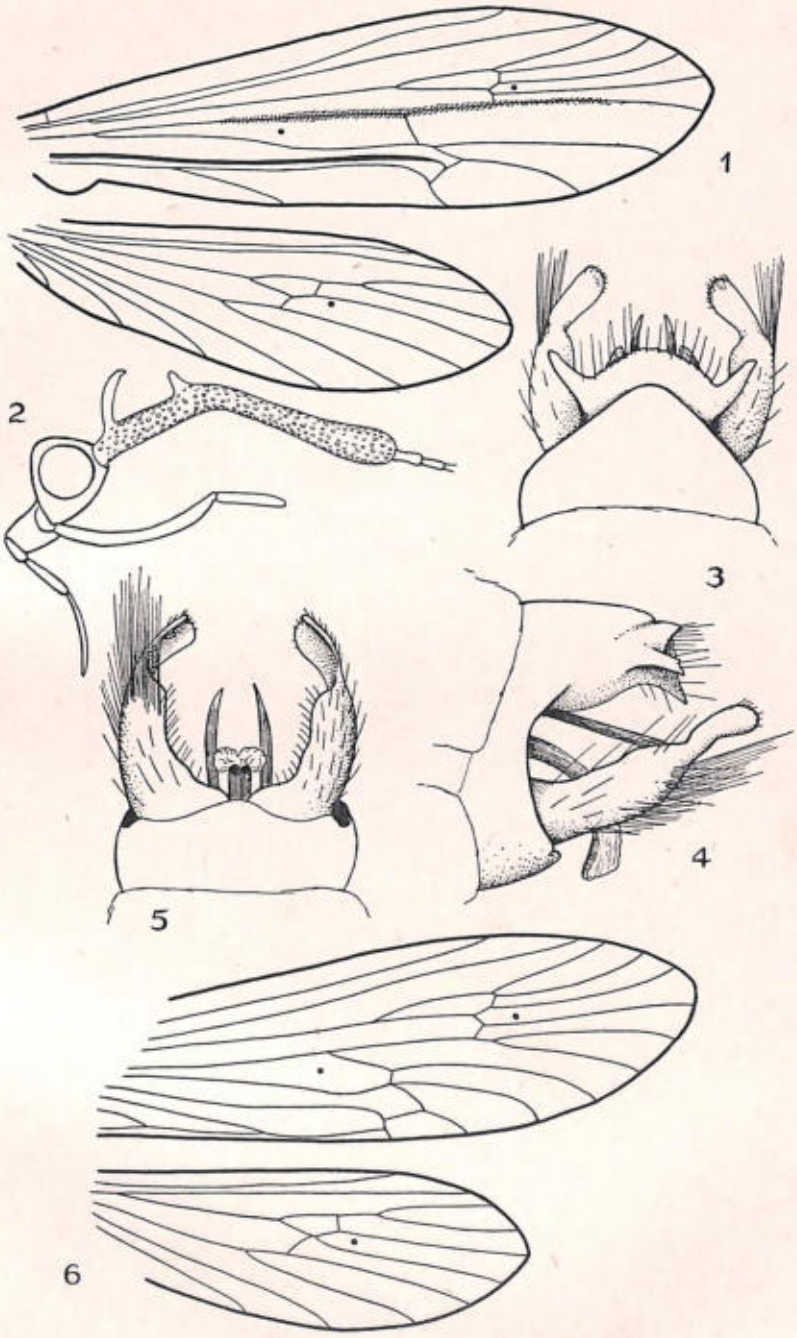
Dinarthrum punjabicum sp. n. ♂. Fig. 1, Anterior wing. Fig. 2, genitalia lateral. Fig. 3, dorsal. Fig. 4, ventral.
(After Martynov.)



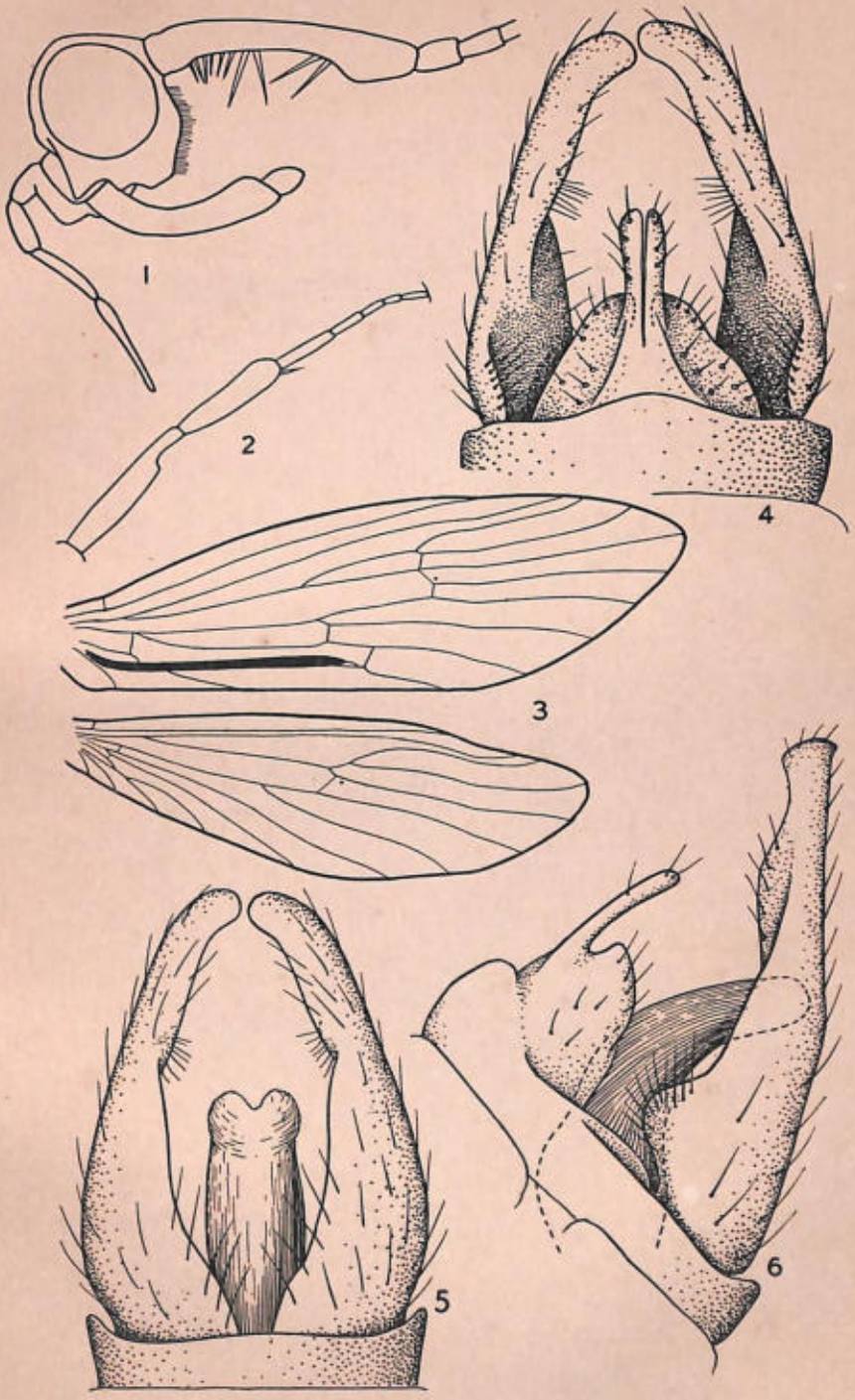
Dinarthrena shanta sp. n. ♂. Fig. 1, Wings. Fig. 2, basal joints of the antenna. Fig. 3, penis and sheaths dorsal. Fig. 4, genitalia lateral. Fig. 5, ventral, penis and sheaths omitted.



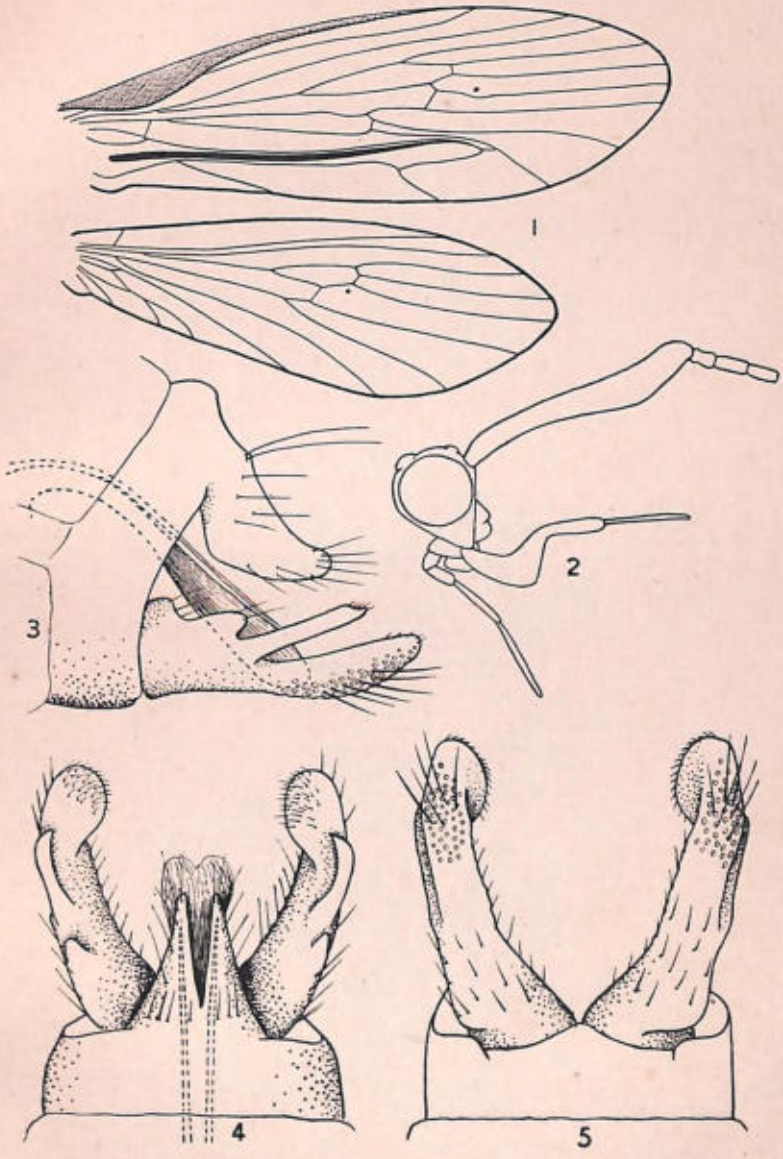
Dinarthrena shanta sp. n. ♂. Fig. 1, Wings. Fig. 2, basal joints of the antenna. Fig. 3, penis and sheaths dorsal. Fig. 4, genitalia lateral. Fig. 5, ventral, penis and sheaths omitted.



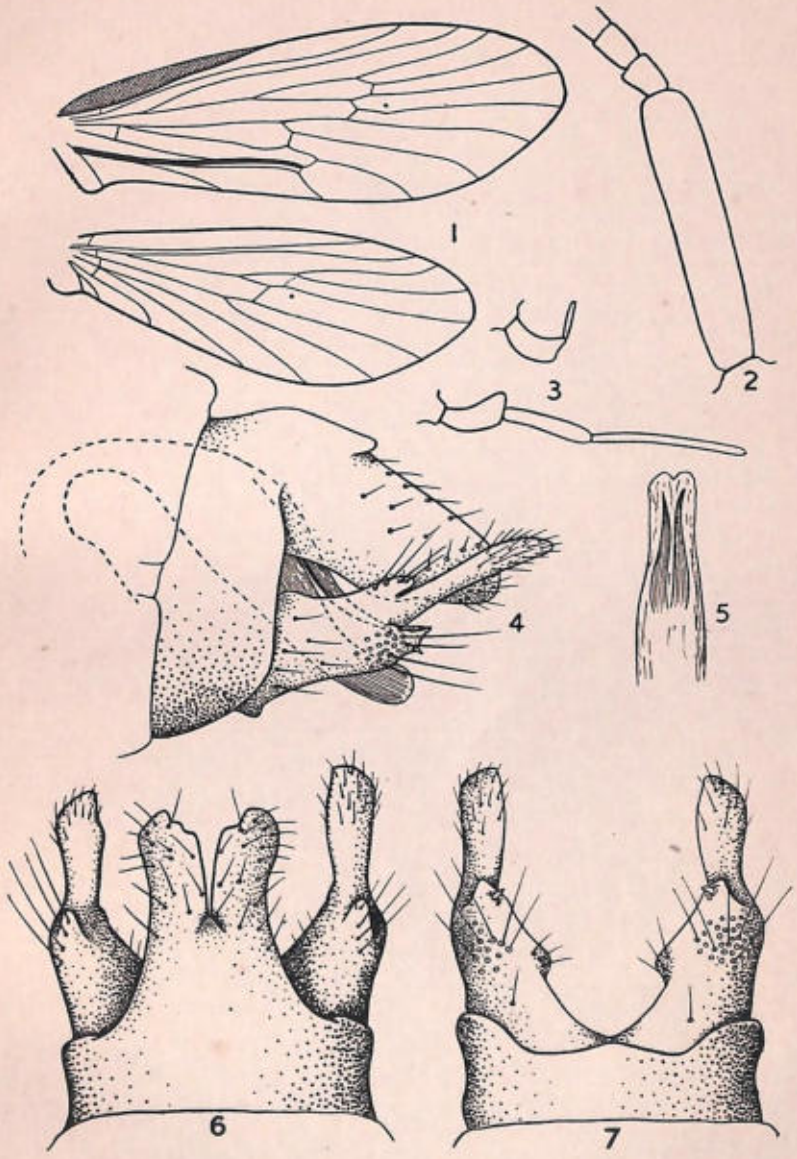
Dinarthrena steelae sp. n. ♂. Fig. 1, wings. Fig. 2, head. Fig. 3, genitalia dorsal. Fig. 4, lateral. Fig. 5, ventral. Fig. 6, wings, ♀.



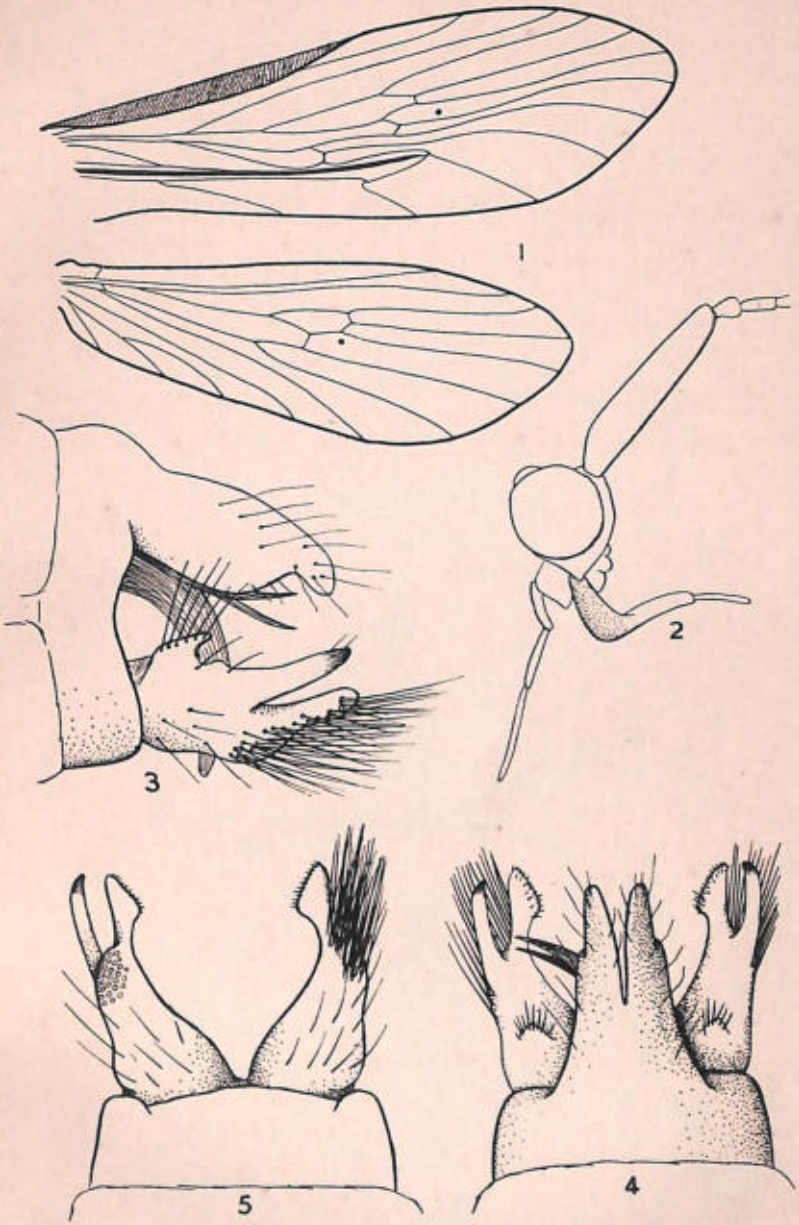
Agoerodella punkata sp. n. ♂. Fig. 1, head. Fig. 2, anterior leg, dorsal. Fig. 3, wings. Fig. 4, genitalia dorsal, penis omitted. Fig. 5, genitalia ventral, dorsal plate omitted. Fig. 6, lateral.



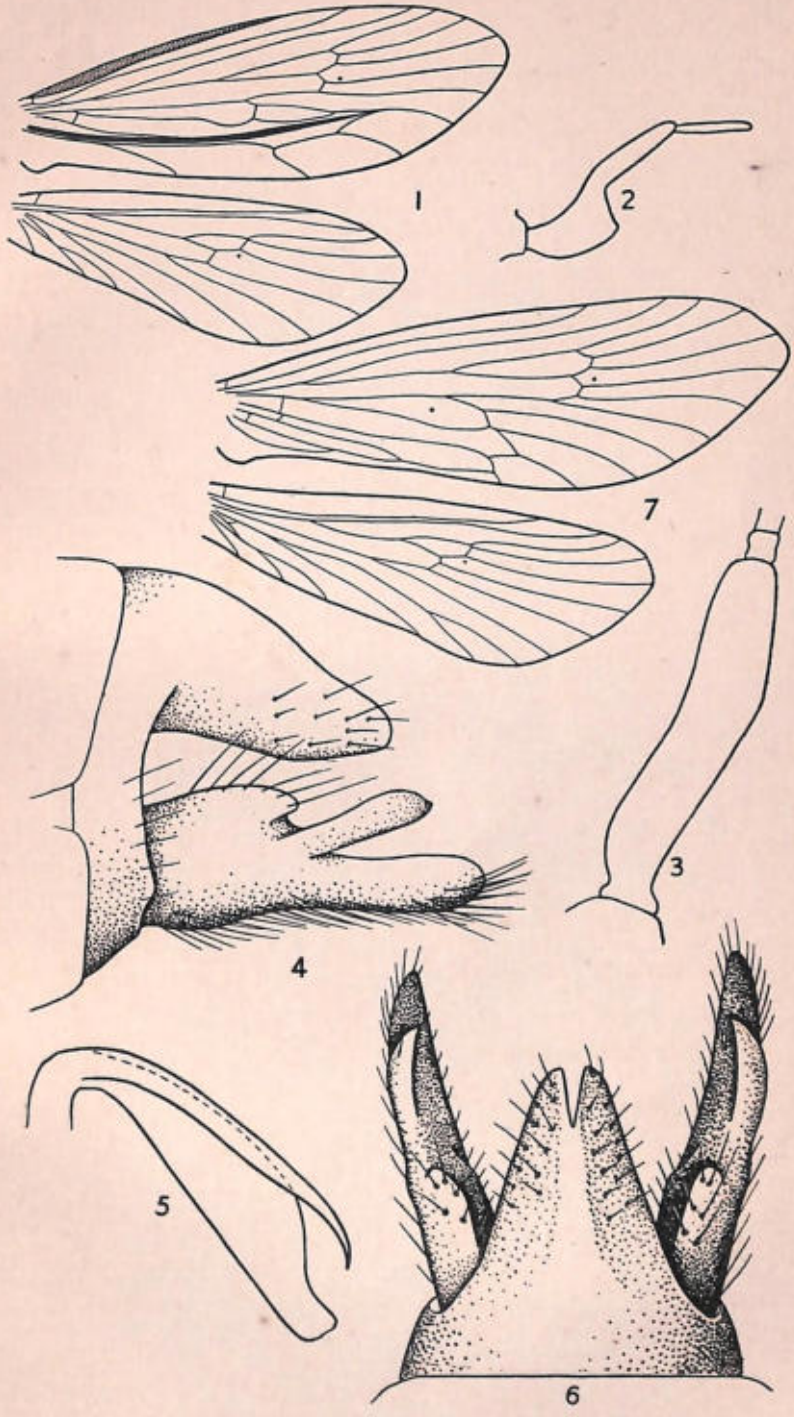
Adinarthrella brunnea sp. n. ♂. Fig. 1, wings. Fig. 2, head. Fig. 3, genitalia lateral. Fig. 4, dorsal. Fig. 5, ninth sternite and inferior appendages.



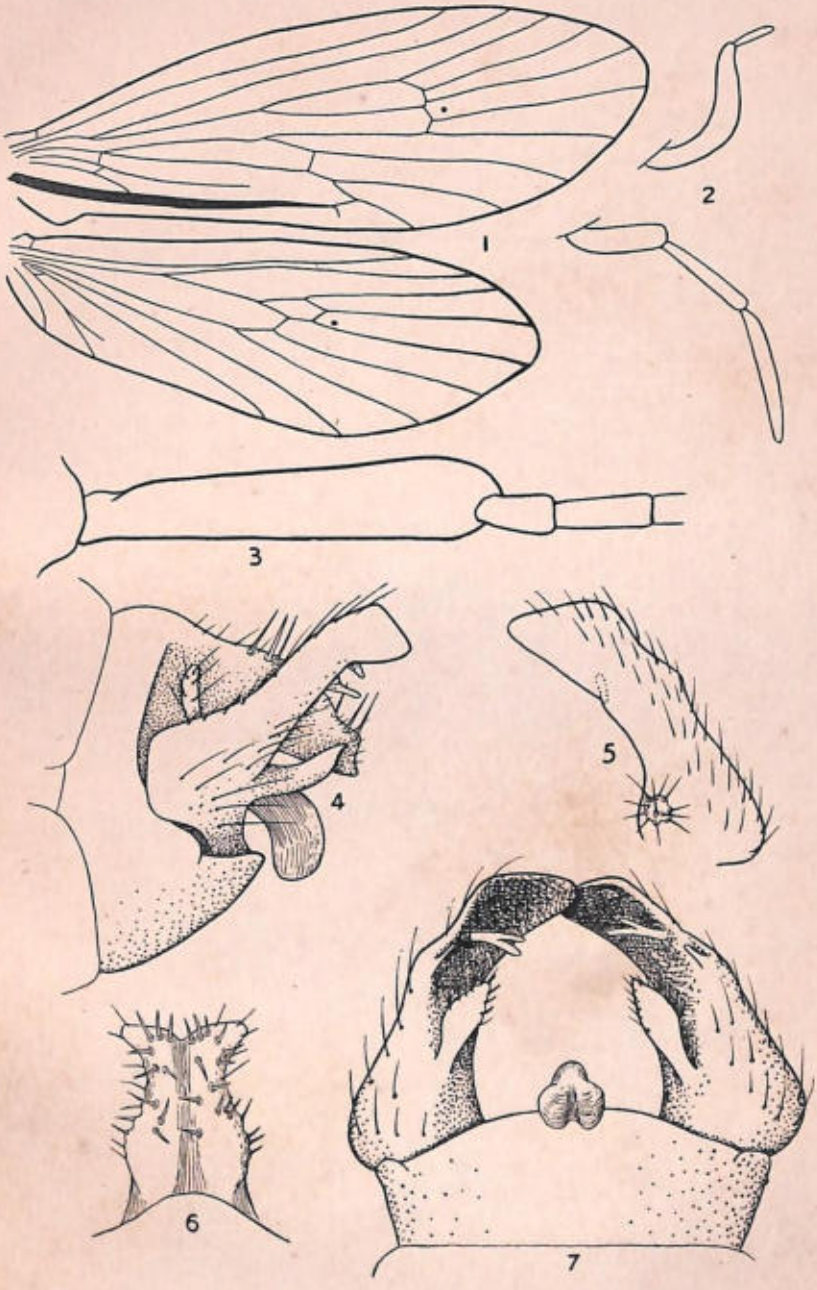
Adinarthrella inconspicua sp. n. ♂. Fig. 1, wings. Fig. 2, basal joints of antenna. Fig. 3, palpi. Fig. 4, genitalia lateral. Fig. 5, penis dorsal. Fig. 6, genitalia dorsal. Fig. 7, ninth sternite and inferior appendages.



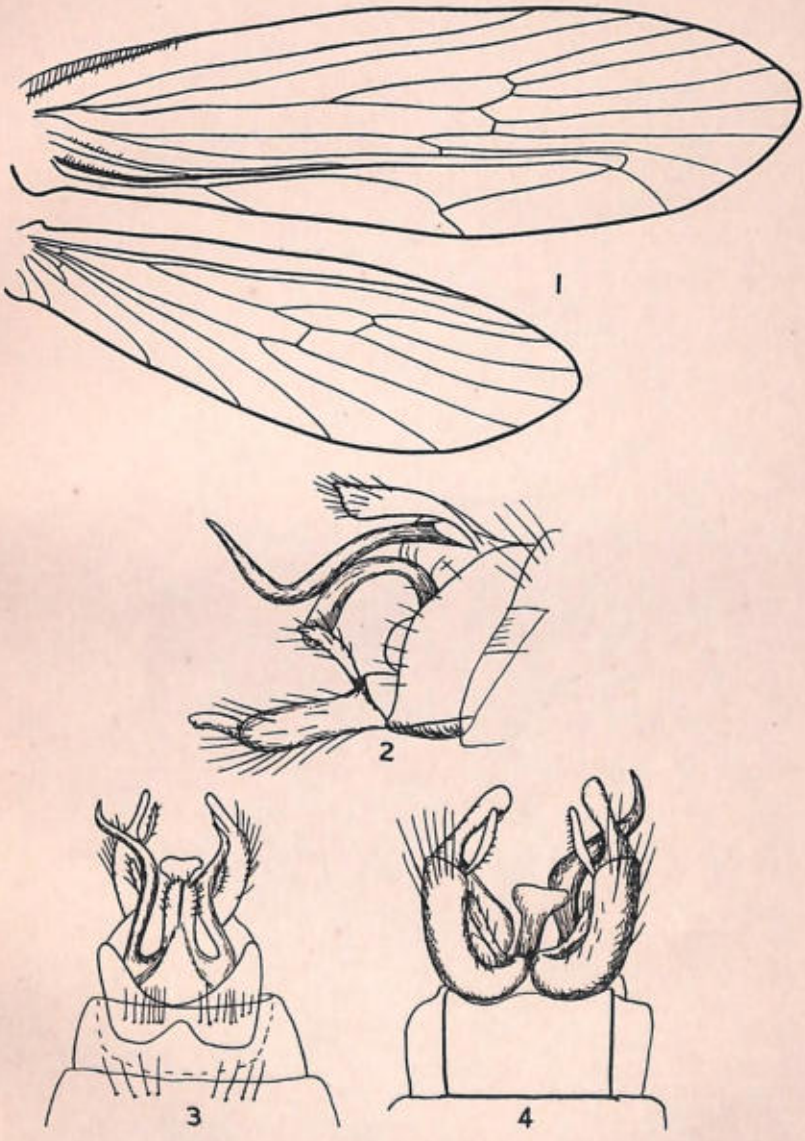
Adinarthrella kimsa sp. n. ♂. Fig. 1, wings. Fig. 2, head. Fig. 3, genitalia lateral. Fig. 4, genitalia dorsal. Fig. 5, ninth sternite and inferior appendages, bristles from one apex removed.



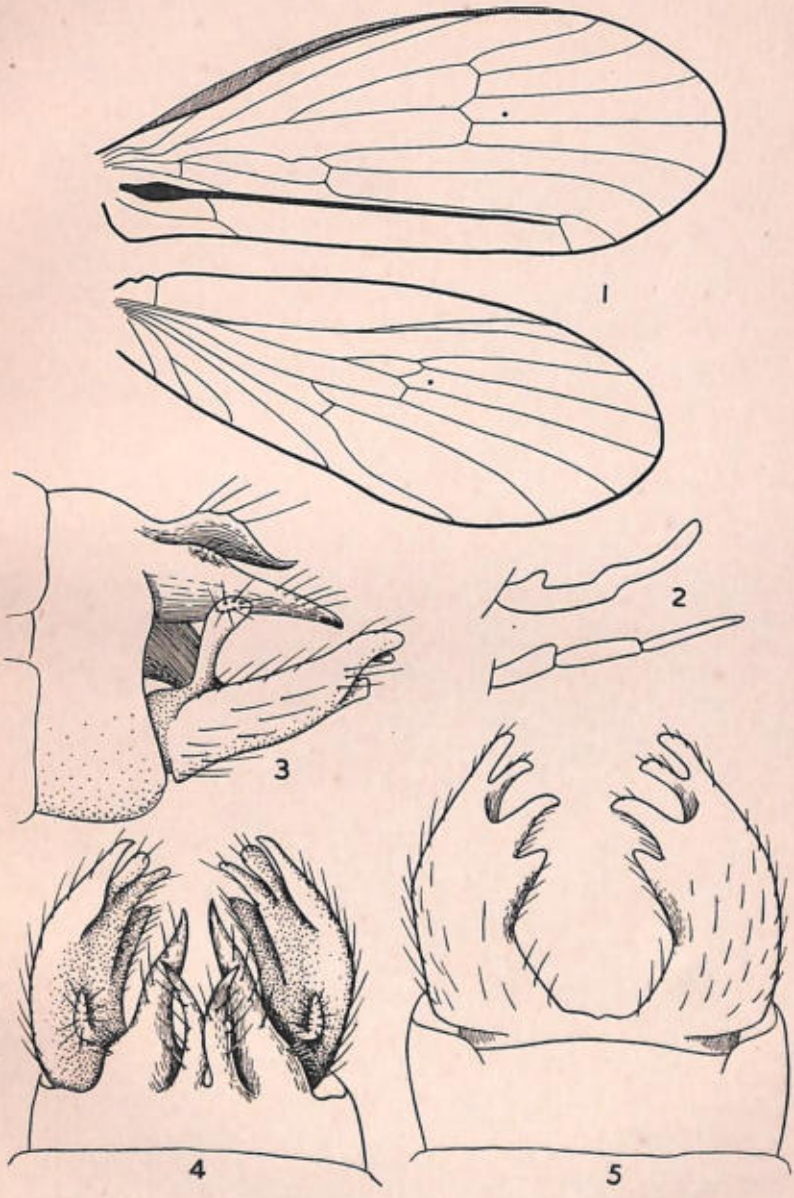
Adinarthrella parva sp. n. ♂. Fig. 1, wings. Fig. 2, maxillary palpus. Fig. 3, basal joints of antenna. Fig. 4, genitalia lateral. Fig. 5, penis and sheaths lateral. Fig. 6, genitalia dorsal. Fig. 7, wings, ♀.



Goerodes indica Mart. ♂. Fig. 1, wings. Fig. 2, palpi. Fig. 3, basal joints of antenna. Fig. 4, genitalia lateral. Fig. 5, inferior appendages from above. Fig. 6, dorsal plate. Fig. 7, genitalia ventral.



Goerodes inæqualis Mart. ♂. Fig. 1, wings. Fig. 2, genitalia lateral. Fig. 3, dorsal. Fig. 4, ventral. (After Martynov.)



Goerodes kanda sp. n. ♂. Fig. 1, wings. Fig. 2, palpi. Fig. 3, genitalia lateral. Fig. 4, dorsal. Fig. 5, ninth sternite and inferior appendages.

furrowed on its upper surface; inferior appendages very broad, five-branched; from beneath, four short branches are situated in the apical third, directed inwards and tailwards; the fifth branch arises on the upper surface of the appendage towards its base; it is short with a slender stem and clavate apex.

Length of the anterior wing ♂ 7 mm.

Ceylon: Mousakande, Gammaduwa, 19-24-xi-1933, Colombo Museum.

Type ♂ in the collection of the British Museum.

NOTES ON SOME INDIAN BIRDS.

BY

E. H. N. LOWTHER, M.B.O.U., F.Z.S.

(*With* 8 *plates*).

VI.—AN INDIAN RIVER-BED.

(*Continued from page* 777 *of Vol.* xli, *No.* 4).

March gave place to April a fortnight ago, and already the heat in the United Provinces is such as to necessitate the closing of all doors, windows, and shutters, by 8 o'clock in the morning at the latest, the bungalow thereafter remaining in a dark and more or less air-tight state for some nine hours until the air without becomes cooler. 'Tis then that the coppersmith *tonks* his loudest and the koel repeatedly informs us *we're ill*, till we begin to think such really is the case. Unnecessary noises leave our nerves on edge; the sight of the cook with his *hissab* makes one itch to wring his neck; everybody and everything seems to conspire to make us thoroughly crossgrained, and we wonder 'if we had only known before that it was going to be like this' whether we would have come out to India to earn our living.

Although, with the advent of the hot weather, such thoughts annually assail many of us, the true bird-lover is not rattled by the rising thermometer; rather does he welcome the arrival of April, because he knows it is during the next three or four months that the nesting season in India reaches its peak. On all sides now—except at the *jhils*—there is plenty to interest him, nowhere more so than on the bare sandbanks in our large rivers where, already, the little pratincoles, skimmers, and the different species of terns and plovers are nesting. In spite of the fact that a visit to the breeding haunts of these birds means braving a relentless sun, and is made with the knowledge that we are going to be well 'cooked' long before we are back home again, we decide that we cannot let the month pass without seeing again how the several river-bed birds are faring. But whereas formerly we made the rather tiresome journey to the river in the early morning, we now go overnight, so as to be on the scene of operations with the first blush of dawn. Thus we not only conserve our energies—*very* necessary as we grow older—but are likely to see far more of interest during the early hours of the day. Nor is this all: between 6 and 8 a.m. the light is more favourable for photography in the river-bed than during the remainder of the twenty-four hours. And so, having dined well, we proceed about ten miles by car; then, boarding a small boat, are rowed some five or six miles up the Jumna, a full moon making our passage through the shallow channels easier, and showing up an occasional country boat laden with ballast or fodder, anchored for the night. Not a

human sound is to be heard, though other noises keep us awake for a while. The croaking of frogs never ceases—a sure sign we have had rain recently; now and again spur-winged plovers or red-wattled lapwings leave the small islands on which melons are being grown, and where their nests are, to circle over the boat, rending the night with their piercing alarm notes. At this late hour we can note more accurately than is possible during day-light the difference between the notes of the two species: how the former's call is neither so frequently uttered nor so penetrating as that of the *did-he-do-it* bird. Then, as we soliloquise, jackals ululate from the river's bank; which makes us communicative too. Asked for his views concerning the war, the *manji* (boatman) holds forth on the Hindu-Muslim *larai* (war). Questioning him further we learn he has not heard that the Empire is at war with Germany; this inspite of the fact that he lives within ten miles of the *de jure* capital of the United Provinces. Surprising though this may seem, the incident is not without parallel in our experience. We recall a friendly talk round the Christmas camp-fire in a wild part of the Hazaribagh district in Bihar, when several of the beaters denied all knowledge of the Great War of 1914-18; which shows how little the masses in India are affected by Armageddon, so we'l are they cared for, in spite of its many imperfections, by the SARKAR.

It is soon after this 'discovery' that the batrachian chorus and the rhythmic beat of the oars lull us to sleep, but not before we have donned a cardigan and pulled a blanket over us, so chilly does it become on the water towards midnight even at this season of the year.

We tie up at our destination at 3 a.m., skimmers and terns protesting at this unwarranted intrusion of their haunts, but continue sleeping for another two hours. Then, as *Rosy-fingered Dawn, Child of the Morning*, appears, we step ashore and climb the right bank in order to obtain the best possible view of the sand islands below us, and to observe through the glasses the teeming bird life on them. A sight fit for the gods is presented to our astonished view, and as we regard it with bated breath we instantly feel as must that hushed throng have felt which gazed on Aeneas as he addressed Dido, the crowd whose bearing is so graphically described in the opening line of the Second book of the AENEID :—

Conticuere omnes intentique ora tenebant.

We cannot believe that so many birds or so many species can breed in such close proximity to one another: literally *hundreds* of Indian river terns, black-bellied terns, and little terns are sitting on their eggs, a duty which numbers of skimmers and little swallow-plovers are also performing. Many young birds too are to be seen running about the bare sand. Our pulses are quickened by the sight; and though we realise that to-day our time will be well occupied photographing the nests and eggs, as well as the young, of the several species, we decide we must attend to the

requirements of the 'inner man' before investigating matters further.

While breaking our fast with chicken cutlets, and bread, and butter, washed down with copious draughts of delicious iced coffee from the several flasks, we needs must observe the unceasing pageant of bird-life which passes before us. On the stake to which our boat is secured sits a pied kingfisher, watching the water below for some unsuspecting fish to appear near the surface. Something frightens the bird and it leaves its point of vantage, only, however, to quarter the river in front of us, bill pointing downwards and hovering in the air much like a kestrel. Twice it drops almost vertically, but when within a foot of the water, changes its mind, and rising, hovers once more, wings beating rapidly. Down it dives again—no half-heartedness about the plunge now—and this time the bird strikes oil, or rather a fish, and uttering a squeal of delight, flies off with the victim. A pair of large pied wagtails keep flying to and fro between our bank and the sandy islands, returning always with food in their bills. Investigation shows that they have a nest tucked well away under the exposed roots of a tree a little further up the river. This contains four large young. We learn later that *in* our boat is another nest of this species, also containing four well-feathered young birds. The parents have not accompanied us on our outing, so their offspring will have to remain unfed for some hours: which incident seems to indicate that the adults do not remain overnight with the young when they are a week or more old.

This discovery reminds us of a number of other large pied wagtails' nests we have seen on ferry-boats plying on the same river, and of the numerous occasions that we have noted the adult birds visit the old and dilapidated tubs when in midstream, in order to feed their young. Most nests of this species that we have seen, however, have been built on the underside of pontoon bridges, immediately over water.

Yet other birds we notice are sarus cranes, blacknecked storks, and a Pallas' fishing eagle. Normally the sarus is seen in pairs, or in family parties of three or four, according as to how the parents succeeded in hatching off their eggs, but at this time of the year numbers of these birds foregather on the banks of rivers, apparently for feeding purposes. To-day we count fifty-three collected together, and a wonderful spectacle *Antigone a. antigone* always presents, whether standing proudly or flying with slow, measured wing-beats, red legs and long neck outstretched, and uttering the loud trumpet-like call which is one of the most familiar sounds near *jhils* in many parts of northern India. The black-necked storks—a family party of four—are feeding not far from the cranes, moving about energetically in a shallow stretch. We note the manner of their progression, how the foot is first removed from the water by a slightly backward movement, then is raised and finally advanced clear of it, and not forced forward through the element as one might expect. Wonderfully handsome the parents are in their glossy black and snow-white plumage: how dowdy though are the young in their smoky brownish-black garments. The Pallas' fishing eagle flies from a large *pipal* tree

A Pied Kingfisher with food for its young.

standing back a short distance from the left bank. On it is the bird's eyrie which, to our knowledge, has been used every year for the past fifteen years, and, according to the villagers, for a very much longer period. Nesting duties are now over, and the young gone out into the world. We are impressed by the large size of the eagle, the yellowish-white colouring about the head and neck, and the wide white subterminal band in the tail, all of which, together with the loud clanging call, make identification easy.

The sight of the eagle reminds us of a visit made during an earlier year to the same place, when both birds were observed to swoop down again and again to the far end of the island, there to remain for short periods, all the time chased and mobbed by skimmers, terns, and plovers. Investigation later showed they had ravished countless clutches of these birds' eggs. No young ones were to be seen. Was this due to none being left or because they had not yet hatched out? We believe the latter was the case as what eggs remained were either fresh or only slightly incubated.

The Pallas' fishing eagle is not the only enemy of these river-bed nesting birds. Common or garden house crows, and even kites, plunder the eggs in exactly the same manner—indeed I possess quite a good photo of a pair of house crows at a skimmer's nest, one of them with an egg in its beak. Jackals too are partial to the eggs of terns and skimmers and not one escapes their attention when the birds have laid on a peninsula instead of an island. I am not sure the great stone plover does not also occasionally help itself to the eggs or young: of this more anon. The *manjis*, fortunately, do not seem to be interested in these birds' breeding arrangements.

In spite of the season being so late a small colony of sand martins is still engaged in nursery duties. By the margin of the far shore numbers of little stints—smallest of all waders—are feeding. Energetic creatures, they are constantly on the move in their quest for food. Often also they take to flight; at one time they appear to be all brown and the next moment all white, this depending on whether we see their upper or lower plumage as they 'bank'. On a spit of one of the islands some forty or fifty teal are attending to a leisurely toilet. Elsewhere Brahminy ducks stand in pairs, all suspicion and ready to take to wing for little or no reason, calling *honk-honk*. They, as well as the stints and teal, will soon be departing to cooler climes—in fact they ought to have gone ere this.

Closer at hand the fowls of the air whose nests, eggs, and young we shall shortly study, are going about their lawful occasions. River terns and little terns fly past us, upwind, twenty feet or more above the water, on the look-out for the tiny surface-feeding fish on which they live. As one is spotted, down the tern plunges, perpendicularly, or nearly so. If the dive is successful, the fish is either eaten, head first, on the wing, or is taken to the mate sitting on eggs. Each piece of water is quartered two or three times before the terns seek pastures new: frequently this is the same stretch but nearer the bank, or further out towards the middle of the river. Now and again the terns strike a shoal of

tiny fish; then, flying round in graceful circles, they help themselves freely at the banquet provided. At times, however, fish are apparently not to be found, or had easily. I have seen a little tern, with a fish in its bill, flying in the direction of its breeding ground five miles away. This I had just visited. There was no other nesting haunt in between. There can be no doubt that the fish was being taken to a sitting mate. Thus the capture of the fish, and the return journey to the nesting island, meant a flight of *at least ten miles.*

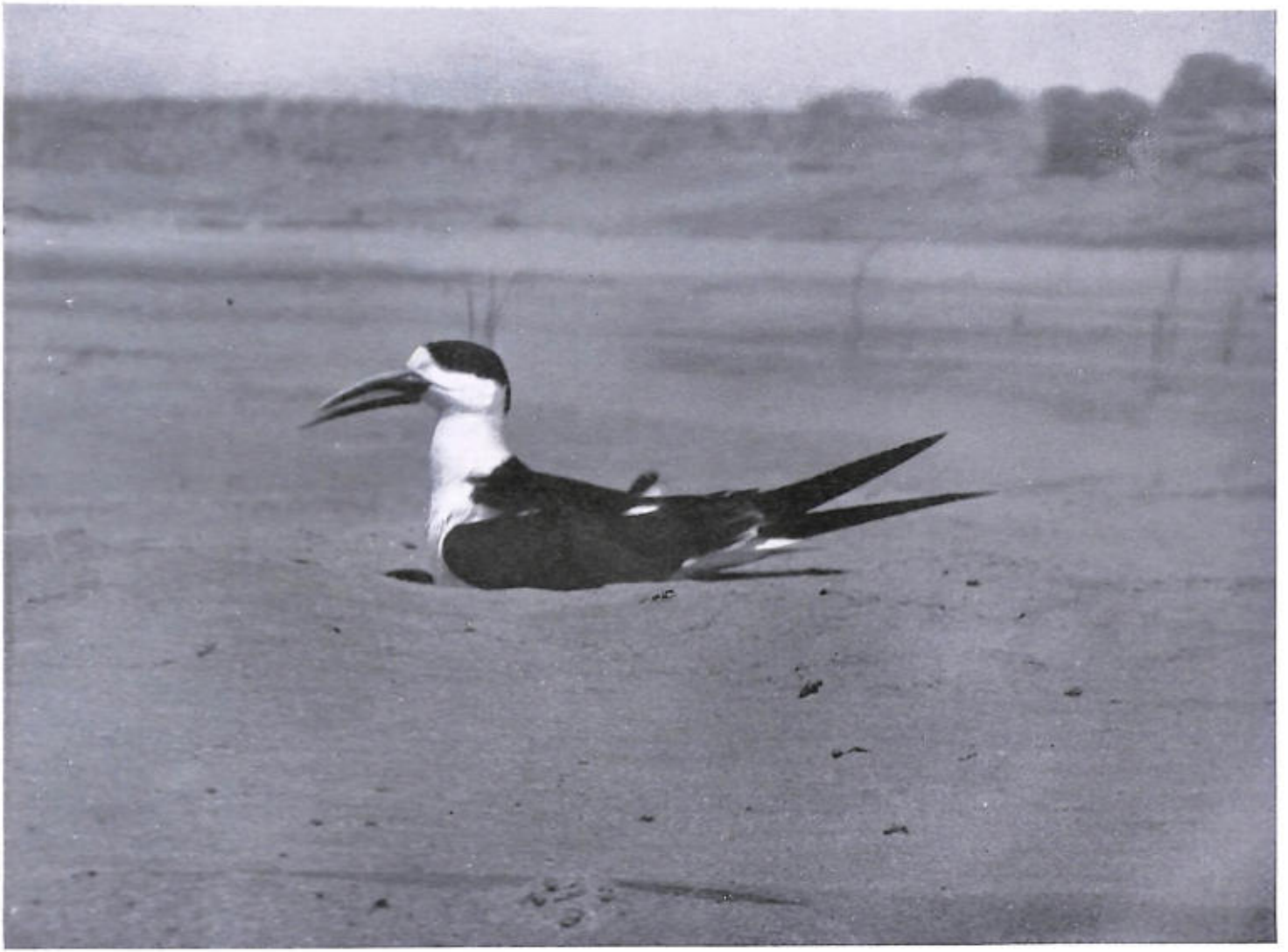
The black-bellied tern's feeding arrangements differ somewhat from those of the river and little terns. Certainly the bird flies over water and obtains much of its food from that element, but this seems to consist of insects more than fish, though the latter are also taken. It also hawks over the bare sand banks for what it may consume; in which respect its departure from the normal is similar to that of the white-breasted kingfisher which, even the casual observer will tell one, lives more on insects than on fish.

Identification of the different species of terns with which we are concerned here is, fortunately, a simple matter, size alone making this easy. Largest of them all—I do not include the skimmer, to which I shall refer presently—is the river tern; then comes the black-bellied tern, and smallest in size, the little tern. All have the tail long and forked; all have a french-grey upper plumage, with the top and sides of the head, and nape, black, the little tern in addition possessing a conspicuous white forehead. In the colouring of the lower plumage, however, the three species differ; while the under parts of the river tern are a greyish-white, the black-bellied tern's lower plumage, is either chocolate or black. The little tern has the under parts a chaste white. All three species have the bill yellow, though the depth of colour varies from deep yellow in the river tern to light yellow in the little tern, and orange-yellow in the case of the third species. The legs of the three species are also different in colour: the river tern's legs are red; those of the black-bellied tern orange-red, and of the little tern yellow.

I have said that size alone makes identification of the terns easy, and that the river tern is the largest of the three. But the river tern must not be confused with the skimmer which has a wider expanse of wing, and differs markedly from the terns in other respects also. It is a large black and white bird—much of the black is really a dark brown—with very long pointed wings. At rest, and above, when the bird is flying, the wings are black; viewed from below, the wings in flight are white. The forehead, the lower sides of the head, and from the end of the nape right down the back are white, as is the entire lower plumage and the tail, excepting the central feathers which are dark brown. The rest of the skimmer's plumage is brownish-black. It will be seen therefore that the skimmer is a very distinguished looking bird. Even more compelling than its plumage, however, is the bill. In size, shape, and colouring this is distinctive. It is large, somewhat arched, the upper mandible noticeably shorter than the lower, and a lovely shade of coral in colour, with the ends tipped yellow. Should the reader have the good fortune to examine a skimmer

A Little Tern brooding its eggs.

The River Tern—the largest of them all.



Even more compelling than its plumage is the Skimmer's bill; the mandibles, the upper shorter than the lower, look like two knife blades set edge to edge.

really closely, he will notice that the mandibles are closely compressed, so that they look like two fine knife blades set edge to edge. The reason for this highly specialised structure of the bill becomes immediately apparent if the skimmer is watched obtaining its food. The bird skims over the water with the beak wide open—it is amazing how the wings do not touch the water at all—the lower mandible cutting through the water like a plough, the upper one clear of it. Any fish or other food met with *must* run up the incline formed: there is no escape. In much the same way, in British railway practice, an express train locomotive picks up water, while running at a high speed, from troughs placed between the rails.

By 6 a.m. those skimmers which are not covering their eggs are collected in packs twenty to thirty strong, at the water's margin, there, except for occasional flights, or to relieve their mates, to spend the best part of the day, leading a thoroughly idle life. If we would watch the skimmer feeding freely and see the bird at its best we must visit its haunts late in the evening—the hour before sundown is the best time. Feeding begins again at the false dawn but lasts only a short while. Observation at this early hour is, moreover, difficult, and at best guess work. Even under the most favourable circumstances, however, it is difficult to determine what exactly is the nature of the skimmer's diet. Very small fish are certainly taken but my observations go to show this is not the staple food; indeed a skimmer usually holds a fish crosswise in its bill for such long periods, and toys so much with the wretched creature that I always feel it regards the victim with lack-lustre eyes. On the other hand I have seen a skimmer pass a fish over to another of its kind; the gift was promptly accepted though some minutes passed before any attempt was made to swallow the fish. More usually, it is my belief, the skimmer prefers insects for its food, and probably also small shrimps. One would imagine dissection should settle the problem, but apparently even this has not elucidated matters greatly as I see Stuart Baker states that the stomachs of those examined held nothing but a thick oily fluid.

The different species of terns, and the skimmers, naturally attract our attention most, but there are two other species that have their being on the sand banks, which we cannot fail to observe from our vantage point, though at this range we must use the glasses to see whereabout exactly is the main stronghold of the little pratincoles or swallow-plovers; these birds being the colour of the sand it is not an easy matter to pick them up with the naked eye.

The little swallow-plover has the upper plumage a sandy-brown with a black line close to the eye. The lower parts are white, including the tail which, however, is tipped black. There is some black and white in the wings which are long and pointed and give this small aberrant plover a swallow-like appearance in flight, though it is appreciably larger than any swallow. Much of the bird's time is spent in the air, both over water and sand, where it captures its insect food; in which respect it differs from the true plovers who obtain their meat from the soil. Lest it be

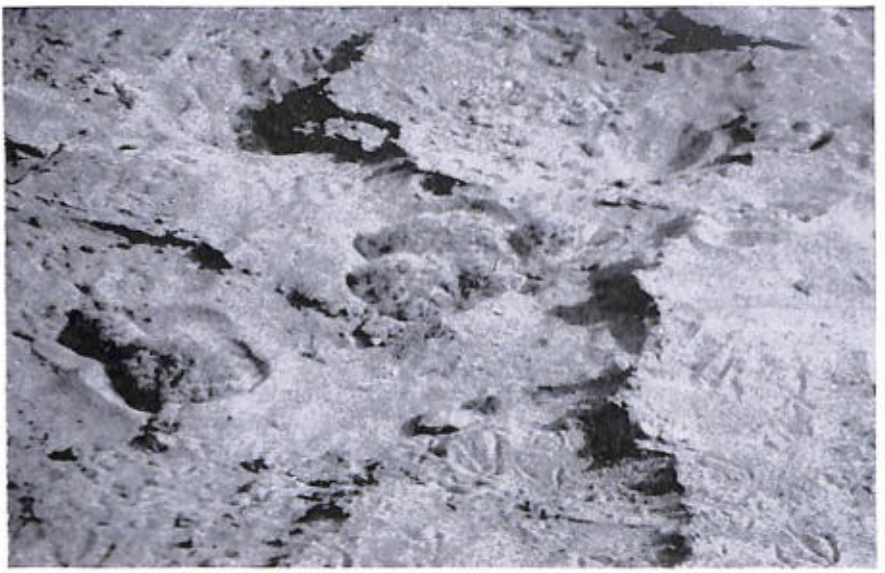
thought that the little pratincole does not obtain its meals from the ground also I hasten to add that it does, in considerable quantities, and possesses short legs which take the bird over the sand at a very creditable speed.

The spur-winged plover is of much the same size as the *did-he-do-it* bird, but possesses none of the self-assurance of that species. It has a small black crest, black head, chin, throat and bill, and a black band across the abdomen. The upper plumage is a greyish-brown, the under parts a greyish-white; there is a good deal of white in the wings and tail, and a black terminal band as well in the tail. Always—in the breeding season at all events—the spur-winged plover seems to be sneaking away from our direction, body and head lowered; always it appears wishful to avoid our gaze, as though it had committed some foul deed, and was now thoroughly ashamed of itself. It is strange that those very methods which the bird employs to escape our notice usually bring the spur-winged plover under observation. Not flashily clad, its alarm note is not so penetrating or interrogative in character as is the red-wattled lapwing's. It is usually a clear *did*, or *did-did*.

But we have tarried too long over breakfast, and must be up and doing if we would avoid the sun's fiercest rays, and the dust storm which is such a trying feature of the month of April. So, boarding the boat once more, we are rowed across to the largest of the islands, on which the different river-bed birds are breeding. As we land, river and little terns fly overhead, and make an appalling noise. Presently an unusually bold river tern swoops down on us repeatedly, without, however, actually striking us, its loud and rather drawn out note—*ping*—sounding like the scream of a bullet whistling past us. But before we have seen a single nest or young bird we halt to enquire the explanation for a number of holes going vertically into the sand. The *manji* tells us they have been made by the *goo-goo*, which lives at the far end of the burrows. Intrigued to see the creature, we have not long to wait, for, as the boatman pours some water down a burrow, up pops a remarkable looking cricket with a thick body some two inches in length, over which is a finely checked grey sheath. Over the tail is an object that looks like a watch spring. On either side of this is a single spike about a quarter of an inch in length. Other remarkable features are the very long, fine whiskers, the fierce-looking jaws, the prominent black eyes and the three sets of feet, all powerfully arrayed with spikes, the centre pair armed both fore and aft, the leading pair in front, and the trailing pair in rear. All these feet end in 'hands', used apparently first to dig up the sand or earth, and then to throw it away. The general colouring is light brown, with dark brown markings. The boatman volunteers the information that *goo-goos*, when matched against each other, fight to the death; that they are nocturnal in their habits, and those that return to their homes late are greedily snapped up by kites and crows. A reference to the Society, however, tells us that the *goo-goo* is less terrifying than its appearance, in spite of scientists having saddled it with the appalling name of *Schizodactylus monstruosus;* that it is a

The Little Swallow Plover hunts its insect food in the air or on the ground.

A Spur-winged Plover approaching its nest.

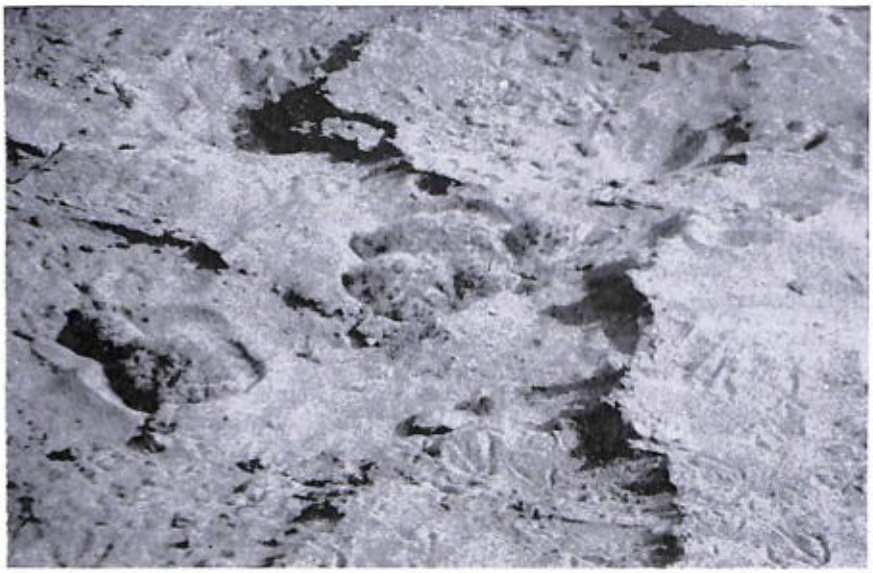


Baby Skimmers are even more difficult to detect than the eggs. They are indistinguishable from the indentations of crusted sand in which they lie.

A young Skimmer hiding after its first flight.

species of cricket which burrows into the sand banks in rivers, and into the loose soil in fields. We learn too that it occurs in the drier parts of northern and north-west India, and is described as doing a certain amount of damage to cultivation by cutting the roots of plants in the course of burrowing. Very little, however, is known of the insect's habits.

But we came not to study *goo-goos*, fascinating though these must be to the bug-hunter. Let us therefore press on and see what the teeming bird-life has to show. Ah! here's the first lot of eggs . . . Yes, three is the largest number I have known laid by any tern . . . Not much of a nest, is it? . . . The eggs lie on the bare sand. House furnishing is a very simple matter, all that the female has to do being to turn round once or twice, the circular depression so formed serving as a nest. Sometimes, however, a few straws line the nest; particularly is this the case when the eggs are laid near the water's margin, where the sand shows signs of remaining damp . . . Judging by the size of the eggs, and the greenish tinge in their ground colour, I should say this clutch is the property of a pair of river terns. The skimmer's eggs are about the same size as the river tern's, but are invariably of a buff or stone colour. However, eggs of both species are commonly similarly coloured, so that identification is by no means always easy. The only certain method of identifying the eggs of the river tern and skimmer is to watch the parent bird to the nest . . . All terns and skimmers' eggs are spotted or blotched with dark brown or reddish-brown markings on the surface, with under-lying patches of a purple shade. In the case of the little tern these markings frequently form a pronounced band about one-third the way down the egg, though the remainder of the egg is also marked . . .The eggs blend astonishingly with their surroundings . . . *More* nests? Yes, of course, skimmers and all these terns are very colonial in their breeding arrangements . . . Hereabouts all three species of terns are nesting together, hopelessly mixed up. Not many black-bellied terns though—they always seem to remain somewhat aloof. At other times territory appears to be carefully parcelled off, so that each species keeps to itself. The eggs are seldom deposited on the bare expanses of fine, glistening sand; usually the nests are made along the ridges left by the receding water at the close of the previous monsoon . . . A clutch of *four* eggs? . . . Without doubt they are a skimmer's. Every year I happen on one or more clutches of *five* laid by this species. . . *Hullo! eggs sprinkled with water* . . . *More* treated in this wise?. . . From mid-April onwards, when the sun is well in the heavens, I usually come across eggs, and young birds too in the down state, sprinkled with water. I suppose the parent birds do this to prevent the eggs being baked . . . Just put the back of your hand on the sand . . . Wickedly hot, isn't it? . . . Ah! some young birds . . . Sandy-brown in colour with buff markings on the head and back . . . Lying stretched out full length, as flat as pancakes, and not moving a hair, they are even more difficult to distinguish from their surroundings than are the eggs, particularly when they rest in indentations in the 'crusted' sand. These are baby skimmers. Young terns have the down a



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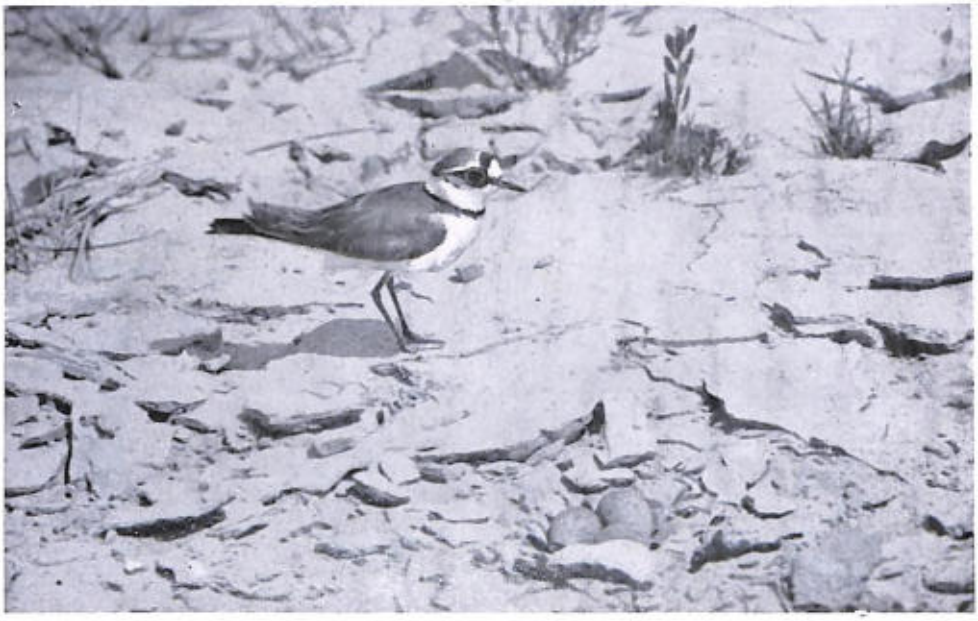
richer brown, and are more heavily marked about the head and body . . . I wonder when the young skimmer's bill becomes shaped like, and assumes the colour of, the adult's? Certainly not before it has learnt to fly. At this age the young skimmer's bill and feet are of a horn colour. The bill has assumed, more or less, the shape of two knife blades placed edge to edge, but the two mandibles are of much the same length, and the upper is not yet arch-shaped. Now we are approaching the breeding territory of the little swallow-plovers . . . Becoming a bit excited, are they not? Yes, as they flutter about before us, every single one apparently either with legs or wings broken, they look as though some sportsman (*sic*) had 'browned' them. Actually they are as hale and hearty as either of us. They have eggs or young, and this is their method of decoying us away from their treasures . . . No good your chasing the birds, Pokhi. Look about for their eggs instead . . . We must be right on the spot now—the swallow-plovers are almost dancing on their heads in their anxiety. Yes, here are the eggs—only two in each nest. At one time and another, I suppose I must have examined quite one thousand nests of this species, but only once have I seen one with more than two eggs—a clutch of three . . . Must be quite fifty nests hereabouts. Most of them on caked sand; some in the shelter of a small plant that looks like groundsel. Some in no nest proper, others in a slight depression. Like terns' eggs, those of the swallow-plover vary greatly in colouring, the ground ranging from light fawn to grey and pale green, with brown, reddish-brown and purple blotches, spots and pencillings superimposed . . . *There* are a couple of newly hatched pratincoles. Already they know how to lie low. What large gapes they have—rather like young nightjars. Clothed in grey down—different from the baby terns and skimmers . . . Here's an interesting find—a light blue-coloured egg of the little swallow-plover, and without any spots on it. I remember seeing a clutch of river tern's eggs similarly coloured. The species possesses notes which I would never have dared to attribute to it had I not heard and seen them uttered while inside a hiding tent photographing a little swallow-plover at the nest. Some sounded like the *tuck-tuck-tuck* call of the house lizard; others made me feel I was listening to a greenfinch singing . . . Look at that spur-winged plover on our left, sneaking away, *ventre à terre*. Its nest is probably alongside those derelict *bajra* stalks about thirty yards our side of the bird . . . As I thought, the four eggs lie in a noticeable depression, their pointed ends meeting in the centre. A real effort at nest building here, the eggs lying on several small pieces of straw. A favourite situation for the nest is among the melon beds on these islands. The owners do not usually demonstrate while we examine the nest. However, a member of this species once endeavoured to draw me away from its eggs by playing the broken wing game. It is a different matter when the spur-winged plover has young: then the parents show their anxiety by flying over us, calling the while.

We now make for the island's 'coast line', the ground there being firmer and walking consequently easier than over the soft

Like Terns' eggs, those of the Skimmer vary greatly in colouring.

A young Swallow Plover hiding.



A Little Ringed Plover comes to its nest.

'A little ball of fluff, mottled grey and brown above'
Little Ringed Plover.

sand we are traversing at present. We have not gone far when we see a little ringed plover running from inland towards the water's margin. About six inches in length and assimilating with its surroundings to a remarkable degree, the bird is always hard to spot and its eggs even more difficult to locate. I am confident, however, that the bird we have just seen has a nest; otherwise it would not have been such a distance away from the water. Mark carefully the place where we first saw the plover and look about ten or fifteen yards to the right, as the bird had probably run that distance before we spotted it . . . We search diligently, each step taken with the greatest care lest we crush the eggs. Soon they are found, within seven yards of where they were expected to be, lying in a depression of the 'caked' sand . . . Notice how the little ringed plover stands by the water, not uttering a sound but, every now and then, pretending to be searching for food. The bird's conduct is in strong contrast to that shown by another of the same species whose downy babes I once examined. Hearing the plaintive notes of an adult ringed plover and fancying these indicated the presence of young birds I commenced looking for them, my search made to the accompaniment of even more plaintive calling. As I examined her children—little balls of fluff, mottled grey and brown above and pure white below, wearing the inevitable 'collar' peculiar to baby plovers and possessing conspicuous black-eyes—the parent ran close up to me and literally seemed to *beg* me not to harm her young. . . Nests of this species which I have found in the plains have never contained more than three eggs; in Kashmir all my nests contained four eggs.

Two personal experiences immediately come to mind in connection with the photography of the little ringed plover. The first concerns a *hide* which had been put up against a nest of this species on the left bank of the Chumbul river. I was inside the *hide* and my *shikari* had taken his departure, when the sound of heavy footsteps was borne in on me. Thinking the obtruder would soon veer off I remained quiet. The steps came nearer and before I could act, the *hide* and camera, to say nothing of myself, were knocked over by a cow which had come to graze off the branches, grasses, etc., stuck on to the outside of the tent for purposes of camouflage. The camera shutter was broken; so were the three eggs in the nest . . . The second experience produced far more satisfactory results to everybody concerned. I had taken a number of photos of a little ringed plover at the nest. The plates on development being found to be heavily over-exposed, I returned the following day to the *hide*—fortunately it had been left *in situ* over night—to correct my error. The ringed plovers were now very tame. Having made a few exposures I dismantled the tent and sat down less than five feet away from the nest, in full view of its owners. This made no difference to the birds who proceeded to incubate and even change places on the nest as though nothing untoward had occurred. During this session too I was to learn that birds sometimes continue to woo each other after the eggs have been laid. The male ringed plover not only courted his mate vigorously—rushing up to her with the lower plumage fluffed out—but indulged

in the sex act, the female leaving the three hard set eggs for the purpose.

We are now nearing the extreme end of the island. It was a fortunate thought that made us tell the *manji* to meet us here with the boat, for it is now 10-30 and the sun uncommonly hot. Before, however, we commence the journey home, we *must* (as we are so near) investigate that long, narrow limestone or *kanker* reef standing only two or three feet out of the water some two hundred yards upstream; it is just the sort of place where we may expect to find the great stone plover nesting . . . That tiny bird you nearly trod on then did not delay its departure for nothing . . . It was a Ganges sand-lark . . . *There* is the nest, a snug little affair, made of grass and fine roots, lined with vegetable fibres, tucked away in a small cavity in the ground where the great heat has cracked the clay soil till huge fissures appear. The nest contains three eggs, in general appearance very similar to miniatures of those laid by the large pied wagtail. How difficult it is to realise, even as we stand almost over it, that we are looking into a bird's nest. In this terrible glare the structure harmonises wonderfully with its surroundings.

Now we are in for it—here comes the sand storm. We can do nothing, situated as we are, except bear its full force. The sand will get into our mouths, our hair, down our throats, into our eyes and ears, penetrate everything, even the cameras in their cases and the loaded dark slides . . . I shall have to be more than careful when I take out the plates to develop . . . Ugh! how *beastly* it is crunching sand, and how it *lashes* one in the face . . . Every year I make up my mind never to bother again with these river-bed birds; every succeeding year they appeal with even greater force . . . Yes, I suppose there is no fool like an old fool . . . But *our* sufferings are nothing compared with those of the young skimmers and terns. After such a storm I have seen large numbers of these young birds practically buried by the drifting sand, only the tops of their bodies, heads and bills visible. However, they soon crawl out of their temporary tombs, the sand that still adheres bearing eloquent testimony to the discomfort they have suffered. On such occasions the parent terns and skimmers do overtime splashing water over their eggs and young. Many clutches of eggs also become completely buried; only the tops of others are to be seen. Matters are, however, soon put right and in a few minutes all the eggs again lie in neat, circular depressions.

The storm having spent itself at last, we board the boat to see whether our surmise is correct with regard to the nesting of the great stone plover . . . It *is*, by Jove . . . There goes one of the pair, running as hard as it can. It is a considerably larger bird than the stone plover, and essentially a denizen of the river bed, where outcrops of rocks, mingled with patches of sand, occur. The bird's most conspicuous feature is (to my mind) the bill which is shaped very much like a mortising chisel . . . Now the second bird comes into view—standing still, watching us. . . Very likely the female, and in all probability she has just come off the eggs. . . Here they are—beautiful objects, of a stone colour with bold dark brown blotches and underlying markings. . .

The Great Stone Plover may possibly be an egg-lifter and a baby snatcher.

No nest worthy of the name really . . . Two is the full clutch . . . The egg is about 2.1″×1.6″ in size.

Earlier I hinted that the great stone plover may possibly be an egg-lifter, a baby-snatcher. I have very little to advance in support of this view and possibly the facts can also be used in argument against my theory; any way, here is the evidence for what it is worth. Passing a small island one morning, on which some driftwood and small *babool* branches lay scattered about, I noticed river and black-bellied terns swoop constantly at something under one of the aforesaid branches. The glasses showed it to be a great stone plover; and a thin time old 'goggle-eyes' was having, judging by the manner in which he—perhaps she—I shall revert to this presently—flinched every time a tern dived at him. Obviously the great stone plover was incubating eggs, and equally obviously the bird was thoroughly scared. An hour later, on my return from a visit to a crested lark's nest, I waded out to the island. Now no mobbing was taking place, nor were there any signs of a great stone plover under the lopped off *babool* branch. A pair of these birds were, however, standing at the end of the island, each on one leg, looking the forlorn souls they often do. Past them flew an occasional tern, now taking no notice of the great stone plovers. Investigation of their nest showed that a tragedy had very recently occurred: the two eggs were broken, their yolks still drying in the sand. Did a tern smash them? or did the great stone plover itself cause the damage, exasperated beyond measure at being persistently mobbed, and having to incubate under such trying circumstances? Personally, I incline to the latter view. But *why* did the terns mob the great stone plover in such determined manner before, when now they took no notice of the birds? We can only speculate as to the reason, but the impression that was created in my mind at the time still remains to-day, that the great stone plover had been caught in *flagrante delicto* filching an egg or young bird, and the terns were determined that Justice should be done.

Somewhere I have read that only the female great stone plover incubates. This may be the case generally but it is not the invariable rule. At the one and only nest on which I have succeeded in photographing this species, the 'change over' took place three times during the course of two days. Certainly the bird which I took to be the female incubated for long periods, but on one occasion the male (presumably) sat continually for a little over two hours.

This brief study of the great stone plover concludes the list of breeding birds we may normally hope to study when visiting a river-bed. There are, however, two other species I constantly meet with when proceeding to the nesting haunts of skimmers and terns; not that the nests of the two species referred to are not found also in localities far removed from the neighbourhood of our large rivers, because they are, the wire-tailed swallow's sometimes even in the verandahs of our houses, and those of the cliff swallow under the arch of a canal bridge. But the cliff swallow's nesting site, *par excellence*, is the high bank of a river, such as the Jumna or Chumbul. These high banks are cliffs to all intents

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and purposes, and are a feature of parts of the Agra and Etawah districts, through which these rivers flow. Similarly the nesting of the wire-tailed swallow is associated in our minds with shelving rocks, whether these be on the river's bank, or piled one on another in mid-stream.

Never shall I forget my first glimpse of the nests of the cliff swallow. I was on the right bank of the Chumbul and noticed, upstream, on the face of the left bank, something that looked like a large map of India. Due to the shimmer that was coming off the sands I was unable to tell, even with the glasses, what the 'map' was. I therefore waded across and in due course investigated matters. The 'map' turned out to be between two and three hundred nests of the cliff swallow! They looked just like so many carafes, their bases stuck to the cliff face, the mouths of the bottles protruding towards the river. *What* a scene of activity pervaded the colony—birds flying in and out of their nests the whole time, feeding the young, twittering the while. The ubiquitous sparrow had taken possession of a number of nests, and where this was the case the tubular entrances were broken away in varying degrees.

A beautiful and striking bird is the wire-tailed swallow, with its bright steel-blue upper plumage, chestnut-capped head, spotless white under-parts and long wire-like outer feathers some seven inches longer than their companions. The nest of this species, a shallow, pellet constructed affair, lined scantily with dried grass and a few feathers, and containing up to three eggs, ground colour white, with reddish-brown spots and speckles, mostly collected round the broad end, is commonly attached to the under surface of a sloping rock, sometimes only a foot or two above water.

I cannot conclude this article without some reference to the photography of river-bed birds. A *hide* placed in the tree tops is quickly accepted by spoonbills, cormorants, etc. as part and parcel of the tree in which their nests are located, but the sudden appearance of a hiding tent on a large sandy island is regarded with disfavour by terns and skimmers, even though at first this is placed at some distance from any nest. This suspicion of the *hide* is only natural, as whether it is erected to look like a bush, or a large pimple or wart in the sand, the creation is, to say the least, something quite out of the ordinary on what, after all, is a bare desert island. With the river-bed birds, therefore, the photographer starts at a disadvantage. But this is not all. The west wind, or *loo*, which blows throughout April and the first half of May, the principal breeding season of the terns, skimmers and swallow-plovers, literally speaking *rocks* the *hide*, no matter how deep the uprights go into the sand, or how tight-fitting on its frame is the canvas work. Every bird-photographer knows there is nothing that alarms a sitting bird so much as movement of the hiding tent. And what shall I say of the heat inside the *hide*? This is greater than anything one can conceive. Many a time, on crawling out of the tent after photographing a tern or swallow-plover, blinded with perspiration and almost in a state of collapse, have I felt, on exposure to the sun, as though I had suddenly been transported to the Arctic regions, so cool is it in

the open after the stifling heat within. I do not exaggerate the conditions; I merely state the facts so that the would-be photographer may know what he is up against. But if the obtaining of pictures of skimmers and terns is attended with difficulties, the photographer is, at all events, a constant spectator of most interesting and exciting episodes in the bird-life around him, as the following extracts from my diaries indicate:—

'From time to time I am a silent witness of the most affectionate intimacies in the lives of these birds and cannot help feeling a horrible Peeping Tom. One little tern brings a small fish which it holds proudly and delivers to its sitting mate, to the accompaniment of much loving chit-chat on the part of both birds. A photo of such an incident might well be entitled "From the Bridegroom to the Bride". Sometimes, after presenting the fish, the donor proceeds to incubate the eggs, while his mate flies off; at others, on the approach of her mate, the sitting bird runs off the eggs to greet her husband, and having swallowed the fish, returns to incubate. Occasionally one bird relieves the other without first having presented it with a fish, and when this is the case I think it must be the female returning to the nest.'

'I have just witnessed a most amazing incident. A little tern arrived at one nest with a fish in his bill, and the bird's movements indicated that he intended presenting it to his wife who, by her movements also, obviously anticipated receiving the dainty morsel. Instead he withdrew, and then strutted round his sitting mate three times, finally "treading" her on the nest; which done, he pranced round and round his wife again, and once more "trod" her, whereupon he presented her with the fish and then flew away. The nest holds three eggs.'

'A disappointing day so far but I have just seen something that compensates for a great deal. A young river tern—no young birds here are more than two or three days old—ran across the open sand and was about to pass a sitting skimmer when the latter left its eggs and attacked the young bird. The baby tern bolted in alarm, hotly pursued by the skimmer who tried to pick up the tot in its feet. At the third attempt the skimmer was successful in doing this and carried the little thing off, vigorously chased by a pair of river terns. All three birds twisted and turned during the hurly-burly, and eventually the skimmer dropped the ternling in the river. I feared the worst had happened to the mite but presently saw it heading for the island, on reaching which it at once went into hiding.'

OCCURRENCE OF *SYNANTHERIAS SYLVATICA* SCHOTT IN THE BOMBAY PRESIDENCY, AND NOTES ON SOME OTHER *ARACEAE* OF INTEREST.

BY

CHARLES MCCANN, F.L.S.

(With 4 plates)

Synantherias sylvatica Schott. *Gen. Aroid.* (1858)*t.* 28.

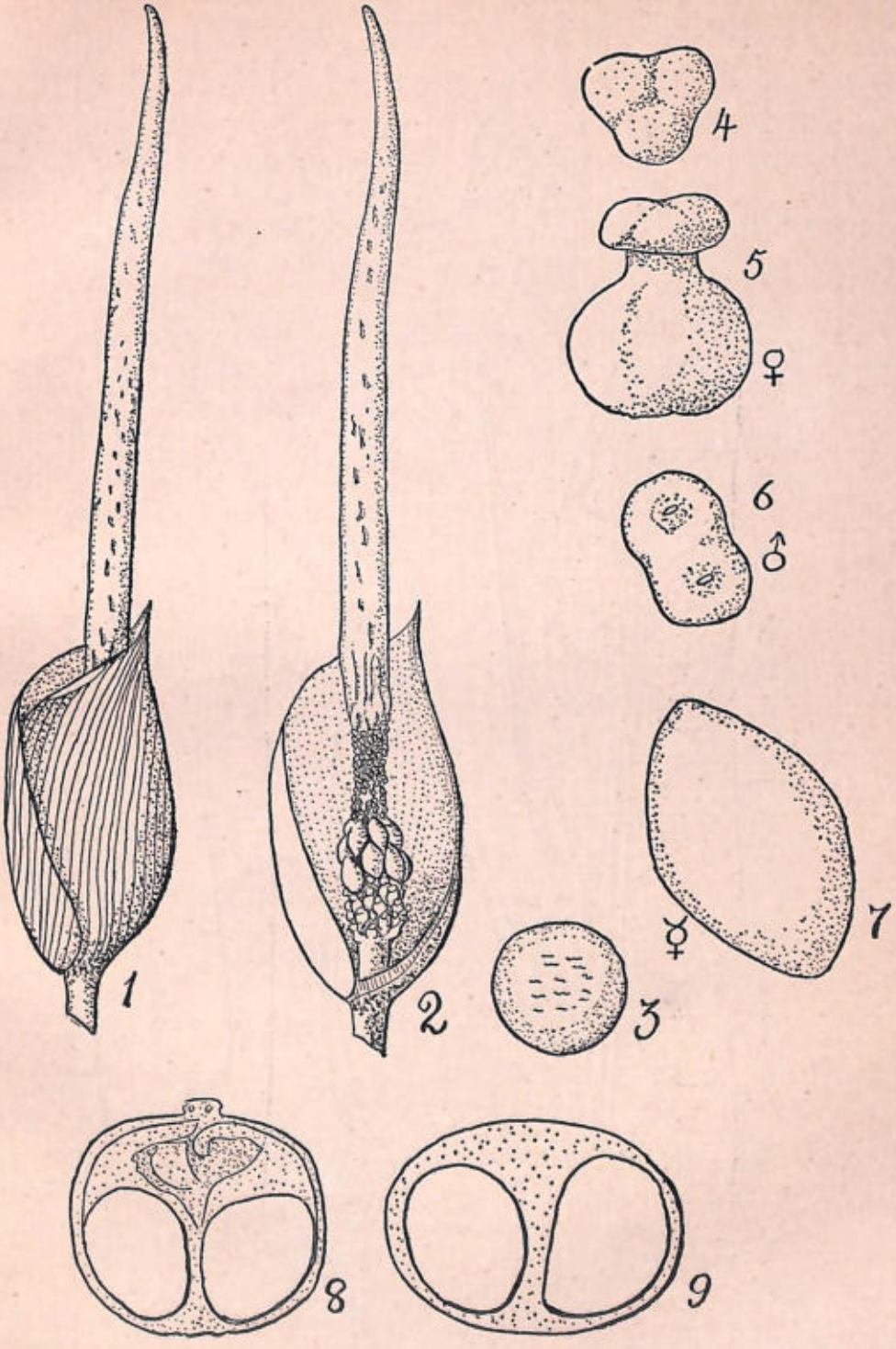
As far back as 1917, soon after I had commenced my botanical training, I had seen the leaves of an aroid which appeared different from the species I was familiar with. Perhaps I had seen the fruit also, but had mistaken it for that of one of the more common species of *Amorphophallus*—quite an easy mistake in this instance. The leaves were characteristic enough, but in the absence of the inflorescence, they could not be identified with any degree of certainty. I repeatedly tried to obtain the inflorescence, especially at the time when I made a special study of some of the local aroids, but without success. I visited the known habitat, Bhandup, Salsette Island, repeatedly in all weathers, but I seemed doomed to failure. The reason for the disappointment was obvious, I was not at the spot at the *right time*, a most important point when dealing with many of the aroids. Then again, weather conditions may retard or accelerate the flowering period.

Some years ago, I was in the same locality towards the end of the rains and I came across a number of the plants in leaf. The old longing to solve the problem of this baffling aroid returned, and so I brought some of the plants home and planted them in a pot in my garden. The corms leafed regularly every year at the break of the monsoon, but never flowered. The reason for this non-flowering was obvious to me, the corms I had brought were not yet large enough—this fact is common to many species of the order. At last, towards the end of May 1941, an inflorescence appeared in the pot, and on the 24th of the month was fully open. It was *Synantherias sylvatica* Schott, a plant excluded by Cooke[1] from the *Flora of the Bombay Presidency*. At long last, almost after a quarter of a century I was able to fix the identity of this illusive aroid! Elated with my 'discovery', I sat down at once and worked late into the night to complete the accompanying drawings. Next morning I made the colour notes and took the necessary measurements before setting off for work. No rain had fallen up till now.

On the 3rd June there were a few showers with all the signs of the approaching monsoon. On the 4th I visited Bhandup with the sole purpose of obtaining further material for examination and preservation, thinking that *Synantherias*, like *Amorphophallus*, flowered soon after the first showers. This was precisely my mistake all these years. Most of the inflorescences I now found were already in well advanced fruit, which clearly indicated that the former flowered some time before the rains.

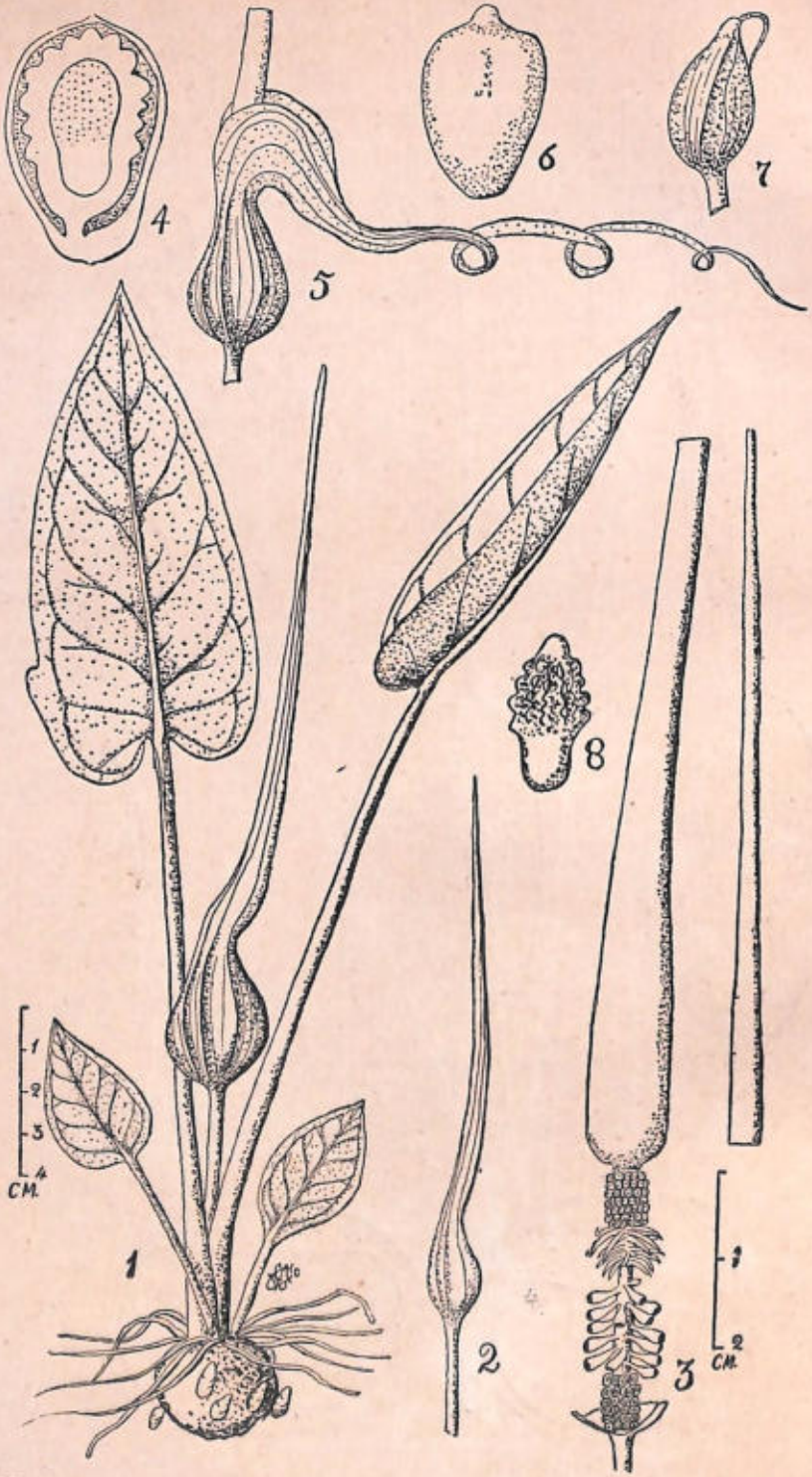
In the *Journal B.N.H.S.*, xxxv, p. 29, Blatter and I recorded the occurrence of this species in the Presidency from a sheet in the Herbarium of the Economic Botanist, Poona, from Bedoli, N. Kanara. The date on the sheet 'Sept. 1893' indicated that it flowered in September. Likewise there is a reference to the flowering period in Trimen's flora as 'September 1885.' Why there should be this difference between the Kanara and Ceylon specimens and the Salsette plants I fail to understand. *Amorphophallus* generally blooms only after the first showers of rain. Another point of difference between the two genera is that the corms of *Amorphophallus* either flower or leaf in the same season, but do not do both in the same season, whereas the corms of *Synantherias* flower and then bear leaves in the same season—a point worth consideration.

Authors appear to be undecided as to whether this plant should be considered as a species of *Amorphophallus* or be treated as a member of a separate



C. McCann del.

Synantherias sylvatica Schott. 1, Inflorescence; 2, Inflor. in section; 3, grain of pollen; 4, top view of stigma; 5, pistil; 6, anther; 7, neuter; 8, l. s. of fruit; 9, t. s. of fruit.



Typhonium flagelliforme (Lodd.) Blume. 1, entire plant; 2, bud; 3, spadix; 4, T. S. of bacca; 5, open flower; 6, seed; 7, tube of spathe in fruit; 8, seed.

genus, *Synantherias* Schott. Hooker[2] (1893) considers it as a species of *Synantherias*; Cook[4] (1908) follows Hooker; but Fischer[3] (1931) considers it as a species of *Amorphophallus*! In the absence of firsthand knowledge of the plant Blatter and I[7] followed Fischer when revising the *Araceae* of the Presidency, but in the light of my recent observations I feel that *Synantherias* should be retained as a separate genus.

Blume created the genus *Amorphophallus*, and according to the works I have at my disposal, distinctly says, 'neuters o'. 'In *Synantherias* neuters are present. Hooker[2] under the generic characters of *Synantherias* writes, 'Characters of *Amorphophallus*, but male and fem. infl. distant, with oblong depressed interposed neuters.' Fischer, 'Neuters o or few.' This appears a departure from Blume's definition. I do not know of any of our species of *Amorphophallus* in which neuters are present. Therefore, as neuters are present in *Synantherias* I consider it worthy of generic rank. Coupled with the presence of the neuters is the absence of a distinct limb to the spathe. Then again, there are the two field characters already referred to, namely (*a*) the earlier flowering period, and (*b*) the production of inflorescence and leaf by the same corm in the same season—both physiological character, perhaps of some importance. The size of the leaf or the inflorescence is relative to the size of the corm. Colour is also often a variable character. Though the general tones are similar there is much individualism, and it is also dependent on age, i.e. whether the inflorescence is fresh or old.

Measurements and colour notes taken from fresh specimens: Peduncle reaching 550 mm., dark green with lighter longitudinal markings, or pinkish with or without the markings, the markings when present are greenish brown. Inflorescence reaching 310 mm. Spathe 86×36 mm. dia. (when in bloom) similar in tones for the basal third as the peduncle then passing into deep purplish tones with or without markings. Internally, deep red-purple for the upper two-thirds, passing downward to almost black at the base. Spadix 305 mm. the flower-bearing portion reaching 59 mm., included within or exceeding the opening of the tube; appendage reaching 240 mm., smooth or slightly wrinkled, olive green or purplish-brown. Males purplish; female flowers at first creamy, the ovaries passing to green, the stigma yellow; neuters 14×14 mm. at first creamy, smooth, turning light earthy brown (like the skin of a potato) and finally becomes pinkish and somewhat rugose. The portion of the spadix bearing the female flowers alone enlarges in fruit. Fruit at first dark green then turning scarlet. Corm 80×50 mm. creamy or earthy brown.

Distribution.—'The Deccan Peninsula, from the northern Circars to the Concan, and southwards to Ceylon' (Hooker).[2] 'A native of the mountainous parts of the Circars' (Roxburgh)[1]. Cooke[4] mentions it under the 'Excluded Species' and gives the following reasons for its exclusion :—

'I cannot find any satisfactory evidence for the occurrence of this as a Bombay plant. [Engler D. C. Monog. Phan. v. 2 (1879) p. 320] gives Bombay as its habitat from the specimens in the Herbarium of Hooker and Thomson, which were however obtained from the Nilgiri Hills and Kurg, localities quite outside the Bombay Presidency. There is in Herb. Kew. a solitary specimen which was presented to the Glasgow Botanic Gardens by Mrs. Nimmo, but this is accompanied by no authentic note of locality and may have been collected anywhere. Woodrow gives Mārmāgāo in his list, but the Marmagao plant is *Amorphophallus commutatus*, Engl., which though quite distinct, has often been mistaken for this.

The plant occurs in S. India and is common in the drier parts of Ceylon.'

Localities: The only place where I know this species exists is at Bhandup, Salsette Island. It is very common in the area. Here it grows in the open among rocks or under mango trees. Elsewhere, I do not remember having seen the plant.*

Illustrations.—Wight's[8] table 802 though it certainly gives a good idea of the plant is a little defective in detail. The spathe, as far as I have been able to observe (I have examined several) does not fold over on the left side, but on the right. The spathe seldom opens to the middle (old fls.) it usually

* Since writing the above, I discovered this plant in leaf in the forest along the road to Vajrabai, near the Tansar river, on the 13th July 1941.

fits closely round the spadix. The neuters are not the correct shape. The details of the female flowers are not quite correct.

Note.—Both in the wild state and in my garden example I found species of small cockroaches (*Blattidae*) within the tube, but it was not clear whether these insects were just tenants, or whether they were concerned with pollination. The pollen is spherical, smooth and yellow.

Amorphophaltus commutatus Engler.

On the 25th June 1934 I came across an outsize of this species on the banks of the Powai lake, Salsette Island. Some of the measurements are as follows :— Tuber 210 mm. across, and weighing 3 lbs. 10 oz. Cataphyl, the longest 365 mm. Spathe 420 mm. by 130 mm., rough within to the height of the male and female flowers. Appendage of spadix 420 mm., purple, tip subacute.

Typhonium flagelliforme (Lodd.) Blume.

I have had ample opportunity of observing this plant both in the wild state and in pots in my garden. To my detriment I introduced this plant into my garden. It is most prolific, the parent corm gives off innumerable small bulbils which give rise to new generations—it is a pest. The reason for this prolific propagation by budding was soon apparent. The plant flowers profusely, but does not set seed in proportion. It is the frequent infertility of the flowers which is counterbalanced by a generous tuber formation.

With regard to the colouration of the spathe there is a difference of opinion :—

Hooker[2], 'lurid red, papilose within.'

Cooke[1], does not mention this point.

Trimen[6], 'spathe 4-5 in., peduncled, green.'

Fischer[3], 'greenish, white or lurid without, red within.'

Strangely, very little is mentioned in any of the works of the colour of the other parts of the inflorescence. My own observations after several years are as follows :— Spathe at first pale green with a very narrow, faint purplish margin. The tube becomes intensely green with age, then yellows before it dies off. The limb is at first a translucent pale green turning whitish as it dies. The limb first falls away from the appendage, flat, then soon after becomes spirally twisted and falls back. The tube thickens, becomes strongly winged (ribbed)—a character omitted by most authors. Trimen being the only one who mentions this point. The neck closes tightly. The appendage is a pale sulphurous or orchreous yellow. Male flowers yellow; upper neuters white, lower neuters white with deep purple tips; females pale yellow turning greenish. In no instance have I found the spathe to be lurid or red in this species. Attention was drawn to this point in vol. xxxv, 22, of the *Journal*.

Trimen[6] has got the disposition of the neuters in his description all wrong— there are no neuters above the male flowers—all the neuters are between the male and female flowers. The subulate neuters are below the males and below these are the clavate neuters followed by the females as in the accompanying illustration.

Measurements.—Peduncle 95 mm. Spathe, tube 35 mm., limb 170 mm. Spadix, appendage 152 mm. ♂♂ 5 mm; upper neuters 8 mm. lower neuters 10 mm. ♀♀ 5 mm.

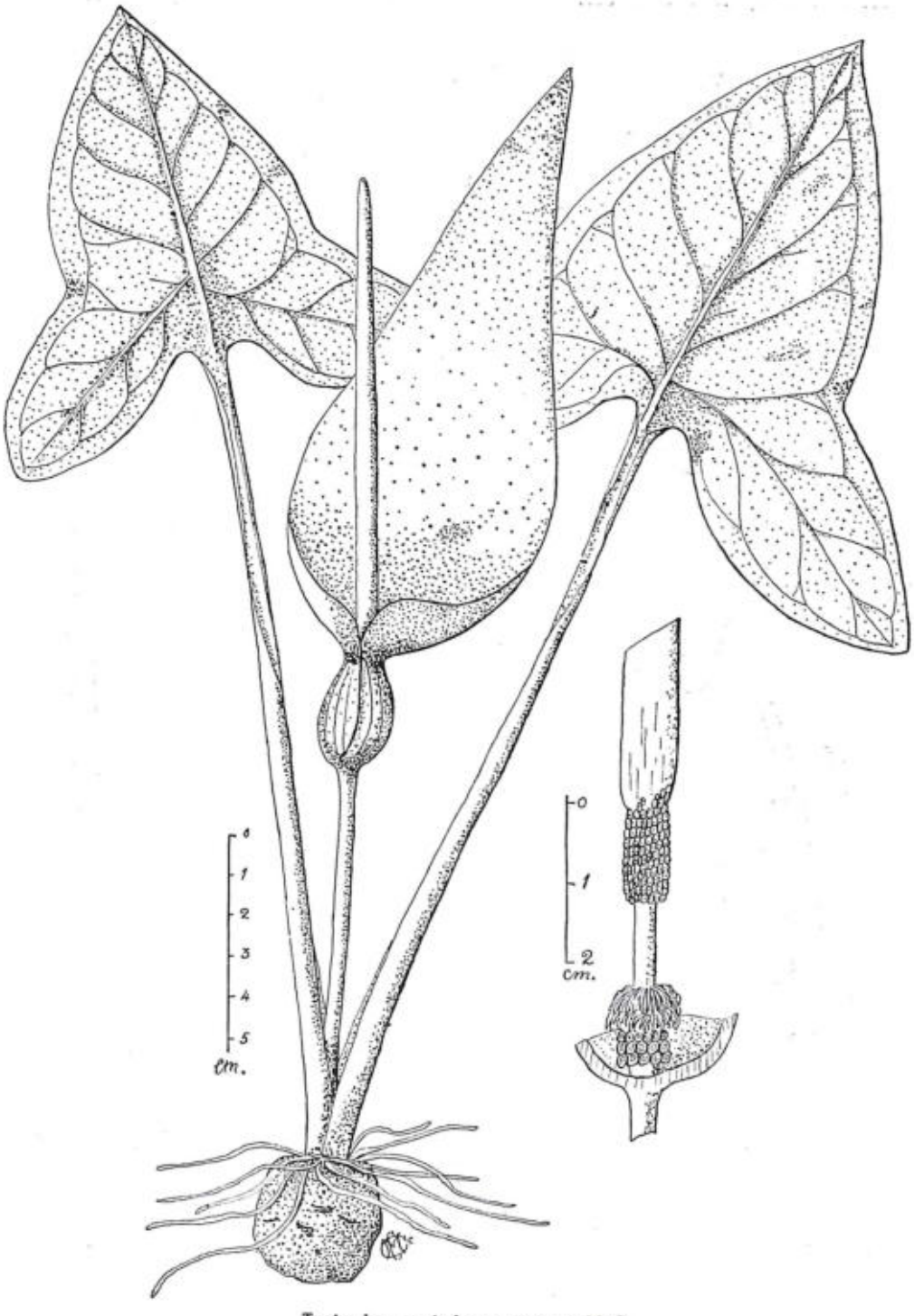
Illustrations.—Wight's table 791 is a figure of a robust plant with the inflorescences still in bud. The corm is too bulb-like.

Localities.—*T. flagelliforme* is an extremely common plant in some of the roadside gutters at Andheri often forming dense tufts. The plants continue to produce leaves as long as there is moisture. It flowers profusely in August and September, but may continue to do so later into the year.

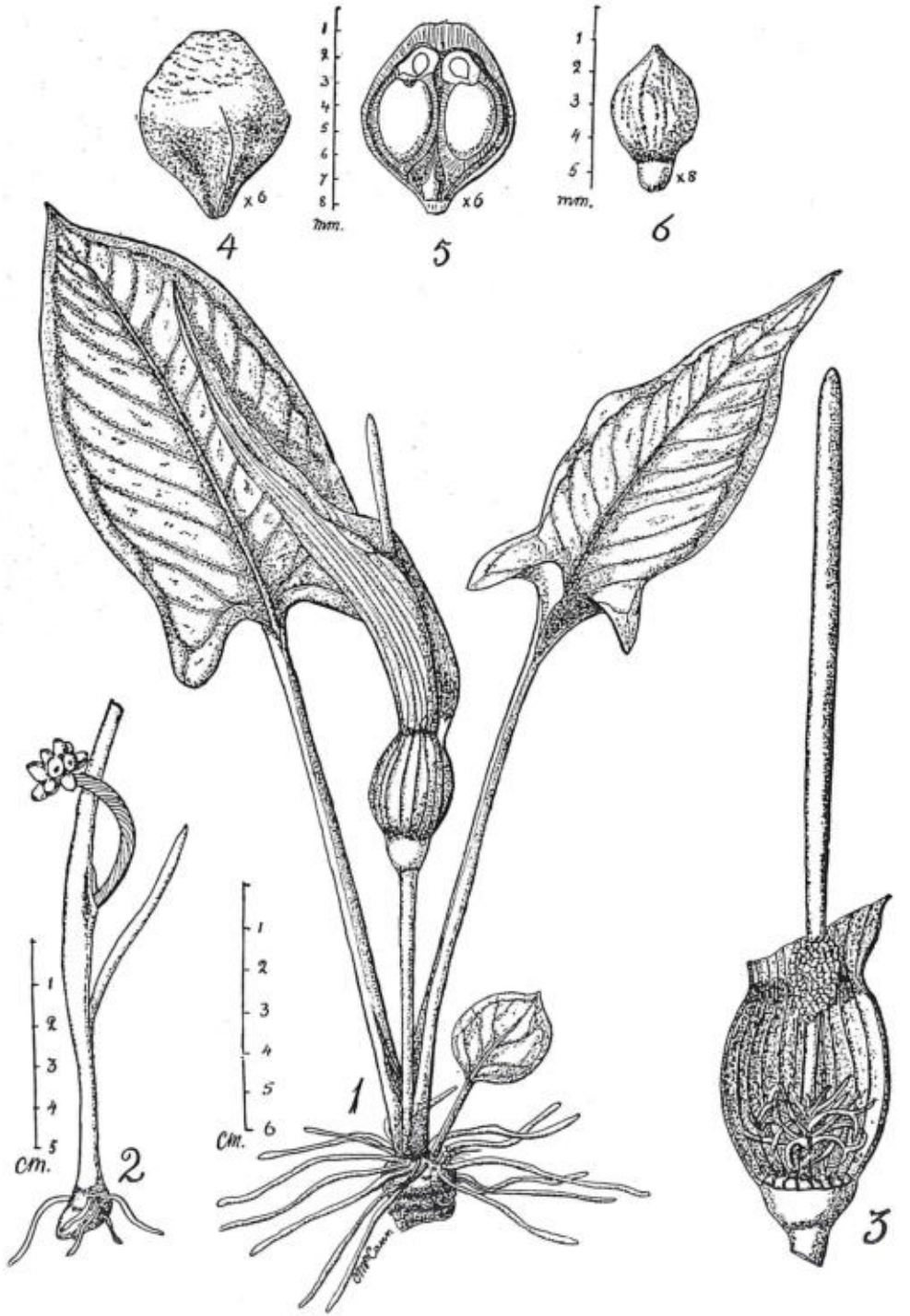
Typhonium amboinense Blatt. & McCann.

On the 21st June 1940 Mr. J. Jacobs, Secretary of the Prince of Wales Museum gave me a specimen of this species in flower which he had found in the Museum grounds. I saw a second specimen which was in bloom collected by Fr. Santapau in the grounds of St. Xavier's College, Bombay, during the month of May 1941.

The colour of the museum specimen was recorded as follows :—Spathe deep red-purple within, darker outside. Spadix appendage deep purple, male flowers



Typhonium amboinense Blatt & McC.



Theriophonum indicum Dalz. 1, entire plant; 2, fruit; 3, inflorescence in section X2; 4, bacca; 5, bacca in section; 6, seed.

pinkish; neuters yellow; females purplish. The spathe opens flat, but becomes twisted towards the tip as it gets older—a point common to the spathe of several aroids.

Wight's table 803 is the figure of a robust specimen.. The corm is much too bulb-like. Comparing table 803 with table 790 there seems little to choose between, but a closer examination shows a difference; t. 803, *T. amboinense* has the neuters *recurved* whereas t. 790, *T. divaricatum*, portrays the neuters *erect*.

Theriophonum indicum Dalz.

This plant is common on the eastern faces of some of the Salsette Hills in the neighbourhood of Mulland. I have come across it at Borivli, but it is less frequent on the western side of the island. The leaves appear soon after the break of the rains followed by the inflorescence. Generally there is only a single inflorescence to each plant. The tube of the spathe is at first pale green, it then turns almost white. The limb is red-purple. Appendage of spadix purple. The leaves are very variable in size and may reach 300 mm. long, by almost half as broad.

In fruit the peduncle elongates and becomes twisted. The interval between the appearance of the flowers and the formation of the fruit is almost a month (22-7-'35 to 18-8-'35).

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A NEW FOSSORIAL SNAKE (*RHINOPHIS DORSIMACULATUS*) FROM CEYLON.

BY

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Director, Colombo Museum.

(*With one plate and one text-figure*).

The new snake here described belongs to the genus *Rhinophis* Hemprich, a genus restricted to southern India and Ceylon and representing one of the most advanced phases of fossorial adaptation in the suborder Serpentoidea.

In this genus not only are the head shields and tail strongly modified for such a habitat but the pigmentation is remarkable in that a number of species, particularly those from the more arid districts, display the reverse condition to that usual in ordinary snakes by being light dorsally, and dark ventrally. The variety of bright colors displayed by this family, the Uropeltidae, and the related Ilysiidae, affords a striking contrast to the sombre pigmentation of either the equally fossorial Typhlopidae, or some of Ceylon's fossorial lizards of the family Scincidae. Members of the family Uropeltidae are remarkably stenotopic, and the variety and abundance of the species of Rhinophis in Ceylon as compared with India, suggests that this Island is the original home of the genus from whence it apparently entered the sub-continent during one of the more recent Pleistocene connexions between the two countries. Six of the seven species recorded from Ceylon possess large caudal shields which are longer than half the shielded area of the head. These are further sub-divided into species in which the rostral shield is at least half the length of the shielded area of the head, and into those in which it is shorter. Another method of sub-division is by estimating the relative lengths of the rostral and parietals in fractions of the length of the frontal shield. When the species is not uniformally colored the easiest method of identification is by attention to pigmentation which is more or less constant for each species, but this is not possible in decolorized spirit specimens.

The large rostral and caudal shields and distinctive color pattern of black vertebral blotches along an orange dorsal band assist in the ready identification of the new *Rhinophis* for which the specific name *dorsimaculatus* is here proposed.

In Ceylon there are two recorded species with large caudal and rostral shields, the rostral being twice as long as the frontal or longer. In one of them, *R. punctatus* Müller, the frontal is as long as the parietal; in the other, *R. porrectus* Wall. it is only about two thirds (Wall *Snakes of Ceylon* 1921, fig. 13). The following comparison of these two species, as described by Wall, with the new form shows the relationships between the three. Features of interest in

the new species are its reduced number of scales and body length, the larger rostral, and the breaking up of the black vertebral band into blotches which might be regarded as signs of progressive specialization.

	R. porrectus	*R. tunctatus*	*R. dorsimaculatus* sp. nov.
Frontal length in rostral length.	twice	twice	more than twice
Frontal length in parietal length.	two-thirds	equal	twice
Caudal shield length in shielded part of head length ...	three-quarters	equal	three-quarters
Number of ventrals ...	281	246–236	238
Anterior and posterior costal counts	19, 17	19, 17	17, 16-17
Body diameter contained in total length	76	49–47	43
Dorsal yellow band marked with dark vertebral ...	band	band	blotches

Rhinophis dorsimaculatus sp. nov., pl. 1.

This snake is readily distinguished from other species of *Rhinophis* by the characters tabulated above. It is known from two specimens, in one of these

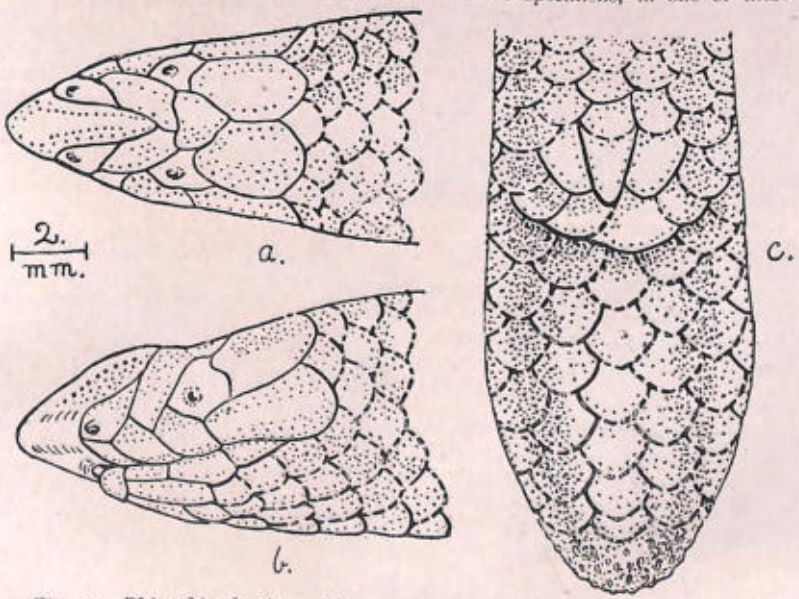

Fig. 1. *Rhinophis dorsimaculatus* sp. nov. × 5½ natural size.
(*a*) dorsal view of head.
(*b*) ventrilateral view of head.
(*c*) ventral view of tail.

P. Deraniyagala del.

A NEW FOSSORIAL SNAKE (*RHINOPHIS DORSIMACULATUS*) FROM CEYLON.

BY

P. E. P. DERANIYAGALA, M.A. (Cantab.), A.M. (Harvard), F.C.P.S., F.L.S., F.Z.S.,

Director, Colombo Museum.

(*With one plate and one text-figure*).

The new snake here described belongs to the genus *Rhinophis* Hemprich, a genus restricted to southern India and Ceylon and representing one of the most advanced phases of fossorial adaptation in the suborder Serpentoidea.

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	R. porrectus	*R. punctatus*	*R. dorsimaculatus* sp. nov.
Frontal length in rostral length.	twice	twice	more than twice
Frontal length in parietal length.	two-thirds	equal	twice
Caudal shield length in shielded part of head length ...	three-quarters	equal	three-quarters
Number of ventrals ...	281	246–236	238
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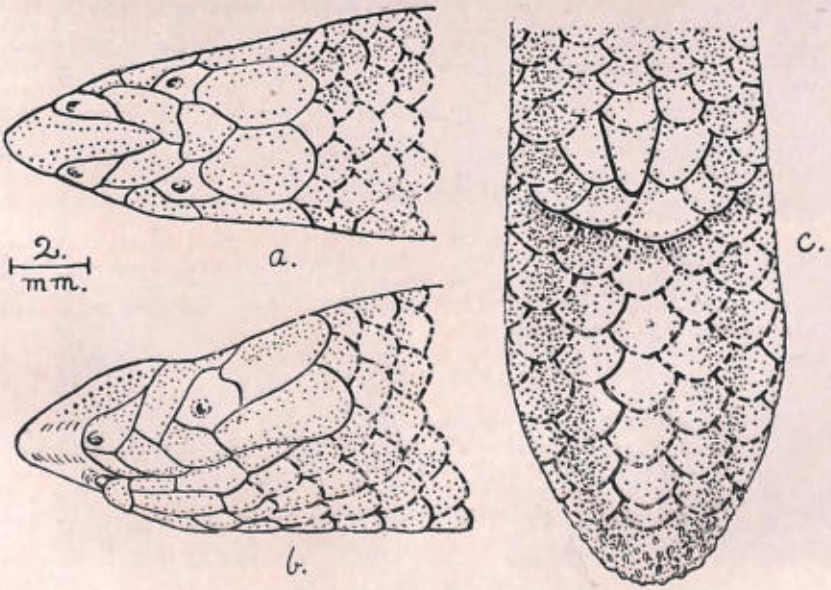


Fig. 1. *Rhinophis dorsimaculatus* sp. nov. × 5¼ natural size.
(*a*) dorsal view of head.
(*b*) ventrilateral view of head.
(*c*) ventral view of tail.

P. Deraniyagala del.

the head is missing. The snake possesses a strongly arched, overshot snout and the body is not noticeably enlarged anteriorly.

Colour. One of the most conspicuously coloured snakes of Ceylon (Pl. 1). In the freshly preserved specimen the head shields are brown, suffused with bright orange. Dorsally there is a broad orange vertebral band occupying about five or six longitudinal rows, and in it the three more or less median rows possess black centres and form a zig-zag band for about [illegible] head lengths, after which it breaks up into a series of about forty black blotches, each larger than the head. The remaining body scales are black with yellow margins which form fine, zig-zag, yellow, longitudinal lines both laterally and ventrally. The sixth or seventh longitudinal scale row from the ventrals lacks black pigment as in a few other species of *Rhinophis*. The caudal shield is brown suffused with orange and possesses a dark 'U' shaped mark opening dorsally.

Pholidosis. Shielded portion of head slightly longer than caudal shield, rostral shield strongly carinate, arched, equals half the head length and completely separates the nasals; prefrontals contiguous and about twice as long as broad; frontal subtriangular as broad as long, is less than half the length of rostral and equals half the length of the parietal. Ocular about thrice length of pupil and somewhat narrowly in contact with frontal which it slightly exceeds in size. Supralabials four, the last being the largest head shield. Mental with a broadly rounded posterior margin, infralabials three, the second the largest; the suture between the first and second infralabials is under the suture between the second and the third supralabials, that between the second and third is under the suture between the third and fourth supralabials. The first row of post-mental scales is elongate and does not extend behind the anterior halves of the second infralabials (fig. 1*b*). Body scales as wide as long, subequal, 17 costals at two head lengths behind head, 17 or 16 at mid-body, ventrals 238 extremely feebly enlarged, preanals enlarged two or three in one or two rows, subcaudals entire 6, (fig. 1*c*), scales round caudal shield 12, caudal shield convex, rugose with numerous small tubercles and is about three-fourths the length of the shielded part of the head.

Dimensions. The type specimen No. 86 Colombo Museum, measures as follows:—length of shielded area of head 7.6 mm., diameter of body 8 mm., total length 350 mm., tail length 8.5 mm., width of frontal 1.7 mm., length of frontal 1.7 mm., length of rostral 3.8 mm., length of parietal 2.8 mm., interorbit 2.6 mm., length of gape 6 mm., caudal shield 6 mm. long 5.2 mm. wide.

Distribution. Known from two specimens, one obtained in February 1938 the other in March 1941 from the coastal village of Marichchukate, North Western Province, Ceylon. This area is unusually arid, and is of special interest in possessing such Indian dry zone reptiles as the scaly gecko *Lophopholis scabriceps* (Annandale), the sand boa *Gongylophis conicus* Russell, and the saw-scaled viper *Echis carinata* Russell.

In conclusion I wish to express my thanks to Dr. Baini Prashad, Director of the Zoological Survey of India, Indian Museum, Dr. A. Aiyappan, Acting Superintendent, Madras Government Museum, and to Mr. S. H. Prater of the Bombay Natural History Society for comparing photographs of this snake with the specimens in their collections.

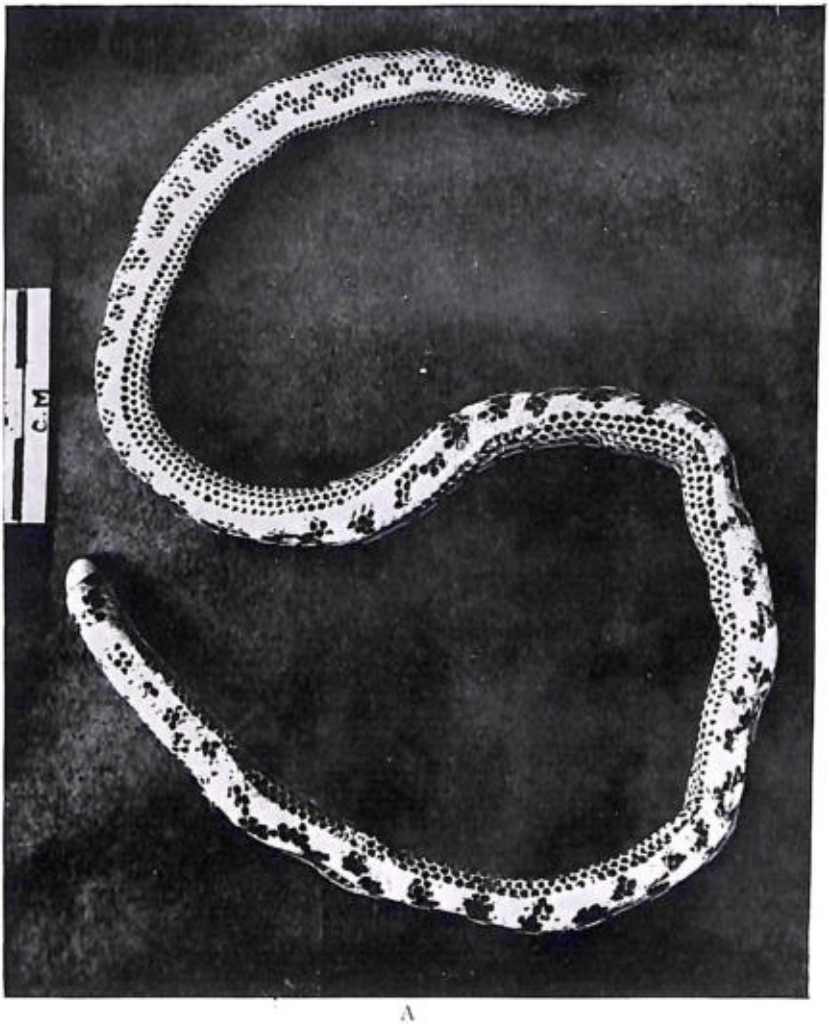
EXPLANATION OF PLATE I.

Photographs of *Rhinophis dorsimaculatus* sp. nov.

(A) Showing size of caudal shield, black dorsal blotches and lack of anterior enlargement of the body × ⅔ natural size.

(B) Ventrilateral view of head × 7 $\frac{2}{10}$ natural size.

(C) Enlarged head of photograph (*a*) showing dorsal scalation × 7 natural size.



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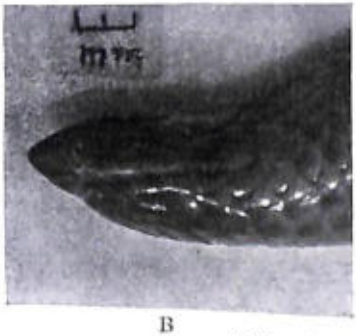

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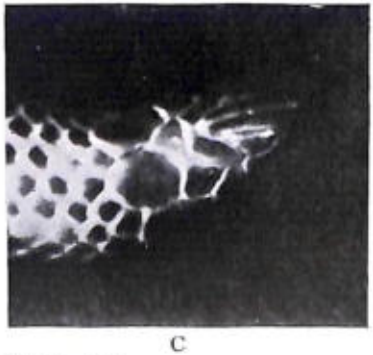

C

Rhinophis dorsimaculatus sp. nov.

For explanation see end of article.

THE GAME FISHES OF INDIA[1].

BY

SUNDER LAL HORA, D.SC., F.R.S.E., F.Z.S., F.R.A.S.B., F.N.I.,

Assistant Superintendent, Zoological Survey of India, Calcutta.

(*With 3 plates and 2 text-figures*).

(*Continued from page 532 of Vol.* xlii, No. 3).

XIV. THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

7. THE BLACK MAHSEER WITH NOTES ON OTHER COLOUR VARIETIES.

Mr. R. E. Parsons, F.R.E.S., Indian Police, Dibrugarh, Lakhimpur District, Assam, directed the attention of the Bombay Natural History Society to the lack of information about Black Mahseer in my series of articles on the Game Fishes of India and made the following interesting observations in his letter of May 5, 1941:—

'I have read with great interest Dr. Sunder Lal Hora's series, *The Game Fishes of India*, with particular reference to Mahseer. I have not, unfortunately, got the numbers of the *Journal* in which they were published before me at the moment, but one point has struck me, which I think is correct and that is that Dr. Hora makes no mention of a *black* Mahseer. I do not know whether these black fish are a distinct species of Mahseer or whether they are instances of melanism. They inhabit the same water, take the same bait and fight in exactly the same way as the ordinary Mahseer that one usually obtains in Assam rivers. They are also of the same shape, but the colour is definitely black with a little white about the belly scales. I have personally caught only two of these black Mahseer. The first I obtained on the 19th November 1934 on the Sisseri river in the Sadiya Frontier Tract, Assam. It weighed 16 lbs. and was a game fish, giving an excellent fight on a light 7 ft. 'Victor' rod. The other I caught at Ukiam on the Um Khri river in Kamrup District, also in Assam, on the 29th December 1937. This latter fish weighed 11¾ lbs. and had a little more white about the belly. These black fish are evidently very rare, although they are occasionally caught. Mr. F. Needham of Munkongselek, in the Sadiya Frontier Tract, has obtained several, the biggest being just over 20 lbs. I enclose photographs of the specimen I obtained on the Sisseri where it is photographed with the remainder of my catch for that day; the contrast in colour is very striking. It is noticeable that even the fins are black, as well as the tail. I do not think that it can possibly be that the black colour of these fish is due to the nature of the bed of the river they inhabit, for there are the ordinary type of Mahseer in the Um Khri and the four fish on the right of the enclosed photograph, including the black specimen, all came from the same pool in the Sisseri. The other three fish show the usual colouration. This pool was not very deep and had a sandy bottom at the lower end with small boulders at the top end. The river is in a wide valley at this point and was by no means in a dark gorge.

'There was no doubt that the two specimens I got were Mahseer and not some other species. The general shape and appearance were quite unmistakable. It was only the colour which was so completely different. It is, I suppose, quite possible that melanism is met with in fish as in other orders.'

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[1] Published with permission of the Director, Zoological Survey of India.

In a subsequent letter, dated 31st May 1941, Mr. Parsons referred to two more records of Black Mahseer from Assam and stated:

'On looking more closely through my records, I find that I have caught two other black Mahseer besides those mentioned in my previous letter. The two fish I did not mention previously were caught (1) on the Syon River, a tributary of the Brahmaputra on its right bank about 40 miles north of Pasighat in the Sadiya Frontier Tract. This fish weighed 18 lbs. and the name of the place I caught it was Pangin. (2) The other fish was caught at Rongdoi near the confluence of the Brahmaputra and the Lohit on 29th January 1937 and it weighed 10 lbs. Rongdoi is also in the Frontier Tract.'

Mr. Parsons' surmise about the identity of his Black Mahseer is correct and morphologically the black specimen photographed by him (Plate ii, fig. 2) is indistinguishable from the common Mahseer of Assam, *Barbus (Tor) putitora* (Hamilton). It may be pointed out that though melanism is not so common a phenomenon in fishes as albinism, several interesting cases of melanism in divers types of fishes are on record. Attention is directed below to some of these cases.[1]

In 1871, Günther (6) recorded a black specimen of *Platyglossus notopsis* Blkr., and observed:

'We have received from the Godeffroy Museum a specimen from Savay of a uniform black colour; however, the two ocelli on the dorsal fin are present, and it has also thirteen soft dorsal rays, so that it must be regarded as merely a variety.'

In 1875, Fatio (4) discussed melanism in *Phoxinus laevis* and concluded that though the nature of food is generally responsible for melanism, in the case of *P. laevis* presence of Helminth parasites encysted in the skin of the fish were probably the cause of the change in colouration. Knauthe (13) was of the opinion that melanism in fishes resulted not from the nature of the food taken by them, but through lack of food, *i.e.*, starvation. He had observed melanism in *Cyprinus carpio* var. *nudus* v. *alepidotus*, *Carassius carassius*, *Gobio fluviatilis*, *Leucaspius delineatus*, *Leuciscus phoxinus*, *Nemachilus barbatulus* and *Esox lucius*. In an important contribution on melanism in animals in general, Klunzinger (11, pp. 280, 281) dealt with some of the earlier records among fishes and considered the secretion of black pigment under the following headings: (*a*) inner constitutional peculiarities and (*b*) external factors, such as (i) influence of light, (ii) influence of temperature, (iii) influence of humidity (iv) influence of food and (v) influence of climate. Four years later, he (12) observed a large proportion of frogs and trout of certain ponds with a uniform black colour and ascribed this colour peculiarity to the acids produced by the humus soil. At the same time, he referred to the changes of colouration in the males of certain fishes during the breeding season. Annandale (1) described certain melanic specimens of *Barbus ticto*, but Hora, Misra and Malik (8, p. 267) found them to be males of *B. conchonius* and stated (p. 270) that during

[1] Numerals in thick type within brackets refer to the serial number of the various publications listed in the bibliography at the end of the paper.

the breeding season males of several species of Carp-Minnows develop melanic colouration.

In 1935, Goff (5) recorded a case of melanism in *Lepisosteus osseus* and observed :

'During April 1933, while gigging gars in Lake Harris, Lake County, Florida, a melanistic specimen was picked up. It was the common long-nosed gar, *Lepisosteus osseus*. At first it was thought that it might be covered with some foreign substance but a vigorous washing and closer examination showed the coloring to be in the specimen itself. Since the writer had never seen a gar that approached this one in color a picture was taken of the specimen beside a normally colored individual. This picture brings out fairly well the degree of darkness in comparison with the normal.'

The observations recorded by Goff are similar to those made by Mr. Parsons regarding the Black Mahseer (*vide supra*, p. 803).

An interesting case of localized cutaneous melanosis occurring in lungfishes (*Lepidosiren*) of the New York Aquarium is recorded by Smith and Coates (19). They are of the opinion that 'Abnormal black pigmentation of the skin of fishes seems to depend on both genetic and post-embryonal factors.' Further, it is stated that 'Pathologic pigmentation of the skin caused by an increase in the number of melanophores occurs, for example, when certain parasitic larvae gain access to the skin and become encysted.' Attention is also directed to the fact that 'Experimental studies covering a wide biological field attribute pigmentation to disturbances involving the endocrine system or enzyme activity.'

So far as I am aware, the melanic pigmentation of Black Mahseer has not been properly investigated, but from the nature of the records available it seems that it may either be due to some genetic or pathological causes. As pointed out by Mr. Parsons, there is no difference in the ecological conditions of the Black and Ordinary Mahseer which could account for melanism among these giants of fresh waters.

The first reference to Black Mahseer I have been able to find is by Macdonald (14, p. 305) who regarded it as a distinct variety and characterized it as follows:—

'3. *The Black Mahseer.*—He is quite a different fish and of a stocky build. Head small and black, mouth small. Barbels and eyes black.

'This fish is marked by a jet black line two half scales above the lateral line, scales above having a tinge of gold on the scale tips running to jet black on the back. Below lateral line scales are lighter but dirty white, almost shot black to the scales on belly, which are dirty white with a black fringe. Fins black with grey at base. Best fish taken 19 pounds.'

The above description is not sufficient to distinguish the variety, but fortunately a good photograph of the black variety along with 4 ordinary Mahseer is published by Macdonald (plate i, fig. 2). A study of the figure shows that though the depth of the body is proportionately greater than that in the ordinary type, the length of the head is considerably greater than the depth of the body. On this character alone, it is possible to regard it as conspecific with the ordinary type—*Barbus* (*Tor*) *putitora* (Hamilton). The greater depth of the body may be due to its being a mature female.

In 1933, Macdonald (15) described once again the varieties of Mahseer in Burma and regarding the Black Mahseer stated (p. 107)

that it is common in all the rivers of Burma, where the banks are thickly wooded. Earlier, on p. 106, it is mentioned about the Black Mahseer that it 'is common both in India and Burma, where the banks of streams are overgrown with thick forest.' According to Macdonald, therefore, there is a correlation between melanism in Mahseer and the type of locality frequented by such specimens. There is no doubt that environment plays considerable part in determining the colouration of a fish, but how far melanism in Mahseer is due to the shade-factor in its habitat I am unable to say. (For further discussion on this point see below pp. 811-814).

Shebbeare (**18**) described a Dark Variety of Mahseer from the Eastern Himalayas and stated:

'The dark fish, or this specimen at any rate, was in shape far more like a Katli than a Mahseer. The fins were partly the yellow of the Mahseer and partly the slate colour of the Katli—the general colour of the fish was intermediate but the eye was golden, as in the Mahseer; only one spot on one iris was copper as in the Katli, but this may have been blood-shot. There were no tubercles on the upper lip.'

The Dark Mahseer of Shebbeare was a thick-lipped specimen with the length of head, as shown in the sketch, considerably shorter than the depth of the body. There seems hardly any doubt that Shebbeare was dealing with a partially melanic specimen of *Barbus (Tor) tor* (Hamilton).

From South India also there is a record of a Black Mahseer. Van Ingen (**10**), in his observations on Mahseer Fishing in Mysore, gives a figure of a Black Mahseer which is not unlike the ordinary Mahseer of the Mysore waters—*Barbus (Tor) khudree* Sykes (Hora, S. L. and Misra, K. S.—*Journ. Bombay Nat. Hist. Soc.*, vol. xl, pp. 24-28, 1938).

From the records of Black Mahseer referred to above, it is clear that it cannot be regarded as a distinct variety, since melanic specimens belonging to different species have been described or figured as Black Mahseer.

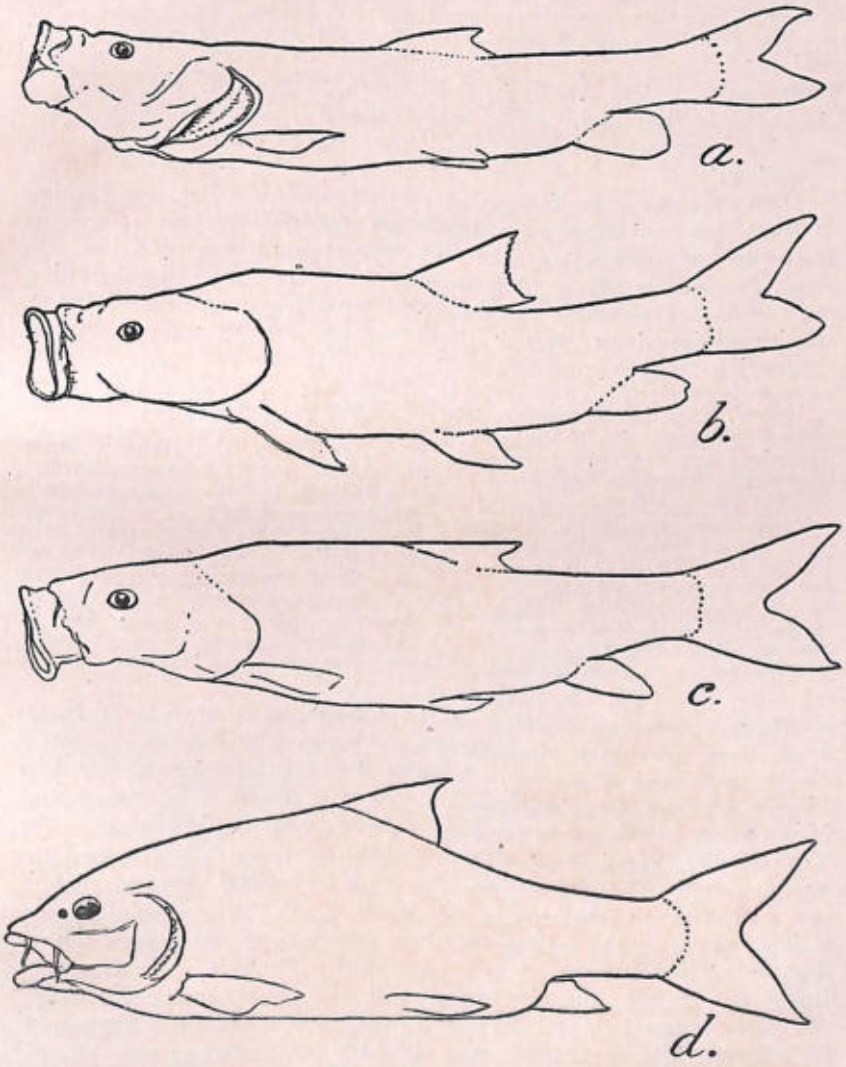
Though relying on the authoritative work of Day (**3**), different kinds of Mahseer have been treated as one species, *Barbus tor* (Hamilton), the anglers have long been familiar that there are more than one kind of Mahseer in Indian waters. But unfortunately in recognising varieties, anglers have been influenced by the colour of their specimens or by the nature of the lips. It has been pointed out in my articles on Mahseer (**9**) that these characters are not constant and, therefore, very little reliance can be placed on them for distinguishing species. In this connection, it may be recalled that Hamilton (**7**), who was the first person to make Mahseer known to science, recognised three species from the Himalayas, *Cyprinus putitora*, *C. tor* and *C. mosal*. Hamilton was familiar with the affinities of the three species and under *C. putitora* he observed:

'This and the two following species have, in many points, a strong resemblance, being very large fishes, affording an excellent wholesome nourishment, free from bones, although not quite so delicate as the *Rohita*. They are all

Fig. 1.—A Black Mahseer from Mysore.
(Reproduced from *Journ. Darjeeling Nat. Hist. Soc.*, vol. xii, facing page 30, 1937).

Fig. 2.—A Black Mahseer (15 lbs.) from Burma in the centre with four ordinary Mahseer (38, 21, 9 and 6 lbs. respectively). (Reproduced from *Journ. Bombay Nat. Hist. Soc.*, vol. xxxiii, facing page 304, 1929. This illustration has also been published in the *Journ. Darjeeling Nat. Hist. Soc.*, vol. vii, 1933).

also strong, well formed, handsome fishes, peculiarly distinguished by the enormous size of their scales, which, in large individuals, almost equals the hand, insomuch, that cards for gaming are sometimes made of them at Dakha. *Mahasaula* and *Tora*, variously altered or corrupted, or with various additions, may be considered as generic appellations among the natives for these fishes, all of which frequent large rivers.'



Text-fig. 1.—Outline sketches of Black Mahseer from different parts of India.

a. A specimen from Assam (From a photograph sent by Mr. R. E. Parsons, *vide* Plate ii, fig. 2); *b*. A specimen from Mysore (After van Ingen, *vide* Plate i, fig. 1); *c*. A specimen from Burma (After Macdonald, *vide* Plate i, fig. 2); *d*. A specimen from the Eastern Himalayas (After Shebbeare, *Journ. Darjeeling Nat. Hist. Soc.*, vi, p. 73, 1931).

Though in the 3rd edition of his *Rod in India*, Thomas (**20**, p. 27) bowed before the authority of Day and recognised *Barbus tor* as equivalent to Mahseer, he made it clear that:

'Further experience has confirmed me in the view advanced in 1873, that there are more Mahseers than have been named, and that if it were possible that as much accurate attention could be given to the Mahseer as has been devoted to the Salmonidae of Great Britain, of Europe, and of America, it would be found that the Mahseers of India would likewise grow in numbers.'

Thomas, chiefly dealing with South Indian Mahseer, was of the opinion 'that there are at least three distinct forms with difference of external structure, and many more with differences in colouring.'

This has been the feeling of all subsequent writers on angling in India, but no one dared to challenge the views of Day as regards the scientific nomenclature of this important group of fishes. In 1919, Annandale (**2**, p. 134) broke away from the orthodox view and while commenting on the systematic position of the Indian species assigned to *Barbus* Cuvier made the following remarks concerning Mahseer:

'Indeed, there is no group in which confusion is greater than that of the Mahseer so familiar to Indian sportsmen.

'I have not the material to attempt a revision of the Mahseer group, specimens of which are difficult to preserve in large series on account of their size, but two species have recently come to my notice which it seems justifiable to rescue from the oblivion of synonymy as they possess differential characters of a marked nature and likely to be constant. These species are *Barbus putitora* (Ham. Buch.) and *Barbus mussullah*, Sykes. That Hamilton's *mossul* and Jerdon's *hamiltonii* differ in some respects from the *forma typica* of *Barbus tor* the collection in the Indian Museum provides abundant evidence, while specimens from the upper Kistna seem to differ from any of these; but the question whether the differences should be considered specific or merely racial must be left to be answered with more extensive experience.'

In the preceding articles on the Large-scaled Barbels of India, I (**9**) have attempted to differentiate between the forms found in North India and shown that, besides the three species described by Hamilton, there is probably another species, *Barbus* (*Tor*) *progeneius* McClelland, in the rivers of Assam (*Jungha* of the Assamese). The Katli of the Nepalese or Bokar of the Assamese, *B.* (*Lissochilus*) *hexagonolepis* McClelland has also been described, but this fish is not a Mahseer in the true sense of the word, for its labial groove is interrupted in the middle and the lips never form flaps. I have thus recognised 5 species of Large-scaled Barbels from Northern India and Burma, but the specific identity of *progeneius* is rather doubtful. From these regions, Macdonald (**14, 15**), Shaw and Shebbeare (**16**) and Shebbeare (**17, 18**) have recognised several varieties of Mahseer and it may be worthwhile to comment here on their scientific position.

From his experience of fishing in the Myitkyina District, Northern Burma, Macdonald (**14**, p. 304) recognised six different varieties of Mahseer, though he noted that "They all fit the description of Dr. Day's *Barbus tor* in the main points i.e. Barbels, "Fin" rays, and lateral line, etc.' His first variety is the Golden or Himalayan

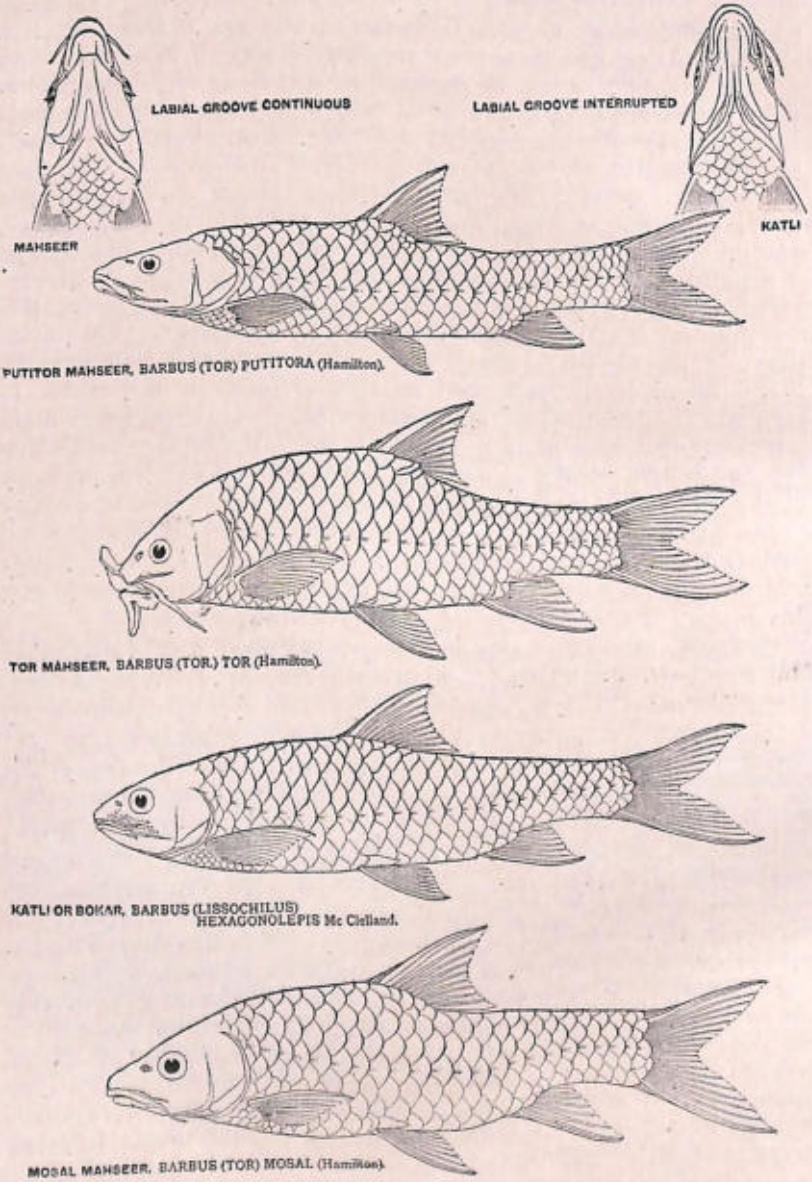
Mahseer with a decided black line down the side. His photographs show that this is *Barbus* (*Tor*) *putitora* (Hamilton). The Thick-lipped variety is described as 'Same colouring as Himalayan Mahseer differing only in the head. Chief features are the thick lips with the adipose extension which is well illustrated in Thomas' *Rod in India*.' It has been shown in my previous articles (**9**) that extensions of lips may occur in several species of *Barbus* of South-eastern Asia and Africa and though the true significance of these structures is not clear, they cannot be regarded as specific or racial characters. The Thick-lipped variety is also stated to be fairly common. Regarding the Black variety, it has been shown above (*vide supra*, p. 806) that it is only a convenient name for the melanic specimens of different species. His photographs of both the Thick-lipped and Black varieties show that they are referable to *Barbus* (*Tor*) *putitora* (Hamilton). Mr. Macdonald sent me another photograph of his Black variety from Burma and this proved to be *B.* (*Lissochilus*) *hexagonolepis*. It would thus appear that colouration served as the main character for differentiating varieties. The photograph of the Copper Mahseer shows that its head is almost equal to the depth of the body and on this character it is possible to assign it to *Barbus* (*Tor*) *mosal* (Hamilton). This species is more commonly met with in Burma. The Chocolate Mahseer, with thin lips and bright orange spots under lower jaw on chin, is probably *B.* (*Lissochilus*) *hexagonolepis* McClelland, while the specific identity of the Red Mahseer is difficult to ascertain as the author has not published a figure of the variety. Mr. Macdonald has very kindly sent me a photograph of this variety (Pl. ii, fig. 1) which shows that this is also referable to *B.* (*Lissochilus*) *hexagonolepis*.

In 1929, Shaw and Shebbeare distinguished four varieties of Mahseer from the Dooars, the Teesta and North West Assam. Their 'Commonest' type and the 'Greyhound' type are undoubtedly *B.* (*Tor*) *putitora*. The very thick-lipped and red-finned type, the so-called cock-fish, was at first regarded as a separate variety, but next year Shebbeare (**17**) considered it to be a 'breeding phase rather than a variety'. The fourth variety, from the description given, seems to be *B.* (*Tor*) *tor*. The specimen figured as 'Young of Commonest Type (?)' has a head shorter than the depth of the body and would thus seem to belong to Tor Mahseer. In 1931, Shebbeare (**18**) described a Dark variety which has been referred to above and seems to be a melanic specimen of *B.* (*Tor*) *tor*.

In commenting on Shebbeare's articles, Macdonald (**15**, p. 105) redescribed the varieties of Mahseer met with in Burma, and reiterated that the Thick-lipped variety is quite distinct and not a sex-phase of some other variety. According to him, the cock-fish of this type has 'a bump on the nose, and a more developed appearance about his whole form'. The distinction between the two sexes is given as follows:

'The male fish can easily be distinguished by the swelling or fleshy protuberance on the nose being extended farther and being more fully developed than in the female. The lips of the male fish are also much thicker and coarser than those in the female fish.'

I (9) have discussed fairly fully the causes which may be responsible for the enlargement of the lips in Mahseer, but observations are lacking to elucidate the exact significance of the hypertrophied lips. In view of the fact that individuals with hypertrophied lips



Text-fig. 2.—Mahseers or Large-scaled Barbels of Himalayan waters.

are to be found in practically all the species of Mahseer, this character cannot be regarded as a specific or racial feature.

The following key may help to distinguish specimens, over 9 inches in length, of the species of the Large-scaled Barbels of Northern India and Burma.

I. Labial groove interrupted in the middle; lips comparatively thin and never hypertrophied; cheeks covered with tubercles.

Barbus (*Lissochilus*) *hexagonolepis* McClelland.
The Katli of the Nepalese and Bokar of the Assamese. The Chocolate, Olive, Black or Red Mahseer of Burma.

II. Labial groove continuous; lips thick and well formed, sometimes produced into adipose flaps; cheeks smooth.[1]

A. Length of head considerably greater than depth of body.
Barbus (*Tor*) *putitora* (Hamilton).
The Golden or the Common Himalayan Mahseer including Greyhound and thick-lipped varieties.

B. Length of the head considerably shorter than or more or less equal to depth of body.

1. Length of head considerably shorter than depth of body.
Barbus (*Tor*) *tor* (Hamilton).
The Deep-bodied Mahseer.

2. Length of head more or less equal to depth of body.
Barbus (*Tor*) *mosal* (Hamilton).
The Copper Mahseer.

Addendum.

Copies of the typescript of the above article were sent to a number of well known anglers in India and their suggestions were solicited. Messrs. R. E. Parsons (Assam), A. Macdonald (United Provinces), C. Fairweather (Bengal) and Lt.-Col. R. W. Burton (Mysore) have very kindly sent their comments which throw further light on Black Mahseer and other races and varieties of this game fish.

Mr. Parsons notes that though Mr. R. W. Godfrey, Indian Police, Political Officer, Sadiya Frontier Tract, Assam, has caught several Black Mahseer, he has kept no records of them. 'The only one about which he was able to give me any details was a fish of about a pound in weight, caught on the Deopani river near Sadiya. This seems to indicate that the black colouration is inherent in this type of fish from a very early age.' Mr. Godfrey also mentioned to Mr. Parsons 'that while fishing in the Siang (Brahmaputra), some considerable distance into the hills north of Pasighat in the Frontier Tract, he noticed that the Bokar he killed were of a dark purple-plum colour instead of being the usual type. The Siang Valley in that locality is very shut in and even the water and stones in it looked black. It therefore seems that the dark colouration of the Bokar in the area referred to is due to conditions of environment and not to any question of melanism. However,

[1] In some of the true Mahseers of the Deccan and Southern India, tubercles are present on the cheeks. These forms will be dealt with in the subsequent articles of this series.

the Mahseer caught there were not different from the usual type.' Mr. Parsons on the basis of his records of Mahseer fishing finds that one black specimen turns up for about every 800 fish caught in Assam waters.

Mr. C. Fairweather in his communication to Mr. C. M. Inglis, Curator, Natural History Museum, Darjeeling, stated '"Black" Mahseer are quite common: I am inclined to agree that "wooded" banks have something to do with this *protective* colouring. . . I also caught Black Mahseer and Ordinary Mahseer from the same pool but the fish were travelling up at that time so the "same pool" means nothing.'

Mr. Fairweather also directs attention to another type of Mahseer—nicely streamlined, which is found in the Champamati, District Goalpara, and looks like a Katli with a sharper head but has the eyes and scales of a Mahseer. It is stated to be 'Very short and very deep in the belly . . . His tail and fins were bright red'. He suspects it to be a *cross-breed* and states 'There must be innumerable "crosses" between various types of Mahseer with infinite *modifications* of "lips". I cannot see the males of one type carefully selecting females of the same type for attention or rather "attendance". Therefore "noses" will get graded up or down.'

Hybridisation is a fairly common phenomenon among Carp or Cyprinid fishes and several instances have already been described. I (*Rec. Ind. Mus.*, vol. 36, pp. 307-310, 1934) have myself described cross-breed between two snow trouts—*Schizothorax labiatus* McClelland and *Oreinus sinuatus* var. *griffithii* McClelland and shown the occurrence of all gradations between the trilobed lower lip of the former and the papillated, flat lip of the latter. Mr. Fairweather's suggestion is very valuable and needs close scrutiny at the hands of those who have opportunities to handle large series of specimens of these game fishes. It is likely, however, that the nicely streamlined Mahseer of the Champamati may have been *Barbus* (*Tor*) *mosal* (Hamilton).

Col. Burton also states that Black Mahseer are found in the Cubbany River near Kartikolam below Manantoddy and he caught one black specimen of 5 lbs. (Plate ii, fig. 3) from the Bhavani also. He is also inclined to attribute variations in colouration to environmental factors. He states that:

'The pool in the Bhavani river where I caught the Black Mahseer was deep and shadowed by giant trees. The upper waters of the Cubbany river are in many places similarly dark and gloomy. So I feel sure that environment has much to do with the colouration of Black Mahseer.

'Many of the Mahseer taken by my party in the upper waters of the Kakki Ar in Travancore in 1933 were very deep in colour. That was a stream with much peaty looking water and running through thick forest.

'From the fact that during many years I never saw a Black Mahseer in the open sunlit rivers of Central India and Hyderabad—Godavery, Beema, Kistna, Tungabadra—it would seem that Mahseer of this colouration are not in those rivers, at any rate in the plains portions of them.'

Col. Burton has so far collected only one specimen of the Thick-lipped type in the Indravati on the Central Provinces border.

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Fig. 1.—A Red Mahseer from Burma. (Reproduced by courtesy of Mr. A. St. John Macdonald.)

Fig. 2.—A Black Mahseer (second from left, 16 lbs.) from Assam with six ordinary Mahseer. (Reproduced by courtesy of Mr. R. E. Parsons.)

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Mr. Macdonald has also written to say that melanic specimens of the Ordinary Himalayan Mahseer, *Barbus* (*Tor*) *putitora* (Hamilton), are fairly common and may frequently be seen (one or at the most two) cruising about in shoals with the golden variety. He has found such specimens 'from ½ a pound to 37½ lbs., over as wide a range and as far as the Indus and the Jhelum and Mahl in the West Punjab; in the Ganges and Surju rivers in the U.P.; in the Girwa and Bhagmati in Nepal; and in Burma.' Mr. Macdonald has never collected a black specimen of the Putitor Mahseer with thick lips and this is certainly a matter of unusual interest and well worth further investigation.

Mr. Macdonald has observed that the black variety of Mahseer of the Naini Tal Lake 'can be seen in shoals by themselves, and aloof from the other fish, (*putitora*)'. It seems probable that in the lake there are two distinct species which do not mix with each other, but any further information on this point will be very interesting.

Regarding the stocky-type of Black Mahseer, Mr. Macdonald has sent the following further information:—

'I have only taken these fish in N. Burma in the Namti and Sahmaw Chaung. I have also seen them taken in the Mali H'Ka. In shape it resembles the Katli or Bokar far more than *putitora*. The Sahmaw Chaung is a small gin clear stream, no more than 10 yards across, and 15 miles over its total length. The Namti Chaung was a river of greater depth and size, but so far as my observations went here too, only this black variety of fish was caught. I never saw or caught a Chocolate Mahseer or Bokar in its common or more general colouring.'

A photograph of the stocky-type sent with the above description clearly showed that Mr. Macdonald had specimens of the Katli, *Barbus* (*Lissochilus*) *hexagonolepis* McClelland. As I have shown in my two articles on this species in the present series, this fish is liable to vary considerably in colouration. In fact, in Burma alone it has been called as 'Chocolate Mahseer' of the Myitkyina District, 'Olive Mahseer' of the Pegu District and 'Red Mahseer' of the Myitkyina and Tavoy Districts. The stocky-type Black Mahseer of Mr. Macdonald seems to correspond in colouration and habitat to Mr. Godfrey's Bokar of dark purple-plum colour from the Siang in Assam.

Regarding the development of thick lips, Mr. Macdonald has sent the following very interesting observations:—

'While fishing in the Ladaya in Kumaon, we used the casting net for catching small fish, small Mahseer provided the chief bait. These fish were from 4 to 10 inches in length, and in shoals of from 100 to 200 fish. We could get a dozen or more in the net at a time. In one place all would be of the thick-lipped variety, and in another the ordinary type. Is it possible that these fish all came from the same spawner, or through environment all developed these lips, or collected together for some special reason? Until I read your article I was inclined in the belief that they must be yearlings from the early spawn and had not separated. We caught some two hundred and fifty fish on this trip, and fully half were the thick-lipped variety. This is exceptional as the ratio is usually one in ten.'

As noted in my previous articles, I am unable to throw any definite light on the causation of the hypertrophy of the lips in the large-

scaled barbels of India and the neighbouring countries. Even some very young specimens possess this character in a marked degree, but we do not know what changes these structures undergo with growth and sex. These points are still open for investigation by enthusiastic anglers.

About his Red Mahseer, Mr. Macdonald has sent me the following further note:—

'These fish were in fairly large numbers at the same confluence in Burma in 1928. They were chiefly seen in quiet water of pools cruising about in shoals of 15 to 20 fish, and appeared to keep apart from the other varieties. They were in habit more like the Bokar, sucking vegetation from the surface and avoiding fast water so beloved of *putitora*.'

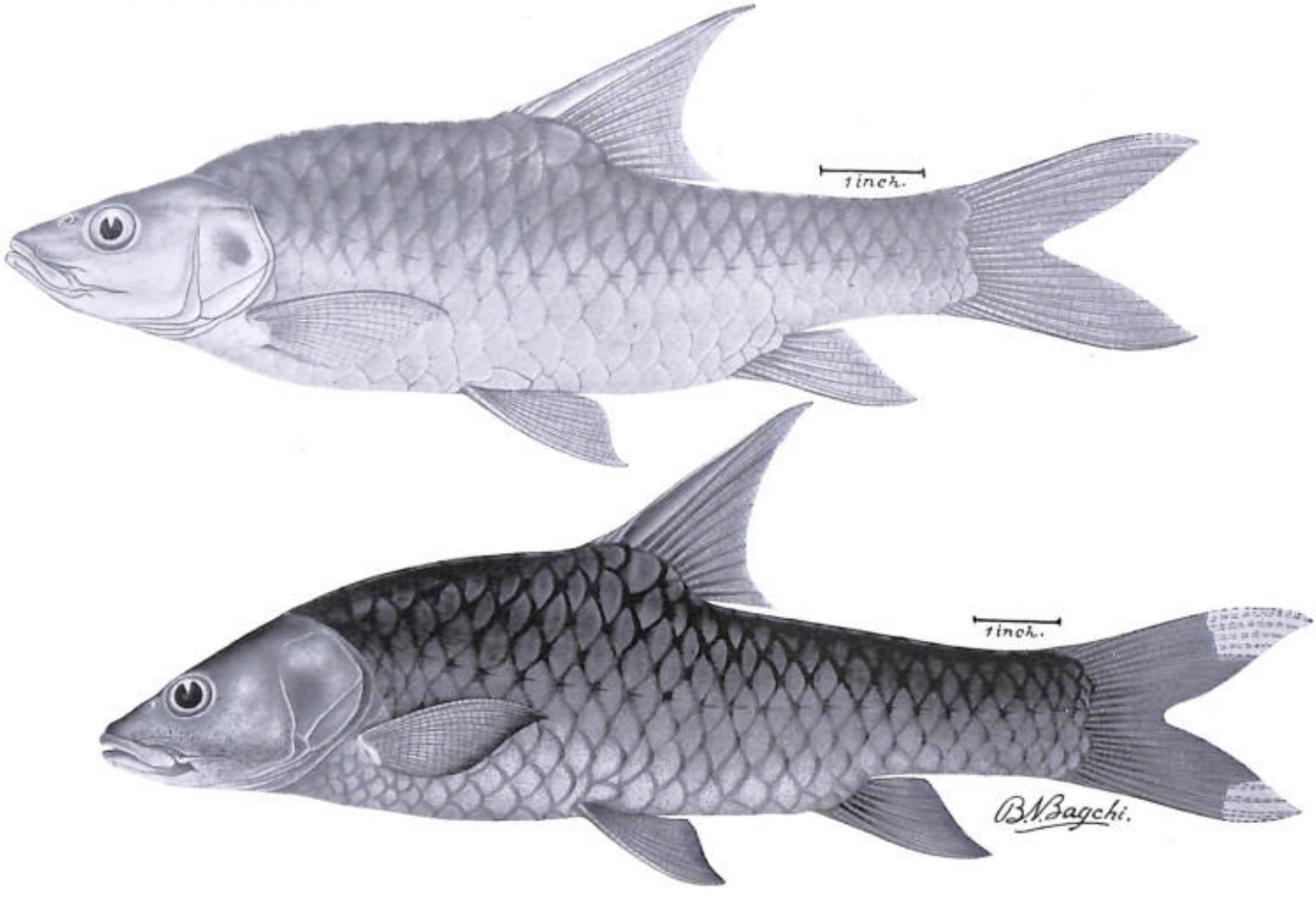
The photograph (Plate ii, fig. 1) that accompanied the above description showed that this variety is also referable to *B.* (*Lissochilus*) *hexagonolepis*. It may be noted that Mr. D. E. B. Manning sent specimens of the Red Mahseer of the Tavoy District which were found to be *B.* (*Lissochilus*) *hexagonolepis*.

To sum up, there appear to be four species of the Large-scaled Barbels in the Himalayan waters of which two. *Barbus* (*Tor*) *putitora* (Hamilton) and *B.* (*Tor*) *tor* (Hamilton) are found all over this region, while the remaining two, *B.* (*Tor*) *mosal* (Hamilton) and *B.* (*Lissochilus*) *hexagonolepis* (McClelland) are found towards the west only as far as Nepal but are more common in Burma. The last species is very variable in colour and is known to anglers under several names; its range has been extended to Nepal (Garwa and Bhaghmatti rivers) on the data supplied by Mr. Macdonald.

Through the courtesy of Mr. B. S. Bhimachar, Fisheries Officer, Department of Agriculture, Mysore, I have received two specimens of Mahseer from Bangalore which show normal and melanic colouration. Though I have not yet studied the races and varieties of Mahseer found in South Indian waters, I give here the drawings (Plate iii) of these specimens to show differences in colouration and at the same time their structural identity. The systematic position of these specimens will be discussed later. In sending these specimens Mr. Bhimachar observed that 'among the Mahseer at Bangalore, the local people distinguish two types—the ordinary type and a black variety'. It would thus appear that the melanic specimens are of frequent occurrence in those parts. In this connection reference may also be made to Col. Burton's observations given above (*vide supra*, p. 812).

ACKNOWLEDGMENTS.

As will be seen from the text and descriptions of figures, in writing this article I have received much help from several persons interested in the study of Mahseer and it gives me great pleasure to extend my sincerest thanks to Messrs. R. E. Parsons, A. St. John Macdonald, C. E. S. Fairweather, S. H. Prater, C. M. Inglis, B. S. Bhimachar and Lt.-Col. R. W. Burton. I am indebted to the Darjeeling Natural History Society for the loan of blocks used for plate i, and to the *Bombay Natural History Society* for bearing the entire cost of the illustrations.



The two varieties of Mahseer from Bangalore, Mysore—"the ordinary type and a black variety".
(*Drawings were made from specimens sent by Mr. B. S. Bhimachar, Fisheries Officer, Mysore State*).

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[1] In this list only those papers are included which were consulted by the author. The following papers dealing with melanism in fishes are not available in any of the libraries in Calcutta. 1. Arnold, J. P.—Ueber Melanismus bei den lebendgebirenden Zahnkarpfen. *Wochenschr. Aquar. Terrar. Kunde*, pp. 377-379 (1912); 2. Siebold, C. T.—Ueber den melanotischen Hautausschlag der Cyprinoiden. *Amtl. Ber. Vers. Deutsch. Naturf.* vol. 35, pp. 138, 139, 1860 (1861).

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SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

M. SAYEEDUD-DIN,

Professor of Botany, Osmania University, Hyderabad—Deccan.

(With three plates).

(Continued from page 601 of Vol. xlii, No. 3).

VIII.—EVOLVULUS ALSINOIDES Linn.

(CONVOLVULACEAE).

SYNONYMY AND SYSTEMATIC DESCRIPTION.

Evolvulus alsinoides Linn. Sp. Pl. ed. 2 (1762) p. 392; H.F.B.I., IV, 220; Cooke, Fl. Pres. Bomb., V. II, Pt. 2, 229; Gamble, Fl. Pres. Madras, Pt. V, 923; Duthie, Fl. upper Gangetic Plain, II, 104; Trim., Fl. Ceyl., III, 227; Watt, Dict. Econ. Prod., Ind. V. III, 305.

Syn. : *Evolvulus hirsutus* Lamk. Encyc. Méthod., V. III, 538; Dalz. and Gibs., Bomb. Fl., 162.

A perennial herb with a small woody root stock; annual branches numerous, prostrate, spreading, slender wiry, clothed with long hairs. Leaves alternate, 1/4-3/4 by 1/6-1/3 in., elliptic-oblong, strongly apiculate, densely clothed with appressed silky hairs; petioles very short or sometimes almost o. Flowers light-blue, usually solitary, or sometimes two from a pair of lanceolate bracts on the peduncle; peduncles very long, axillary, filiform; pedicles filiform. Calyx densely silky; sepals 5, lanceolate, very acute. Corolla sub-rotate; limb 5-plaited. Stamens 5, included; anthers ovate; pollen grains spherical. Ovary 2-celled; ovules 4; styles 2, each cleft into 2 subclavate stigmas. Fruit a globose, thin, 4-valved capsule. Seeds usually 4. (Plates I & II.) Flowers practically throughout the year, but more abundant from July-November. Medicinal (Kirtikar, 6).

INDIAN NAMES.

Sankhpushpo (*Punjab*); Shankaveli (*Bombay*); Vishnukrandi (*Tamil*); Vistna--clandi (*Malayalam*); Vishnukranta (*Telugu*)

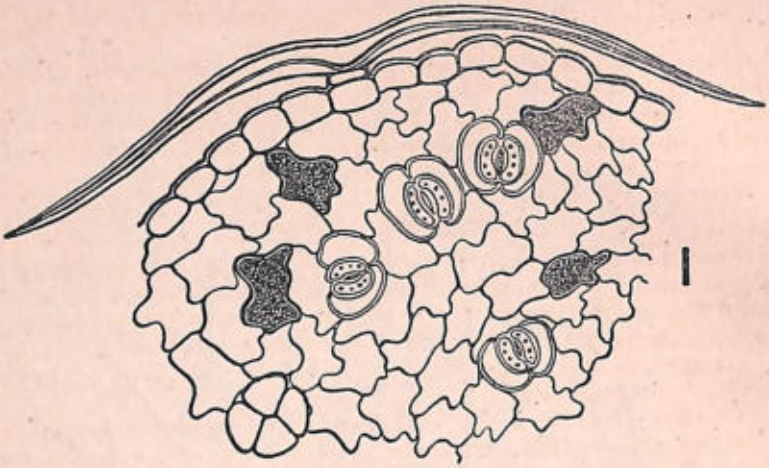
HABITAT.

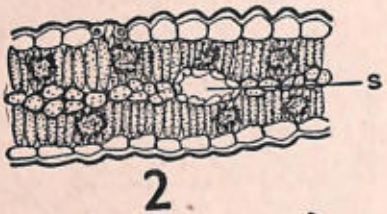
Throughout India and Ceylon, very common; rare in very damp regions (Hooker, 4); common everywhere in the Bombay Presidency in grassy places (Dalz. & Gibs., 2); very common in Madras

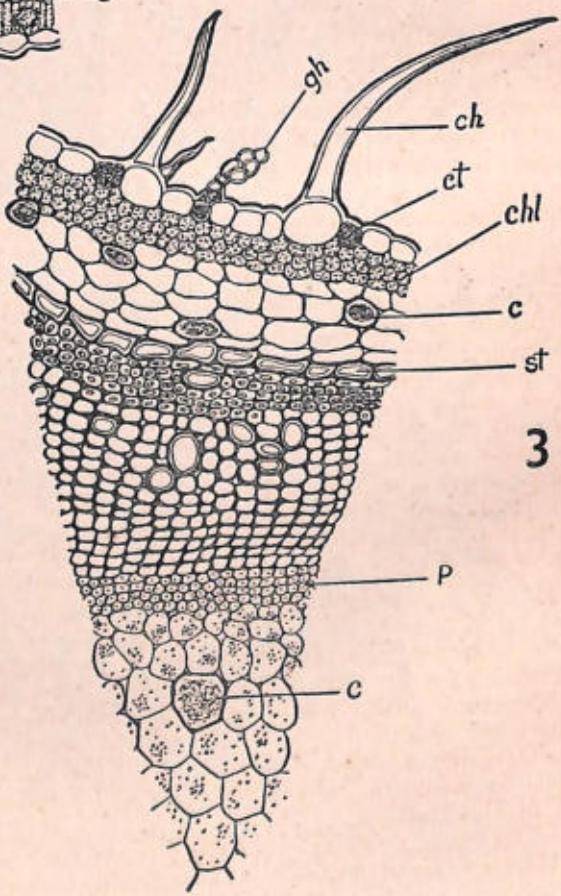
Sayeedud-Din.—**Evolvulus alsinoides** Linn.

Sayeedud-Din.—**Evolvulus alsinoides** Linn.

For explanation see end of article.







Sayeedud-Din.—**Evolvulus alsinoides** Linn.

For explanation see end of article.

Presidency in grassy places except in the driest months (Mayuranathan, 7); commonly wild in Hyderabad on grassy lands and waste places (Sayeedud-Din, 10); very common in most parts of the Upper Gangetic Plain, especially on open sandy ground and by roadsides (Duthie, 3). Distrib.: Tropical and subtropical countries.

Anatomical Notes.

Structure of the leaf. (Plate III, Fig. 1.) The cuticle is thin and striated. The epidermal cells are enlarged, and their outer walls are arched convexly outwards. The stomata are developed on both surfaces where they are deeply sunk, and are accompanied by two subsidiary cells placed parallel to the pore. The leaf-structure is isobilateral.

Oxalate of lime occurs in varied shape in the leaf and stem. The clustered crystals occur only in the veins of the leaf. Secretory elements occur in the form of isolated cells containing whitish substance in the mesophyll, and in the cortex and pith. They do not, however, possess the surrounding specialised cells as, for example, those figured by Mullan (8) in the case of *Ipomaea pes-caprae* Sweet, or described by Sabnis (9) in the case of some species of the Convolvulaceae. Epidermal cells in the leaf and stem hold tanniniferous contents.

The clothing hairs consist of two cells. In the stem the long terminal cell is simple and unbranched, and inserted vertically on the short stalk-cell (Plate III, Fig. 2), whereas in the leaf the terminal cell has two nearly equal horizontally placed arms (Plate III, Fig. 1).

The glandular hairs consist of a short and unicellular stalk-cell seated on an epidermal cell. In the leaf the head is flat, and consists of four cells. In the stem the head is ellipsoidal and is divided by horizontal and vertical walls (Plate III, Fig. 2).

Structure of the axis. The cuticle is striated. The outer and inner epidermal walls are thickened and arched convexly outwards and inwards respectively. The lateral walls are straight. The primary cortex consists of chlorenchyma. The pericycle contains stone-cells in a broken ring. The vascular bundles are bicollateral. The vessels are numerous and arranged in rows, and the medullary rays are narrow and uniseriate. The intraxylary phloem is developed in the form of isolated groups of soft bast.

The above observations tally a great deal with those recorded by Solereder (11) in other species of *Evolvulus*.

Conclusions.

The following is a brief summary of the characteristic features revealed by the anatomical study of *Evolvulus alsinoides* Linn.

1. Stomata are surrounded by two subsidiary cells parallel to the pore of the guard-cells.

2. Oxalate of lime occurs in the form of ordinary solitary crystals in the stem, and in the form of clustered crystals in the veins of the leaf.

3. The hairy covering consists of two kinds of 2-celled hairs. The hairs on the stem possess a long straight terminal cell, whereas

those on the leaf have a 2-armed terminal cell, the arms lying horizontally.

4. The glandular hairs are of two types. In the stem the head of the hair is elongated and is divided by horizontal walls, but a few vertical walls are also seen. In the leaf the head is spherical and divided by vertical walls into four cells.

5. Isolated secretory cells with whitish contents occur in the mesophyll of the leaf, and the cortex and the pith of the stem. Those in the leaf are elongated horizontally. The epidermal cells in the leaf and stem hold tanniniferous contents.

6. The vascular bundles are bicollateral.

ACKNOWLEDGEMENTS.

I am thankful to Mr. Sri Ramloo for the photograph and the drawings which were prepared under my supervision, and to Mr. M. Moinuddin for kindly preparing the slides.

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EXPLANATION OF PLATES.

Evolvulus alsinoides Linn.

PLATE I.

Photograph of *Evolvulus alsinoides* Linn.

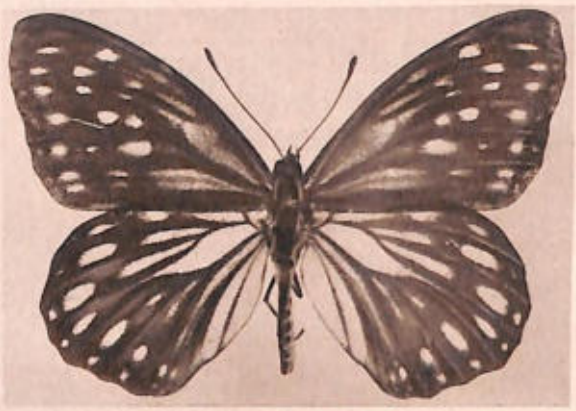
PLATE II.

Fig. 1. Black and White drawing of *Evolvulus alsinoides* Linn. (Nat. size).
Fig. 2. Corolla opened out. (× 10).
Fig. 3. Silky calyx. (× 10).
Fig. 4. Pistil. (× 10).
Fig. 5. Pollen grain. (× 215).

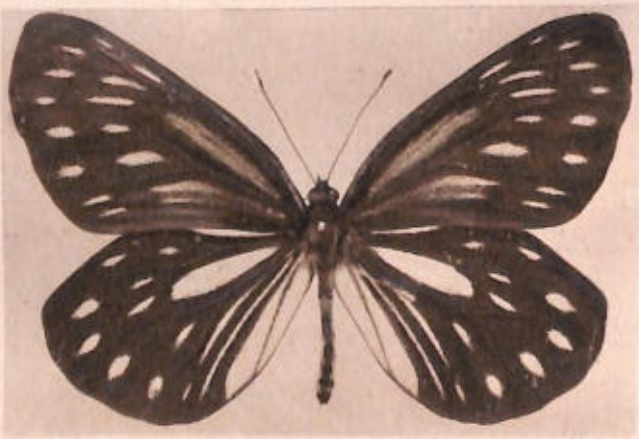
PLATE III.

Fig. 1. Leaf-epidermis, showing a 2-armed hair, stomata, cells with tanniniferous contents, and a gland. (× 215).
Fig. 2. T. S. Leaf, showing, s, secretory cell. (× 215).
Fig. 3. T. S. Stem, showing, ch, ordinary clothing hair; gl, glandular hair; chl, chlorenchyma; ct, cells with tanniniferous contents; c, cells with whitish contents; st, stone cells; p, intraxylary phloem. (× 215).

DIAGORA NICEVILLEI
(*Moore*)
(Type) ♀
Indian Museum, Calcutta.



DIAGORA NICEVILLEI
(*Moore*)
(Neallotype) ♂
Godaveri, Nepal.
6000 feet. 16.5.37.
(Upperside).



APORIA AGATHON
(*Gray*) ♂
from Nepal.

DIAGORA NICEVILLEI (Moore).

BY

LT.-COL. F. M. BAILEY.

(*With a plate*).

This butterfly was first described by de Nicéville (1883, Journ. As. Soc. Beng., 52, pt. II, p. 65, Pl. I, Fig. 2) as the ♀ of *Hestina zella* (Butler). De Nicéville stated that the insect was taken on the forest-clad road between Chamba and Kujiah on 22nd May 1879.

Moore in 1893 (Lep. Ind. III, p. 37, Pl. 202, Figs. 2 & 2a) reproduced de Nicéville's figure and described the insect as a ♂ under the name of *nicévillei*, quoting de Nicéville's statement as to locality and date. Moore probably saw the specimen as he figures the underside (Fig. 2*A*.) which was not shown by de Nicéville. Moore said that only this single example was known to him.

The specimen in the Calcutta Museum bears a label with the same data as given by de Nicéville and is certainly the insect figured by Moore and must be the type of *nicévillei*. It is apparently a ♀ as stated originally by de Nicéville who was qualified to know. Authorities in the British Museum believe the figure to represent a ♀; but on the other hand, the authorities in Calcutta declare the insect to be a ♂.

On the outskirts of the Nepal Valley near Katmandu, I obtained specimens of a *Diagora* which is described below. De Nicéville's single type specimen was presumably an outlier in its extreme western range; but it is curious that this butterfly should never have turned up in the six hundred and odd miles between de Nicéville's locality and the area where I found it not uncommon. In this stretch of 600 miles lies Simla which has been pretty thoroughly searched for butterflies.

Another curious fact is that de Nicéville's single specimen should have been a female. I obtained over 20 males and no females. The female is probably a skulker and seldom seen, like many similar butterflies.

In view of the above facts it is possible that the Nepal butterfly may belong to a separate sub-species. It is to be hoped that someone will eventually find either the ♂ of de Nicéville's species in Chamba or the ♀ of the insect here described in Nepal.

I first took a single specimen a few miles N.-W. of Katmandu at 4,500 feet on 11-5-35.

About 20 more specimens of this butterfly were taken in the middle of May 1937 in the hills S.-E. of the Nepal Valley at 5,000 ft.

This insect is an excellent mimic of *Aporia agathon* which flies with it, but *Diagora* seems to be more plentiful at slightly higher altitudes. In fact, *A. agathon*, in the locality where *D. nicévillei*

was mostly found, does not occur much above 4,500 ft. *D. nicévillei* is partial to excreta and less often sucks the moisture from damp sand.

So good is this mimic that I was at first completely deceived. I was casually watching a group of *A. agathon* at damp sand when I suddenly noticed that one of them had a yellow proboscis. It did not take me long to capture it and realise that I had a Nymphalid and not a Pierid. At first I thought that I had a new species of *Diagora*, but in view of the fact that I did not obtain a female, and that the male of *Diagora nicévillei* has never been seen or described, it seems probable that the insect here described is the male of *D. nicévillei*. The above is written on this assumption.

Through the courtesy of Dr. Baini Prashad, Superintendent of the Indian Museum, to whom I am indebted for information about the Calcutta ♀ holotype, I am able to figure the upperside of that insect. I also show a photo of the upperside of a Nepal ♂ specimen as well as of *Aporia agathon* from the same locality which it so closely mimics. I am also much indebted to Mr. G. Talbot of the British Museum, for his help generally and especially for looking up the previous data regarding this butterfly.

Description.

Upperside: As compared with the ♀ type in Calcutta, the light areas are much reduced, but post-discal spots conspicuous, somewhat elongate, and with well defined rounded edges. Forewing post-discal spots in areas two and three not produced; Cell much darkened. Hind wing, post-discal stripes in areas 5 and 6 shorter and narrower than in the female.

Underside: The whole with a curious greasy appearance. Forewing cell stripe narrower than in the ♀ forming at the end of the cell a somewhat oval patch which tends to become separated from the proximal stripe; other markings as on the upper side, but somewhat larger especially the patch below vein 2 which is as large as in the female. Hindwing with light markings tinged with yellow excepting the cell stripe; inner stripes yellow as in the female; no prominent stripe in area 1C; post-discal spots in 2 and 3 minute; stripes in 4 to 6 short, those in 5 and 6 shorter than the stripe in 4 and much shorter than on the upper side; basal costal yellow stripe much shorter than in the female. The tongue is yellow; head, antenna, palpus, body and eyes as in allied species.

Expanse: 80 mm.; length of forewing 38 mm.

Hab.: Nepal, Godaveri Valley, 6,000 ft. 10th to 16th May, 1937. The neallotype and 5 paratypes have been deposited in the British Museum.

THE FOOD AND HABITS OF THE HOUSE-SPIDER (*HETEROPODA VENATORIA*, LINN.)

BY

G. C. BHATTACHARYA,

Bose Research Institute, Calcutta.

(*With two plates*).

All spiders are carnivorous and generally live on the more helpless invertebrates. But instances of their preying upon vertebrates also are not wanting. Accounts of the capture of fish, rats, snakes, frogs, lizards, etc., by some species of spiders have been recorded (**1-9**), but an instance of a spider preying upon a bat is unknown to me. Some months ago, I came across such an instance.

One evening, early in May, 1940, while observing the preying habits of a species of gregarious spider, *M. faltana*, (**10**) in the village of Kristapur, near the salt lakes of Calcutta, my attention was drawn by a cow-boy who cried out that a big spider was struggling with a peculiar creature in an adjacent cow-shed. Entering the shed I came upon an astonishing sight—a tiny bat (*Pipistrellus* sp.), caught as in a trap between two bamboo-strips of a matted wall, was struggling hard to free itself from the grip of the powerful mandibles of a big house-spider, *Heteropoda venatoria* (**11**), clinging to its neck with all its might (Plate II, Fig. 1). The bat screamed at intervals and gasped. As it was getting dark inside the shed a torch was focussed on the spot. The bat squeaked as the light fell upon it, and suddenly came out of the trap vigorously flapping one of its wings. The spider tried its utmost to maintain its original hold. The bat dragged itself out with the spider on its back and crawled a short distance to a smoother part of the wall with the peculiar gait of its own. It was tired and could not move far. It gasped hard and its voice was weak. It remained stationary for about 15 to 20 minutes, when all at once it began to flap its right wing and finally stretched it out to the fullest extent. After a minute or two the stretched wing began to fold itself back like an organ in atonic condition. In order to capture them *in situ* I very cautiously covered them with a crystallizing dish. A piece of plain glass was then slowly pushed under the dish so that both of them, the aggressor and the victim, were transferred on to the flat glass. Notwithstanding the slight disturbance caused by this process the spider did not release its grip but clung to its prey more firmly than ever. While carrying the captives to my laboratory the spider released its victim and took its stand on the vertical wall of the glass dish. For the night they were kept in a suitable place. Next

morning the spider was found with its legs outspread resting upside down at the top of the inverted dish. Its victim with its wings folded lay slightly inclined on its right side. It was taken out and found to be stone dead, *rigor mortis* having started long before. Evidently it remained untouched by the spider during the whole of the night because no wounds or scratches, other than the first, were traceable.

This strange incident led me to investigate the habits of these spiders, some of which are highly interesting and peculiar.

Barring a few species, spiders are not social creatures. Besides most of them are cannibalistic. Fights often occur when two happen to meet. *H. venatoria* displays this habit. If by chance one happens to come within close range of another of its species, both at first, try to avoid an encounter by running away, or by taking cover, but failing this they fight.

I had an opportunity of witnessing such a fight. The encounter took place on the wall of a room. Two big spiders, faced each other at a distance of not more than ten to twelve inches (Plate I, fig. 1). Both were females each carrying its egg-case under its breast. All quiet on the sooty wall,—a lull before the storm! Suddenly one of the antagonists, raising the front pair of legs high up in the air, rushed at its opponent, which, at first, showed signs of retreating, then stood its ground, meeting the onslaught with its two front legs raised. They stood at the 'on guard' for a while, then the aggressor fell upon its enemy with surprising agility (Plate I, fig. 2). They wrestled for two or three seconds only and then separated; the breathing space was short—an interval of two or three minutes—and the spiders joined combat for the second time. Throughout the grim struggle they kept a firm hold on their great egg-cases with the help of the pedipalpi. In the fury of the fight they suddenly lost their balance and fell into an enamelled tub at the foot of the wall. The fall in no way perturbed the fighters and the struggle continued with the same intensity. One of the combatants lost a leg, but did not evince the slightest sign of submission. Now they disengaged themselves a second time, there was an interval of a few minutes and the third round commenced. The spider with the lost limb showed signs of weakening and presently lay still. The victor turned it over till it lay flat on its back, then bit into its body maintaining its hold for a long time. The legs of the prostrate spider moved spasmodically, expanding and retracting. The egg-case was still held to its breast. This, the victor now removed, and holding it with one of its legs made off with its booty (Plate I, fig. 3). But the steep walls of the tub compelled it to remain a captive. I permitted it to enjoy its victory for a while.

At nightfall these spiders come out of hiding in search of prey and lie stationary in some suitable place with legs outspread. Innocent crickets (*Gryllus domesticus*), cockroaches are also night-roamers. At night they too come out of their crevices and move about in search of food and frequently fall victims to the spider lying still in ambush. Careless in their movements they come within easy reach of the spider which pounces upon the unwary

Fig. 2.—They come to grips.

Fig. 1.—The spiders faced each other, holding their egg-sacs securely.

Fig. 3.—The victor kills her opponent and carries off her egg-sac.

HOUSE SPIDERS (*Heteropoda venatoria*) IN COMBAT

VICTIMS OF THE HOUSE SPIDER (*heteropoda venatoria*).

Fig. 1.—An unusual victim: House Spider gripping a pipistrelle bat in its mandibles.

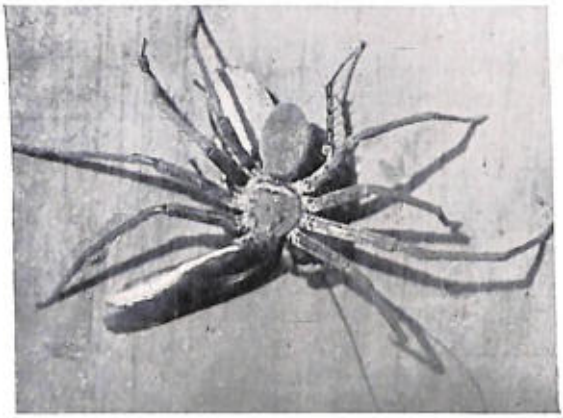


Fig. 2.—A useful service: These spiders help in ridding the house of cockroaches.

Fig. 3.—House Spider attacking a scorpion.

victim with lightning speed. Over-powered by its powerful bite and its poison a cricket dies almost instantaneously, but the cockroaches resist for some time. The spider carries the struggling cockroach from place to place until the poison takes effect and the insect's struggles cease, when it begins to chew the body to a ball-like mass sucking at the same time the juice out of it (Plate II, fig. 2). Their ways with house-flies are quite different and extremely interesting. This I had an occasion to observe while rearing and feeding them with flies. Flies were released into the rearing chamber one by one and the spider took them one by one in its jaws—a fly thus held cannot escape when the jaws open to receive the next victim. I have seen a spider take and keep in its jaws from ten to fifteen flies at a time. When it can hold no more, it starts to chew them *en masse*. In half an hour or so the juice is sucked to the last drop and the dried mass is ejected.

Once I came across a house-spider, *H. venatoria*, on the wall of a house with a young scorpion in its jaws. I tried in vain to capture the spider, but during the chase it dropped the scorpion. It was dead. The scorpion was identified as *Isometrus maculatus* (De Geer) and measured about one and three-fourths of an inch in length. Presumably it was preyed upon in the early hours of the morning. Scorpions are formidable, venomous creatures and it is astonishing that such a creature should be overpowered by a spider. In order to observe how this is accomplished I put a big spider, *H. venatoria*, in a spacious, flat, enamelled dish with high vertical walls. Here it was kept for some days after which a scorpion about two inches in length was let into the dish. The spider did not move at all. The scorpion remained stationary in the centre of the dish for a few minutes and then began to crawl about. Then it stopped and lay still at a point farthest from the spider. Nothing happened for two hours. Then the scorpion moved slowly along the angle of the dish till it came within reach of the spider; immediately the latter sprang upon the scorpion's back and firmly gripped the anterior portion of its body with its sharp fangs. The scorpion tried its utmost to sting its opponent reverting its tail over the spider's back, but it failed to drive its sting home perhaps because of the hard chitinous shell of the carapace. Unable to sting, the scorpion seized the legs of the spider in its pincers but could not keep its hold for a long time. It then tried hard to free itself from the grip of the spider by contortions of its body. The manœuvre did not succeed. The spider, seemingly yielding to the movements of the scorpion kept its grip on the victim as rigidly as ever. As the struggle continued the scorpion grew visibly weaker until it ceased to move at all and lay with its tail stretched flat on the surface of the dish. It was to all appearance dead. A few minutes elapsed. The spider now slowly moved its abdomen sideways and finally sat astride the scorpion's back. This seemed to bring the scorpion back to life. It suddenly swung its tail upwards and, bending it in an arch, tried over and over again, but without success, to sting the spider (Plate II, fig. 3). The spider avoided the thrusts shifting its abdomen with peculiar alertness. This was the scorpion's dying effort, in a while it collapsed and moved no more. The struggle had lasted for about an hour.

At about 8 o'clock, on a mid-August night in the year 1940, I was sitting inside a thatched cottage near Barrackpore, when a peculiar sight attracted my attention. I saw a big house-spider, *H. venatoria*, with its distended abdomen moving around a spot on the vertical matted wall of the room. I kept a watchful eye on it. The spider displayed a peculiar movement of its abdomen. Evidently it was not spinning a web as these spiders are not known to spin for shelter. So I waited to see what it was about. A few minutes later, I was surprised to see a round cup-shaped thing, about three-fourths of an inch in diameter gradually emerging. Was it making its sac for the deposition of its eggs? Never before had I an opportunity of observing *H. venatoria* making its egg-sac. It took half an hour to complete the lower half of the sac. With the lateral movements of its abdomen there issued fine threads of silk, which adhering together in layers, gradually took the form of a cup-shaped structure. The complete sac is composed of several layers of finely woven silk which give it great strength. Having completed the under half of the sac, the spider rested a while. Then lowering its abdomen it began to extrude its yellowish globular eggs in rapid succession into the cup-shaped capsule. The extruded eggs are covered with a thin film of adhesive fluid which hardens immediately on contact with the air, and are laid on the inner surface of the capsule in a layer. In quick succession eggs were deposited layer upon layer. In half an hour's time a goodly number had accumulated in a pile on the floor of the capsule. Laying continued at intervals till the capsule was full. When the egg-laying was over the spider paused for a while and then started spinning the cover for the capsule. The complete egg-sac looked like a double-convex lens, about an inch in diameter. The spider held the sac firmly against its sternum with the help of the pedipalpi which work like a pair of fasteners or holdfasts. Then it slowly walked some distance where it rested for a long time. These spiders carry their egg-cases for ten to fifteen days; when the young emerge from the sac and hang suspended by means of fine silk threads in clusters. The empty case is then discarded by the mother spider who takes no more interest in her brood. Remaining suspended in this way for two or three days the young spiders gradually disperse and begin to take up their independent existence.

The young spiders possess a sort of aeronautic habit which they utilize for dispersal to distant places. They climb to some height and, turning their heads to the breeze, raise the abdomen up in the air and extrude from it, fine threads of silk. When the thread is sufficiently long it catches the wind and exerts a pull on the spider. The young spider then releases its grip and is carried by the breeze. One might think that the process of climbing, lifting the abdomen and spinning the thread preliminary to the aerial flight takes some time, but far from it, these actions are often all but simultaneous and take little time. A tiny spider may in an instant run up a small twig and take straight to the air. Such an aerial journey may be short, or may cover miles. Thus carried through the air the spider establishes itself in a new territory.

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1. Cambridge, *Proc. Zool. Soc. Lond.*, 1903, I, 152 and 158.
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4. Gudger, *Nat. Hist. Mag.*, 1925, 35, 266.
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MESOPOTAMIAN DESERT LEPIDOPTERA[1]

BY

E. P. WILTSHIRE, F.R.E.S.

THE DESERT.

The desert with which this article deals covers a wide area; yet it cannot be clearly separated from the Syrian and Arabian deserts by any line of demarcation, and indeed also merges, though less imperceptibly, into the mountainous desert regions of Southern Iran. The localities at which the insects in the list were taken are in Syria, Iraq and Iran, though mostly in the second, but faunistically the area concerned can be regarded as one and the same and may suitably be termed 'Mesopotamia', a name now devoid of political connotation. The area's homogeneity does, however, allow of certain minor climatic differences, between the northerly and southernmost localities. For instance, the average humidity on the desert shores of the Persian Gulf is between 70% and 80%, that at Bagdad 56%, and that at Mosul well below 50%; and the average rainfall at Bagdad is 9 inches (230 mm.), and at Bushire 12 inches (300 mm.). This rain only falls in the winter.

The Mesopotamian desert is geologically of two kinds: the stony upland, and the alluvial plain. The former lies northward of the latter, but encircles it like a horse-shoe. To the north-east of the alluvial plain are the foot-hills and ridges of the Zagros range; to the south-west of it, the low plateau of scorched steppe whose northern part is the Syrian, whose southern, the Arabian, desert. A line drawn from Ramadi to Balad, about fifty miles north of Bagdad, approximately marks the northern limit of the alluvial plain. This plain is geologically very recent. Until, and probably during most of the Pleistocene period, the waters of the Persian Gulf covered it. Then the swiftly-advancing delta of the Karun and Kerkheh turned the sea-arm north of these two rivers into a vast lagoon, which gradually silted up with the slower advance of the Euphrates and Tigris delta, and passed, after a transitional marsh stage, into its present desert condition, only relieved by the more or less extensive irrigation systems of antiquity and today. This alluvial desert is less rich in life than the upland desert for reasons given below; so that, even after Central

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[1] This article is an abbreviated version of an article already announced as under preparation with the title 'The Saharan and other affinities of the Mesopotamian Fauna'. The present state of Europe has made it impossible to complete the zoogeographical analysis of the desert insects here recorded, and I have therefore excised the zoogeographical sections, as the change in the title indicates; the analysis will, it is hoped, appear later, together with one or two additions to the list of species not yet determined. The present article is thus a truer companion to those already published about Iraqian lepidoptera, viz: 'Lepidoptera of a Bagdad Orchard' (*Ent. Rec.* Feb. 1939), 'Autumnal Lepidoptera in Kurdistan' (*Ent. Rec.* Aug. and Sept. 1937) and 'More Notes on Kurdish Lepidoptera' (*Ent. Rec.* July and October 1939).

Iraq became dry land this alluvial plain was a barrier to some of those steppe species that inhabited the western and eastern shores of the former Gulf and prevented the races which had there grown up from any re-admixture. This explains the eastern and western Iraqian races of *Euchloe charlonia* and *Zegris eupheme*.

The alluvial plain is composed of a light calcareous loam, unusually rich in lime, and in many places salty,—the eroded waste of the limestone hills of Armenia and Iran. This soil forms a fine dust when dry; frequent strong winds scour its surface; in the spring it is liable to extensive inundation, and the lakes so formed usually stand for months, and sometimes for a year, but eventually dry up. Such conditions are particularly unfavourable to animal and vegetable life. The upland desert, however, (gypsum, conglomerates, sandstone, etc.) is a scorched steppe and boasts a more varied vegetation, its stony soil providing plants with a firmer hold and rocks and in places cliffs giving shelter to the more sensitive kinds. After rains, the desert blossoms, sometimes becoming a mass of colour for a short period; on the other hand, standing pools quickly drain away. Such are the conditions responsible for the greater richness of the upland desert fauna. Similar causes also operate to favour the desert hills of the south-east. In southern Iraq and Khuzistan a degree of confusion between the alluvial desert and the marshes occurs and the higher humidity of these parts also enriches the desert-fauna to a certain extent. The foothills of the Zagros however lack this ambiguity and prolong our desert area, on the east shores of the Persian Gulf, towards India. The mountains and coastal plain here however enjoy a more humid climate than the northern and western fringes of our area, while remaining typically desertic. The true boundary of our desert area along the whole length of the vast Zagros chain is the lowest limit of the woodland zone, though in many places deforestation has obscured its whereabouts; that is, at about 1,500 feet in the north, (Kurdistan) and at about 3,000 feet in the south (Fars). The easterly offshoots of the Taurus, and the southward-running Lebanon range may be said similarly to demarcate this vast desert in the north and west; I am unable here to discuss the Anti-Lebanon and Transjordanian hills which are steppe-like and resemble the Persian mountains. Just as the Mesopotamian desert's ground rises slowly northwards towards Mosul, so the Syrian desert rises imperceptibly but steadily westwards towards Palmyra and Damascus; in fact one could say the same of all Arabia. Climatic conditions therefore obviously must differ at different localities in the Arabian-Syrian-Mesopotamian desert, but the translation from the low desert with mild winters to the high with regular snowfalls is gradual. In no part however is the area as high as the high steppes of Anatolia and Iran; and even the latter, of course, are not in the same class as the Russian steppes, which are covered with deep snow during a longer winter, and, indeed sometimes enjoy summer rainfall. There is comparatively little sand in those parts of the desert with which this article deals,—certainly nothing to compare with the dunes of Arabia or the Sahara.

The Desert Insects.

The list which follows is one of species of lepidoptera taken by myself during the last five years. I have endeavoured to confine it to desert-species, leaving those characteristic of other biotopes to be dealt with elsewhere; in a word, it deals with an ecological category of insects, not with a zoogeographical category; for the former, I use the word 'desert-species' or 'desert-insect' (just as I use 'desert-tree' and 'desert-animal')—meaning one regularly found in the desert, whereas for the latter I use the term 'eremic'.

Desert-insects, by the above definition, are those for whom the desert is a means of distribution; they may feed on desert plants, or, breeding elsewhere, may be regular migrants over the desert. But desert-flora itself varies locally, not only according to the latitude and altitude, but according to the nature and the drainage of the soil at any one place. Certain valleys or quite shallow depressions, which are not oases because they contain no wells, no cultivation, and, except immediately after heavy rains, no surface water, nevertheless boast a denser and more varied vegetation, and consequently a richer insect-fauna, than the surrounding ground. Such flora and fauna must be regarded as of a desert kind. It is however rare to find tamarisks growing in the Mesopotamian desert except where there is perennial surface-water, and I class the tamarisk as an oasis-tree here. In other deserts this may not be so. The nebek or sadr tree (*Zizyphus Spina-christi*) however must be considered a true desert-tree of our area, though limited only to certain parts of it, in the south. One might also include the wild pistaccio (*Pistacia mutica*) as a desert-tree of Mesopotamia, for it is still to be found on the Jebel Abdul Aziz, Jebel Sinjar, and some of the hills between Raqqa and Palmyra, and once grew on other desert-hills in N. Iraq, its disappearance from which is probably due to centuries of charcoal-burning; no entomologist has however visited these desert-mountains where the tree still grows, so I do not here record the species usually associated with this tree, such as *Thaumetopoea solitaria* and *Oulobophora externata*, which one might expect in these places. Perhaps these surviving trees are the relics of a woodland which in the several pluvial periods of the Pleistocene Age may have covered a great deal of the desert.

Oasis-insects, if not also desert-insects, are excluded from this paper:—i.e. those species biologically dependent on poplar, tamarisk, fruit-trees, crops, shady undergrowth, or marsh-plants, which do not also migrate over the desert. They are treated in two separate papers, one concerned with the orchard species, the other with the river species. The first of these papers is quoted in footnote (1), p. 826 while the second, dealing with the insects attached to tamarisk and Euphrates poplar, has not yet been published.

Such plants as *Alhagi camelorum* and *Prosopis stephaniana*, which are typical desert-plants, thrive also in oases; similarly many true desert-moths are to be found breeding in numbers in oases. Oases therefore are much more ambiguous biotopes than the desert, in which one finds few species from other biotopes, and those few wandering intruders.

The ecology of desert-insects has been ably discussed by Buxton[1], Bodenheimer[2], and Amsel[3], so no detailed account of it is here called for. Suffice it to say, that insect activity is concentrated in the early summer and autumn, the two seasons when the climate is most favourable, with larval activity in late autumn and spring. Between these two active periods come the winter and summer pauses, during which imaginal flight is much rarer. *Ocnogyna loewi* is the principal winter moth, while *Zizera galba* and several Cossids are the most successful midsummer fliers. Rootfeeding or diurnally subterranean larval habits enable many species to appear in the utmost profusion as adults, even in the most dry and torrid parts of the desert.

The facies of desert insects is in general lighter than that of lepidoptera from colder and moister climes. Bold disruptive colouring appears on the wings of several species, though not so frequently as on the Iranian plateau; more frequently black bands on a white hindwing form a striking contrast to 'desert-coloured' forewings, and operate as 'flash' colouring in flight. Dayflying is more frequent in the Agrotidae than in less hot climates. Metallic gold or fiery-brown markings on a white satin ground, are another colour-scheme favoured by the representatives of unrelated families. A desert-collector's cabinet thus recompenses him, by its attractive contents, for the cheerless scenery in which he collects.

The Agrotidae and the Pyralidae are the families of Lepidoptera best represented in the desert. Geometridae, which are to a large extent a wood-loving family, are comparatively few.

While many of the desert-species in the list have vast range, there are one or two notable local species (e.g. *Lithostege buxtoni, Armada leprosa*) which seem only to range from the Iranian plateau to the plains below.

A brief summary of the faunistic affinities of the desert-species was given in my article 'Insect Biotopes in Syria Iraq and Iran' (*Ent. Rec.* April 1940), anticipating the analysis referred to in footnote (1).

Description of Localities.

1. Mosul Desert (M. D.)

The exact place is Kharbat al Bayadir near Tel Hawa, 1,300 ft.; undulating steppe-desert between Jebel Sinjar and the Turkish foothills. Inhabitants, Shammar Arabs. Visited in vi-viii, 1935.

2. Mosul (M).

Similar country, 700 ft., on the banks of the Tigris. There is practically no irrigation here, but in places spring barley is grown. Visited, mid-v to ix-35, and x-36. Inhabitants mixed Arab, Kurd, and Christian (Semitic).

3. Fatha Gorge (F. G.)

The Tigris here breaks through the Jebel Hamrin, a ridge whose height is nowhere more than 600 ft. No cultivation or river trees. A brief day-time visit 30-iii-36. Arabs.

[1] *Animal Life in Deserts* by P. A. Buxton, London, 1923.
[2] *Animal life in Palestine* by F. S. Bodenheimer, Jerusalem, 1935.
[3] *Die Lepidopteren Palastinas*, by H. G. Amsel; Zoogeographica Oct. 1933.

4. Baiji (Bi.)

A few miles S.-W. of 3. Open steppe-desert. A single night, at the pipe-line station, 1-x-36. Arabs.

5. Haditha (H.)

At 400 ft., in typical Syrian-desert country, a mile or two east of the Euphrates. One night at the pipe-line station, 30-ix-36. Arabs.

6. Palmyra (P.)

In the centre of the Syrian desert. Height, 1,300 ft. Visited on two nights, 7-iv-34 and 29-ix-36, the latter visit being to station T. 3 on the pipe-line. Arabs.

7. Table Mountain (T. M.)

The Dyala here breaks through the Jebel Hamrin. Height, 200-400 ft. Visited several times in iii and iv-36. No cultivation. Arabs.

8. Qaraghan (Q.)

The Dyala here flows between low hills and plateaux, the foot-hills of the Zagros. Close by is the similar locality of Qizil Robat, where Peile took many of the butterflies described in *Journ. Bombay N.H.S.*, Dec. 1921 and March 1922. Quite similar to 7. Visited in iii-37. Arabs and Kurds mixed.

9. Jebel Darwishka (J. D.)

Height 750 ft. (*Fasilah Pass*). The road here passes over one of the foot-hills mentioned under 8, before dropping down to locality 10. Bare arid hills of conglomerate. Visited, iii-36, iii-37, and xi-xii-36. Arabs and Kurds.

10. Khanikin (Kh.)

On the Dyala, between 9 and the Zagros. Some palm-gardens and other cultivation on a narrow alluvial strip between stony hills and plains. Visited same times as 9. Arabs and Kurds.

11. Naft-i-Shah (N. S.)

On the Persian side of the frontier, but similar country to localities 8, 9, 10, and adjacent to them. Visited on one night, 14-xi-39.

12. Bagdad (Bd.)

Alluvial plain, irrigated by lift from the Tigris. 100 ft. Was collected in all the year round. Orchards, gardens, and river trees make this a very ambiguous locality. Arabs.

13. Seleucia (Sa.)

In the alluvial plain, near Bagdad. Irrigated crops, but few trees. Arabs.

14. Kerbela Desert (K. D.)

Steppe desert, 600 ft., more arid than the Mosul Desert, but even so with some thick patches of local low vegetation. The actual locality is 150 miles west of Kerbela, 20 miles north of Nukhaib Post, at Habbariyah well. I visited this place for two nights in late iii-37, and from that date until vi-37 Mr. Diamond, who was in camp there, collected regularly for me everything that came to light. This material therefore gives a fairly complete picture of desert moths in this area flying before the midsummer pause. Anizeh Arabs.

15. Ukhaider (U.)

Similar to 14 but rockier, 400 ft. 50 miles west of Kerbela. A fine ruined castle is the focal-point for butterflies here. A short daylight visit, 29-iii-37. Anizeh Arabs.

16. **Nejf** (N.)

400 ft., steppe desert, even more arid than 14. Arabs. Visited, 26-III-37.

17. **Salehabad** (S.)

Irrigated steppe desert, a flat plateau at 600 ft. Near Dizful, Persia. Also called Andemeshk. Visited on single nights, 4-iv-38, 29-x-38. Bakhtiari winter quarters.

18. **Ahwaz** (A.)

A ridge of sandstone outcrops from the alluvial plain of Khuzistan. Height, 200 to 400 ft. With a south wind, the climate can be very humid; the winters are also milder than most of the preceding localities. Was collected in during iv, v, vi, viii, ix and x-38. Population, mixed Arab and Persian. The river Karun breaks through the ridge, and provides water for a certain amount of cultivation. Some nebek trees.

19. **Maidan-i-Naftun** (M. N.)

Arid limestone and gypsum hills (c. 1000 ft.), with considerable low herbage, and water in the principal valleys. Visited 5-v-38. Bakhtiari Inhabitants.

20. **Bushire and Dalaki** (Bsh. & D.)

Though my collecting in Farsistan is not concluded yet, it will not be out of place to add to this article several records made at and near Bushire in xi-40. Bushire is a low peninsula of mixed sand, gypsum and sandstone, with a certain number of nebek, *Prosopis* and other trees. The Filfil Pass near Dalaki, is a completely arid but hilly locality, 800 ft. in the lowest Zagros foothills. Both these localities are unpleasantly hot and humid in summer, pleasant in winter. Inhabitants, of mixed race.

The initials in brackets are used as abbreviations for the above localities in the following records.

P., H., K. D., U., and N. are west of the Euphrates.

T. M., Q., J. D., Kh., and N. S. might be regarded all as one locality, and they, together with S., A., M. N., Bsh. and D. are east of the Tigris and subject to a strong Iranian influence.

The localities are given above in order north to south.

M. D., and M. are well north of the limit of palm-cultivation, while F. G., B., H. and P. lie slightly north of the limit.

Specimens collected at Kh., Bd., Sa., S., and some of those at A. were taken on ambiguous ground (i.e. oasis and desert fauna), those at M, M.N., and Bsh. on slightly ambiguous ground; the rest of the localities collected at were unrelieved desert.

List of Desert Lepidoptera.

(Taken by the author at the above localities).

If no locality is indicated for an insect below, it may be taken that that species is generally distributed in the whole area.

Rhopalocera.

Papilio machaon L. **centralis** Stgr.

On low foot-hills, at Q, etc., in spring.

Zegris eupheme Esp. **tigris** Riley and **dyala** Peile.

The form *tigris* occurs from Transjordan eastwards into Iraq where F. G., east bank of Tigris, is its easternmost known limit. The Jebel Hamrin, however, on which it breeds and flies, extends hence without interruption into the territory of the other form, *dyala*, which, first taken near Q by its author, flies also on J. D. and extends thence south-eastwards into Farsistan, where Brandt took it at about 2,550 ft.

Detailed information about this and other butterflies was given by Peile, *loc. cit.*, so I abbreviate my comments on this and other Rhopalocera, to avoid repeating.

Short migrations have been recorded of this species but it cannot be a long-distance-migrant.

Glycestha aurota Fab. **(= mesentina)**

This species passes the winter as an imago in the low hills around Q, and thence south-eastward.

Euchloe ausonia Hbn. **persica** Verity.

Euchloe belemia Esp.

Euchloe charlonia Douz. **mesopotamica** Stgr. and **transcaspica** Stgr.

The bright yellow form *mesopotamica* occurs at U., while the whiter *transcaspica* flies in iii and iv at T. M., Q., and J. D., and thence into Fars where Brandt took it with *dyala*. Pfeiffer regards this race as distinct from *transcaspica*, to which Riley and Brandt attribute it.

Pontia daplidice L.

Pontia glauconome Klug. **iranica** Bien.

Colias croceus Fourc.

Noted in the Iraqian plain in every month except viii and ix.

Teracolus fausta Oliv.

Catopsilia florella F.

At J. D. and F. G., in iii and iv. Perhaps not every year, for Peile did not record it.

Eumenis telephassa Hbn.

Eumenis persephone Hbn.

Eumenis pelopea Klug.

The third of these species I only found at M.D., but the others are widespread.

Pyrameis cardui L.

On the wing all the winter, but less seen in summer than *croceus*, the other migrant which breeds here. Foodplant: malva parviflora, etc.

Melitaea trivia Schiff.

Not seen on the alluvial plain.

Danais chrysippus L.

At Bd. a garden insect, feeding on *Asclepias curassavica*, but associated with *Calotropis procera* in the desert in the south-eastern corner of our area.

Chilades galba Led.

Chilades trochilus Frey.

Tarucus theophrastus Fab.

Tarucus mediterraneae B-B.

Tarucus balkanicus B-B. **areshanus** Frr.

At Bagdad the nebek is an oasis-tree but in the south-east corner of our desert area it grows in the desert, accompanied by the above three species.

Hesperia geron Wats. (det. Evans).

Three dwarf specimens near A, 16-x-38.

Eogenes alcides H. S. **elama** Wilts.

M. N., 6-v-38. This remarkable local form [1] differs in having the less-pointed forewing unmarked except for three small contiguous apical spots in spaces 6 to 8.

Adopaea thaumas Hufn.

M. N., in V.

HETEROCERA.

Syntomis aurivala Schaw.

This rare species has been re-taken at Abu Wajna near Mosul, on 7-v-29, by Yusuf Lazar, the collector for the Field Museum Chicago. I do not know the exact whereabouts of this locality.

Utetheisa puchella L.

This species breeds in Iraq. Commonest in autumn.

Ocnogyna loewii Z.

Widespread except on the alluvial plain.

Axiopaena maura Eich.

One perfect specimen indoors at Bsh, in v-40, a most surprising date, since I had previously only taken the species in the autumn in the Kurdish hills. Watkins (in *Journ. Bombay N. H. S.*, Dec. 1921) recorded a specimen of *Lasiocampa grandis* taken at Amara in May 1917. Until my capture of *maura* I almost inclined to think that that date was an error, but it may be that certain species, normally autumnal, regularly emerge in early summer in very torrid desert localities and perhaps aestivate. The perfect condition of my *maura* was in strong contrast to the usually ragged condition of this moth in the hills in autumn, and this suggests to me that perhaps the specimen was sexually immature, and that aestivation plays a part similar to hibernation in *Vanessa urticae* in England. I have however no proof that aestivation takes place, nor has the specimen been dissected. But these two records certainly raise a point which desert collectors should not lose sight of. (I have taken *L. grandis* at 5,000-6,000 ft. near Shiraz in the autumn, thus confirming Watkins' record. Its occurrence at Amara and Shiraz would make it probably eligible for inclusion in this list as a desert-moth.)

Chondrostega aurivillii Pungl. **feisali** Wilts.

Bi., H., Q., and near A. The male comes to light in early x, and the larva often swarms in iii and iv.

This form (1) is about the same size as *fasciana* Stgr., which is probably conspecific, but with a white ground colour, and brown median and sub-marginal bands, which often almost vanish. Typical *aurivillii* are apparently more heavily marked and smaller. In Arabia an extreme development of *feisali* occurs, in which the wings are pure white and unmarked. The larva is described in the full description referred to in footnote (1), p. 826.

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[1] A full description, with photographs, of the two new forms *elama* and *feisali* is being published elsewhere; but if these should prove not to have priority the above brief descriptions must be taken as the preliminary but valid ones.

Chilena proxima Stgr.

The commonest Bombyx in Iraq, and a characteristic insect of the Mesopotamian desert, from the Turkish foot-hills to Khuzistan. The pretty lackey caterpillar, described at length and figured in *Ent. Rec.*, June 1940, feeds in rapid successive broods on *Prosopis stephaniana*.

Celerio lineata livornica Esp.

Two broods occur in spring and early summer, and the larvae are often to be seen in profusion in the desert at that season; the imago sometimes appears in the autumn. A well-known migrant.

Macroglossa stellatarum L.

A well-known migrant.

Dyspessa asema Pungl. (det. le Cerf)

Two specimens at K. D. in early v.

Dyspessa wiltshirei Dan.

Q., 14-iii-37; the types.

Stygia saharae Luc. **(det.** le Cerf.)

Common to light, M. D., vii-viii. This is the first record of this species outside Africa.

Holcocerus gloriosus mesopotamicus Watk.

Most variable in extent of markings and size. Common to light at K. D. from 20-v to 20-vi-37. A single specimen taken at A on 16-viii is apparently *f. laudabilis* Stgr., which I have little doubt is the Palestinian form of this species, and not a distinct species.

Bryophila divisa oxybiensis Mill.

M.D., in v.

Bryophila tabora Stgr.

Bryophila probably **eucta** Hamps.

These two species were taken at M., 3-x. Stone is plentiful here, but desert conditions in most other localities do not favour this genus, which feeds on lichen, so it is not surprising that I only took representatives in the north.

Euxoa conspicua Hbn.

Common in iv-v, and again in ix-x; widespread except in alluvial plain.

Euxoa canariensis Reb. **diamondi** Brsn.

18-iv-37, K. D. (the type of the subspecies.). The same form of this widely distributed Eremic species has been taken by Brandt in Fars.

Agrotis segetis Hbn.

Agrotis ypsilon Rott.

This species seems to appear, in the desert and oases of the Mesopotamian plain, only in the cooler months between ix and vi. It has been suggested that a migration to higher ground accounts for its summer absence, but this suggestion seems to me to be unnecessary, aestivation being so frequent in lepidoptera in the desert, though I have certainly taken it on the wing in high mountains during those months when it is not to be seen at lower elevations. The same seems to be the case with *segetis* Hbn. These species that fly continuously during the cooler months are not in the same class as those

which have two distinct generations, in autumn and spring, such as *Dyscia plebejaria, Elaphria bodenheimeri*, and *Cornifrons ulceratalis*.

Agrotis crassa golickei Ersch.

Golickei is perhaps an oasis-insect at Bagdad, but further north seems to be a true desert habitant. Autumnal.

Agrotis flavina H. S.

This species, typical of the high steppes of Turkey and Iran, occurs in the desert only at the higher elevations, e.g. M., 18-v-35. I have also taken it, in the Bekaa (Syria), and at Hamadan and Tehran, and Brandt has recorded it from as far south as Farsistan.

Agrotis puta Hbn.

Kh., 27-xi. Also at Kirkuk in iii-36.

Agrotis (Powellinia) lasserrei Ob.

The reddish hue of Iraqi specimens seems to put them closer to N. African than Central Asian forms. Very common in xi on both alluvial and stony desert.

Agrotis (Powellinia) matritensis Vasq.

Bsh. 21-23. xi. These examples have rather dark grey hindwings: males: to light. (Also taken at Bi. by Peile, 1919).

Agrotis haifae Stgr. (det. Brsn.)

J. D., 7-x. Boursin gives as synonyms or races of this species: *hoggari* Roths., *securifera* Tur., and *saracenica* Tams.

Rhyacia flammatra Schiff. **centralasiæ** Wagn.

A steppe insect, with a similar range to *flavina* (*vide supra*) M. and M. D., in v, vi, and x.

Rhyacia taurica Stgr. (b. sp.) (det. Brsn.)

M., x-36.

Triphaena pronuba L.

K. D., iv.

Actinotia hyperici Schiff.

M. D., in vi.

Polia consanguis Guen.

P., 30-ix.

Pronotestra silenides Stgr.

K. D., iii.

Scotogramma trifolii Rott. (= **taylori** Roths.)

Discestra arenaria Hamps.

A, late iv and x, 38, with a partial brood in captivity in v. The larva was described and figured in *Ent. Rec.* June 1940.

Discestra eremistis Pungl.

Near A, 14-x-38. Boursin wrote of this example: 'Si ce n'est pas *eremistis* c'est *vaciva*; mais du point de vue biogéographique, c'est la même chose.'

Cardapia sp.

P., 30-ix.

Hphilare loreyi Dup.

Brachygalea albolineata Blach.

One specimen, 5-iii-37, Bd. Previously only known from Tunis and Algeria.

Cucullia boryphora F-Wald. (det. Boursin).

K. D., iii- and iv-37. Known from Central Asia, S. Russia, Armenia and Anatolia, and, according to Boursin, 'probably the same as the Spanish *achillea* Guen.'

Cucullia strigicosta Brsn.

The types were reared from larvae found on the ridge of J. D. in iv-36, hatching in iii-37. Foodplant, *Scrophularia*.

Cucullia wredowi Costa (det. Boursin).

T. M., Bd, Sa, and A. Also on the Iranian high plateau, and known from Anatolia, Italy, S. France and N. Africa. The larva of the Iraqi moth differs recognisably from that of the Lebanese *wredowi-judaeorum* Strand.

Lithophasia = (Hypomecia) quadrivirgula Mab. (det. Brsn.)

Three females to light, J. D., 14-xi-36. They belong to the N. African form, not to the Palestinian, *jordana* Stertz.

Copiphana gafsana Blach. (det. Brsn).

K. D., 28-iii-37. Previously only known from Tunis.

Metopoceras delicata Stgr. (det. Brsn).

The rather dark-rose female from T. M. was determined by Boursin as this species, and not as *pilleti* Brsn, which I thought it was on catching it. The type of *pilleti* was taken at Deir es Zor, on the Euphrates (Syria) from which I have ordinary specimens of *delicata*. Only one female of *pilleti* has ever been caught and I suspect it to be an extreme aberration of *delicata*. The T. M. example was taken in xi, and a series from K.D. (1-v-37) is paler, and more typical.

Metopoceras omar Ob.

The form *caspica* Alph. certainly occurs in Iraq but this name cannot be used, as by Rothschild, to describe the race. The species varies here from ash-grey to deep red-brown. I infer that there are two consecutive spring broods from the following records: T. M., 13-iii-37, a very varied series; K. D., 1 to 6-v-37, a paler, less varied series. Common at A. in iv. Brandt refers his *Farsistan* examples to *felix* Stfs.

Cleophana pectinicornis Stgr. (det. Brsn).

A common spring moth on the stony desert, previously only known from N. Africa.

Cleophana jubata Ob. (det. Brsn).

A N. African species, flying in Iraq commonly together with *baetica* Q, K. D.

Cleophana baetica diluta Roths.

T. M., Q, K. D. Common to light in iii and iv. Also known from Spain, N. Africa, the Taurus, Georgia, and Farsistan.

Calophasia pampaninii Krug.

K. D., 31-iii-37, one. Previously only known from Cyrenaica.

Metalopha liturata Chr.

S, 4-iv-38.

Acrobyla kneuckeri Rebel.

Two, in iv at A. The type being inaccessible, the species has been determined according to the British Museum's examples from Arabia. The Ahwaz form is darker than these, though closer to them than to *ariefera* Hamps.

Derthisa lederi Christ.

Kh., in xi. Commoner a little earlier higher up in the Zagros range.

Aporophila nigra ssp. n. **dipsalea** Wilts.

This remarkable desert form (perhaps also occurring in the Zagros hills) differs from the typical by its lighter, 'drier' coloration. Forewing, above: pale wood-brown, with a somewhat obfuscated median area, and a narrow dark grey marginal shade, approaching which the nervures become dark grey also. Lines, clear, outlined in sooty brown. Orbicular stigma, with grey centre and pale outline; reniform, similar, the distal outline being whitish. Fringe, smoky grey with lighter brown interruptions at the nervures. Underside, greyish white with a pale coppery glint; nervures and post- and antemedian lines distinctly outlined in faint brown; reniform stigma, darker brown; fringes darker brown. Hindwing (male) white, with nervures marked in pale brown and margin in rather darker brown. Expanse, 40 mm.

Holotype, ♂, 14-xi-39, Naft-i-Shah. In coll. m.

The distinctly brownish race found in the Lebanon seems to be an intermediate between the normal and the desert forms, and is larger than *dipsalea*, spanning 46 mm.

Antitype canescens Dup.

This typically Mediterranean moth also flies commonly in autumn in the Zagros up to at least 5,000 ft. (Kermanshah and Shiraz), but also comes down to the lowest desert: Bsh., and D., late xi. The larva is here polyphagous, but especially fond of *Calendula*.

Autophila limbata Stgr. (det. Brsn).

M. D., vi-35.

Autophila cerealis ssp. **amseli** Drdt.

A, K. D., common in iv and v, the 10-footed larva feeding on *Salvia*.

Autophila cymaenotaenia Brsn. ssp.

K. D., 4-v-37, one.

Apopestes spectrum Esp.

M. D., in vi. In the Lebanon, it flies in ix, at Suleimani (S. Kurdistan) a specimen was taken in xii; at Hamadan, it first emerged in early vi. I have never seen any sign of second-brood larvae, and believe the late Suleimani date can be explained by its habit of long rests and ultimate hibernation indoors. In Mediterranean areas it feeds on Spanish broom, but in the interior of Iran I have found *Glycyrrhiza* bushes amidst cultivation infested locally with its larvae and cocoons. This is probably its chief foodplant in Mesopotamia.

Tathorhynchus exiccata Led.

K. D., 14-iv-37, one.

Scythocentropus inquinata Mab.

P., 30-ix. Previously known from Tunis.

Pseudohadena chenopodiphaga Ramb.

Prodenia litura F.

Hypeuthina fulgurita Led.

Kh. and Bsh., xi. At 3,000 ft. in the Bekaa (Syria), at coast-level in the Lebanon, at about 2,000 ft. in Kurdistan, and at 3,000 ft. in Farsistan (Shapur), this species is associated with *Stilbina hypaenides* Stgr, which flies with it, but I have not yet taken *hypaenides* in the desert proper, unless Shapur (an intermediate locality) be considered such.

Rhabinopteryx subtilis Mab.

K. D. and Bd., iii.

Laphygma exigua Hbn.

Elaphria clavipalpis Scop.

Elaphria bodenheimeri ssp. **chlorotica** Brsn.

M, Q, J. D., Kh., S and A. The autumn brood (x and xi) is very numerous; the spring brood, which consists of larger specimens, is the reverse. (iii and iv). This race comes closer to the Iranian race (*plesiarchia* Brsn) than the nomino-typical Palestinian-Lebanese race, and indeed fuses with the former by transitional forms difficult to assign to either.

Elaphria flava Ob. (det. Brsn).

K. D., 27-iii to 11-iv-37. Boursin considers old records of this species from Palestine an error for *bodenheimeri*, which had not then been described. These are the first sure records out of N. Africa, and its occurrence in the southern desert parts of Palestine seems likely after all.

Elaphria belucha Swinh. b. sp. (det. Brsn)

P., M, and Kurdistan, in x. The type came from Quetta.

Catamecia minima Swinh.

A, 7-v and late x. The relation of this Sindian species to congeners described from Palestine and N. Africa requires further investigation.

Pseudathetis fixseni Chr.

A, in iv and again more commonly in x.

Dysmilichia bicyclica Stgr. (det. Brsn).

One, Q, 13-iii-37. Also at Tehran, ii-v-39, on hilly steppe at 5,000 ft., a quite waterless locality.

Hadjina viscosa Frr.

A, 27-iv, and 6-v-38.

Aegle ottoi Schaw.

Originally described from near M, I have a short series of this species from K. D., taken in v, and a longer series from A, taken in late iv. The markings vary somewhat in intensity.

Aegle rebeli Schaw.

M. D. and M. in v; M. N., 5-v-38. Also Kurdistan.

Metaegle pallida Stgr.

M. D. and M, common in v and vi. Also Kurdistan.

Chloridea peltigera Schiff.

Chloridea obsoleta Fab.

Chariclea delphinii f. **darollesi** Ob.

M. D., one (3-vi-35).

Aedophron phlebophora Led.

M. D., in vi and vii. This and the foregoing species only occur at the higher levels of the desert.

Porphyrinia parva Hbn.

Porphyrinia albida f. **peralba** Schaw.

Of this form, probably the Iraqi subspecies, described from M, I have two examples from K. D. (4-v-37).

Glaphyra lacernaria Hbn. **cretula** Frr.

M. D., vi- 35.

Tarache biskrensis Ob. **orientalis** Brdt.

Bd., K. D., A., iv and early v.

Tarache lucida Hfn.

At A it was noted that the specimens flying in iv were typical, while those flying in v and the autumn were f. *insolatrix* or f. *albicollis* F. It is generally distributed.

Anua tirrhaca Cr.

P., iv-34. Cannot occur far from the wild pistaccio tree.

Mormonia neonympha Esp.

M. D., early vi.

Anophia sp.

M., 10-vii-35.

Cortyta vetusta Walk. or **profesta** Chr.

Pericyma squalens Led.

Pericyma albidentaria Frr.

Cerocala sana Stgr.

I have only taken the autumn brood, which shewed considerable variation, but, on the whole, had less yellowish hind wings than Beirut specimens. Flies near A, in x.

Leucanitis kabylaria B-Haas.,

A., 21-iv and 16-x.

Syngrapha circumflexa L.

Phytometra gamma L.

Phytometra ni Hbn.

Raphia cheituna Brdt.

I took three examples of this species, recently described from Bander Abbas, at Bsh., in late xi-40.

Pandesma anysa Guen.

M. (vii-ix), Bd. (ii-ix), K. D. (10 to 26-vi-37). The larvae were found in great numbers on *Populus euphratica* in iii and iv on an island in the Tigris. The main emergence at Bd occurs at the end of iv though odd specimens are seen earlier; larvae and imagines then continue to be found, at Bd, throughout the summer. At K. D. (far from the river), the species appeared in great numbers at light in vi, but not a single specimen before. The inference is that it can only breed continuously on the cultivated riverain tracts, and that desert examples are emigrants from such breeding grounds. A specimen was taken in an Elburz river valley at about 5,000 ft. on 28-v-39.

Anumeta spilota Ersch.

K. D., in early v.

Anumeta major Roths.

A., 26-v-38. This species may be the same as *spatzi* Roths.

Aleucanitis flexuosa Men.

Armada leprosa Brdt.

D., 25-xi. Common about two months earlier at 6,000 ft. on the Bushire-Shiraz road.

Armada panaceorum Men.

A common insect from mid iii to early v on the stony desert. The eastrn-most localities (T. M., Q, etc.) seem to produce slightly browner specimens than the Syrian-Arabian desert side.

Armada hueberi Ersch.

Common to light along the Kurdish-Persian foothills, from T. M. to A. (iii and iv).

Armada ornata Brdt.

16-x-38, near A. A Persian species.

Rhynchodontodes revolutalis Z.

Very common along the river valleys but occurring also in unrelieved desert, in bushy places. I consider *eremialis* Swinh. and *syriacalis* Stgr. synonyms of this species, which thus ranges from Sind to Egypt, perhaps further west. The type of *revolutalis* is in the British Museum, and came from South Africa! There is no other specimen like it from S. Africa in the Museum collection, rich though it is in S. African material.

Pingasa lahayei Ob.

A., 22-v., and Bsh., late xi. Probably associated with the *Zizyphus* (nebek) tree.

Neromia pulvereisparsa Hamps.

N. S., 14-xi-39. Known from Aden, the Persian Gulf, and Palestine.

Microloxa herbaria Hbn. **advolata** Ev.

K. D., v-vi.

Rhodometra sacraria L.

M. D., vi; A: larvae on wild *beta* in hollows (the more usual foodplant is *Polygonum*).

Scopula beckeraria Led.

A characteristic insect of the poor steppes of the Middle East, appearing in a spring and an autumn brood. It is commoner at higher elevations, but occurs in the desert: Kh., xi; A., x.

Glossotrophia asellaria semitata Prt.

K. D., v; M. N., v; M. D., vi.

Lithostege palaestinensis Ams. ssp. n. **ali** Wilts.

Rather resembles *griseata* than the nominotypical form from Palestine, being darker grey, especially the hindwings. Varies somewhat in size. This must be the same species that was recorded in 1921 by the *Bombay N.H.S.* as *farinata*. It flies in iv and v at practically all the localities from F. G. southwards. At K. D. and N dwarf forms occur, doubtless due to the great aridity of the desert here.

Lithostege notata B-Haas.

T. M. (14-iii-36), one.

Lithostege dissocyma Prout.

The type was taken at T. M. on 14-iii-36. It laid eggs but I failed to persuade the young larvae to feed. No other specimen has yet been taken.

Lithostege buxtoni Prout.

One of the two types came from Shergat, a stony locality near Bi. The other came from between Kermanshah and Hamadan, Iran (c. 5,000 ft.) I have taken examples at Suleimani (Kurdistan), Kermanshah and Shiraz in xii.

Eupithecia tesserata Brdt.

A., iv. A common insect in Farsistan.

Macaria syriacaria Stgr.

Widespread, common in oases, but also a habitant of the unrelieved desert. Larva feeds on prosopis stephaniana and was described in *Mitt. Muench. Ent. Ges.* 1939, Heft 1.

Dyscia plebejaria Ob.

The typical Saharan form occurs at M. and K. D., in a spring and autumn brood.

Gnopharmia crema Whrli.

In early v at K. D. and M. N.

PYRALS AND MICROS.

The determination of these is not yet complete, so they are omitted *in toto* from this paper.

DOUBTFULLY DESERT SPECIES.

The following were taken at ambiguous localities, and not enough is known about them yet for one to attribute them with certainty to the ecological classes of desert-insects.

Taragama siva Lef.

This Indian species reaches as far as Bagdad, where it is chiefly attached to river and garden trees (*Populus euphratica*, apple, willow, pomegranate,

tamarisk) but also feeds freely on the small thorn *Prosopis stephaniana* on cultivated ground. There seems no reason why it should not accompany this thorn into the unrelieved desert, but the fact remains that the moth has not yet been noted there. In Bsh., and S. Mesopotamia it feeds on the *Prosopis* tree.

Dyspessa bipunctata marginepunctata Wilts.

A., iv-38. This is the only place in the desert where I have taken this species, common higher up in the Zagros range. Its early stages are unknown. Another species of *Dyspessa* was also taken near Ahwaz but has not yet been identified.

Agrotis exclamationis

M., 25-vii-35, one only.

Elaphria zobeidah Brsn.

M., Bd. in iii and x. It also occurs in high Persia.

Spodoptera latebrosa Led.

A., in iv and ix. Bsh., in xi.

Chloridea nubigera H. S.

A., 2-v.

Leptosia velox rubescens Schw.

M. N., 3-v-38.

Thermesia arefacta Swinh.

Like *siva*, feeds on *P. stephaniana* and has only so far been taken on irrigated ground or river-sides. Bd., and near A. Late summer and autumn.

Chloroclystis lita palearctica Brdt.

A., 28-iv.

Zamacra flabellaria Heeg.

Bd., 18-xii-35. Peile also took a series at Mirjana, on the Dyala near T. M. and I do not know if this locality was or was not ambiguous.

TWO NEW NITELLAS.

BY

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(With 2 plates).

In the present paper two new Nitellas have been described. For *N. pseudotenuissima* I am indebted to Dr. H. Chaudhuri of the Punjab University who kindly placed at my disposal the specimens collected by Prof. Dewan Mohindranath, a former student of his, from a shallow tank at the foot of the Murree Hills. I take this opportunity of thanking Rev. Father Pew of St. Xavier's College, Calcutta, for the Latin version of the descriptions.

DESCRIPTION.

Nitella pseudotenuissima sp. nov.

Arthrodactyla homoeoclema conoteles subflabellata gymnocephala macrodactyla monoecia.

Caulis tenuissimus, 235-305 μ crassa, non incrustata, verticilli duplicis generis: principalis caulis radiantes et dispersi atque ramorum maxime congesti et moniliformes; ambo fertiles, generaliter tantum unus ramus ad nodum caulis. Ramuli caulis sex ad nodum et semel vel bis furcati, radii primarii 2/5 longitudinis ramuli, radii secundarii 6, raro 5; sex secundariorum radiorum quatuor iterum dividunt in 2-4 ultimos radios et inequales longitudine sunt. Parviores verticilli cum ramulis brevissimis et capitibus densis, ramuli generatim 6 ad nodum, 2-3-furcati, primarii radii circiter $\frac{1}{3}$ longitudinis totius ramuli, radii secundarii 4-5, radii tertiarii 3-4, tantum unus vel raro duo tertiariorum radiorum divident in 3 vel 4 ultimos radios. Dactyli bicellulati, apex penultimae cellulae rotunda apicis cellula conica. Fructificationes non invenluntur in prima furcatione ramulorum. Oogonia solitaria vel frequenter geminata, ovoida. Oospora subglobosa subflavo maura cum 6 iugis non altis; 188 μ longa, 174-178.5 μ lata; membrana flavo-aurea, vermiformis granulata. Antheridia 158-162.5 μ in diametro.

Stem very slender, 235-305 μ in diameter, not incrusted; internodes 3-6.5 cm. long. Whorls of two kinds: those on the branches much congested and more or less moniliform. Both kinds of whorls are fertile. One or more frequently two branches develop at a stem node. Branchlets on the stem 6 at a node; 1-2 times furcate; primary rays about 2/5 the entire length of the branchlet; secondary rays 6, rarely 5; of the 6 secondary rays 3-4 divide again into 2-4 ultimate rays and the other 2 or 3 do not divide and are usually much longer than the dividing secondary rays, sometimes more or less equalling the combined length of the secondaries and their ultimate rays. Smaller whorls with very short branchlets forming dense heads; branchlets usually 6 at node, 2-3 times divided; entire length of branchlets 900-1650 μ. Primary rays about 1/3 the entire length of the branchlets, 300-600 μ long, 85-136 μ thick; secondary rays 4-5, 235-300 μ long, 45-70 μ thick; tertiary rays 3-4, 225-300 μ long, 52-75 μ thick; only one or rarely 2 of the tertiary rays divide into 2-4 ultimate rays (dactyls); sometimes the secondary rays do not divide at all. Dactyls 2-celled, rarely 3-celled, 47-84 μ thick; in the case of the smaller whorls 405-600 μ long; apex of the penultimate cell rounded; apical cells conical, 35-105 μ long, 18-28 μ broad at base.

Fructifications not found in the first furcation of the branchlets. Oogonia solitary or in many cases 2 together, ovoid in shape, 282-310 μ long (including

coronula), 221-258 μ broad, showing about 8-9 convolutions; in mature oogonia the convolutions are often displaced; coronula small, persistent, 24 μ high, 58.5 μ broad at base. Oospore subglobose, yellowish brown with 6 low ridges often ending in a short crown; in most cases the ridges are irregularly arranged; 188 μ long, 174-178.5 μ broad. Oospore membrane golden yellow brown, verniformly granunate. The membrane of a young oospore does not show any decoration. Antheridium 158-162.5 μ in diameter.

Shallow ditch at Kahatu at the foot of the Murree Hills, *Dewan Mohindranath*, March, 1940.

It is a very slender plant and can be at once recognised by the branched nature and by the two kinds of whorls. The whorls of the branch appear more or less moniliform to the naked eye.

It is allied to *N. tenuissima* Kutz. and agrees with that species in having 6 branchlets at a node, the first branchlet-node sterile, but can at once be distinguished from that species by its regularly branched nature, the whorls of two different kinds, the branchlets less frequently forked (especially in the case of the stem whorls), the smaller number of secondary (in the case of the whorls of the branches) and tertiary rays, the occasional presence of 3-celled dactyls, oogonia being geminate in many cases, only 6 ridges in the oospore and by the entirely different decoration of the oospore membrane.

Distinguished from *N. habrocoma* Groves and Stevens in having the following characters :—(i) shorter primary rays, (ii) smaller number of secondary and tertiary rays (iii) not having a central ray, (iv) in *N. habrocoma* the lower cell of the dactyls somewhat narrowed at the apex where they are not broader than the base of the conical upper cells; in *N. pseudotenuissima* the lower cells are not narrowed towards the apex, apex rounded and broader than the base of the conical upper cells; (v) the decoration of the oospore membrane.

It differs from *N. batrachosperma* Braun in having less numerous branchlets in a whorl, the first branchlet-node sterile, the low ridges of the oospore and by the different decoration of the oospore membrane.

From *N. mucronata* Miq. and *N. gracilis* Agardh, and their various varieties it is distinguished by the first furcation of the branchlets sterile, smaller oospore and the decoration of the oospore membrane and also by the general habit of the plant.

Nitella bengalensis sp. nov.

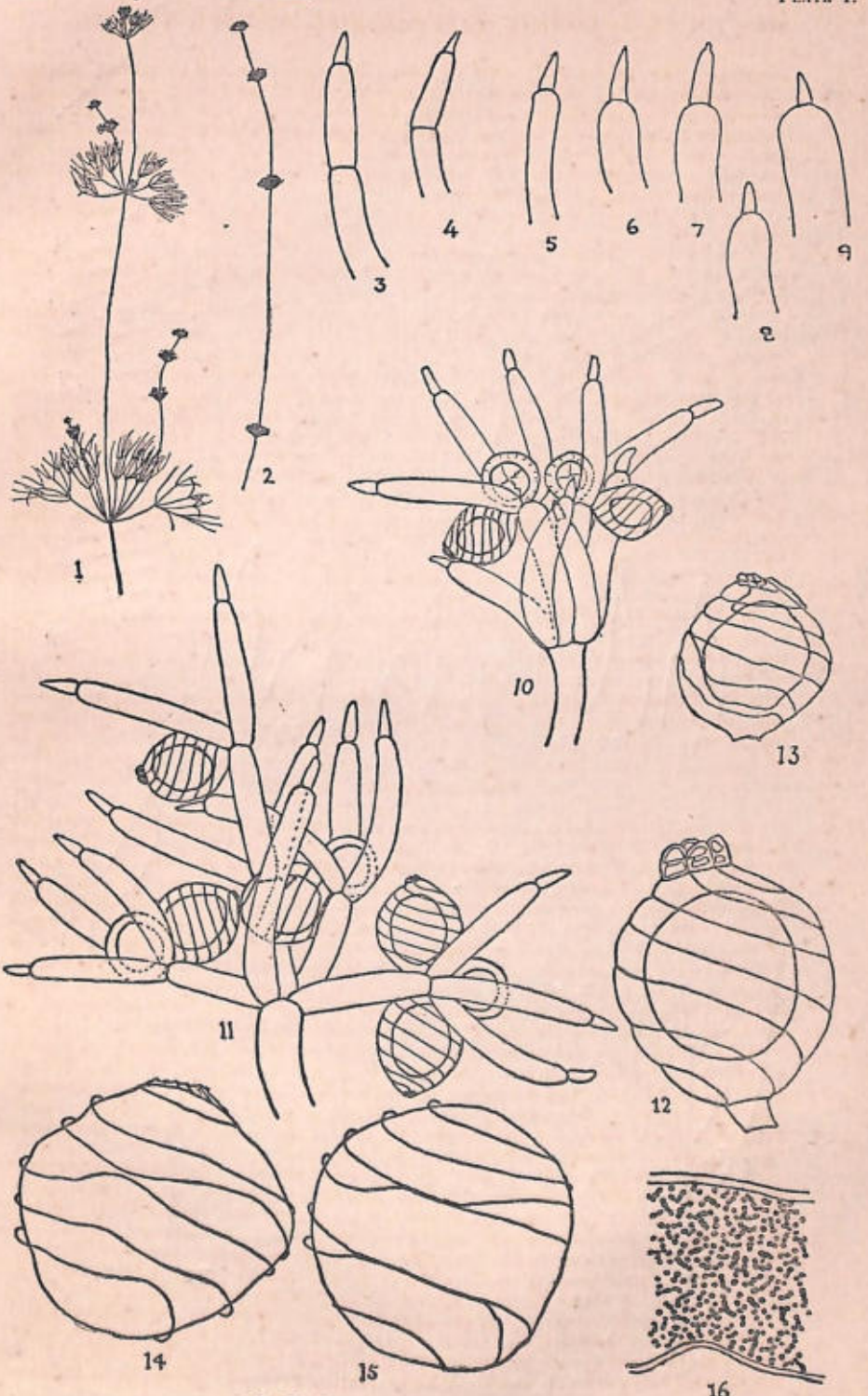
Arthrodactyla homoeoclema conoteles subflabellata gymnocephala macrodactyla monoecia.

Caulis 360 μ in diametro, verticilli 6 ramulorum, sterilis et fertiles dissimilares. Verticilli steriles—ramuli bis vel ter divisi, primarii radii circiter ½ longitudinis totius ramuli, secundarii radii 4-6, tertiarii radii 2-4; quando 2 unus non dividitur et quando 3-4 duo non dividuntur; quaternarii radii 2-3. Verticilli fertilis densi et congesti, ramulorum 6 inequales, bis vel ter divisi; primarii radii circiter ⅓ longitudinis totius ramuli; secundarii radii generatim 4-5, inequales cum unus centralis, tertiarii radii 2-4, 1-2 dividuntur in 2-3 ultimos radios; aliquotis omnes tertiarii radii non dividuntur. Dactylus 2-celluloris, cellula penultima attenuata ad finem distalem, cellula ultima conica, acuta vel parve acuminata.

Fructifitiones generatim in secunda et tertia furcatione ramulorum, aliquoties in prima. Oogonia solitaria generatim cum una antheridia, 432-450 μ longa (incl. coronula), coronula persistens, aliquoties decidua, cellula superiora aliquantulum elongata. Oospora subglobosa, parums subflavo-maura cum 6 iugis, 240-270 μ longa, 210-240 μ lata; membrana tenuis, tranlucens, exquisito reticulata, 11-12 spatia in fossula. Antheridium 225 μ in diametro.

Plants monoecious. Stem 360 μ in diameter. Whorls of 6 branchlets, sterile and fertile whorls dissimilar. Sterile whorls—branchlets 4.5-7 mm. long; 2-3 times divided; primary ray about 1/3 to 2/5 of the entire length of the branchlets, secondary rays 4-6, nearly equal in each branchlets, varying in length in different branchlets; tertiary rays 2-4, one where there are only 2, or 2 where there are 3-4 tertiary rays do not divide; quaternary rays 2-3, nearly as long as or longer than the penultimate rays, rarely shorter.

Fertile whorls overlapping, congested; branchlets 6, unequal, 1800-4500, μ long, 2-3 times divided; primary rays about 1/3 to 3/5 of the entire length of the branchlets, 450-1800 μ long; secondary rays usually 4-5, rarely 3, very unequal in length, one being central, 405-945 μ long; tertiary rays 2-4, 495-675 μ in length;



B. C. Kundu.—TWO NEW NITELLAS.

For explanation see end of article.

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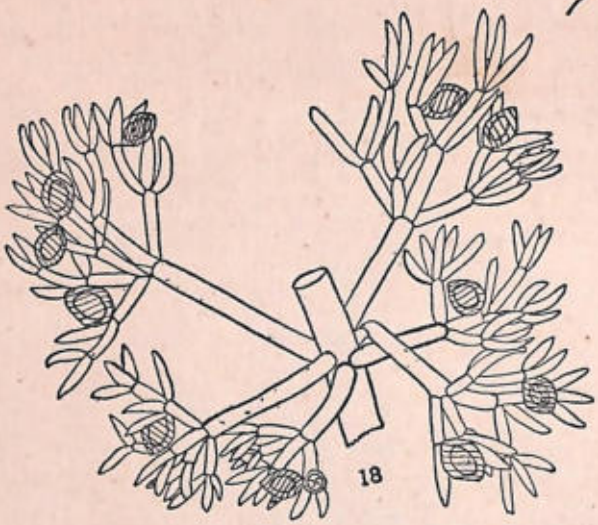

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B. C. Kundu.—TWO NEW NITELLAS.

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1 or 2 of the tertiary rays usually divide again into 2-4 ultimate rays; in some cases all the tertiary rays do not divide again. Dactyls always 2-celled, 2025-2475 μ long, 90-112.5 μ thick, penultimate cell slightly tapering at the distal end; ultimate cell narrow, conical, acute or slightly acuminate, 58.5-126 μ long, 31.5-40.5 μ broad at base.

Fructifications usually at the second and third furcations of the branchlets, sometimes also in the first. Oogonia solitary, usually along with an antheridium at the second and third furcations of the branchlets, but without an antheridium when in the first furcation of the branchlets, 432-450 μ long (including coronula), 315-350 μ broad; spiral cells showing about 7-9 convolutions; coronula persistent, occasionally deciduous, 31.5-36 μ high, 51 μ broad at base, upper cells somewhat elongated. Oospore subglobose, 240-270 μ long, 210-240 μ broad, light yellowish brown, showing 6 slightly flanged ridges; membrane thin, translucent, finely reticulate, 11-12 meshes across the fossulae. Antheridium 225 μ in diameter.

Dhapdhapi, about 20 miles south of Calcutta, 30-1-40.

The plant was collected from a shallow ditch near Dhapdhapi Railway Station, which was fast drying up. The entire area round about the small ditch was covered with water during the rains and formed part of a shallow lake 'the Kalidaha'. At the time the specimen was collected a large part of the lake had already dried up excepting small ditches formed here and there, the places being slightly deeper than the surrounding area. The plants were growing under 6 inches of clear water in the middle of one of such ditches.

It is a rather slender plant, not more than 8-10 cm. in height and is somewhat tufted in habit. It is covered with annular incrustations or in some cases incrusted all over its body.

Its nearest relation seems to be *N. mucronata* Miq. from which it is separated by the following characters:—(i) dactyls uniformly 2-celled, (ii) shape of the apex of the lower cell and of the end cell, (iii) short internodes, (iv) first furcation of the branchlets frequently sterile, (v) branchlets being unequal in the fertile whorls, (vi) presence of a central ray, (vii) small oospore with low ridges, (viii) colour of the oospore.

From *N. gracilis* Agardh it is distinguished by the above characters and also by the character of the oospore membrane.

It resembles *N. tenuissima* Kutz. in having 6 branchlets at a node and the first branchlet-node being frequently sterile, but differs from that species in its entirely different general habit and having internodes shorter than branchlets, overlapping and congested fertile whorls, the branchlets of the fertile whorls being unequal in length, smaller number or ridges in the oospore and the nature of the reticulation of the oospore membrane.

Summary.

Two new Nitellas *N. pseudotenuissima* Kundu and *N. bengalensis* Kundu are described. *N. pseudotenuissima* has the general habit of *N. tenuissima* Kutz., but is sharply distinguished from the latter by its regularly branched nature, the whorls of two different kinds, the branchlets less frequently forked especially in the case of the stem whorls, the oogonia being sometimes geminate, less number of ridges in the oospore which are often irregularly arranged and by the entirely different decoration of the oospore membrane. By the above characters it is dstinguished from all other Nitellas. *N. bengalensis* Kundu is characterised by short internodes, overlapping and congested fertile whorls, the branchlets of the fertile whorls being unequal in length, dactyls uniformly 2-celled, fructifications mostly at the second and third furcation of the branchlets, oospore showing only 6 ridges and the oospore membrane being finely reticulate, having 11-12 meshes across the fossulae.

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Explanation of plates

Plate I.

Figs. 1-16.—*N. pseudotenuissima* Kund.
Fig. 1.—Part of a plant with branches (nat. size).
Fig. 2.—A well developed branch with small congested whorls (nat. size).
Figs. 3-9.—Ends of dactyls. × 65.
Figs. 10-11.—2 branchlets from a branch with fruiting organs. × 65.
Fig. 12.—A young oogonium. × 188.
Fig. 13.—A mature oogonium showing displacement of the convolusions. × 65.
Figs. 14-15.—Oospores. × 188.
Fig. 16.—Part of oospore membrane showing decoration. × 575.
Figs. 17-30.—*N. bengalensis* Kund.

Plate II.

Fig. 17.—A plant. × 11/16.
Fig. 18.—A fruiting whorl showing unequal branchlets. In this fructifications are not found in the first furcation of the branchlets.
Figs. 19-25.—Ends of dactyls. × 62.
Fig. 26.—Part of a young fruiting whorl with antheridium and oogonium. × 22.
Fig. 27.—A mature oogonium. × 45.
Fig. 28.—Top of an oogonium showing the coronula. × 179.
Fig. 29.—An oospore. × 41.
Fig. 30.—Part of oospore membrane showing decoration. × 550.

OBSERVATIONS ON THE BIOLOGY OF SOME SOUTH INDIAN COCCIDS.

BY

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(*With 4 plates*).

The insect group Coccidae constitutes one of the largest and most important families of Homopterous bugs, and from the economic point of view this family is one of the most important groups of insects which man has to deal with.

With the idea of supplementing our knowledge of the species of this group found in South India, an attempt is made in this paper to give descriptive accounts and life-histories of three species, one of which is recorded for the first time from India. The results of the studies embodied in this paper are based mainly on the material collected by the writer during his stay as a research student in the laboratory of the Government Entomologist, Agricultural College, Coimbatore, during the year 1934.

Pulvinaria durantae, var. nov?

(Plate I; figures 1 to 11).

Ayyar (1936) recorded this new variety for the first time from India on the roots of cultivated *Amaranthus* plants in and around the Agricultural College Estate, Coimbatore.

On plants which are badly infested with this scale, almost all the different stages of the insect can be found at any time. The attacked plants have a sickly appearance, with the foliage faded and drying up. In fact these insects were revealed when such withered plants were pulled out.

Adult female: The mature female measures 2.86 mm. in length (average of 6 adults) and 2.4 mm. in breadth at the broadest region, which is very near the posterior extremity. The anterior portion is slightly pointed. The general shape is ovoid with the dorsum highly convex. In older specimens the posterior region is flattened. The body is covered all over with long curved spines which are longer and more numerous towards the posterior end. The anal cleft extends to about one-fifth the length of the body. The limbs and antennae are well-developed. The anal operculum is quite prominent and darker in colour than the rest of the body. The general colour of the insect is dark brown, more or less obscured by a white powdery secretion. The stigmatic clefts are shallow, transverse grooves and are not very clearly demarked in life.

The development of ovisac and oviposition are in *P. maxima* Gr., (Ayyar, 1925). The sac attains a maximum length of 8 to 10 mm. There is a median longitudinal groove along the ovisac with two lateral ones on either side.

The Formosan species, *P. durantae* to which this species is allied, is described by Takahashi (1931) as below:—

'Adult female: Very closely related to *P. psidii* Mask., but differs from it in the following characters.

1. Marginal setae simple, not dilated nor furcated apically, nearly half the length of the longest stigmatic spine but longer than the shorter one; about 0.0277 mm. in length.

2. Legs shorter; hind femur about 0.18 mm.; hind tibia about 0.16 mm.; hind tarsus about 0.097 mm. in length.

3. The three setae arranged in a row near the base of each antenna, a little smaller.

The body of the adult female is about 3 to 4 mm. in length and is provided with many circular or sub-circular small pores over the dorsum and the abdominal and thoracic segments are defined on dorsum.'

The adult female when mounted, is broadly ovate, with the anterior end pointed. The antenna is well-developed, eight-segmented. In some specimens the third segment shows a division, making the antenna nine-jointed.

The lengths of the various antennal segments of six specimens are as follows. The right antenna is taken into consideration and measurements are given in microns.

Specimens	Segments							
	1	2	3	4	5	6	7	8
I	15	17	20	13	14	8	7	10
II	16	17	21	12	15	9	8	12
III	15	16	19	11	14	7	6	11
IV	13	18	20	11	13	9	7	12
V	12	15	19	11	14	7	6	Broken
VI	14	15	20	11	14	8	7	11

The average length of antenna is 0.44 mm. The antennal formula is *3, 2, 1, 5, 4, 8, 6, 7*. The third segment is the longest and the second is the stoutest and next to the third in length. The terminal segment carries four to five hairs. The stigmatic cleft is shallow and in older specimens not demarked. There are three stout spines marking the stigmal region, central one twice as long as the lateral. The spiracular opening is wide and conspicuous. There is a series of pores leading from the margin up to the stigmata. The margin of the body is fringed with slender spines. In this variety the spines are of two kinds. There are the usual spiny curved hairs intermingled with stout, dilated and furcated hairs as in *P. psidii* Mask.

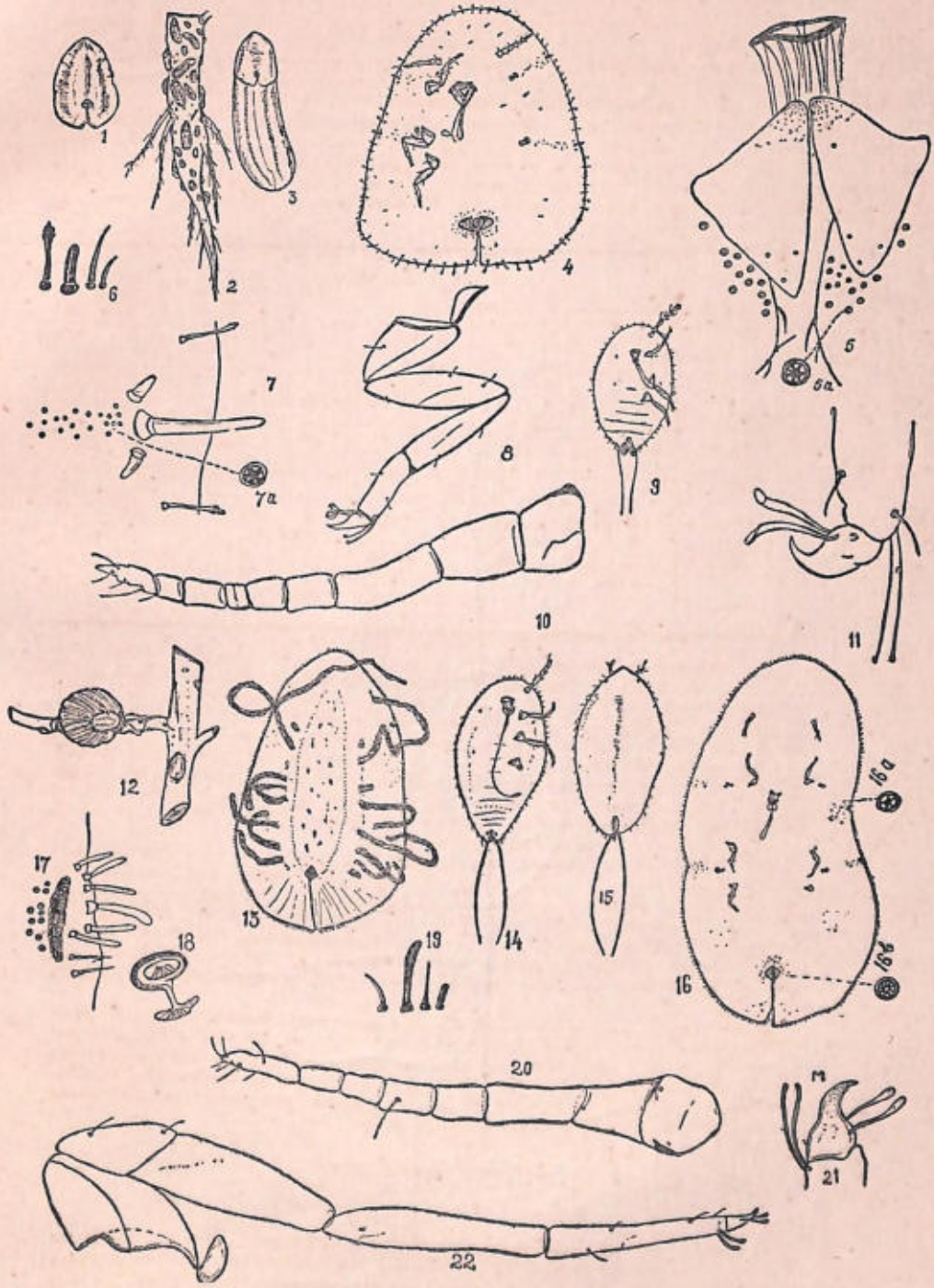
The leg is well-developed. The femur is longer than tibia; tarsus more than half the length of tibia. The claw is well-developed and curved. The tarsal digitules are short, stout and dilated distally. The unguals arise from the sides of the claw. The anal cleft extends to about one-fifth the length of the insect. The anal plates are more or less triangular, the inner side the longest. The outer angle carries a very long seta. On the distal end also there are smaller hairs. The anal region is provided with numerous multilocular pores.

Remarks.—This form appears to be a variety of *P. durantae* Tak., the adult female agreeing with it in possessing smaller legs and shorter setae arranged near the antennae, but differing in that some of the marginal hairs are dilated and furcated apically as in *P. psidii* Mask. This form is intermediate between *P. psidii* Mask., and *P. durantae* Tak. In external appearance and production of ovisac it resembles very much *P. psidii* Mask.

Ceronema koebelei Green.

(Plates I, II; figures 12 to 28.)

This coccid was found by the writer on the branches and stems of *Caesalpinia coriaria*, a familiar tree around the Agricultural Farm, Coimbatore, during January 1934. Ayyar (1936) recorded this insect for the first time from India. It was originally described by Green (1909) from Kandy, Ceylon, on branches of



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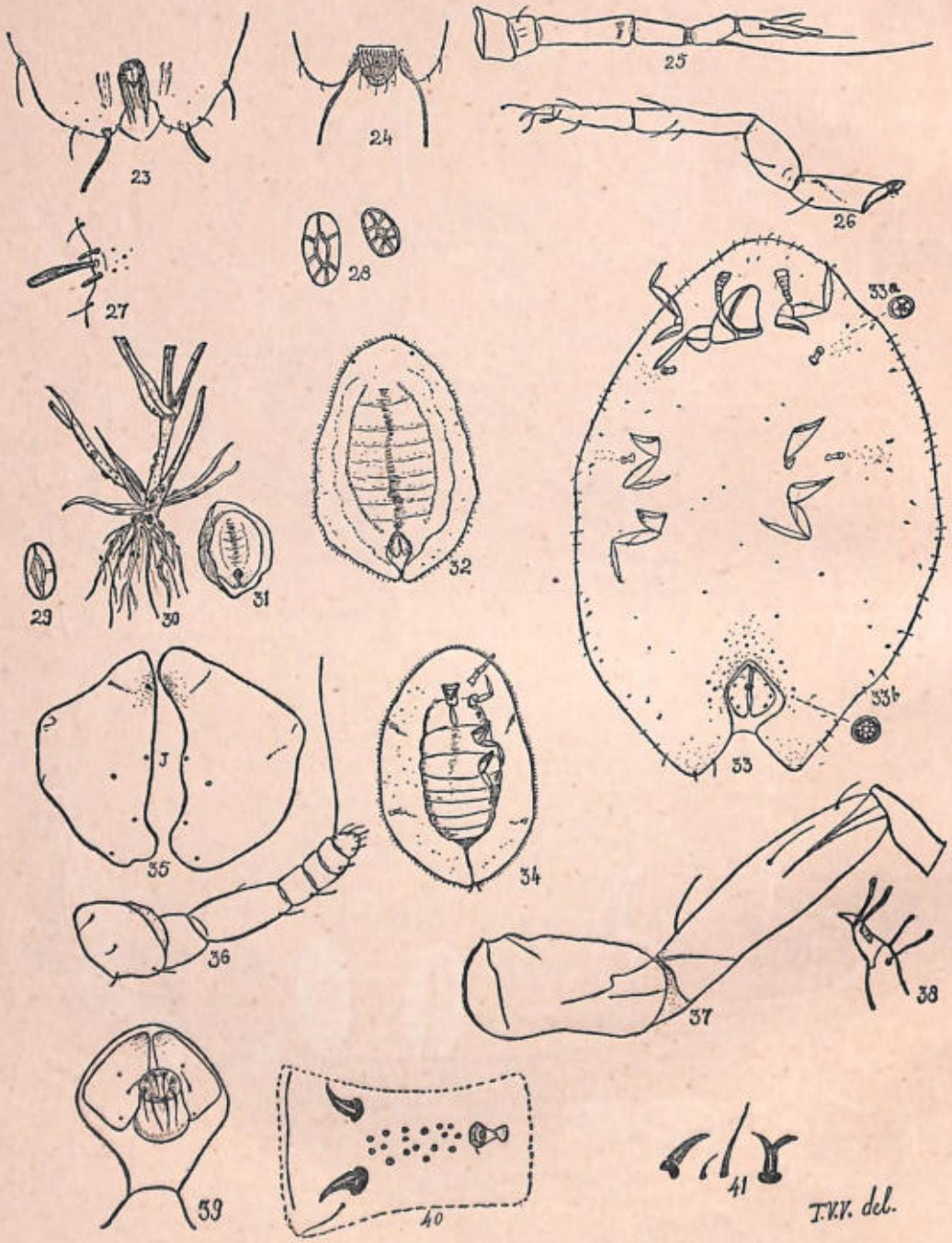
Venkatraman.—SOUTH INDIAN COCCIDS.

For explanation see end of article.



Venkatraman.—SOUTH INDIAN COCCIDS.

For explanation see end of article.

Sapium sebiferum collected by Alber Koebele after whom it is named. According to Green it has never been noted as a pest in Ceylon. Rutherford (1915) has recorded it from Ceylon on the twigs of *Pithecolobium saman*.

Description, life-history and habits. The adult females were noted on the older branches of the tree and the freshly hatched nymphs were seen migrating slowly to the tender shoots.

The mature female insect measures from 7.5 mm. to 8.2 mm. in length and 6 mm. to 7.25 mm. in breadth. The broadest region is just behind the middle. The general shape is elongate oval, convex above, with an inconspicuous carina on the dorsum. The general colour is greenish brown. The ventral surface is slightly lighter in colour. The eyes and the anal operculum are chocolate brown in colour. The mid-dorsal area is covered with a fine coating of mealy material. The anal cleft extends to about one-sixth the length of the whole body. The anal valves are small.

The ovisac is made up of a felted buff-white secretion, secreted by special glands found on the dorsum of the insect. The ovisac is formed by the fusion of seven to eight pairs of coiled-up creamy white processes arising from either side of the dorsum. These processes spread outwards coiling and fixing themselves on the host plant. The fusion of these processes are clearly indicated on the ovisac by prominent ridges. Due to the formation of the ovisac the adult is carried up and assumes a tilted position as in the genus *Pulvinaria*. In the early adult female a crenulate line of white secretion along the sides marks the formation of the future ovisac. The margin of the body is fringed all round with stout pointed spines. The female insect, after maceration in potash agrees with Green's description. The following remarks may, however, be added to his description.

The body is broadly ovate. The derm is covered irregularly with more or less polygonal cells. The spinning glands corresponding to the ridges of the ovisac are placed round the margin of the body just dorsal to marginal spines. Anal lobes are furnished with a variable number of spinose hairs and the anal operculum is provided with eight to ten long hairs. The margin of the body is provided with a close series of pointed spines. The stigmatic clefts are furnished with ten to eleven spines each, including a large central spine and the cleft is bordered by a lunate chitinous plate. The antenna is eight-jointed; third and fourth joints apparently without any hairs and sixth with a very long hair. Legs are well-developed; foot with four digitules, dilated distally. Claw is bent strongly at the tip, and provided with a minute denticle on the inner side near the extremity.

The adult females with their eggs are found grouped together on the same branch. The ovisac under normal conditions, is fairly big and handsome. The interior of the ovisac is smooth. Each ovisac encloses numerous eggs, all beautifully and closely packed together. The number of eggs in a single ovisac was found to be 640. The eggs are greenish in colour, smooth, elongate and measures about 0.28 mm. in length. The eggs in each mass do not hatch all at the same moment, but it takes three to four days for all the nymphs in one mass to hatch out. The nymphs break through the walls of the ovisac and emerge through small slits made on the ovisac.

The early larval stages. The just hatched larva, which is a fairly active creature, is elliptical and reddish in colour. It bears a pair of caudal setae as long as the body. The margin of the body is fringed with fine curved hairs. The antennae and legs are well-developed. The antenna consists of six segments the third segment is longest and the fifth carries a very long seta. The fifth and terminal segments show traces of segmentation. The anogenital ring is provided with six stout hairs. Length 0.72 mm., breadth 0.6 mm.

The just hatched larva after moving about for some time near to its birth place, migrates slowly to a favourable spot and settles down to feed. The nymphs are restless only for five or six days after which they permanently settle down on the food plant. The nymphs are very slow in developing. They moult thrice before they attain the adult stage. In the process of moulting the whole outer covering is involved including the rostral apparatus and anal plates.

Although the male puparia were found in large numbers adult males could not be noticed.

The female insect is clearly marked out in the second stage; the insect grows broader and the waxy spots appear on the dorsum. The life-cycle is found to occupy 95 to 100 days.

Natural enemies.—A few adult coccinellids, *Scymnus coccivora* Ramakrishna, were found feeding inside the eggsacs.

Lecanopsis ceylonica Green.

(Plates II and III; figures 29 to 53.)

These insects were collected by the writer on the roots of grass in Coimbatore during April 1934. They were mostly found on the roots of grass covered by stones or pebbles. Green (1922) first described the species collected from Ceylon, 'at the base of a grass plant, below a large stone'. It is clear that these insects require a cool and shady place to thrive well. This is the first record of this insect from India.

The nature of the damage done by the insect.—A number of adult females with conspicuous eggsacs were revealed on removing a few stones, mostly attached to the lower sheathing base of the stem and roots of the grass. They were noted in all stages and generally the mature females selected the broad blades of the grass for oviposition. The attack spreads rapidly all over the place and the plants dry up. The young nymphs are very active, crawling over long distances in search of a suitable place. A species of black ant visits them in large numbers to feed on the honeydew secreted by the maturing female. The ants sometimes go under the soil in search of the sweet sugary fluid.

Description, life-history and habits.—On grasses which are pretty badly infested with the scale, almost all the different stages can be noted at any time.

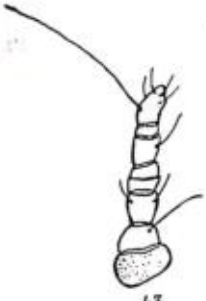
The mature female, just before it develops the ovisac measures from 3.0 to 3.5 mm. in length and 1.5 to 1.7 mm. in breadth; more or less ovate, broadest portion near the posterior end. The derm is highly convex and the insect is partially surrounded by a white felted test.

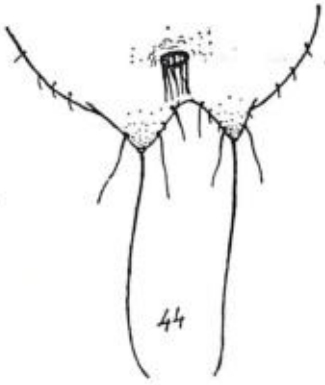
Specimens collected by the writer are larger than the Ceylonese form and are very closely pitted on the dorsum.

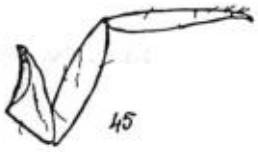
The antenna is six-segmented, without any trace of further segmentation. The 6th segment carries a very long lateral seta which is longer than the antenna itself. Antennal formula may be noted down as *3, 2, 1, 6, (5, 4)*. Measurements of the right antennal segments of 6 adults are as below: (Measurements in microns).

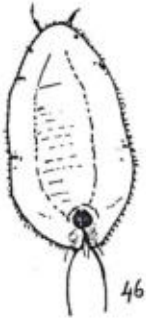
Adults	Segments					
	I	II	III	IV	V	VI
1	8	9	20	5	6	7
2	8	10	21	5	5	6
3	7	9	20	5	6	7
4	7	10	19	5	5	6
5	8	11	22	6	6	8
6	6	9	21	6	6	8

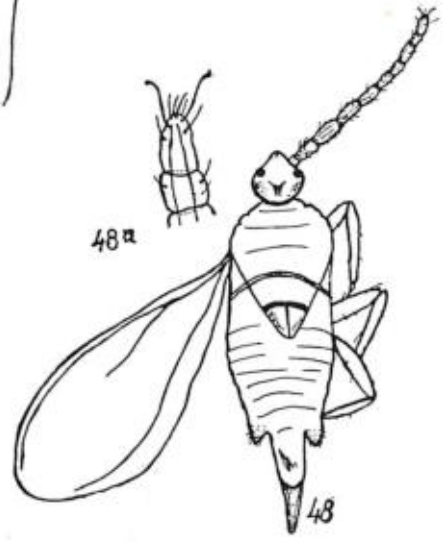
Legs well developed, 2.7 mm. in length with the tibiotarsal articulation subobsolete. Tarsus is about half the length of tibia. Tarsal digitules slender, long and knobbed. The ungual digitules are dilated. Anal plates surrounded

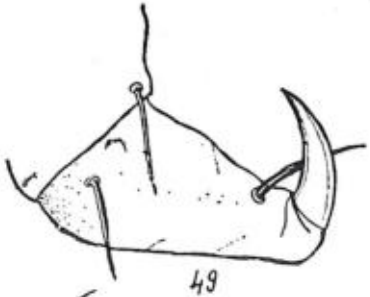












T.V.V. del.

Venkatraman.—SOUTH INDIAN COCCIDS.

For explanation see end of article.

Adult female of *Ceronema koebelei* gr. with egg-sac *in situ*. (nat. size).

by a narrow, densely chitinised area, the base about equal to outer margin; outer angle rounded; three dorsal and one sub-apical spines; stigmatic spines two, of equal length, stout, curved, pointed and wide apart; the distance is at least equal to thrice the length of the spine. Dorsum rather densely chitinised, thickly set on the margin with small circular openings leading to tubular ducts. Margin with long setae. There is also another shorter series slightly more internal. Some of the spines of this series are branched. This species is closely related to *Loemica ghesquierei* L., a subterranean form found on the roots of grass in Belgian Congo (Laing, 1929).

The early larval stages.—The newly hatched larva is a very active creature, crawling up the blades of the grass. It is about 1.0 to 1.2 mm. in length; 0.5 to 0.7 mm. in breadth, with fairly well-developed limbs and antennae. The general colour is yellowish, with brownish eyes. Antenna of larva apparently 6-segmented, but the 4th and 5th segments show clear traces of division, thus making the antenna 8-segmented instead of 6. The terminal segment carries nine hairs including one long lateral hair, which is longer than the antenna itself. Legs robust; tibia and tarsus approximately of equal length and the articulation is distinct. Claws slender and strongly curved. Stigmal spines as in the adult. The anal lobes are prominent, with 3 to 4 long setae. The anal ring is provided with 6 long hairs.

The male insect.—The male puparia have the usual glassy test with longitudinal and transverse ridges on the surface. It is about 2.0 mm. in length and 0.8 mm. in breadth. It is more or less elongate and made up of a shining secretion of wax. The adult emerges in about 10 days after pupation. The waxy caudal filaments are seen protruding from the posterior end of the puparium just before emergence.

Males are comparatively fewer than females and the emergence of males takes place mostly in the afternoon. Soon after emergence they remain stationary for some time, drying their wings and body. Then they try to move about slowly and in about ¾ to 1 hour they begin to react to the presence of females, by raising the tips of their abdomen. The male wanders about climbing up various females, and finally selects a fairly mature one for copulation. It clings on to the posterior end of the female and slowly introduces the genital sheath into the aperture of the female. Copulation lasts for two to three minutes. In the course of about an hour, a single male was observed to copulate with 5 females.

The adult male is a delicate active creature, yellowish-red in colour and with transparent wings. It is about 1.8 mm. long. Ocelli black. Antennae and legs long and slender. The antenna consists of 10 segments, the terminal segment carrying a few curved hairs. Wings fairly large, about 1.2 mm. in length, clear, with very few lines. The genital sheath is long, curved and with a pointed tip (about 0.34 mm. in length). There is a pair of long waxy filaments, rising from the caudal end of the abdomen. The caudal end bears two rounded prominences on either side, carrying a number of spines.

Natural enemies.—This scale is subject to the attack of a very interesting Epipyropid caterpillar which feeds on the eggs and young nymphs of the insect. The caterpillars were found under the soil feeding voraciously on the eggmasses. In the Insectary, a single caterpillar, in the course of week, devoured about 18 fully matured eggsacs and a few young nymphs. The young larva is pale white in colour and hardly distinguishable from the bases of the grass.

Fully developed caterpillars are 15-18 mm. in length. General colour is brownish. The anterior end is tapering and the posterior bulging out. The stoutest portion is about 5 to 8 mm. broad. The dorsum is covered with numerous, regularly arranged, long hairs. Each segment bears about 8 to 10 hairs. Head chocolate coloured, with well-developed dark mandibles. The prolegs are flattened and fringed with a complete circle of crochets. The true legs are well-developed, with robust, recurved claws. The curved claws help the larva in crawling through the soil.

The caterpillars pupate under the soil, often attached to the leaf-sheath of the plant. The cocoon is made up of tough silk, mud particles and remnants of eggsacs of the scale devoured by the caterpillar. The cocoon is oval, about 12 to 13 mm. long. The adult moth emerges through a circular hole near the anterior extremity of the cocoon. The adult moth is bright rufous; head brownish; thorax with scales tipped with grey. Fore wing with small spots. Expanse 40 mm.

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Explanation of Plate I.

Pulvinaria durantae var. nov?

Fig. 1.—Adult female before gestation, dorsal view, ×8.
Fig. 2.—Insects on *Amaranthus* roots, (2/3 nat. size.)
Fig. 3.—Adult female with eggsac, ×6.
Fig. 4.—Adult female before gestation, after maceration in potash, ventral view, ×18.
Fig. 5.—Anal operculum and pores, adult female, ×180.
Fig. 5*a*.—Multilocular pore in the anal region, female, ×400.
Fig. 6.—Different kinds of setae, adult female, ×180.
Fig. 7.—Stigmatic region with spines, adult female, ×180.
Fig. 7*a*.—Quinquelocular pores in the stigmal area, female ×400.
Fig. 8.—Mid leg, adult female, ×36.
Fig. 9.—Just hatched larva, ×18.
Fig. 10.—Right antenna, adult female, ×180.
Fig. 11.—Tarsus of midleg and claw, adult female, ×400.

Ceronema koebelei Green.

Fig. 12.—Adult female with eggsac, in situa (2/3 nat. size).
Fig. 13.—Adult female, beginning to oviposit, ×8.
Fig. 14.—Larva, 15 days old, ventral view, ×18.
Fig. 15.—Larva, 15 days old, dorsal view, ×18.
Fig. 16.—Adult female, after maceration in potash, ×8.
Fig. 16*a*.—Quinquelocular pore from stigmal region, ×400.
Fig. 16*b*.—Multilocular pore from anal region, ×400.
Fig. 17.—Stigmatic area and spines, adult female, ×180.
Fig. 18.—Anterior spiracle, ×400.
Fig. 19.—Different kinds of setae from adult female, ×400.
Fig. 20.—Antenna, adult female, ×180.
Fig. 21.—Foot of mid leg, adult female, ×400.
Fig. 22.—Mid leg, adult female, ×180.

Explanation of Plate II.

Ceronema koebelei Green. (Contd.).

Fig. 23.—Posterior Extremity, larva, (15 days old) ventral view, ×180.
Fig. 24.—Posterior extremity, larva, (15 days old) dorsal view, ×180.
Fig. 25.—Right antenna, larva, ×180.
Fig. 26.—Mid leg, larva, ×180.
Fig. 27.—Stigmatic region, larva, ×180.
Fig. 28.—Male puparium (enlarged).

Lecanopsis ceylonica Green.

Fig. 29.—Test of male (enlarged).
Fig. 30.—Insects on grass (sligthly reduced).
Fig. 31.—Adult female, dorsal view, (enlarged).
Fig. 32.—Adult female, before oviposition, dorsal view, ((enlarged).
Fig. 33.—Adult female after maceration in potash, ventral view, ×400.
Fig. 33*a*.—Quinquelocular pore from stigmatic area, adult female, ×400.
Fig. 33*b*.—Multilocular pore from anal region, adult female, ×400.
Fig. 34.—Adult female, before oviposition, ventral view, (enlarged).
Fig. 35.—Anal valves, female, ×180.
Fig. 36.—Antenna, female, ×180.
Fig. 37.—Mid leg, adult female, ×180.
Fig. 38.—Tarsal claw, adult female, ×180.
Fig. 39.—Posterior extremity, female, ×180.
Fig. 40.—Anterior spiracle and stigmal spines, adult female, ×180.
Fig. 41.—Different kinds of setae, adult female, ×180.

EXPLANATION OF PLATE III.

Lecanopsis ceylonica Green. (Contd).

Fig. 42.—First stage larva, after maceration, ventral view, ×28.
Fig. 43.—Antenna, first stage larva, ×180.
Fig. 44.—Abdominal extremity, first stage lava, ×180.
Fig. 45.—Leg, first stage larva, ×180.
Fig. 46.—Female nymph, 2nd stage, (enlarged).
Fig. 47.—Foot of adult male, ×400.
Fig. 48.—Adult male, ×180.
Fig. 48*a*.—Terminal segments, antenna, adult female, ×400.
Fig. 49.—Leg of predatory caterpillar on *L. ceylonica* Gr., showing the curved claw. (highly magnified).
Fig. 50.—Anterior pro-leg of caterpillar (enlarged).
Fig. 51.—Anal pro-leg of caterpillar (enlarged).
Fig. 52.—Cocoon of caterpillar, ×2.
Fig. 53.—Cocoon of caterpillar on grass, (2/3 nat. size).

EXPLANATION OF PLATE IV.

Fig. 54.—Adult female of *Ceronema koebelei* Gr., with eggsac, *in situ*. (nat. size).

INSECTICIDAL AND PISCICIDAL PLANTS OF INDIA

BY

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The discovery and application of cheap insecticides for the diverse needs of agriculture, destruction of household pests, and preventing of vectors of malaria and similar insect-borne diseases play a very important part in the economy of nations at the present day. At a moderate estimate the total annual loss to India through insect pests has been computed at roughly 2,000 millions of rupees and over a million and a half of human lives. Added to this is the fact that, in spite of all efforts to the contrary, advances in civilization are producing conditions specially suited for insect multiplication in most areas.

Most of the insecticides used in India at present are very expensive as they have to be imported from foreign countries. Further, owing to shipping difficulties and the rise in prices due to war conditions, the situation has become so acute that even ordinary well-to-do people are unable to afford these protective remedies against the ravages of insects. The great masses of India, whose economic condition is proverbially low, could ill-afford to use the costly imported commodities even before the outbreak of war while the present-day prices are entirely beyond their means. The ever-increasing demands of the large fighting forces has further made it imperative to fall back on the easily available indigenous supplies which may replace the imported materials. The Medicinal Plants and Food Poisons Inquiry has of late received many inquiries from various parts of India and overseas for information in regard to the medicinal and insecticidal plants of this country. Thanks to the foresight of the Imperial Council of Agricultural Research for financing this Inquiry six years ago, it is now possible to help with advice scientists, agriculturists, and commercial concerns interested in this field. Chopra and Badhwar (1) recently discussed the vast potential resources of the country in these directions and published a comprehensive survey of Indian plants poisonous to man, livestock, insects and fishes. Their studies revealed that a much larger number of potential insecticidal plants are available in India than in any other area of a similar size. In this paper we deal with the distribution, chemistry, and

other details with regard to the Indian insecticidal and piscicidal plants.

Arsenicals, lead and silicofluoride insecticides, etc., are very efficacious but have the serious drawback of being injurious to human beings and other warm-blooded animals generally. It is for this reason that increasing attention is being directed nowadays to insecticides of vegetable origin which, besides being effective against insects, are less harmful to man and animals. A large number of plants have been the subject of investigation in different countries, and, in this field of research, workers have taken advantage of the fact that quite a number of plants which are employed by the local natives as fish poisons from time immemorial have also been found to possess insecticidal properties. It is for this reason that we deal with the commonly recognized Indian insecticidal and piscicidal plants in this article, so that workers may be able to select plants for investigation from as large a list of suitable material as is known at the present day. The most outstanding results of the investigation of native fish poisons have been the discovery of the important insecticidal properties of certain species of *Derris, Lonchocarpus,* and *Tephrosia.* It does not, however, follow that, because a particular plant possesses piscicidal properties, it is necessarily of equal value as an insecticide. Pyrethrum,' for example, which yields pyrethrin as its active constituents, is one of the very potent and widely used insecticides at the present day, but its use as a local fish poison is not recorded anywhere.

Biological investigations are very essential to evaluate the effect of insecticides on various kinds of insects, before any plant can be pronounced as a suitable insecticide. No plant must without detailed experimental data be regarded as universal insecticide, for, several which cause cent per cent mortality in one species of insects, may be less efficacious or even useless for others. Attention has recently been drawn to the fact that the total toxic effect of a mixture of two different insecticides is greater than the sum total of the individual effects of the two component insecticides taken independently (2). This phenomenon is known as synergism, *i.e.*, working together or co-operating, and is important not only from the point of view of increasing the efficiency of known insecticides by making suitable combinations, but also for the utilization of many insecticidal plants of Indian origin that may not be quite up to the standard when used alone.

Important Vegetable Insecticides

Among vegetable insecticides of proven value may be mentioned some species of *Chrysanthemum* (pyrethrum), *Derris* (tuba root), *Lonchocarpus* (cube root), *Tephrosia, Nicotiana* (tobacco), *Picrasma* (quassia), *Delphinium* (larkspur), *Veratrum,* etc. Of these *Chrysanthemum cinerariifolium* Vis. and *Derris elliptica* (Roxb.) Benth. have acquired great importance as plant insecticides during the last 15 years.

On account of the proved effectiveness of the flower-heads of *Chrysanthemum cinerariifolium* in destroying insects and mosquito larvae, Japan, Kenya, Yugoslavia, Brazil and some other countries

have taken up extensive cultivation of this plant. According to Holman (3), the total world production of pyrethrum flowers at the present time is probably over 15,000 tons. Various types of powders, dusts and sprays, with pyrethrum as the main insecticidal constituent, are available in the market for horticultural, household, and veterinary use. Recently the control of insect pests, which damage stored products in warehouses, has been successfully attempted with the help of pyrethrum sprays. At least two efficient aqueous base pyrethrum insecticides are now available in the market for destroying insects and mosquitoes in the interiors of aircraft, thus preventing the transmission of diseases, such as yellow fever, where for obvious reasons it is imperative to use non-inflammable spray (4). A very important use to which pyrethrum is being put nowadays is as a mosquito larvicide in antimalarial measures. A large number of the known larvicides are unsuitable for this purpose as they are definitely injurious to the aquatic vegetation and fishes in the areas treated, but a pyrethrum larvicide prepared according to a formula developed by Guisbug (5) is stated to be free from these disadvantages, and still a very useful larvicide.

As suggested by Chopra and Badhwar (6), outer temperate Himalayas and hill stations in other parts of India are likely to prove suitable for the cultivation of pyrethrum in this country; and it may be noted that the plant, on the whole, has grown well at altitudes of 5,000 to 6,000 ft., but it is advisable to avoid areas of high rainfall. A series of samples analyzed at the Calcutta School of Tropical Medicine from plants grown in Kashmir and the Murree Hills were found to be of as good a quality as any produced elsewhere. Both the total pyrethrin content of the flower-heads and biological tests compare favourably with the imported stuff. Large areas in the North-West Himalayas, especially in Kashmir, are available where good quality of pyrethrum could be grown in practically unlimited quantities and where ideal conditions for successful cultivation prevail. Amongst the attempts so far made for the cultivation of pyrethrum in India may be mentioned those at Baramulla and Tangmarg in Kashmir, Murree Hills, Kulu Valley, Palampur and Kasauli in the Punjab, Parachinar in the Kurrum Agency, North-West Frontier Province, the United Provinces, Bengal, Madras, and Mysore State. Cultivation has so far failed at Ranchi, Poona, Kasauli, and in Sind. The failure of pyrethrum germination at Kasauli in the Punjab and at Ranchi must be regarded as accidental, and further attempts to grow it are likely to meet with success.

Derris elliptica is found in Burma, Siam, Cambodia, Cochin-China and Malaya, and also in the East Indian Archipelago and the Philippines. It is found in India only to a limited extent in Chittagong. Practically all the tuba root of commerce is produced in Malaya, Dutch East Indies, Philippine Islands and Sarawak, where large-scale cultivation of the plant is carried out. It has also been successfully cultivated experimentally in other tropical countries, such as parts of East and West Africa, the Congo and West Indies. Of the other species of *Derris* examined, only *D. malaccensis* Prain has assumed commercial value equal in importance to *D. elliptica*, and is being largely cultivated. Experi-

mental cultivation of *D. elliptica* and *D. malaccensis* has been attempted in Travancore, the Punjab, Kashmir, Mysore, and Dehra Dun; that grown in Mysore has been found to contain up to 7 per cent of rotenone in its roots, which is encouraging. Over 20 species of *Derris* are found in India, several of these growing abundantly. There is a great possibility that some of these at least may prove to be of important insecticidal value. Of the Indian species so far examined, only *D. ferruginea* (Roxb.) Benth. has been shown to contain rotenone, and may prove a good insecticide. A number of species of *Derris* are known to be used extensively in tropical countries for catching fish. The crushed portions of these plants thrown into streams and ponds stupefy fishes, and make them float up to the surface.

Of other plants containing rotenone and allied compounds, mention may be made of species of *Lonchocarpus, Tephrosia,* and *Mundulea,* which, like derris, are locally used as fish poisons. Some species of *Lonchocarpus,* such as the cube root (*L. utilis* A.C. Smith and *L. uruca* Philip and Smith) have assumed importance as insecticides equal to that of derris. Commercial supplies of both *L. utilis* and *L. uruca* at present are obtained only from Peru and Brazil, where their cultivation is being successfully carried out. No attempts so far have been made to cultivate any of the cube roots in India, but there seems little doubt that successful plantations could be raised in Bengal and the Madras Presidency. Some of the foreign species of *Tephrosia* have been shown to possess marked insecticidal properties, while others have been found to be of little or no value. *T. vogelii* Hook. *f.* has been shown in Africa to be an efficient insecticide for fleas, lice and ticks, and has been suggested as a cheap commercial dip for cattle. *T. vogelii* is largely cultivated in the tea gardens of Assam for use as a nitrogenous manure. Chopra and collaborators (7) have recently found that the leaves of the Assam-grown plants do not possess insecticidal properties to any marked degree. It is possible, however, that this conclusion may have to be modified when leaves plucked at various times of the year are examined. Its seeds, which are stated to be the most toxic part of the plant, have not been investigated so far. *Mundulea sericea* (Willd.) Greenway (*M. suberosa* Benth.) is extensively found in South India; some samples of its leaves, bark, seeds, and root have been shown to be fairly toxic to certain types of insects (3).

Tobacco and its preparations in the form of sprays, dusts and fumigants are widely used as insecticides in horticultural and to some extent in veterinary practice. The very simple but quite efficient method used in many places is to prepare tobacco extracts by soaking or macerating tobacco leaves in water. In fact, a large proportion of the insecticides based on nicotine consists of crude tobacco extracts. Other insecticides prepared from tobacco contain nicotine sulphate, nicotine tannate, nicotine bentonite, etc. Nicotine is generally regarded as a contact insecticide, but it appears to act principally as a fumigant and sometimes as a stomach poison. Tobacco (both *Nicotiana tabacum* Linn. and *N. rustica* Linn.) is extensively cultivated in India, and the agriculturists should be educated to use it against insect crop pests.

Quassia (*Picrasma excelsa* Planch.), a foreign species, is also used as an insecticide, and there is every likelihood that some of the allied Indian species possess similar properties. We have recently been informed that powdered young leaves and twigs of *P. javanica* Blume, var. *nepalensis* (Benn.) Badhwar *nov. comb.* (*P. nepalensis* Benn.) are used to destroy mosquito larvae in Assam.

Several Indian species of *Delphinium* are even now used for destroying maggots in wounds and may be potential insecticides. It has also been stated that the alkaloid cytisine is an important constituent of the Persian and Australian insect powder. This alkaloid, which resembles nicotine in its action, has been found in at least six genera of which *Euchresta* and *Sophora* are represented in India. The rhizomes of hellebores (*Veratrum album* Linn. and *V. viride* Ait.), both foreign plants, are quite efficient insecticides, but they have failed to survive the introduction of rotenone-containing insecticides, and are very seldom used nowadays.

Insect-repellent Plants

The importance of insect-repellent plants in the economy of nations is obvious. The cheaper and larger the number of effective insect repellents that could be used from amongst the common indigenous plants, the greater the likelihood of the masses of India benefiting from their use. The leaves of neem (*Azadirachta indica* A. Juss.) and of patchouli (*Pogostemon heyneanus* Benth., syn. *P. patchouli* Fl. Brit. Ind., *non* Pellet.), and the roots of costus (*Saussurea lappa* C. B. Clarke) are used to protect woollen fabrics from insects. Articles placed in boxes made of sandalwood (*Santalum album* Linn.) are immune from the attacks of these pests. Some essential oils, such as the eucalyptus oil from *Eucalyptus globulus* Labill. and citronella oil from *Cymbopogon nardus* (Linn.) Rendle (*Andropogon nardus* Linn.), when applied to the body, give relief from the bites of mosquitoes so long as the odour lasts. Hemp (*Cannabis sativa* Linn.), if spread under a bedsheet, affords ample protection against fleas which disturb sleep at night in many of the hill stations of India. The simple device of mixing of the leaves of *Trigonella foenum-graecum* Linn., *Vitex negundo* Linn., etc., with the grains before storage, especially during the rainy season, as practised by the agriculturists in some parts of this country, saves the produce from the ravages of insects. All these plants contain essential oils, which are well known for their repellent or attracting properties for different kinds of insects. Research is being directed nowadays for finding suitable essential oils for use against particular insects. Pine oil in dilute solution appears to have repellent properties and is being increasingly used as an ingredient of plant sprays, household fly sprays, and cattle sprays. It has a greater solvent power for rotenone than mineral oils, and is believed to possess the important property of increasing the toxicity of pyrethrin and rotenone. Similarly, citronella oil, eucalyptus oil, and oil of wintergreen constitute one of the ingredients for several sprays. The use of repellent sprays for protecting cattle from the attacks of flies nowadays constitutes an integral

part of routine protective measures in all progressive countries of the world, although opinion appears to be still divided as to whether the protection thus afforded results in an actual increase in the yield of milk. Sen (8) reports that the use of a spray consisting of high-speed Diesel oil, 'Pyrocide 20' (a concentrated extract of pyrethrum flowers), and pine oil, when applied on Sahiwal cows for 21 consecutive days proved very effective against some species of biting flies, and resulted in an appreciable increase in the yield of milk. Investigation of suitable plants which, when grown, will keep away mosquitoes from habitations has been engaging the attention of malariologists for some time. No really effective plant for this purpose has so far been discovered but extended trials with the shrubby basil (*Ocimum gratissimum* Linn.), absinthe (*Artemisia absinthium* Linn.), and other plants, which diffuse strong fragrance in the surrounding atmosphere, are likely to yield valuable results.

Control of Mosquito Larvae by Vegetation

Hackett, Russell and others (9) have discussed the naturalistic methods practised for the control of mosquito larvae, and have referred to the role of plant kingdom in this connection. It is stated that pollution by vegetable matter in the form of industrial wastes has often been tried with success as an antimalarial measure. Bagasse from sugarcane mills in the Philippines in one reported case seemed to keep a stream free from *Anopheles flavirostris;* the refuse from the Government Sisal Experiment Station is said to have a similar action, and numerous large pits used for macerating canepa hemp in Italy did not breed anophelines. Stagnant pools, such as engineering borrow-pits into which green-cut vegetation has been thrown are stated to breed culicines only, as no anophelines were found. The lethal effect of a fortnight-old brew of cut grass is said to be remarkable. The extension of this method in the form of 'herbage-packing' to shallow, small volume running channels has been advocated by Williamson and these authors. They are of the opinion that the effect is biological and not mechanical, and advocate the use of green-cut vegetation only, for dry straw results in a hay infusion favourable to larval growth. It is not every plant, however, that is suitable for use in running waters. According to these authors: 'The best so far found in India are *Cleistanthus* species and *Holorrhena antidysenterica* (*sic*). The first of these are fish poisons; the latter contains several alkaloids'. We are confident, however, that many more plants mentioned in the conspectus, which is appended, would be found to be equally good or even better for this purpose. The piscicidal plants cannot, however, be used if the waters contain fishes, or drain into tanks or reservoirs which contain such animal life.

Plants Poisonous to Fishes

For centuries, vegetable products of diverse nature have been used in different parts of the world for poisoning or stupefying

fishes in streams, ponds and pools for facilitating their capture. Wholesale poisoning of fishes by means of these plants is very uneconomical and is not allowed in any civilized country, but cases are known where such plants have come into contact with water and enormous number of fishes have died as a result. As pointed out already a knowledge of the local fish poisons has assumed a great importance in modern times, and a systematic investigation of these plants is gradually leading to discoveries of several potent insecticides. A comprehensive list of Indian piscicidal plants was published by Chopra (18) and lately considerable additions to it have been made by Chopra and Badhwar (1).

Potentialities in India

India with its great variety of climatic and edaphic conditions is particularly well suited for the cultivation of almost every plant. Vegetable insecticides of such proved value as pyrethrum and derris can be extensively grown in a number of suitable areas. The indigenous vegetation also abounds in potential insecticides and insect repellents, and a search from amongst the resources existing in this vast country will repay scrutiny. A list of those already in use as insecticides and insect repellents, as well as of those which are reputed to have piscicidal properties, is given below. The distribution of such plants in India, their active principles and properties and uses are also briefly mentioned. In addition to the plants detailed in the list, a number of essential-oil-bearing plants could be usefully investigated, especially as insect repellents or for use as valuable adjuncts in sprays.

A perusal of the following conspectus shows that the family Leguminosae contains the largest number of reputed insecticidal plants. Other important families in this connection are: Araceae, Euphorbiaceae, Compositae, Solanaceae, Ranunculaceae and Rubiaceae. The family Leguminosae also contains the largest number of piscicidal plants, while other important families in this respect are: Euphorbiaceae, Rubiaceae, Sapindaceae and Thymelaeaceae.

Name of Plant	Distribution	Constituents	Remarks
1. **Acacia pennata** (Linn.) Willd.	A large scrambling or climbing shrub found in the Central and Eastern Himalayas up to 5,000 ft. ; also in Oudh, Bengal, Bihar, and in Central, Western and South India. Reported from the North-West Himalayas.	.....	The fruits and stems are used in Burma to poison fish (**10**).
2. **Acorus calamus** Linn.	A semi-aquatic herb found throughout India in marshes or on river banks, wild or cultivated, up to 8,000 ft. on the Himalayas.	An essential oil in all parts (**11, 12, 13**). A glucosidic bitter substance in rootstocks (**14**).	Aromatic rootstock used to protect clothes from insect attacks; in powder form effectively employed for destroying fleas in some parts of India.
3. **Acorus gramineus** Soland.	A semi-aquatic herb found in the Khasia Hills and Sikkim Himalayas between 4,000 to 6,000 ft.	Essential oil (**15**).	Rootstock used in China as an insectifuge and insecticide (**16**).
4. **Acronychia pedunculata** (Linn.) Miq. (Syn. **A. laurifolia** Blume)	A small tree found in Dehra Dun, Konkan, North Kanara, the hill forests of the Western Ghats of Madras Presidency up to an altitude of 6,000 ft., South Deccan slopes, Northern Circars, Orissa, Sikkim 3,000 to 4,000 ft., Khasia Hills up to 4,000 ft., Assam and Chittagong.	.....	Pammel (**17**) reports it to be a fish poison.
5. **Adina cordifolia** (Roxb.) Benth. & Hook. *f.*	A large deciduous tree found in the Sub-Himalayan tract from the Jumna eastwards, ascending to 3,000 ft. and extending throughout the moister regions of India. (Common in Western India, especially in the forests of Surat, Ratnagiri and Thana districts ; also plentiful in Mysore, Upper Godaveri and Bhandvara).	Bitter principle (**18**).	Juice employed to kill maggots in sores.

Name of Plant	Distribution	Constituents	Remarks
6. **Agave americana** Linn.	A stout shrubby plant with a rosette of spiny leaves. A native of America; planted in parks and gardens throughout India.	Acrid volatile oil in the leaves (**19**). A crystalline saponin in the roots (**20**). Leaves likely to contain saponins.	Wall paper impregnated with juice of the leaves is said to be proof against the ravages of white ants (**21**). According to Pammel (**17**), the plant is used as a fish poison in some countries.
7. **Albizzia chinensis** (Osbeck) Merr. (Syn. **A. stipulata** Boiv.)	A large tree found throughout India, ascending to an altitude of 4,000 ft. in the Himalayas.	Saponin (**20**).	Pammel (**17**) records it as a fish poison.
8. **Albizzia procera** (Roxb.) Benth.	A tall tree found in the Sub-Himalayan tracts from the Jumna eastwards; also in Bengal, Bihar and Orissa, Central Provinces, Bombay Presidency and South India, usually in moist places. Occasionally seen as an ornamental or roadside tree.	.....	Raizada & Varma (**10**), on the authority of Watt (**21**), state that the bark of this tree, if pounded and thrown into a pond, stupefies fish. We do not, however, find any such reference in his book which they quote. Kirtikar & Basu (**16**) mention that the leaves have insecticidal properties.
9. **Anacardium occidentale** Linn.	A small tree from South America; now established in the coastal districts of South India, Chittagong and the Andaman Islands.	A black, caustic, oily juice containing phenolic compound cardol, anacardic acid and an ether-soluble substance (**22**).	Juice used to protect timber, books, etc., from white ants.
10. **Anagallis arvensis** Linn.	An erect or procumbent annual found over the greater part of India up to an altitude of 8,000 ft. in the Himalayas. The red-flowered variety is found in Kashmir, but the blue-flowered one is more common in India.	Volatile oil (**11**) and two glucosidic saponins have been isolated from the herb, while the root contains cyclamin which is also a glucosidic saponin (**20**).	Used in India to intoxicate fish and to expell leeches from the nostrils of livestock.

11. **Anamirta cocculus** (Linn.) Wight & Arn.	A large climbing shrub found in Assam, Eastern Bengal, Oudh, Orissa, and Konkan southwards to Ceylon.	Picrotoxin in the seeds (**20**).	A kind of ointment prepared from the drupes employed as an insecticide. They are also used to poison fish.
12. **Andrachne cordifolia** Muell.-Arg.	An erect shrub met with in the temperate Himalayas from the Indus eastwards to Nepal at 4,000 to 8,000 ft.; common in shady places.	Hydrocyanic acid in the leaves (**17**).	Leaves believed by people in Jammu to have insecticidal properties. The powdered root-bark of *A. ovalis* Muell.-Arg. of Africa, used as a fly exterminator by the Zulus, after it is mixed with milk (**19**).
13. **Annona reticulata** Linn.	A small American tree. Cultivated, but not so extensively as the following species, *A. squamosa*.	An alkaloid anonaine in the bark (**23**).	Properties similar to *A. squamosa*.
14. **Annona squamosa** Linn.	An American tree about 20 ft. high. Cultivated and naturalized in several parts of India.	Seeds contain an oil and a resin which contains an acrid principle (**21**). Leaves and seeds contain an amorphous alkaloid (**24**).	The seeds, leaves and the immature fruit contain an acrid principle fatal to insects; the dried unripe fruit, powdered and mixed with gram flour, used for killing vermin and the seeds to kill body lice. The powdered seeds and an aqueous infusion of leaves have valuable insecticidal properties (**25**). Pammel (**17**) records the plant as a fish poison.
15. **Apama tomentosa** Engl. (Syn. **Bragantia tomentosa** Blume)	Herbaceous plant found in Assam and Manipur.	.....	Recorded as a fish poison (**17**).
16. **Arenga obtusifolia** Mart.	A Malayan palm, found in India only under cultivation.	.....	In the Philippine Islands it is used for poisoning fishes (**16**).

Name of Plant	Distribution	Constituents	Remarks
17. **Arisaema speciosum** (Wall.) Mart.	Tuberous herb found in the temperate Himalayas from Hazara to Sikkim and Bhutan at 7,000 to 10,000 ft.	Acrid juice.	Properties similar to *A. tortuosum*.
18. **Arisaema tortuosum** (Wall.) Schott	A tall tuberous herb found in the temperate and subtropical Himalayas from Simla to Bhutan at about 8,000 ft.; also in Khasia Hills, Manipur, Chota Nagpur, Ranchi and Parasnath. In Western India, met with in Konkan; and in the Madras Presidency in Rampa Hills at 4,500 ft., Horsley-konda at 4,000 ft., and in the Western Ghats at 3,000 to 4,000 ft.	Acrid juice.	The tubers are used to kill worms which infest cattle during the rainy season. A decoction from the tubers prepared from some other species of *Arisaema* also used to kill insects in India and abroad.
19. **Aristolochia bracteata** Retz.	A slender prostrate herb growing on the banks of the Jumna and the Ganges, and in Bundelkhand, Sind and Konkan. In the Madras Presidency found in the Northern Circars, the Deccan and Carnatic, on dry especially the black cotton soil. Its occurrence in Bihar is doubtful.	A nauseous volatile substance and an alkaloid (**26**).	Juice applied to foul and neglected ulcers to destroy insect larvae. The vernacular name, *kirimar* (insect killer), is expressive of this fact.
20. **Artemisia Absinthium** Linn.	An aromatic herbaceous perennial met with in Kashmir and Kurrum Agency at 5,000 to 7,000 ft.	Volatile oil (**20**), a bitter glucoside absinthin (**27**) and a bitter substance anabsinthin (**20**).	Used to protect garments from moths.
21. **Artemisia vulgaris** Linn.	A gregarious shrub-like herb found throughout the mountainous tracts of India, especially between 5,000 and 12,000 ft.	Yields an essential oil containing α-thujone, borneol, etc. (**28**).	Used to prevent moths and other insects from infesting clothes and furniture.

22. **Asclepias curassavica** Linn.	A native of the West Indies; often grown in gardens and has become naturalized in many parts of India.	The herb contains the glucoside asclepiadin (**29, 30**). The roots contain vincetoxin (**31**), which closely resembles emetine in its physiological action (**26**).	Used to procure fish in the West Indies and in Queensland.
23. **Azadirachta indica** A. Juss. (Syn. **Melia azadirachta** Linn.).	A large evergreen tree planted all over India; doubtfully indigenous to the Jhelum Valley.	Amorphous bitter principle and a crystalline substance, margosopicrin. Seeds also contain a bitter fixed oil with objectionable odour due to the presence of sulphur compounds and some fatty acids (**32**).	Leaves largely employed to protect woollen fabrics and books from insect attacks.
24. **Balanites roxburghii** Planch.	A shrub or small evergreen tree found in the drier parts of India extending from South-East Punjab and Delhi to Sikkim, Bengal, Central India, Bombay Presidency and South India.	The flesh of the fruit contains about 7·2 per cent of saponins (**33**).	The bark is used in several places in India and by African Arabs as a fish poison.
25. **Bambusa arundinacea** Willd.	A common bamboo in Central and South India; cultivated in many places in North-West India and Bengal.	Benzoic acid and traces of cyanogenetic glucoside in shoots (**34**).	Shoots have lethal action on mosquito larvae (**34**).
26. **Barringtonia acutangula** (Linn.) Gaertn.	A small or medium-sized tree most plentiful in Bengal, especially near the coast beyond the tidal range. It is also frequently found in Kanara and Bombay along the banks of streams.	The fruits contain two saponins.	The bark is used to stupefy fish in many parts of India. The seeds and roots are also said to be used for the same purpose (**26**).
27. **Barringtonia asiatica** (Linn.) Kurz (Syn. **B. speciosa** Forst.)	A rather small or moderate-sized tree which is a native of the Andaman Islands, Singapore and Ceylon. It also occurs on the Southern Deccan Peninsula, but not in a wild state.	The active principle of bark is stated to be a volatile oil combined with a resin (**21**). The seeds contain 3·27 per cent of a glucosidic saponin, barringtonin, and 1 per cent of a substance designated as barringtogenetin (**35**).	The plant possesses narcotic properties and stupefies fish without killing them. The seeds are also said to be a fish poison.

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21. **Artemisia vulgaris** Linn.	A gregarious shrub-like herb found throughout the mountainous tracts of India, especially between 5,000 and 12,000 ft.	Yields an essential oil containing α-thujone, borneol, etc. (**28**).	Used to prevent moths and other insects from infesting clothes and furniture.

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27.	**Barringtonia asiatica** (Linn.) Kurz (Syn. **B. speciosa** Forst.)	A rather small or moderate-sized tree which is a native of the Andaman Islands, Singapore and Ceylon. It also occurs on the Southern Deccan Peninsula, but not in a wild state.	The active principle of bark is stated to be a volatile oil combined with a resin (**21**). The seeds contain 3·27 per cent of a glucosidic saponin, barringtonin, and 1 per cent of a substance designated as barringtogenetin (**35**).	The plant possesses narcotic properties and stupefies fish without killing them. The seeds are also said to be a fish poison.

Name of Plant	Distribution	Constituents	Remarks
28. **Barringtonia racemosa** (Linn.) Roxb.	An evergreen ornamental tree common along the Western Coast from Konkan to Travancore and from the Sundarbans eastwards.	.....	The seed is used as a household vermifuge in Madagascar and is stated to be a fish poison (**17**). The plant possesses toxic and insecticidal properties (**36**).
29. **Berberis aristata** DC. (possibly some other species of **Berberis** also)	A robust shrub found in Garhwal, Jaunsar and Nepal.	.....	The plant is mentioned by Pammel as a fish poison (**17**).
30. **Butea monosperma** (Lam.) Kuntze (Syn. **B. frondosa** Koen. ex Roxb.)	A small or medium-sized tree common throughout the greater part of India up to 3,000, sometimes up to 4,000 ft.	Fixed oil, a small quantity of a resin and a large quantity of a water-soluble albuminoid in the seeds (**18**).	Maggots are killed by sprinkling the powdered seeds over them (**16**).
31. **Caesalpinia nuga** (Linn.) Ait.	A large prickly climber found on the banks of rivers near the coast, *e.g.*, in Konkan, West Coast, Orissa, Sundarbans and Eastern Bengal near Chittagong, and in Sylhet.	.....	The pulped fruit and stems yield a fish poison (**10**).
32. **Callicarpa longifolia** Lam., var. **lanceolaria** C. B. Clarke	A shrub occurring plentifully in Central Bengal, Tippera, Chittagong and in the Khasia Hills up to an altitude of about 3,000 ft.	.....	Pammel (**17**) records *C. longifolia* as poisonous to fishes. It is likely that the variety *lanceolaria* also is a fish poison.
33. **Calonyction muricatum** (Linn.) G. Don (Syn. **Ipomoea muricata** Jacq.)	A large twiner found in the Himalayas from Kangra to Sikkim up to an altitude of 5,000 ft., and also in the Upper Gangetic Plain, Bengal and Deccan Hills; it is often cultivated for the sake of its thickened pedicels which are edible.	Seeds contain a resin (**19**).	The juice of the plant is used to destroy bugs (**21**).

34. **Calophyllum Inophyllum** Linn.	An exceedingly handsome moderate-sized tree cultivated throughout India, especially near the sea, as an ornamental plant.	Saponins (**17**).	The plant according to Pammel is a fish poison (**17**).
35. **Cannabis sativa** Linn.	An aromatic resinous annual herb found in several parts of India on waste ground and by the roadside. In the Himalayas it grows wild and is widely distributed.	Resinous substance which contains about 33 per cent of a toxic red oil (**37, 38, 39**).	Has the property of driving away bugs. For this purpose, the leaves or the whole plant are scattered under the bedsheet, which is effective in getting relief from these pests.
36. **Careya arborea** Roxb.	A medium-sized tree frequently found in the Sub-Himalayan tract from the Jumna eastwards, and in Bengal, Central, Western and Southern India, ascending to an altitude of 5,000 ft.	The leaves and wood contain tannins, the former to the extent of 19 per cent (**20**).	The Mundas of Chota Nagpur use the root, bark and the leaves to kill fish (**16**). In Mysore the inner bark is rubbed on the shoes to ward off leeches and is said to be quite effective for this purpose.
37. **Casearia graveolens** Dalz.	A shrub or small tree found in the Upper Gangetic Plain, westwards to Chenab ascending to an altitude of 5,000 ft. and in Garhwal, Kumaon and the Deccan Peninsula. In Sikkim it is found at an altitude of 1,500 ft.	.....	The fruit is used to poison fish.
38. **Casearia tomentosa** Roxb.	A shrub or small tree common throughout India especially in open lands, ascending to 3,000 ft. in the Himalayas.	.....	According to Brandis, the fruit yields a milky acrid juice which is employed to poison fish (**21**). Sometimes the crushed fruit is used for the same purpose.
39. **Cassytha filiformis** Linn.	A wiry leafless twining parasite found throughout the greater part of India, especially near the seacoast.	Alkaloid (**40**).	According to Pappe, quoted by Watt and Breyer-Brandwijk (**19**), it has been used as a wash in 'scald head and for the destruction of vermin'.

Name of Plant	Distribution	Constituents	Remarks
40. **Centratherum anthelminticum** (Willd.) Kuntze (Syn. **Vernonia anthelmintica** Willd.).	A tall annual met with throughout India up to 5,000 ft. on the Himalayas and Khasia Hills.	Bitter principle in the seeds (**41**).	In Travancore, the bruised seeds ground up into a paste with lime juice are largely employed for destroying pediculi in the head and body. The plant roasted in a room, or pounded and thrown about the floor, is believed to expel fleas; hence the popular English name, purple fleabane (**21**).
41. **Cerbera manghas** Linn. (Syn. **C. odollam** Gaertn.)	A small tree or a large shrub found throughout India in the salt swamps or on the seacoast. It is abundant on the Malabar coast but not very common in the Bombay Presidency and elsewhere.	The seeds contain a poisonous glucoside, cerberin, having a digitalis-like action.	Pammel (**17**) records the plant as a fish poison.
42. **Chrysanthemum cinerariifolium** Vis.	A glaucous perennial, experimentally cultivated in some parts of India, especially in the North-Western Himalayas.	Pyrethrin I and pyrethrin II in flower-heads (**42**). These, however, do not appear to be the only insecticidal principles in the plant, as watery extracts of the flower-heads are also toxic to mosquito larvae (**43**).	The flower-heads of pyrethrum have of recent years gained very great importance because of their insecticidal properties. They are employed in the form of powder or as a prepared extract for use as (*a*) household insecticides (*b*) as livestock sprays, and (*c*) as horticultural dusts and sprays. Till recently Japan and Yugoslavia were the biggest producers of pyrethrum, but of late years Kenya is assuming increasing importance. It is also being grown

			on a commercial scale in Persia, Algeria, Australia, Brazil, France, Spain and Switzerland. Examination of various samples of flower-heads of *C. cinerariifolium* cultivated in Kashmir and Murree hills has shown 0·702 to 1·300 per cent of pyrethrins, which compares favourably with foreign-grown commodity which is imported. The biological tests against different species of mosquitoes and flies have also shown that the Indian-grown stuff compares favourably with the flower-heads imported from Japan and also with another powerful proprietary extract sold under the name of 'Pyrocide 20'. Thus both the chemical and biological tests carried out in connection with pyrethrum grown in India, lead to the conclusion that the cultivation of *C. cinerariifolium* should be extended at a rapid rate so that the large and growing demand for it in this country is met with (**43**).
43. **Chrysanthemum coccineum** Willd.	A glabrous perennial, experimentally cultivated in Murree and some other places in India.	See under *C. cinerariifolium*.	A very important insecticide but not nearly as efficacious as *C. cinerariifolium*, at least in case of specimens grown in India (**43**).

Name of Plant	Distribution	Constituents	Remarks
44. **Cimicifuga foetida** Linn.	A tall robust perennial found in the Himalayas from Kashmir to Bhutan at 7,000 to 12,000 ft.	Rhizomes of *C. racemosa* (Linn.) Nuttal, a foreign species, contain a saponin, a glucosidic tannin, a water-soluble glucoside, and a glucoside insoluble in water but soluble in alcohol (**44**). They also contain an essential oil. It is possible that the Indian plant contains identical or similar constituents.	The roots are used to drive away bugs and fleas in Siberia; the flowers and unripe fruits have an extremely foetid smell and probably have the same property; hence its English name, bugbane.
45. **Cinchona calisaya** Wedd.	A native of Bolivia and Peru, this species may be said to have succeeded well under Indian climatic conditions, and is largely cultivated in Sikkim at elevations of 1,500 to 3,000 ft. above sea level.	A number of alkaloids (about 20 in number), which resemble each other in their chemical and pharmacological properties, have been isolated from this and other species of *Cinchona*. The best known of these are quinine, quinidine, cinchonine and cinchonidine. Besides these alkaloids, cinchona bark contains a few free organic acids, tannins, some neutral substances, colouring matters, traces of volatile oil, etc.	According to Pammel (**17**), various species of *Cinchona* are poisonous to fishes.
C. **calisaya** Wedd., var. **ledgeriana** Howard	Cultivation of this variety is now being developed in all Indian plantations and is gradually replacing *C. succirubra* Pav. *ex* Klotzsch. It is largely cultivated in Java and yields the most plentiful supply of quinine of all the species.	Ditto.	Ditto.

46. **Cinchona officinalis** Linn.	This species, with several varieties, is a native of Peru and Ecuador at an elevation of 5,000 to 7,500 ft. It is cultivated in South India in the Nilgiris near Ootacamund and thrives at higher altitudes (between 6,000 to 8,000 ft.) better than any other species. The cultivation of this species has been practically abandoned in Sikkim, as the climate is found to be too moist.	Ditto.	Ditto
47. **Cinchona succirubra** Pav. *ex* Klotzsch	This plant is a native of Ecuador and is largely cultivated in South India at an altitude of 4,500 to 6,000 ft. It is also grown in the Government of Bengal Plantations at Mungpoo (Sikkim), and in parts of the Satpura Range in Central India. It has proved to be the hardiest and most easily cultivated species and succeeds well at altitudes of 3,000 to 6,000 ft.	Ditto.	Ditto.
48. **Cinnamomum camphora** Nees & Eberm.	A small tree indigenous to Formosa, China and Japan; planted in some gardens in India up to 4,000 ft. in the North-West Himalayas.	Source of camphor.	Camphor is used to protect woollen fabrics against insects and enters into the composition of several insecticidal preparations.
49. **Cleistanthus collinus** Benth. & Hook. *f.*	A small tree found in the dry forests of Bundelkhand, Chota Nagpur, Central Provinces, Orissa, Northern Circars, Carnatic, the Deccan especially in Hyderabad, and Malabar.	The bark contains saponins and tannins (**45**).	The root, leaf, bark and fruit are employed as a poison for fish.
50. **Corypha umbraculifera** Linn.	A magnificent palm found in the moist forests of the Kumpta and Honavar talukas of North Kanara,	.....	The young fruit is pounded up and used for stupefying fishes (**46**).

Name of Plant	Distribution	Constituents	Remarks
50. **Corypha umbraculifera** Linn.—(*continued.*)	covering extensive areas near the Gairsoppa and Yena rivers, also on the Yellapur Ghats. It also occurs in Malabar and Travancore but in a doubtfully wild state. In the rest of tropical India it is occasionally cultivated.		
51. **Croton oblongifolius** Roxb.	A small deciduous tree found in the Sub-Himalayan tract from Oudh eastwards; also in Bengal, Sylhet, Chota Nagpur, and in the Central, Western and Southern India.	.....	The seeds have an oil with properties similar to those of *C. tiglium*.
52. **Croton tiglium** Linn.	A small evergreen tree planted in gardens more or less throughout India; almost becoming naturalized in Bengal and Assam.	Seeds contain an oil which is the most violent of all cathartics. They also contain an alkaloid, ricinine, and two toxic proteins (**20**).	The oil is sometimes used as an insecticide. The fruit is employed in some foreign countries to poison fishes (**17**).
53. **Cucumis sativus** Linn (wild form)	A hispidly hairy climber cultivated in all warm and warm-temperate countries. It is also found wild in Northern India.	The fruits contain a proteolytic enzyme resembling erepsin (**47**). They are also found to contain a bitter substance, the nature of which has not been ascertained.	It has been said that the juice banishes wood lice and fish insects; freshly cut slices are strewn in their haunts for this purpose.
54. **Curcuma longa** Roxb.	A tuberous herb, extensively cultivated all over India for its rhizomes known as turmeric.	Essential oil, alkaloid (**18**).	Turmeric is used to drive away ants by sprinkling in powder form on the ant holes. There are about fifteen species of *Curcuma* growing wild in India, and most of these could be used for similar purpose.

55. **Cymbopogon nardus** (Linn.) Rendle (Syn. **Andropogon nardus** Linn.)	A tall aromatic grass cultivated for the sake of its aromatic oil. According to some authors, this plant is also found wild in India.	Essential oil known as oil of citronella obtained from the leaves.	The commercial supply of oil of citronella is obtained principally from Ceylon, Burma and the Straits Settlements. It is an important constituent of mosquito repellents found in the market.
56. **Cynanchum Arnottianum** Wight	An erect plant found in Kashmir at 6,000 to 8,000 ft.; also in Baluchistan.	.....	The leaves are dried and powdered, and used to destroy the maggots which infest wounds in animals.
57. **Dalbergia stipulacea** Roxb.	A large climbing shrub, often a small erect tree found in the Eastern Himalayas up to 4,000 ft.; also in Assam, Khasia Hills and Chittagong.	.....	The bark and root of this plant are stated to be used to poison fishes (**10**).
58. **Delphinium brunonianum** Royle	An erect simple herb found in the Western Himalayas and Tibet between 13,000 and 17,000 ft.	*Note.*—Various species of *Delphinium* contain alkaloids, such as ajacine, ajaconine, delcosine, delphinine, delphinoidine, staphisagroine, etc.; of these delphinine and staphisagroine are the most important. *D. brunonianum* and *D. caeruleum* have not been analyzed so far.	Aitchison (**48**) remarks that the juice of the leaves is used in Kurrum Agency to destroy ticks on animals, particularly when they affect sheep.
59. **Delphinium caeruleum** Jacquem. *ex* Cambess.	An erect herb met with on the alpine Himalayas from Kumaon to Sikkim; common in the Sutlej basin at 8,000 to 17,000 ft.		The root is applied to kill maggots in the wounds of goats (**21**).
60. **Delphinium elatum** Linn.	Sparingly branched herb found in the temperate Western Himalayas from Kashmir to Kumaon and in the inner Tibetan Valleys at 10,000 to 12,000 ft.	Alkaloids (**49**).	In Europe the seeds are used as an insecticide (**21**).

Name of Plant	Distribution	Constituents	Remarks
61. **Derris elliptica** (Roxb.) Benth.	A large, handsome climber reported from Kodala Hill near Chittagong. Commercial supply comes mostly from Malaya, Sarawak, British North Borneo, and the Dutch East Indies. Attempts being made to cultivate this plant in different parts of India, such as Travancore, the Punjab, Kashmir, Mysore and Dehra Dun.	Roots contain rotenone, deguelin, tephrosin, *iso*tephrosin, toxicarol, dehydrorotenone and other substances; of these rotenone is said to be the most important (**20**, **50**, **51**, **52**). In commercial assay of tuba roots the total resinous content is regarded as a measure of its toxicity irrespective of the amount of crystalline rotenone because noncrystalline resin is also equally toxic. The fine lateral roots have been stated to contain higher toxic content than the larger tap roots.	The root, known as tuba root or derris, is an important article of commerce on account of being a valuable horticultural and agricultural insecticide. It is useful against many caterpillars, probably all larvae of leaf-eating wasps, many beetles and their larvae, turnip fleas, flower wasps, plant lice and red spider. In animal husbandry it has proved very effective against the larvae of warble fly, poultry pests such as red poultry mite, and forms the basis of proprietary sheep dip. An insecticidal wash effective against a wide range of pests may be made by adding 1 lb. of powdered root and 4 oz. of soft soap to 1 gallon of water (**50**). The powdered root mixed with forty parts of talc makes a very good insect powder for dogs and cats. The toxicity of tuba roots varies with the age of the plant. Harvesting of plant about 23 months after planting is recommended. The tuba root is also poisonous to fishes. *Note.*—Over twenty other species of *Derris* are found in India. It is very likely that a number of them possess piscicidal

			and insecticidal properties, and it would be worth-while investigating their properties. Besides the following species, only *D. robusta* (Roxb. *ex* DC.) Benth. has so far been investigated and shown to be devoid (**53**) of insecticidal properties.
62. **Derris ferruginea** (Roxb.) Benth.	A woody climber found in the evergreen forests of Upper Assam down to Darrang and Sibsagar.	Yields a fair amount of rotenone—up to 2·4 per cent (**54, 55**).	Because of the presence of rotenone, it is very likely that this plant possesses piscicidal and insecticidal properties.
63. **Derris scandens** (Roxb.) Benth.	A very large climber found in the forests of North Oudh, Konkan, Kanara, Madras Presidency from Northern Circars southwards, Bengal especially near Chittagong, and Orissa. It is also sometimes cultivated in gardens.	.....	Used as a fish poison. Devoid of insecticidal properties (**54**).
64. **Derris trifoliata** Lour., var. **uliginosa** (Roxb. *ex* Willd.) Badhwar *nov. comb.* (Syn. **D. uliginosa** Benth.; **Robinia uliginosa** Roxb. *ex* Willd.)	A large climber found on the muddy seacoast and creeks of the Bombay and Madras Presidencies and near the sea from Cuttack tidal forests to Puri (near the Chilka Lake); also in Sundarbans and Chittagong in Bengal, and in Assam.	Power (**56**) examined the stem-bark and found it to contain 9.3 per cent of tannic acid and some resins, and concluded that the toxic effects of the plant were probably due to some constituents of the resin. Krishna & Ghose (**54**), who examined the roots in different seasons of the year, state 'the total ether extract of these roots which is supposed to extract most of the insecticidal principle, was found to vary from 1·2 to 1·9 per cent and although the ether solubles gave distinct colour test for rotenone and allied bodies, no rotenone could be isolated'.	The bark of this plant is used as a fish poison. The plant possesses very poor insecticidal properties (**54**).

Name of Plant	Distribution	Constituents	Remarks
61. **Derris elliptica** (Roxb.) Benth.	A large, handsome climber reported from Kodala Hill near Chittagong. Commercial supply comes mostly from Malaya, Sarawak, British North Borneo, and the Dutch East Indies. Attempts being made to cultivate this plant in different parts of India, such as Travancore, the Punjab, Kashmir, Mysore and Dehra Dun.	Roots contain rotenone, deguelin, tephrosin, *iso*tephrosin, toxicarol, dehydrorotenone and other substances ; of these rotenone is said to be the most important (**20**, **50**, **51**, **52**). In commercial assay of tuba roots the total resinous content is regarded as a measure of its toxicity irrespective of the amount of crystalline rotenone because noncrystalline resin is also equally toxic. The fine lateral roots have been stated to contain higher toxic content than the larger tap roots.	The root, known as tuba root or derris, is an important article of commerce on account of being a valuable horticultural and agricultural insecticide. It is useful against many caterpillars, probably all larvae of leaf-eating wasps, many beetles and their larvae, turnip fleas, flower wasps, plant lice and red spider. In animal husbandry it has proved very effective against the larvae of warble fly, poultry pests such as red poultry mite, and forms the basis of proprietary sheep dip. An insecticidal wash effective against a wide range of pests may be made by adding 1 lb. of powdered root and 4 oz. of soft soap to 1 gallon of water (**50**). The powdered root mixed with forty parts of talc makes a very good insect powder for dogs and cats. The toxicity of tuba roots varies with the age of the plant. Harvesting of plant about 23 months after planting is recommended. The tuba root is also poisonous to fishes. *Note.*—Over twenty other species of *Derris* are found in India. It is very likely that a number of them possess piscicidal

62. **Derris ferruginea** (Roxb.) Benth.	A woody climber found in the evergreen forests of Upper Assam down to Darrang and Sibsagar.	Yields a fair amount of rotenone—up to 2·4 per cent (**54**, **55**).	and insecticidal properties, and it would be worth-while investigating their properties. Besides the following species, only *D. robusta* (Roxb. *ex* DC.) Benth. has so far been investigated and shown to be devoid (**53**) of insecticidal properties. Because of the presence of rotenone, it is very likely that this plant possesses piscicidal and insecticidal properties.
63. **Derris scandens** (Roxb.) Benth.	A very large climber found in the forests of North Oudh, Konkan, Kanara, Madras Presidency from Northern Circars southwards, Bengal especially near Chittagong, and Orissa. It is also sometimes cultivated in gardens.	.....	Used as a fish poison. Devoid of insecticidal properties (**54**).
64. **Derris trifoliata** Lour., var. **uliginosa** (Roxb. *ex* Willd.) Badhwar *nov. comb.* (Syn. **D. uliginosa** Benth.; **Robinia uliginosa** Roxb. *ex* Willd.)	A large climber found on the muddy seacoast and creeks of the Bombay and Madras Presidencies and near the sea from Cuttack tidal forests to Puri (near the Chilka Lake); also in Sundarbans and Chittagong in Bengal, and in Assam.	Power (**56**) examined the stem-bark and found it to contain 9.3 per cent of tannic acid and some resins, and concluded that the toxic effects of the plant were probably due to some constituents of the resin. Krishna & Ghose (**54**), who examined the roots in different seasons of the year, state 'the total ether extract of these roots which is supposed to extract most of the insecticidal principle, was found to vary from 1·2 to 1·9 per cent and although the ether solubles gave distinct colour test for rotenone and allied bodies, no rotenone could be isolated'.	The bark of this plant is used as a fish poison. The plant possesses very poor insecticidal properties (**54**).

Name of Plant	Distribution	Constituents	Remarks
65. **Dioscorea hispida** Dennst. (Syn. **D. daemona** Roxb.)	A climbing plant found throughout India up to an altitude of 2,500 ft. in the Himalayas and up to 4,000 ft. in the Khasia and Naga Hills. It is, however, absent from the plains of Bengal.	Tubers contain an alkaloid called dioscorine (**57**), which runs through the whole plant (**58**).	In the Philippine Islands, poultices of the tubers are applied to wounds which are infested with maggots, to kill them (**58**). Fishes are stated to be poisoned by the tubers. According to Gimlette (**59**), the leaves are also used to poison fishes.
66. **Dioscorea prazeri** Prain & Burkill (Syn. **D. deltoidea** Wall., var. **sikkimensis** Prain)	A climbing plant found in the hill tracts of Northern Bengal, Nepal and Khasia Hills up to 5,500 ft.	Poisonous saponins (**58**).	The Lepchas use the rhizome of this plant as a substitute for soap for washing their hair, because it kills lice. They also employ it as a fish poison.
67. **Diospyros ebenum** Koen.	A large or moderate-sized tree found in the forests of Peninsular India and Assam.	.....	Pammel records it as a fish poison (**17**).
68. **Diospyros montana** Roxb.	A small or medium-sized tree found throughout India, *e.g.* in the Sub-Himalayan tract from Kangra eastwards, Upper Gangetic Plain, Bihar, Konkan, Southern Mahratta Country, Northern Circars, the Deccan, Carnatic and eastern slopes of the Ghats.	.....	The fruit is stated to be used by the hillmen of Travancore for poisoning fish (**26**). Crushed leaves are used for the same purpose in Chota Nagpur (**16**).
69. **Diospyros paniculata** Dalz	A middle-sized West Peninsular tree found in the forests of Southern Mahratta Country, Kanara, Malabar and Travancore up to 3,000 ft. above sea level.	.....	The leaves are used as a fish poison (**16**).

70. **Dodonaea viscosa** (Linn.) Jacq.	An evergreen shrub, rarely a small tree, met with in the North-West Himalayas up to an altitude of 4,500 ft.; also in Sind and South India up to 8,000 ft. in the Nilgiris. Commonly planted in Northern India as a hedge plant.	The plant contains saponins (**60**).	According to Pammel (**17**), the plant is poisonous to fishes.
71. **Dolichandrone falcata** Seem.	A deciduous tree found in Rajputana, Bundelkhand, Bihar, Central Provinces, Berar, Konkan, Deccan, Mysore and most districts of the Madras Presidency in dry deciduous forests and often on rocky places.	.....	The bark is used in the neighbourhood of Poona and other places as a fish poison.
72. **Duranta repens** Linn. (Syn. **D. plumieri** Jacq.)	An evergreen shrub, one of the commonest hedge plants in Indian gardens.	The leaves contain a saponin (**125**). The berries contain an alkaloid analogous to narcotine (**124**).	When macerated the berries exude a juice which is lethal to all anophelines and culicines. Manson (**124**) has found that the juice is lethal to anophelines and culicines in dilutions up to 1 in 100, but not in weaker strengths. The action on culicines is less marked than on anophelines.
73. **Edgeworthia gardneri** Meissn.	A large much-branched bush found along the Himalayas from Nepal to Sikkim and Bhutan, between 4,000 and 9,000 ft. It is also plentiful in Manipur.	.....	Pammel (**17**), on the authority of Greshoff, records it as a fish poison.
74. **Entada pursaetha** DC. (Syn. **E. scandens** Benth.)	A gigantic woody climber found in the Central and Eastern Himalayas ascending to 4,000 ft. in Sikkim; also in Eastern Bengal, Bihar and Orissa	The seeds contain two toxic saponins (**61**); also said to contain a glucoside which is hydrolyzed by emulsin (**62**).	The seeds are used as a fish poison in some parts of India, South Africa and in the Philippine Islands. Watt (**21**) records that

Name of Plant	Distribution	Constituents	Remarks
74. **Entada pursaetha** DC. (Syn. **E. scandens** Benth.)—(*continued*)	especially in damp forests situated at higher altitudes; also in the forests along the Ghats of the Bombay Presidency. In the Madras Presidency it is found in the hill forests of the Northern Circars, the Deccan and on the Western Ghats from South Kanara to Travancore in evergreen forests.	The bark and the wood contain toxic saponins but these are absent in the leaves (**63**).	'the juice of the leaves is employed in Ceylon for stupefying fish'.
75. **Eremostachys superba** Royle *ex* Benth.	An erect herb which has been reported from Garhwal in the Western Himalayas and from Peshawar in the North-West Frontier Province.	.....	Pammel (**17**) records the plant as poisonous to fish.
76. **Eremostachys vicaryi** Benth.	An erect herb common on the Salt Range, ascending up to 2,500 ft.; it is also met with in and near Peshawar and in Baluchistan.	.....	The plant is employed as a fish poison in the Eusafzai country near Peshawar (**21**).
77. **Eucalyptus globulus** Labill.	A gigantic tree of Australia and Tasmania. Introduction into India; a complete success in the Nilgiris. Does not thrive in the plains nor on the outer Himalayan ranges.	Essential oil.	Eucalyptus oil obtained from the leaves is largely used as a mosquito and vermin repellent and is an important constituent of many insecticidal and insect-repellent preparations.
78. **Eupatorium odoratum** Linn.	An obnoxious weed introduced from the West Indies; covers extensive areas in Bengal and Assam.	.....	Recorded as poisonous to fishes.
79. **Euphorbia antiquorum** Linn.	A fleshy much-branched large shrub or small tree with a few decidu-	Acrid milky juice.	Milky juice used to kill maggots in wounds.

	ous leaves. Found in dry places throughout the hotter parts of India up to 2,000 ft. Occasionally cultivated as a hedge plant in villages.		Juice also used by the Mundas of Chota Nagpur to stupefy and catch fish (**16**).
80. **Euphorbia neriifolia** Linn.	A large fleshy shrub or small tree occasionally planted in villages as a hedge plant throughout India and is sometimes found to run wild on waste-land. In Orissa and in the Deccan it is said to occur in a state of nature in rocky places.	.....	According to Pammel (**17**), the plant is a fish poison.
81. **Euphorbia royleana** Boiss.	A glabrous fleshy shrub or small tree common on the dry and hot rocky slopes of the outer ranges of the Western Himalayas from the Indus to Kumaon, ascending to an altitude of 6,000 ft. ; also on the Salt Range in the Punjab. It is commonly grown in hedges in the Sub-Himalayan tract and the adjacent plains.	.....	Pammel (**17**) records the plant as a fish poison.
82. **Euphorbia thymifolia** Linn.	A small prostrate annual found throughout the greater part of India, up to 4,000 ft. on the Himalayas.	Essential oil.	Essential oil used in sprays to keep off flies and mosquitoes from inhabited rooms (**64**).
83. **Euphorbia tirucalli** Linn.	An unarmed shrub or small tree which is a native of Africa and has become naturalized in several places in India. It is often grown as a hedge or occasionally as a roadside tree.	The milky juice contains about 20 per cent of resins (**20**).	Used as a fish poison in the Southern Mahratta Country.
84. **Excoecaria agallocha** Linn.	A small evergreen tree found in tidal forests and swamps on all the coasts of India.	.....	Pammel (**17**) records the plant as a fish poison.

Name of Plant	Distribution	Constituents	Remarks
85. **Fluggea leucopyrus** (Koen.) Willd.	A large rigid bushy shrub found in the Sub-Himalayan tracts of Kheri (North Oudh) and Gorakhpur, outer ranges of the Kumaon Himalayas up to 5,000 ft., in the Punjab plains, Sind, and throughout Bombay and Madras Presidencies usually in open places.	The bark contains about 10 per cent of tannins (**26**).	The bark is stated to be used as a fish poison.
86. **Fluggea virosa** (Roxb. *ex* Willd.) Baill. (Syn. **F. microcarpa** Blume)	A large unarmed shrub or small tree found throughout India, from the Indus and Kashmir eastwards to Assam in the Himalayas up to an altitude of 5,000 ft., and in the rest of India in deciduous forests.	The bark contains about 8.9 per cent of tannins (**26**).	The bark is stated to be used as a fish poison.
87. **Gardenia campanulata** Roxb.	A shrub found at the foot of the Sikkim Himalayas, Assam, Sylhet, Chittagong and at the summit of Parasnath in Bihar.	Saponin (**124**).	The fruit is used as a fish poison, and the fruit juice is an efficient larvicide in dilutions up to 1 in 80 (**124**).
88. **Gaultheria fragrantissima** Wall.	A stout herb met with from Nepal to Bhutan at 6,000 to 8,000 ft.; also on the Khasia Hills, Western Ghats, the Nilgiris, the Pulneys and hills of Travancore at altitudes over 5,000 ft.	Essential oil in leaves and other parts of the plant (**18, 65**).	Essential oil a constituent of several insecticidal and insect-repellent preparations.
89. **Gloriosa superba** Linn.	A tall herbaceous climber found throughout tropical India up to 7,000 ft. on the hills; common in Mysore State.	Rootstock contains a toxic bitter principle, alkaloid colchicine, and two other bases (**66, 67**).	Juice of the leaves used in Guiana to destroy lice in the hair (**16**).

90. **Gnetum scandens** Roxb.	A lofty dioecious climber found in the tropical Eastern Himalayas from Sikkim eastwards to Assam and the Khasia Hills, and through Chittagong, Chota Nagpur and Bihar to the Andamans. In Western India it extends from Konkan southwards to the Ghats of both sides of the Madras Presidency at altitudes of 500 to 5,000 ft.	.....	According to Pammel (**17**), the plant is used as a fish poison.
91. **Gynandropsis gynandra** (Linn.) Merr. (Syn. **G. pentaphylla** DC.)	Strong-smelling, somewhat foetid herb, abundant throughout the warmer parts of India.	An acrid volatile oil (**26**).	The seeds, rubbed with oil, are used to destroy head lice.
92. **Gynocardia odorata** R. Br.	A glabrous tree common in the evergreen forests of Sikkim and Assam, extending eastwards across Chittagong as far as Tenasserim.	The seeds freed from the shell yield about 65 per cent of a fatty oil known as gynocardia oil, which does not contain chaulmoogric acid or its homologues but consists of glycerides of linolic, palmitic, linolenic, *iso*linolenic and oleic acids. They also contain a cyanogenetic glucoside, gynocardin—5 per cent of shell-free seeds (**68, 69**).	The seed pulp is employed in Sikkim to poison fish.
93. **Harpullia cupanioides** Roxb.	A small tree found in the hill tracts near Chittagong.	Saponins (**20**).	Pammel (**17**) records it as a fish poison.
94. **Hedera helix** Linn.	An evergreen climbing shrub found in the Himalayas from 6,000 to 10,000 ft., and in the Khasia Hills at 4,000 to 6,000 ft.	Nearly all parts of the plant contain the glucoside α-hederin and probably other glucosides (**70, 71**). Leaves also contain a saponin which is closely related to α-hederin (**72**).	A decoction of the leaves said to be applied externally in some places to destroy vermin in the heads of children (**21**).

Name of Plant	Distribution	Constituents	Remarks
95. **Hydnocarpus kurzii** (King) Warb. (Syn. **Taraktogenos kurzii** King)	A tree common in the evergreen forests of Upper Assam and Chittagong.	Fresh seeds contain hydrocyanic acid, the yield being about 0·036 per cent of the kernels. They also contain a fatty oil to the extent of about 38 per cent of the entire seeds; this oil consists of the glycerides of chaulmoogric acid, hydnocarpic acid and their lower homologues together with some palmitic acid (**73**). Other acids, such as taraktogenic acid, *iso*gadoleic acid and probably arachidic acid, are also present (**74**).	The hill tribes in Sikkim use the pulp of the fruit to poison fish.
96. **Hydnocarpus laurifolia** (Dennst.) Sleumer (Syn. **H. wightiana** Blume)	A tree common in the Western Peninsula; endemic in tropical forests along the Western Ghats from the Konkan southwards and below the Ghats in Kanara and Malabar, in damp situations especially near water. In Travancore it is common up to an altitude of 2,000 ft.	Seeds contain about 44 per cent of an oil (**21**), which consists of the glyceryl esters of chaulmoogric acid, hydnocarpic acid and some of their lower homologues. They have not been found to contain any cyanogenetic compounds (**75**).	Fruit reported as poisonous to fishes.
97. **Hydrocotyle javanica** Thunb.	A creeping herb with erect flexuose branches, found from Kashmir to Bhutan at altitudes of 2,000 to 8,000 ft.; in the Khasia mountains between 2,000 to 6,000 ft.; and in the mountains of the Western Ghats and the Nilgiris and Pulneys, in shady places.	.....	Referred to as a fish poison by Pammel (**17**), but no such use is reported in India.
98. **Jatropha curcas** Linn.	A shrub or small tree which is a native of America, grown in various parts of India as a field barrier. It is	Seeds contain 20 to 40 per cent of a fixed oil which is a drastic purgative. They also	According to Pammel (**17**), the plant is poisonous to fishes.

		also found in a semi-wild condition in the vicinity of villages.	contain a toxalbumin known as curcin (78), which is a blood poison.	
99.	**Juglans regia** Linn.	The walnut tree is found in the temperate Himalayas and Western Tibet at altitudes of 3,000 to 10,000 ft., both wild and under cultivation. It is cultivated in the inner valleys of Kagan, Kashmir, Chamba, Kulu and Bushahr.	The plant contains essential oil, tannins and a hydroxy-napthaquinone derivative (20, 76).	According to Kanjilal (77), the rind of the unripe walnut fruit is used in Jaunsar and Tehri Garhwal to intoxicate fish. The authors have never heard of this very well-known plant being put to such use in other parts of the North-West Himalayas.
100.	**Kalanchoe spathulata** (Poir.) DC.	A succulent perennial found in the tropical and subtropical Himalayas from Kashmir to Bhutan generally between 1,000 to 4,000 ft.; near Simla ascends to 6,000 ft.	.....	The leaves are stated to be poisonous to insects.
101.	**Lagenandra toxicaria** Dalz. [Many authors view this species as synonymous with **L. ovata** (Linn.) Thw. of Ceylon].	A herb found in marshes and along watercourses, often growing gregariously in Konkan, Southern Mahratta Country, North Kanara, Mysore, Coorg, and throughout the West Coast and Ghats of the Madras Presidency up to 4,000 ft.	Acrid juice.	Plant said to have insecticidal properties (16).
102.	**Lasiosiphon eriocephalus** Decne.	A shrub found in the open forests of the Western Ghats of the Bombay and Madras Presidencies, ascending to an altitude of 7,000 ft. in the Nilgiris.	.....	The bark and the leaves are frequently used for poisoning fish.
103.	**Lepidium draba** Linn.	A weed of cultivation in the Punjab.	The seeds yield an essential oil, containing sulphur compounds. The young leaves yield hydrocyanic acid (20).	The plant is stated to be a fish poison (17).

Name of Plant	Distribution	Constituents	Remarks
104. **Linostoma decandrum** Wall.	An erect evergreen shrub found in Sylhet and Chittagong.	.....	According to Rodger (**79**), fish poisons are made from the pulped up fruits and stems of this plant.
105. **Madhuca latifolia** (Roxb.) Macbride (Syn. **Bassia latifolia** Roxb.)	A large deciduous tree found in Oudh, Bihar, Central Provinces, Central India, Gujerat, Konkan, North Kanara, Southern Mahratta Country and the Deccan. Largely planted elsewhere and liable to run wild.	The seeds contain a neutral saponin (**80**). Leaves contain a glucosidic saponin and traces of an alkaloid (**81**).	The smoke produced during the burning of the oil cake is reported to kill insects. The oil cake used as a worm killer for lawns—4 oz. per sq. yd. (**50**). The residual cake, 'mowrah meal', after the extraction of the oil from the seeds is said to be used to poison fish.
106. **Madhuca longifolia** (Linn.) Macbride (Syn. **Bassia longifolia** Linn.)	A large tree found in the forests of Western India from Konkan southwards to Travancore; common in Malabar, Mysore, Anamalais and the Circars at low elevations.	After extraction of the oil from seeds, a sapo-glucoside called mowrin is obtained from the residue.	The residual cake 'mowrah meal' after the extraction of the oil from the seeds, is used as a worm killer for lawns as in the case of *M. latifolia* (**50**). It is also said to be used to poison fish.
107. **Maesa indica** Wall.	A large shrub found throughout India up to an altitude of 6,000 ft.; common in the North-East Himalayas, Eastern Bengal, Darjeeling district, Manipur, Kanara and along the Ghats.	.....	Leaves used as a fish poison in Kanara (**21**).
108. **Melaleuca leucadendron** Linn.	An evergreen tree found in Tenasserim, Mergui, Malacca, Malay Islands and Australia. Var. *leucadendron* Duthie is cultivated in India.	Essential oil, known as cajuput oil, distilled from the leaves and twigs.	Cajuput oil is an excellent mosquito repellent and has the advantage over oil of citronella in that it volatilizes more slowly.

109. **Melodinus monogynus** Roxb.	A tall climber found in the Sikkim Himalayas, Assam, Sylhet and the Khasia Hills, ascending to an altitude of 4,000 ft.	.....	Roxburgh, while steeping some of the young shoots in a fish pond in order to accelerate the removal of the bark and to clean the fibre, found that many it not all the fish were killed, hence his name *Nerium piscidium* for the plant.
110. **Millettia auriculata** Baker *ex* Brand.	A large robust woody climber, common in the outer Himalayas from Sutlej eastwards to Sikkim up to 3,500 ft. Abundant in the forest tracts of Dehra Dun, the Siwalik range, Rohilkhand, North Oudh, Gorakhpur, and Bundelkhand; also in Bihar, Orissa and Bengal, and in the forests of Ganjam and Vizagapatam up to 4,000 ft.	.....	The powdered root applied to sores in cattle to kill vermin; also used to poison fishes (**21**).
111. **Millettia pachycarpa** Benth.	A large climber found in the forests of Garo and Khasia Hills, Sikkim and Assam up to an altitude of 4,000 ft.	The plant contains a large amount of saponin and possibly also considerable quantities of rotenone.	Known as 'fish poisoning vine' in China, the root being commonly used for this purpose. Mixtures of this plant with soap or tea oil serve not only as a good insecticide but also as contact and stomach poisons, the efficiency for the latter purposes being not inferior to that of derris (**82**).
112. **Millettia piscidia** Wight & Arn.	Found in Sikkim and Assam.	.....	As the name suggests, it is very likely to be poisonous to fish.
113. **Mundulea sericea** (Willd.) Greenway (Syn. **M. suberosa** Benth.)	A stout shrub or small tree found in Western and Southern India in Konkan, the Circars, the Deccan asts Carnatic to Tinnevelly, in dry forend on rocky hills and up to 4,000 ft. above sea level.	According to Pammel (**17**), the bark and the root contain a very toxic glucoside but we have not been able to verify this. The bark is reported to contain only 0·8 to 0·9 per cent of rotenone.	The seeds are used for poisoning fish in Southern and Western India; the bark also possesses piscicidal properties. According to Greenway (**83**), the plant is stated to be poisonous to crocodiles and to have the effect of

Name of Plant	Distribution	Constituents	Remarks
113. **Mandulea sericea** (Willd.) Greenway (Syn. **M. suberosa** Benth.)—(*continued.*)			driving them away from the river. He also states that the people of Tanganyika sometimes tie the strips of bark round the legs of the cattle, when they are taken to the river to water, in order to protect them from these reptiles. It is very likely that the root is also poisonous to fish. The bark is stated to be almost as toxic to various insects as the roots of *Derris elliptica*, in spite of the low content of rotenone (**84**).
114. **Myrica nagi** Thunb.	A small evergreen dioecious tree found in the outer Himalayas from the Ravi eastwards at altitudes of 3,000 to 6,000 ft.; also in the Khasia Hills and Sylhet.	According to Hooper, 100 parts of the 'kino' produced by the bark contain about 60 to 80 parts of tannin (**20**).	According to Gamble (**85**), the bark is used in the Khasia Hills to poison fishes.
115. **Nicandra physaloides** Gaertn.	An erect annual herb introduced from Peru, but now found as a weed on rich soils in many parts of India up to 7,000 ft. on the Himalayas; often grown in gardens.	.....	In Madagascar, a decoction of the leaf is stated to be used to destroy *Pediculus capitis* (**16**). It is also stated to be used as a fly poison in parts of the United States of America (**17**).
116. **Nicotiana rustica** Linn.	An erect herb cultivated in Western Punjab, Baluchistan, Bengal and other places in India, but sparingly as compared with *N. tabacum*.	See *N. tabacum*.	Properties similar to *N. tabacum*.

117. **Nicotiana tabacum** Linn.	An erect herb cultivated throughout India; sometimes met with as an escape.	Leaves, stems and roots contain volatile alkaloid, nicotine. Leaves also contain several other alkaloids (**86**), and two glucosides (**87**).	Preparations from the leaves and crude solutions of nicotine are extensively employed as insecticides in horticulture by dusting or spraying or by vaporization. Similar preparations are sometimes used for external application and as parasiticides in veterinary practice. Tobacco leaves are also used to ward off leeches, for which purpose they are placed under the stockings during marches in damp forest localities that are infested with these pests.
118. **Nigella sativa** Linn.	A pretty herb extensively cultivated in many parts of India for its seeds.	Seeds stated to contain 0·5 to 1·4 per cent of an essential oil and a saponin-like glucoside, melanthin.	It appears to be a common practice in India to scatter the seeds between the folds of linen or woollen clothes to prevent them from being eaten by insects.
119. **Ocimum gratissimum** Linn.	Cultivated in gardens throughout Bengal, East Nepal and the Deccan Peninsula; said to be a common wild plant in Western India.	Essential oil, thymol, eugenol, methyl chavicol (**18**).	The shrubby basil is popularly believed to be a good mosquito repellent and its plantation has been suggested as a measure of biological control of mosquitoes; it diffuses a stronger fragrance than any other member of the genus *Ocimum*. In this connection it may be remarked that *O. sanctum* Linn. is also believed to have similar properties.

Name of Plant	Distribution	Constituents	Remarks
120. **Ougeinia dalbergioides** Benth.	A small or medium-sized tree found in the Sub-Himalayan tracts and outer Himalayan valleys and slopes up to an altitude of 5,000 ft. from the Punjab to Bhutan; also in Oudh, Bundelkhand, Chota Nagpur, Central India, Orissa, the Circars, the Central Provinces, Bombay, and Marwar of Rajputana.	.....	The bark is employed to poison fish. The stem-bark and leaf are stated to be toxic to some caterpillar pests (**56**).
121. **Pachygone ovata** (Poir.) Miers *ex* Hook. *f.* & Thoms.	A lofty climber found in the sandy seashores of the Coromandel Coast from Nellore to Tanjore and Tinnevelly; also in the Deccan in Bellary, Cuddapah and Mysore.	.....	The dried fruit is used for the purpose of destroying vermin and stupefying fish (**16**). Pammel (**17**) also records it as a fish poison.
122. **Peganum harmala** Linn.	A densely foliaged bushy herb, common in the drier waste places and fields of Baluchistan, Waziristan, Kurrum Valley, Sind, Cutch, the Punjab, Kashmir, Delhi, United Provinces, Bihar, Konkan and the Western Deccan.	Seeds contain the alkaloids harmine, harmaline, harmalol and peganine (**86**); also a soft resin (**21**).	The smoke of the plant is commonly used in the Punjab as a disinfectant-fumigant, and is believed to keep off mosquitoes. According to Watt (**21**), the powdered root, mixed with mustard oil, is applied to the hair to destroy vermin.
123. **Phyllanthus urinaria** Linn.	An annual or rarely perennial herb found throughout the plains of India from the Punjab to Assam and Madras Presidency up to an altitude of 3,000 ft.	The plant is said to contain a neutral bitter substance and an alkaloidal principle (**26**).	Pammel (**17**) records the plant as a fish poison.
124. **Picrasma javanica** Blume, var. **nepalensis** (Benn.) Badhwar *nov. comb.* (Syn. **P. nepalensis** Benn.)	A moderate-sized tree found in Assam and Nepal.	.....	We are informed that the powdered young leaves and the twigs of this plant are used as a larvicide in Assam.

125. **Pieris ovalifolia** D. Don	A small deciduous tree found in the outer Himalayas from the Indus eastwards, usually from 3,000 to 8,000 ft.; common east of the Ravi and in the Khasia Hills between 3,000 to 5,000 ft.	A toxic substance, andromedotoxin (**88**).	The young leaves are believed by people in Jammu to have insecticidal properties.
126. **Pithecellobium bigeminum** Mart. (Syn. **Pithecolobium bigeminum** Benth.)	A middle-sized unarmed tree found in the Eastern Himalayas, Khasia and Jaintia Hills, Konkan, North and South Kanara, the Western Ghats of Madras Presidency from Mysore to Anamalais and Travancore, ascending to an altitude of 3,000 ft.	The bark contains 0·8 per cent of an alkaloid, which acts as a fatal poison to fish in a dilution of 1: 400,000 (**89**); it also contains a saponin (**90**). The leaves contain two acids but no alkaloids, glucosides or tannins (**91**).	The plant is poisonous to fish.
127. **Pogostemon heyneanus** Benth. (Syn. **P. patchouli** Hook *f.* in Fl. Brit. Ind., *non* Pellet.)	A strongly aromatic herb found in Western Ghats from South Kanara southwards, in open forest land; often cultivated and then run wild. Also about Kotagiri in the Nilgiris at 6,000 ft. Sometimes cultivated in gardens in the Bombay and Bengal Presidencies.	Essential oil.	The dried leaves are extensively employed for scenting linen and other clothes and to keep off insects from shawls, etc.
128. **Polygonum flaccidum** Meissn.	Common throughout India in wet places, ascending the Himalayas to 4,000 ft., and extending to Ceylon.	.....	It is locally used in Assam as a vermicide and as a fish poison. The greenish mucilaginous juice of the plant kills off mosquito larvae in 15 minutes, but it is not lethal in dilutions (**124**).
129. **Polygonum hydropiper** Linn.	A rather robust annual found in damp places more or less throughout India up to 7,000 ft. in the Himalayas.	The herb contains formic acid, acetic acid and baldrianic acid, much tannin and small amounts of an essential oil (**92**).	It is stated that insects avoid this plant; when dried and strewn among clothes it prevents the attacks of moths. The authors

Name of Plant	Distribution	Constituents	Remarks
129. **Polygonum hydropiper** Linn.—(*continued*).		Root said to contain oxymethyl-anthraquinones (**93**).	are informed that it is used as a fish poison in the Punjab hills. It is very likely that some other plants belonging to the genus *Polygonum*, especially *P. persicaria* Linn., possess similar properties.
130. **Pongamia pinnata** (Linn.) Merr. (Syn. **P. glabra** Vent.)	A moderate-sized almost evergreen tree met with all over India, on the banks of rivers and streams, especially near the seacoast and some forest localities ; often planted as a roadside tree. It sometimes flowers as a shrub on the seacoast.	The seeds contain 27 to 36·4 per cent of a bitter fatty oil and traces of an essential oil (**18**).	The seeds and roots are said to be poisonous to fishes. A 2 per cent *P. glabra* oil-resin spray has been stated to be highly toxic against the nymph and adult stages of the green bug (*Coccus viridis*) on coffee (**94**).
131. **Pygeum gardneri** Hook. *f.*	A medium-sized tree found in the Western Ghats of Madras and Bombay Presidencies, in the hills of Travancore, Malabar, Nilgiris, Pulneys, the Deccan, Southern Mahratta Country, and Konkan at altitudes above 3,000 ft. ; common on the Mahableshwar plateau.	The seeds smell strongly of hydrocyanic acid.	The kernel of the fruit is used as a fish poison.
132. **Randia dumetorum** Lam. [Split up into three species by Gamble (**126**)]	A small tree or rigid shrub found in the Sub-Himalayan tracts from Rawalpindi district eastwards, ascending in Sikkim up to 4,000 ft. Southwards it extends to Chittagong and the Peninsular India.	The fruits contain saponin in the pericarp, a glucosidic saponin in the pulp, and the seeds are said to contain traces of an alkaloid (**95**). An essential oil also present (**18**).	In Konkan the bruised fruit is mixed with grain to preserve it from the attacks of insects (**26**). Subramaniyam (**96**) found that a 10 per cent aqueous extract of the root sprayed against the green scale of coffee gave an 80 per cent mortality of the insects in 4 days.

			The unripe fruit is used to intoxicate fish, and according to Watt (**21**), the bruised root is also employed for this purpose.
133. **Randia uliginosa** DC.	A small rigid tree found in the Eastern, Central and Southern India, but is not common northwards.	.....	The unripe fruits are employed for poisoning fish.
134. **Rauwolfia serpentina** Benth. *ex* Kurz	An erect shrub found in Sub-Himalayan tracts and in the plains near the foot of the hills from Sirhind eastward to Assam, ascending to an altitude of 4,000 ft.; also in Konkan, North Kanara, Southern Mahratta Country, Western and Eastern Ghats of the Madras Presidency (up to 3,000 ft.), many districts of Bihar such as Patna and Bhagalpur, and in North and Central Bengal.	Chemical analysis of the root has yielded five crystalline alkaloids which can be classified into two groups: (**A**) the *ajmaline* group—ajmaline, ajmalinine and ajmalicine; and (**B**) the *serpentine* group—serpentine and serpentinine (**97**). Besides these, there are some more alkaloids present in both the ajmaline as well as the serpentine group.	Pammel (**17**) records this plant as a fish poison, but such use has not been observed by the present authors in India.
135. **Rhododendron barbatum** Wall. *ex* G. Don	A tree found in the temperate Himalayas from Kumaon to Bhutan at altitudes of 8,000 to 12,000 ft.; common in Sikkim.	Contains the toxic substance andromedotoxin (**88**).	The plant is mentioned by Chopra (**18**) to be a fish poison.
136. **Rhododendron falconeri** Hook. *f.*	A tree common in the Himalayas from East Nepal to Bhutan at altitudes of 9,000 to 13,000 ft.	Contains a toxic substance, andromedotoxin (**88**).	Chopra (**18**) mentions the plant as a fish poison.
137. **Ricinus communis** Linn.	A tall stout annual, or perennial and sub-arboraceous. Originally probably from America, it is now extensively cultivated for its oil-bearing seeds and has also become naturalized near habitations in many parts of India.	Seeds contain a fixed oil and a toxalbumin, ricin, which does not pass into the oil (**98**).	Castor oil is said to be an active poison for flies (**98**). Pammel (**17**) records the plant as a fish poison.

Name of Plant	Distribution	Constituents	Remarks
138. **Ruta graveolens** Linn., var. **angustifolia** Hook. *f.*	Cultivated in gardens.	A volatile oil in the leaves, roots and seeds. Also a glucoside, rutin, and a coumarin-like odoriferous principle (**19**).	The plant is sometimes spread on beds to keep off insects.
139. **Santalum album** Linn.	A small evergreen tree, parasitic on roots to start with. Found in Mysore, Coorg, Coimbatore and Salem districts, southwards to Madura and northwards to Kolhapur; wild or cultivated.	Essential oil in the aromatic heartwood of the tree; also in roots.	The essential oil is an efficient insecticide and insect repellent. The wood is largely used in ornamental carving and cabinet work; its odour drives away insects and it is, therefore, of value for making chests and boxes. Small chips and raspings of the heartwood would serve the purpose of keeping off insects, when placed among clothes, at the same time imparting a pleasant odour.
140. **Sapindus mukorossi** Gaertn.	A handsome tree cultivated throughout North-West India, Bengal and Assam; also found wild in the Himalayas up to an altitude of 4,000 ft.	The fruits contain fairly large amounts of saponins—10·5 per cent (**33**).	The plant is described as a fish poison by Pammel (**17**).
141. **Sapindus trifoliatus** Linn.	A handsome tree common about the villages in South and West India; also cultivated in Bengal where it is doubtfully native. It is occasionally planted elsewhere also.	The pericarp contains a fairly large quantity of saponins—11·5 per cent (**99**). According to Brannt, quoted by Watt (**20**), no saponins are contained in the stone	Pammel (**17**) records it as a fish poison. It is more than probable that *S. emarginatus* Vahl, which is treated as a synonym of *S. trifoliatus* in the Fl. Brit. Ind., but which is now regarded as distinct species, possesses similar properties. The fruits of both are

			used as a substitute for soap on account of the large amount of saponins they contain.
142. **Sapium indicum** Willd.	An evergreen tree found in the Sundarbans, and in the West Coast along backwaters in Malabar and Travancore.	.....	The seeds are employed as a fish-intoxicant by local people where the tree is found.
143. **Sarcostemma acidum** (Roxb.) Voigt (Syn. **S. brevistigma** Wight & Arn.)	Leafless, trailing or twining, jointed shrub usually found on arid rocks in Konkan, the Deccan, Northern Circars, Carnatic and on Horsleykonda up to 4,500 ft. Also reported from Ranchi (Horhap forest), Singhbum and Puri. Occurs in Bengal also.	.....	Often used by farmers to extirpate white ants from sugarcane fields. A bundle of twigs is put into the trough of the well from which the field is watered, along with a bag of salt, hard packed, so that it may dissolve gradually. The water so impregnated has been stated to destroy the ants without injuring the crop (**21**). Three other Indian species of this genus, which are almost indistinguishable in a dry state from this plant, are similarly used. Two of them, *S. brunonianum* Wight & Arn. and *S. intermedium* Decne., are inhabitants of Western and Southern India. The third *S. stocksii* Hook. *f.* is found in Sind and Southern Mahratta Country and is more robust than any of the other three. These are known by the same vernacular names as *S. acidum*.

Name of Plant	Distribution	Constituents	Remarks
144. **Saussurea lappa** C.B. Clarke	A tall stout perennial herb found in Kashmir and the surrounding country.	Essential oil, alkaloid saussurine, resin, traces of a bitter substance, etc. (**100**).	The roots of costus are used in India to protect woollen fabric from insects. It is believed by Indian ladies that they do not tarnish gold embroidery on their clothing as does naphthalene.
145. **Schleichera oleosa** (Lour.) Merr. (Syn. **S. trijuga** Willd.)	A large tree found in dry forests of the Sub-Himalayan tracts, from the Sutlej eastwards and throughout Central and Southern India.	Seeds contain a fixed oil and small quantities of a cyanogenetic compound (**101, 102**).	The powdered seeds are applied to ulcers in animals for removing maggots.
146. **Scleria pergracilis** (Nees) Kunth	Widely scattered from Garhwal at an altitude of 5,000 ft. to Assam, Bihar, Chota Nagpur and the Deccan.	.....	The lemon-scented leaves are used to drive away mosquitoes (**103**).
147. **Sophora mollis** R. Grah.	A low shrub found in the Himalayas and Sub-Himalayan tracts of North-Western India from Gilgit, Chitral, Hazara and the Salt Range to Kumaon and Nepal up to 7,000 ft. Locally common near Malakand, in Kagan and Kilba, Bushahr and Sahansradhara near Dehra Dun.	An alkaloid, sophorine, which is identical with cytisine has been isolated from *S. tomentosa* Linn. found in the Andaman and Nicobar Islands, and also occasionally cultivated in Indian gardens. This alkaloid has insecticidal properties although the use of the plant as an insecticide is not recorded. It is likely that *S. mollis* contains similar or identical alkaloid.	The seeds are stated to be useful for destroying vermin (**16**).
148. **Sphaeranthus indicus** Linn.	A strongly scented herb found throughout India, especially in damp places and in cultivated fields after harvest, ascending in the Himalayas up to an altitude of 5,000 ft. from Kumaon to Sikkim.	The herb contains 0·22 per cent of an essential oil (**104**); it is also stated to contain a bitter alkaloid (**26**).	The Mundas of Chota Nagpur bruise the whole plant and throw it into water to kill fish. It is also stuffed into crabs' holes to kill them.

149. **Stephania hernandiifolia** (Willd.) Walp.	A slender twining shrub found on the West and East Coast, Cachar, Sikkim, East Bengal and Assam.	Probably contains saponins (**105**).	The extract acts as a strong poison to frogs (**16**).
150. **Strychnos colubrina** Linn.	A large climbing shrub found in Western and Southern parts of India in Bombay, Konkan, Poona, Kanara, Carnatic, Veligonda Hills of Nellore, Western Coast from South Kanara to Travancore to the lower forests of the Western Ghats.	The roots, seeds, bark and wood contain the alkaloids brucine and strychnine (**20**).	The seeds are likely to be poisonous to fishes.
151. **Strychnos nux-vomica** Linn.	A deciduous tree found in the forests of Gorakhpur, Bihar and Orissa, Konkan, North Kanara, Southern Mahratta Country, Northern Circars, the Deccan and Carnatic; also on the West Coast of the Madras Presidency in deciduous forests and up to 4,000 ft. in hilly country.	Strychnine is the most important alkaloid contained in this plant; besides this there are present brucine and others. These compounds exist not only in the seeds, the most important part of the plant, but also in the root, wood, bark, leaves, fruit pulp, etc. The seeds also contain the glucoside loganin (**20**).	Watt (**21**) states that the seeds are used by the hill tribes of Nilgiris as a fish poison.
152. **Taxus baccata** Linn.	A small or medium-sized evergreen tree met with in the temperate Himalayas at altitudes of 6,000 to 11,000 ft., and in the Khasia Hills at altitudes of 5,000 ft.	The leaves, shoots, and fruits contain a toxic alkaloid, taxine (**86**). According to Lander (**106**), the sap contains a volatile oil. Blyth (**107**) states that the leaves contain much formic acid. The leaves also contain the glucoside taxicatin (**108**), and small amounts of ephedrine (**109**),	Pammel (**17**) records the plant as a fish poison.

Name of Plant	Distribution	Constituents	Remarks
153. **Tephrosia candida** (Roxb.) DC.	A weak shrub found in the tropical Himalayas from Garhwal to Khasia and Assam, ascending up to an altitude of 5,000 ft. in Sikkim ; in Chittagong and the Sameshwar hills. It is occasionally grown as an ornamental plant.	.....	The plant has been recorded by Gamble (**85**) as a fish poison in Eastern Bengal and Burma ; the bark and leaves are chiefly used for this purpose. An extract (**56**) of the seeds has been tested for its insecticidal properties on small-scale field trials, and found to be quite efficacious.
154. **Tephrosia purpurea** (Linn.) Pers.	A sub-erect herbaceous perennial found all over India, ascending in the Himalayas up to an altitude of 6,000 ft.	The roots contain tephrosin, deguelin, *iso*tephrosin, rotenone, etc. (**110, 111**). The leaves contain about 2 per cent of a glucoside, osyritin (**112**).	The root is used to poison fish in French Guiana, but no such use has been reported in India.
155. **Tephrosia vogelii** Hook. *f.*	Reported to be cultivated in Assam by tea planters as a green manure.	Leaves contain tephrosin and deguelin (**113**). Seeds contain tephrosin, deguelin, dehydrodeguelin, *allo*tephrosin and *iso*deguelin (**114, 115**).	The leaves are said to be an efficient insecticide against fleas, lice and ticks ; in the dry state they are used as a flea powder. In fact, it has been suggested that the plant might be used as a commercial dip for cattle (**19**). Chopra and collaborators (**7**) have recently found that the leaves of Assam-grown plant do not possess insecticidal properties to any marked degree. Further work is necessary to find out whether the leaves possess potent insecticidal properties at any time of the

			year. It is possible that the leaves show seasonal variation. About a dozen species are found in India and some of them are commonly met with. It would be worth while investigating the insecticidal properties of these, especially of *T. candida* Linn. and *T. purpurea* Pers., which, as mentioned above, are used as fish poisons.
156. **Terminalia bellirica** (Gaertn.) Roxb.	A large deciduous tree common in the plains and lower hills throughout India with the exception of the arid tracts in the West.	The fruits contain 5 to 17 per cent of tannin (**20**).	The plant has been reported as a fish poison (**17**), but we have never heard of such a use in India in spite of its great abundance.
157. **Thevetia peruviana** (Pers.) Merr. (Syn. T. **nereifolia** Juss. *ex* Steud.)	Originally a native of America and West Indies, this large evergreen shrub or small tree is now almost naturalized in some places. There is scarcely a garden in the plains without a few shrubs, if not a hedge.	Chen & Chen (**116**) have extracted a fatty oil, constituting more than 62 per cent of the kernel, and four crystalline substances—a phytosterolin, ahouain, kokilphin, and thevetin. The roots have also been found to contain thevetin (**118**).	In Brazil the plant has been employed as a fish poison (**117**).
158. **Trigonella foenum-graecum** Linn.	An aromatic annual herb found wild in Kashmir, the Punjab and the Upper Gangetic Plain; widely cultivated in many parts of India.	Alkaloid trigonelline (**18**), and essential oil.	Fenugreek is used as an insect repellent; agriculturists in the Kangra district in the Punjab mix the dried plant with the grains stored up in bags, in order to protect them from attacks of insects during rainy weather.

Name of Plant	Distribution	Constituents	Remarks
159. **Verbascum thapsus** Linn.	A stout woolly herb found in the temperate Himalayas between 5,000 to 12,000 ft., and in Western Tibet. It also occurs in the Western Ghats and in the Nilgiris in the neighbourhood of Ootacamund where it has been introduced and is now rapidly spreading.	The leaves contain an amorphous bitter substance and a saponin (**119**); the flowers a saponin and the seeds 0·37 per cent of a saponin (**120**). The roots contain a glucoside (**121**).	According to O'Shaughnessy (**21**), the seeds are used for poisoning fish. The present authors have not come across the use of the seeds as a fish poison. It is however, likely that the whole plant possesses piscicidal properties, as is apparent from its chemical composition. Pammel (**17**) also records the plant as a fish poison.
160. **Vitex negundo** Linn.	A large aromatic shrub common throughout India up to 3,000 ft. in the North-West Himalayas.	Alkaloid (**18**).	The leaves of Indian privet are laid over stored grains to keep off insects.
161. **Walsura piscidia** Roxb.	A small tree found in the Western Ghats from North Kanara to the Anamalais, Pulneys and Travancore; Northern Circars, Carnatic, the Deccan, Hazaribagh, Gaya Ghats, and in the Puri Division.	The plant is stated to contain saponins (**122**).	Roxburgh and following him many other workers state that the bark is largely employed to intoxicate fish and that fish so caught are not less wholesome to eat than ordinary fish.
162. **Wikstroemia indica** (Linn.) C. A. Mey., var. **viridiflora** (Meissn.) Hook. f.	A bushy shrub found in Chittagong.	.....	The plant has been recorded by Pammel (**17**) as a fish poison.
163. **Zanthoxylum alatum** Roxb.	A shrub or small tree found in the hot valleys of the Sub-tropical Himalayas from the Trans-Indus area	The fruits contain about 1·5 per cent of an essential oil (**123**). The bark contains a bitter	According to Brandis, the bark is used for killing fish, while Atkinson reports that the

		eastwards to Bhutan up to an altitude of 7,000 ft.; also in the Khasia Hills between 2,000 and 3,000 ft., and in the hills of Ganjam and Vizagapatam at about 4,500 ft.	crystalline principle, which is identical with berberine. It also contains a volatile oil and resins (**21**).	fruit is also used for the same purpose (**21**).
164.	**Zanthoxylum hamiltonianum** Wall.	A climbing thorny shrub of Sikkim and Assam.	.....	The roots are used as a fish poison by cutting them into pieces and putting these in a bag which is thrown into a pond containing fish. The action is fairly rapid and the fish become stupefied and their eyes congested in about half an hour. In the laboratory a boiled fresh solution of the roots killed 100 anopheline larvae in 7 minutes. It acts equally on anophelines and culicines but has no action on pupae. The diluted juice loses its potency after 3 days and becomes inert on the 5th day (**124**).

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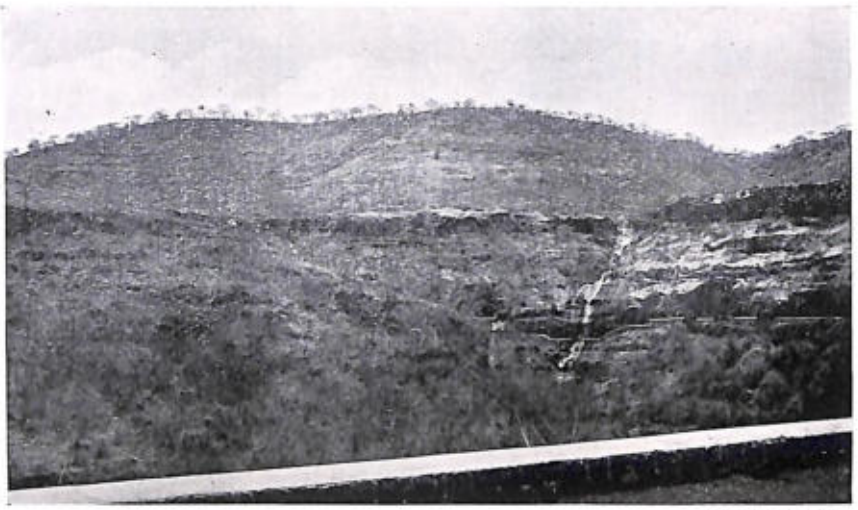

Sayeedud-Din.

Fig. 1.—A view of part of the Ajanta Hills where the forest is of the monsoon type.

Sayeedud-Din.

Fig. 2.—A thicket of *Calamus Rotang* Linn. near the Ramappa tank in Mulug.

ADDITIONS TO OUR KNOWLEDGE OF THE FLOWERING PLANTS OF H. E. H. THE NIZAM'S DOMINIONS, HYDERABAD, DECCAN.

BY

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(*With one plate*).

DICOTYLEDONS.

It is now nearly three years since a contribution was made to the pages of this *Journal*[1]. During this period a number of collections have been made from several districts, *viz.*, Mulug, Sirnapalli, Vikarabad, Amrabad (including Mananur and Farahabad), Adilabad, and from the suburbs of Hyderabad city. This report deals with only such material as has been carefully identified, and later on compared with the type specimens at the Sibpur and Dehra Dun Herbaria. The families and species dealt with number 53 and 170 respectively.

The author is now in a position to say something about the types of forest, and the dominant species met with in the above-mentioned districts. There is really no typical rain-forest in the Dominions. An intermediate form between rain- and monsoon-forest is met with, *viz.*, near Salvoy in the Mulug Talukha of Warangal District (Fig. 1), near Mananur at Pedda Omamaheshwaram, in the vicinity of Kuntala (in Both Talukha of Adilabad District), and along the Ajanta Hills (Fig. 2). The dominant species common to most of these forests are *Tectona grandis* Linn., *Olax scandens* Roxb., *Erythroxylon monogynum* Roxb., *Terminalia tomentosa* W. and A., *Balanites Roxburghii* Planch., *Buchanania latifolia* Roxb., *Semecarpus Anacardium* Linn., *Cleistanthus collinus* Benth., *Bombax malabaricum* DC., *Diospyros tomentosa* Roxb., *Diospyros Melanoxylon* Roxb., *Chloroxylon Swietenia* DC., *Phyllanthus Emblica* Linn., *Aegle Marmelos* Correa, *Strychnos potatorum* Linn., and others. *Strychnos Nux-vomica* Linn. is, however, very common in the Warangal, Karimnagar and Adilabad Districts. *Dendrocalamus strictus* Nees is common in hilly regions. *Calamus Rotang* Linn. is found only in the Warangal District in Mulug below the Ramappa tank (Fig. 3).

The second type of forest is the open-forest which is common. The dominant species in such forests are *Boswellia serrata* Roxb., *Bassia latifolia* Roxb., *Tectona grandis* Linn. of stunted growth, species of *Gardenia* and *Randia*, *Lagerstroemia parviflora* Roxb., *Anogeissus latifolia* Wall., *Feronia Elephantum* Correa, and others.

[1] 'A further contribution to some of the common flowering plants of the Hyderabad State; their distribution and economic importance—Dicotyledons.' (vol. xi, No. 2, Sept. 1938).

The last type of forest met with in the Dominions is the thorn-forest or scrub-jungle. It is common on laterite and on rocky soil. Amongst the trees, members of the Leguminosae family form gregarious patches. Species of *Zizyphus, Gardenia, Wrightia* and *Grewia, Holarrhena antidysenterica* Wall. and *Anona squamosa* Linn. are common. Amongst low shrubs *Cassia auriculata* Linn. is very wide-spread and dominant.

ACKNOWLEDGEMENTS.

I am thankful to all my colleagues, particularly Messrs. M. A. Salam and M. R. Suxena for the help rendered in connection with the collection, preservation and identification of the material. While working at the Sibpur Herbarium, Mr. Salam compared some of our collections with the type specimens there. Mr. Suxena did the same during his work at the Dehra Dun Herbarium.

I. RANUNCULACEAE.

1. Naravelia zeylanica DC. Syst. 1. 167; H. F. B. I., i, 7; Dalz. & Gibs. i; Trim. F. Ceyl. i, 2; Watt. Dict. Econ. Prod. I., V, 317; Talb. For. F. Bomb. Pres., I, 7, Cooke. F. Pres. Bomb., I, 4.

Habitat.—Found in moist forest on the banks of *Dayyum Murgu* near Salvoy in Mulug (Warangal District).
Flowering Season.—Nov.-Dec.

II. DILLENIACEAE.

2. Dillenia indica Linn. Sp. Pl. 535, H.F.B.I., i, 36; Talb. For F. Bomb. Pres., I, 10; Watt. Dict. Econ. Prod. I., iii, 113; Cooke F. Pres. Bomb., I, 6.

Syn.—*D. speciosa*, Thunb. in Trans. Linn. Soc., I (1791), 200; Dalz. & Gibs, 2; Wt. Ic., 823.
Indian Names.—Chalta, Girnar (Hindi); Motakarmal (Mar.); Kalinga, Peddakalinga (Tel.); Chalta (Beng.); Bettakanigala (Canarese); Chalita (Malayalam).
Habitat.—Cultivated in gardens.
Flowering season.—May-June.
Uses.—Medicinal (Kirtikar).

III. ANONACEAE.

3. Saccopetalum tomentosum H. f. & Thos. Fl. Ind. (1855); H.F.B.I., i, 88; Dalz. & Gibs., 4; Talb. For. F. Bomb. Pres., i, 31; Watt. Dict. Econ. Prod. I, VI, Pt. 2, 381; Cooke. F. Pres. Bomb., i, 16.

Habitat.—Found in the Anantgiri forest (Vikarabad).
Flowering season.—April-June, fruits in Aug.

IV. MENISPERMACEAE.

4 Tinospora malabarica Miers Contrib. iii (1864), 32; H.F.B.I., i, 96; Dalz. & Gibs., 5; Trim. F. Ceyl., i, 38; Talb. For. F. Bomb. Pres., i, 36; Cooke. F. Pres. Bomb., i, 18.

Syn.—*Cocculus malabaricus* DC. Syst., i, 518.
Indian Names.—Giloe, Gulancha, Gurch (Hindi); Gulvel (Mar.); Potchindil (Tam.); Padmagaluncha (Beng.).
Habitat.—Common in most forests.
Flowering season.—Collected in Feb.
Uses.—Medicinal. (Kirtikar).

5. Cissampelos Pareira Linn. Sp. Pl. (1753), 1031; H.F.B.I., i, 103.; Dalz. & Gibs., 5; Trim. Fl. Ceyl., i, 46; Talb. For. F. Bomb. Pres., i, 45; Cooke. F. Pres. Bomb., i, 22; Watt. Dict. Econ. Prod. I., ii, 327.

Syn.—*Cissampelos convolvulacea* Willd. Sp. Pl., V, 863.
Indian Names.—Akandi, Dakhnir-bissi, Harjeuri (Hindi); Ambashtha, Brihattikta (Sans.); Padavali, Pharmul (Mar.); Pahadmul, Pahadvel (Bomb.); Appatta (Tam.); Adivibankatige (Tel.).
Habitat.—First collected in the Mulug forest (Warangal District), also subsequently collected at Ooperpalli and elsewhere.
Fowering season.—April-Sept.
Uses.—Medicinal (Kirtikar).

V. BERBERIDACEAE.

6. Mahonia nepalensis DC. Syst. ii, 21.

Syn.—*Berberis nepalensis* Spreng. Syst. ii, 120; H.F.B.I., i, 109.
Indian Names.—Amudanda, Chiror (Punjab); Gurm, Haldia (Garhwal); Chatri (Nepal).
Habitat.—Native of Temperate Himalaya. Cultivated in the Botanic Garden, Osmania University.
Flowering season.—Collected in flower in March.
Uses.—Medicinal (Kirtikar).

VI. CRUCIFERAE.

7. Lepidium sativum Linn. Sp. Pl. (1753), 644 (The Cress), H.F.B.I., i, 159; Watt. Dict. Econ. Prod. I., iv, 627; Cooke. F. Pres. Bomb., i, 35.

Indian Names.—Half, Hurf, Harfulabaz (Arab.); Chaunsar, Halim, Hurf (Hindi); Rukhame ispanda (Pers.); Chandrik (Sans.); Aliverai (Tamil); Adala vitulu (Tel.); Halim (Urdu).
Habitat.—Commonly cultivated.
Flowering season.—March and April.
Uses.—A good pot-herb, also medicinal.

VII. CAPPARIDACEAE.

8. Cleome felina Linn. f. Suppl., 300; H.F.B.I., 170.

Syn.—*Polanisia felina* DC. Prodr. i, 242.
Indian Names.—Ariavila (Malayalam).
Habitat.—Wild throughout the Dominions.
Uses.—Medicinal.

9. Maerua arenaria H. f. & T.; H.F.B.I., i, 171; Trim. F. Ceyl., i, 58.

Syn.—*M. ovalifolia* Cambess. in Jacquemont, Voy. Bot. (1844), 23, t. 24; Talb. For. F. Bomb. Pres., i, 48; Cooke. F. Pres. Bomb., i, 41. *Niebuhria oblongifolia* Royle, Ill. Himal. Bot., 73; Dalz. & Gibs., 8. *Capparis heteroclita* Roxb. F. Ind., ii, 570.
Indian Names.—Bhumi-chakkarai (Tam.); Bhuchakramu (Tel.).
Habitat.—Collected from Mulug forest.
Flowering season.—Nov.-Dec.
Uses.—Medicinal.

10. Crataeva religiosa Forst. *f. Prodr.* (1786), 35; H.F.B.I.; i, 172; Talb. For. F. Bomb. Pres., i, 64; Cooke. F. Pres. Bomb., i, 42; Watt. Dict. Econ. Prod. I., ii, 583.

Indian Names.—Varvunna (Hindi); Nirvala, Kamla, Waiwurna (Mar.).
Habitat.—Planted near temples. Apparently wild.
Flowering season.—March-April.
Uses.—Useful in turnery.

11. **Cadaba indica** Lamk. Encyc., i (1783), 544; H.F.B.I., i, 172; Trim. F. Ceyl., i, 60; Talb. For. F. Bomb. Pres., i, 50; Cooke. F. Pres. Bomb., i, 43; Dalz. & Gibs., 9.

Syn.—*Stroemeria tetrandra* Vahl., Roxb. F. Ind., ii, 78.
Habitat.—Collected from Mulug. Grows in dry situations.
Flowering season.—Nov.-Feb.

VIII. BIXACEAE.

12. **Bixa Orellana** Linn. (The Arnatto) Sp. Pl. (1753), 512; H.F.B.I., i, 190; Roxb. F. Ind., ii, 31; Dalz. & Gibs. Suppl., 5; Wight iii, t, 17.

Indian Names.—Japhar, Kesari, Shendri (Mar.); Kuppamannal (Malayalam); Arnuttu, Kesari (Canarese); Amudadaram (Tamil); Jabura (Tel.); Jolandhar (Beng.).
Habitat.—An American plant, cultivated in the Botanic Garden, Osmania University.
Flowering season.—Sept.
Uses.—The pulp surrounding the seeds gives a flesh coloured dye, used for colouring butter and for dyeing silk fabrics. Bark yields a good cordage. The West Indians rub two pieces of wood to produce fire. Medicinal.

IX. POLYGALACEAE.

13. **Polygala elongata** Klein in Willd. Sp. Pl., iii, 879; H.F.B.I., i, 203; Cooke. F. Pres. Bomb., i, 60.

Syn.—*P. campestris* Dalz. in Hook. Kew Journ. Bot., ii (1850), 40; Dalz. & Gibs., 13.
Habitat.—Wild at Adigmet and elsewhere in the Dominions.
Flowering season.—Sept.-Nov.

X. CARYOPHYLLACEAE.

14. **Polycarpæa corymbosa** Lam. Ill., ii (1793), 129; H.F.B.I., i, 245; Wt. Ic. t. 712; Cooke. F. Pres. Bomb., i, 66; Dalz. & Gibs., 16; Trim. F. Ceyl., i, 88.

Indian Names.—Bhistta (Sans.); Nilaisedachi (Tam.); Bommasari, Rajuma (Tel.).
Habitat.—Common throughout the Dominions.
Flowering season.—Oct.-Dec.
Uses.—Medicinal.

XI. MALVACEAE.

15. **Hibiscus vitifolius** Linn. Sp. Pl. (1753), 696; H.F.B.I., i, 338; Dalz. & Gibs., 20; Trim. F. Ceyl., i, 154; Cooke. F. Pres. Bomb., i, 109.

Indian Name.—Van-kapas (Mar.).
Habitat.—Collected from Humpii ruins, Raichur district. Not common.
Flowering season.—Feb.

16. **Hibiscus cancellatus** Roxb. Hort. Beng., 51; F.I., iii, 201; H.F.B.I., i, 342.

Habitat.—Collected from Sirnapalli forest (Nizamabad District). It is strange that this plant which is not found either towards Bombay or towards Madras, has been collected from this place.
Flowering season.—July-Aug.

17. **Hibiscus schizopetalus** Hook. f.; Bailey, Ency. Hort., 1487.

Habitat.—Cultivated as an ornamental shrub.
Flowering season.—Throughout the year.

18. Urena lobata Linn. Sp. Pl. (1753), 692; H.F.B.I., i, 329; Dalz. & Gibs., 18; Trim. F. Ceyl., i, 147; Cooke. F. Bomb. Pres., i, 100; Watt. Dict. Econ. Prod. I., vi, pt. 4, 212.

Indian Names.—Bachata, Bachita (Hindi); Otte (Canarese); Rantupkadu (Mar.); Van-bhendi (Bomb.); Vanachenda (Sans.); Ottatti (Tam.); Peddabenda (Tel.).

Habitat.—Common; first collected from Nizamabad.
Flowering season.—Oct.-Dec.
Uses.—Medicinal.

XII. STERCULIACEAE.

19. Eriolæna Hookeriana W. & A. Prodr., i, 70; H.F.B.I., i, 370; Cooke. F. Pres. Bomb., i, 131; Watt. Dict. Econ. Prod. I., iii, 265.

Indian Names.—Bute, Bother (Bomb.)
Habitat.—Collected from the Mulug forest.
Flowering season.—March-April.

20. Waltheria indica Linn. Sp. Pl. (1753), 673; H.F.B.I., i, 374; Dalz. & Gibs., 23; Cooke. F. Pres. Bomb., i, 135; Gamble. F. Pres. Mad., i, 111.

Habitat.—Common everywhere in waste places, on roadsides, and as undergrowth in forests.
Flowering season.—Aug.-Oct.

21. Melochia corchorifolia Linn. Sp. Pl. (1753), 675; H.F.B.I., i, 374; Cooke. F. Pres. Bomb., i, 134.

Syn.—*Riedlea corchorifolia* DC. Prodr. i, 491; Dalz. & Gibs., 24.
Indian Names.—Ganugapindikura, Sittanta kura (Tel.); Pinnakkuppunda, Punnakkukkirai (Tam.); Seruvuram (Malayalam); Tikidkra (Beng.).
Habitat.—A widely spread weed, common at Adigmet and elsewhere.
Flowering season.—Collected in October.
Uses.—Medicinal (Kirtikar).

XIII. TILIACEAE.

22. Grewia aspera Roxb. Hort. Beng., 42; Fl. Ind., ii, 591.

Syn.—*Grewia abutilifolia* Juss. in Ann. Mus. iv, 92; H.F.B.I., i, 390; Dalz. & Gibs., 26; Cooke. F. Pres. Bomb., i, 144.
Habitat.—Common in Sirnapalli forest as an undergrowth in shady situations.
Flowering season.—June-July.

XIV. MALPIGHIACEAE.

23. Banisteria laurifolia Linn. Sp. Pl. ed. ii, 611.

Habitat.—Cultivated.
Flowering season.—Jan.-April.

XV. OXALIDACEAE.

24. Biophytum sensitivum DC. Prodr. i (1824), 690; H.F.B.I., i, 436; Dalz. & Gibs., 42; Cooke, F. Pres. Bomb., 167; Gamble. F. Pres. Mad., i, 133.

Indian Names.—Lajalu, Lakhshana, Zarer (Hindi); Jalapushpa (Sans.); Jharera, Ladjiri (Mar.); Jhalai (Beng.).
Habitat.—Cultivated.
Uses.—Medicinal (Kirtikar).

XVI. CELASTRACEAE.

25. Celastrus paniculata Willd. Sp. Pl., i, 1125; Roxb. Fl. Ind., i, 621; Dalz. & Gibs., 47; Wt. Ill. t., 72; Ic. t., 158.

Indian Names.—Malkakni, Malkamni, Malkangni (Hindi); Kangani, Malkangani (Mar.); Bavanji, Malkanguni, Maneru (Tel.); Kangli, Kangondi (Canarese); Lataphatakai, Malkangni (Bomb.); Sankhu (Punjab).

Habitat.—Common. First collected from the Sirnapalli forest (Nizamabad District).
Flowering season.—July-Aug.
Uses.—Medicinal.

26. Gymnosporia Rothiana M. Laws. l. c. 620; H.F.B.I., i, 620; Cooke. F. Pres. Bomb., ii, 232.

Syn.—*Celastrus Rothiana* Wt. & Arn. Prodr., 159; Dalz. & Gibs., 47 & 318.
Indian Name.—Yenkli (Bomb.).
Habitat.—Common throughout the Dominions.
Flowering season.—April-June.

XVII. VITACEAE.

27. Vitis repanda Wt. & Arn. Prodr. (1834), 125; H.F.B.I., i. 648; Trim. F. Ceyl., i, 292; Cooke. F. Pres. Bomb., ii, 251; Talb. For. F. Bomb. Pres., i, 312.

Syn.—*Cissus repanda* Vahl. Symb., iii, 18; Dalz. & Gibs., 39.
Indian Name.—Gendal (Bomb.).
Habitat.—Common in moist forest. First collected from Mulug forest (Warangal District).
Flowering season.—March-April.

XVIII. ANACARDIACEAE.

28. Rhus mysurensis Heyne, *ex Wt. & Arn. Prodr.* (1834), 172; Cooke. F. Pres. Bomb., ii, 272; Talb. For. F. Bomb. Pres., i, 347; Watt. Dict. Econ. Prod. I., vi, Pt. i, 497.

Indian Names.—Amani, Amoni (Bomb.).
Habitat.—Very common throughout the Dominions in dry situations, and in scrub jungle.
Uses.—Bark used in tanning. Wood is employed in fuel (Watt).

29. Schinus molle Linn. Sp. Pl. 388.

The so-called Weeping Willow of Nursery men.
Habitat.—A native of Tropical America. Cultivated.
Flowering season.—Dec.-Feb.

XIX. LEGUMINOSAE.

30. Heylandia latebrosa DC. Mem. Leg. (1825), 201; H.F.B.I., ii, 65; Cooke. F. Pres. Bomb., ii, 291; Dalz. & Gibs., 54.

Indian Name.—Godhadi (Bomb.).
Habitat.—Very common throughout the Dominions. First collected at Adigmet.
Flowering season.—March-June.

31. Crotalaria hirsuta Willd. Sp. Pl. iii, 978; Roxb. F. Ind. ii, 270; H.F.B.I., ii, 68; Gamble. F. Pres. Mad., ii, 293.

Syn.—*C. dichotoma* Heyne, ex Roth, Nov. Sp., 340.
Habitat.—Common at Adigmet.
Flowering season.—Collected in Sept.

32. Crotalaria pusilla Heyne, ex Roth, Nov. Pl. Sp. (1821), 335; H.F.B.I., ii, 70; Cooke. F. Pres. Bomb., ii, 296; Gamble. F. Pres. Mad., ii, 296.

Habitat.—Like the last species common at Adigmet.
Flowering season.—Sept.-Oct.

33. Crotalaria albida Heyne, ex Roth, Nov. Pl. Sp. (1821), 333; H.F.B.I., ii, 71; Cooke. F. Pres. Bomb., ii, 295.

Syn.—*Crotalaria punctata* Grah. in Wall. Cat. 5401.
Habitat.—Common in the Dominions.

34. **Crotalaria verrucosa** Linn. Sp. Pl. (1753), 715; H.F.B.I., ii, 77; Cooke. F. Pres. Bomb., ii, 299; Dalz. & Gibs., 55; Trim. F. Ceyl., ii, 15; Watt. Dict. Econ. Prod. I., ii, 614.

Indian Names.—Banshana, Jhunjhunia (Hindi); Ghagari (Mar.); Dhavani, Shanapushpi (Sans.); Ghelegherinta (Tel.).
Habitat.—Common at Adigmet.
Flowering season.—Oct.-Nov.
Uses.—Medicinal (Kirtikar).

35. **Crotalaria juncea** Linn. Sp. Pl. (1753), 714; H.F.B.I., ii, 79; Cooke. F. Pres. Bomb., ii, 301.

Indian Names.—Ghagahi, Patashana, Shanahuli (Hindi); Son (Pers.); Ghagharu, San, Tag (Mar.); Dhanahari, Sana (Sans.); Chanaka, Sanam (Malayalam); Chanai, Kuttiram (Tam.); Janumu, Gilaka (Tel.).
Habitat.—Cultivated.
Flowering season.—Nov.-Dec.
Uses.—The fibre is the *Sunn Hemp* of commerce. Leaves, flowers and seeds are medicinal.

36. **Crotalaria medicaginea** Lamk. Encyc. Method., ii (1786), 291; H.F.B.I., ii, 81; Trim. F. Ceyl., ii, 18; Cooke. F. Pres. Bomb., ii, 302.

Indian Names.—Gulabi (Hindi and Punj.); Jenjaru (Mar.); Ranmethi (Gujerati).
Habitat.—Collected from Mulug.
Flowering season.—Nov.-Dec.
Uses.—Officinal (Kirtikar).

37. **Crotalaria trifoliastrum** Willd. Sp. Pl., iii, 983; H.F.B.I., ii, 82.

Habitat.—Common at Adigmet.
Flowering season.—Collected in Aug.
Uses.—The root is medicinal (Kirtikar).

38. **Crotalaria umbellata** Wt. & Arn., 191; Gamble. F. Pres. Mad., ii, 294.

Syn.—*C. nana* Burm., H.F.B.I., ii, 71.
Habitat.—Collected from Mulug where it is very common.
Flowering season.—Dec.

39. **Indigofera cordifolia** Heyne, ex Roth. Nov. Pl. Sp. (1821), 357; H.F.B.I., ii, 93; Dalz. & Gibs., 58; Cooke. F. Pres. Bomb., ii, 311.

Indian Names.—Godadi, Bechka (Bomb.).
Habitat.—Common at Adigmet and elsewhere.
Flowering season.—Collected in April.
Uses.—Seeds are eaten in times of famine (Watt.).

40. **Indigofera enneaphylla** Linn. Mant. ii (1771), 571; H.F.B.I., ii, 94; Dalz. & Gibs., 58; Trim. F. Ceyl., ii, 22; Cooke. F. Pres. Bomb., ii, 312; Kirtikar, i, 709.

Syn.—*I. semitrijuga* Forsk. Fl. Aegypt—Arab., 137;
Indian Names.—Kenneggilu (Canarese); Bhuiguli (Mar.); Chalapachi, Cherragaddamu, Yerrapalleru (Tel.); Vasuka (Sans.), Cherupullate (Malayalam).
Habitat.—Common at Adigmet.
Flowering season.—Oct.
Uses.—Medicinal.

41. **Indigofera hirsuta** Linn. Sp. Pl. (1753), 751; H.F.B.I., ii, 98; Dalz. & Gibs., 60; Trim. F. Ceyl., ii, 26; Cooke. F. Pres. Bomb., ii, 319.

Habitat.—Common in all districts. First collected from Nalgonda.
Flowering season.—Oct.-Dec.

42. **Mundulea suberosa** Benth. Pl. Jungh., iii (1851-55), 248; H.F.B.I., ii, 110; Cooke. F. Pres. Bomb., ii, 322; Kirtikar, I. Med. Plts., i, 722.

Syn.—*Tephrosia suberosa* DC. Prodr ii, 249; Dalz. & Gibs., 60.

Indian Names.—Bettahuruli (Canarese); Supti, Surti (Bomb.); Kadupporasu, Pirala-varam (Tam.); Kondavempali, Palasaram (Tel.).
Habitat.—Collected from Nalgonda, common elsewhere also.
Flowering season.—Oct.-Dec.

43. **Zornia diphylla** Pers. Syn. Pl., ii (1807), 318; H.F.B.I., ii, 147; Trim. F. Ceyl., ii, 35; Cooke. F. Pres. Bomb., ii, 334.

Syn.—*Z. angustifolia* Sm.; Dalz. & Gibs., 62.
Indian Names.—Landgu (Bomb.); Nelammari (Malayalam).
Habitat.—Common at Adigmet.
Flowering season.—Aug.-Sept.
Uses.—Medicinal.

44. **Alysicarpus rugosus** DC. Prodr., ii (1825), 353; H.F.B.I., ii, 159; Gamble. F. Pres. Mad., ii, 338.

Syn.—*A. Wallichii* W. & A. Prodr., 234.
Habitat.—Collected from Adigmet.
Flowering season.—Sept.

45. **Desmodium latifolium** DC. Prodr., ii (1825), 328; H.F.B.I., ii, 168; Dalz. & Gibs., 66.

Trim. F. Ceyl., ii, 51; Cooke. F. Pres. Bomb., ii, 356.
Habitat.—Common in the moist forest at Mulug.
Flowering season.—Sept.-Nov.

46. **Desmodium gyrans** DC. (Telegraph Plant) Prodr., ii (1825), 326; H.F.B.I., ii, 174; Trim. F. Ceyl., ii, 56; Cooke. F. Pres. Bomb., ii, 358.

Habitat.—Hitherto not found wild. Cultivated in the Botanic Garden, Osmania University, for its well-known movements.

47. **Atylosia lineata** Wt. & Arn. Prodr. (1834), 258; H.F.B.I., ii, 213; Cooke. F. Pres. Bomb., ii, 382.

Syn.—*A. Lawii* Wt. Ic. t. 93; Dalz. & Gibs., 74.
Habitat.—Common in Mulug.
Flowering season.—Dec.

48. **Atylosia scarabæoides** Benth. Pl. Jungh., iii (1851-55), 243; H.F.B.I., ii, 215; Trim. F. Ceyl., ii, 79; Cooke. F. Pres. Bomb., ii, 384.

Syn.—*Cantharospermum pauciflorum* W. & A. Prodr., 255; Dalz. & Gibs., 73.
Habitat.—Common in Mulug in hilly tracts.
Flowering season.—Oct.-Nov.

LEGUMINOSAE.

(*Caesalpiniaceae*).

49. **Cassia Leschenaultiana** DC., Prain in Jour. As. Soc. Beng. cxvi, ii, 477.

Syn.—*C. Wallichiana* DC.; W. & A., 292. *C. mimosoides* var. *Wallichiana* Baker; H.F.B.I., ii, 266.
Habitat.—Not common.

50. **Bauhinia racemosa** Lamk. Encyc. Method., i (1783), 390; H.F.B.I., ii, 276; Cooke. F. Pres. Bomb., iii, 431; Dalz. & Gibs., 82.

Indian Names.—Ashta, Asoda, Papri (Hindi); Ara, Ayata (Canarese); Apata, Kanraja (Mar.); Are, Manjiyare, Pachare (Tel.); Anupushpaka (Sans.); Banraj (Beng.); Apta, Vanu-raja (Bomb.); Kotapuli, Mandaram (Malayalam).
Habitat.—Common in some of the deciduous forests.
Flowering season.—April-June.
Uses.—The fibre of the inner bark is used for making ropes. Leaves are pickled by the Burmese, and they are also used for making *bidis* in India. Medicinal.

XX. SAXIFRAGACEAE.

51. Hydrangea hortensis Sm. Ic. Pict. xii.

Habitat.—Cultivated in the Botanic Garden, Osmania University.

XXI. CRASSULACEAE.

52. Bryophyllum tubiflorum Harv. in Harv. & Sond. Fl. Cap., ii, 380.

Habitat.—Cultivated in rockeries. A xerophytic plant, multiplying by means of bulbils.
Flowering season.—Jan.

XXII. COMBRETACEAE.

53. Terminalia citrina Roxb. (Citrine Myrobalan). ex. Fleming in As. Res. xi (1810), 183. Roxb. Hort. Beng., 33; H.F.B.I., ii, 446.

Indian Names.—Haritaki, Harra (Beng.).
Habitat.—Common in the Mulug forest.
Flowering season.—Nov.-Dec.
Uses.—Medicinal.

54. Combretum decandrum Roxb. Cor. Pl. t. 59; H.F.B.I., ii, 452.

Habitat.—Collected from the Mulug forest.
Flowering season.—Dec.

XXIII. LYTHRACEAE.

55. Ammania peploides Spreng. Syst. Veg., i, (1825), 444; H.F.B.I., ii, 566; Trim. F. Ceyl., ii, 223; Cooke. F. Pres. Bomb., iii, 506.

Syn.—*Ameletia indica* DC. in Mem. Soc. Hist. Nat. Genev., iii, Pt. ii, 82; Dalz. & Gibs., 96.
Habitat.—Collected from a field in Mulug.
Flowering season.—Dec.

56. Ammania baccifera Linn. Sp. Pl. Ed. ii (1762), 175; H.F.B.I., ii, 569; Cooke. F. Pres. Bomb., iii, 509; Trim. F. Ceyl., ii, 224; Dalz. & Gibs., 97.

Syn.—*A. vesicatoria* Roxb. F. Ind., i (1820), 427; Kirtikar, Ed. ii, ii, 1072.
Indian Names.—Agya (Urdu); Dadmari, Jangli Mehndi (Hindi); Agnivendapaku (Tel.); Bharajambhula (Mar.); Kallarivi (Tam.); Kshetrabhusha (Sans.); Dadmari (Beng.).
Habitat.—Also collected from a moist locality in Mulug.
Flowering season.—Nov.-Dec.
Uses.—Medicinal.

XXIV. ONAGRACEAE.

57. Ludwigia parviflora Roxb. Hort. Beng. (1814), ii; H.F.B.I., ii, 588; Cooke. F. Pres. Bomb., iii, 517; Dalz. & Gibs., 99; Trim. F. Ceyl., ii, 234; Wight. Ill. t., 101.

Habitat.—Hilly places in Mulug and elsewhere.
Flowering season.—Nov.—rather uncertain, because the old material in the Osmania University Herbarium is not dated.

XXV. TURNERACEAE.

58. Turnera ulmifolia Linn. Sp. Pl. 271. var. *angustifolia* Willd.; Gamble F. Pres. Mad., iii, 523. Mayuranathan. Fl. Plts. Madras City., 124.

Habitat.—Collected from an old well in the ruins of Mushk Mahal, and later on from a waste place towards Osmansagar. It is interesting to note that this plant, a native of the West Indies, should be found growing wild in a few places in Hyderabad. It has not, however, propagated profusely. Neither has Hooker nor Cooke recorded it.
Flowering season.—Aug.

XXVI. PASSIFLORACEAE.

59. **Passiflora edulis** Sims. Bot. Mag. t. (1989); Kirt. Ind. Med. Plts. II Ed., ii, 1103.

Habitat.—A native of Brazil, cultivated for its fruit.
Uses.—Fruit edible and medicinal.

XXVII. CUCURBITACEAE.

60. **Ctenolepis Garcini** Naud. in Ann. Sc. Nat. Ser. 5, vi, 13; H.F.B.I., ii, 629.

Habitat.—Collected from Sirnapalli (Nizamabad District).
Flowering season.—July-Aug.

XXVIII. FICOIDACEAE.

61. **Mollugo oppositifolia** Linn. Sp. Pl. (1753), 89; Cooke. F. Pres. Bomb., iii, 558; Kirt. Ind. Med. Plts., ii, Ed., ii, 1184.

Syn.—*M. Spergula* Linn. Syst. ed. 10 (1759), 881.
Indian Names.—Jima (Hindi); Parpataka (Canarese); Jharasi (Mar.); Kaipajira (Malayalam); Phanija (Sans.); Kachantarai (Tam.); Chayun-tarashiaku (Tel.).
Habitat.—Common at Adigmet.
Flowering season.—Sept.-Oct.
Uses.—Medicinal.

62. **Mollugo pentaphylla** Linn. Sp. Pl. (1753), 89; Cooke. F. Pres. Bomb., iii, 558; Dalz. & Gibs., 16.

Syn.—*M. stricta* Linn. Sp. Pl. Ed. ii (1762), 131.
Indian Names.—Jharasa (Mar.); Verrichatarasi (Tel.); Julpapra (Beng.).
Habitat.—Common elsewhere.
Flowering season.—Sept.-Nov.
Uses.—Occasionally eaten for its good properties. Medicinal.

XXIX. UMBELLIFERAE.

63. **Hydrocotyle asiatica** Linn (Asiatic Penny-wort) Sp. Pl. (1753), 234; H.F.B.I., ii, 669; Dalz. & Gibs., 105; Wt. Icon. t., 565; Cooke. F. Pres. Bomb., iii, 562.

Indian Names.—Barhmi (Urdu); Brahmamanduki (Hindi & Beng.) Babassa (Tam. & Tel.); Brahmi (Mar.); Kodagam (Malayalam).
Habitat.—Near water-courses. First collection from a shaded moist situation near a stream in Mulug.
Flowering season.—May-Oct.
Uses.—Medicinal.

XXX. ARALIACEAE.

64. **Panax fruticosum** Linn. Sp. Pl. ed. ii, 1513; H.F.B.I., ii, 725; Dalz. & Gibs. Suppl. 142; Cooke. F. Pres. Bomb., iii, 574.

Habitat.—Commonly grown for its foliage.

XXXI. RUBIACEAE.

65. **Stephegyne parvifolia** Korth. in Verh. Gesch. Nat. Bot., 161; H.F.B.I., iii, 25.

Habitat.—Common in Mulug forest.
Flowering season.—Nov.

66. **Oldenlandia herbacea** Roxb. Hort. Beng. (1814), ii; Fl. Ind., i, 424; Cooke. F. Pres. Bomb., iii, 589.

Syn.—*O. Heynii* G. Don. Syst. iii (1834), 531; H.F.B.I., iii, 65. *Hedyotis herbacea* Linn. Sp. Pl. (1753), 102. *Hedyotis Heynii* Br. in Wall. Cat., 867; Dalz. & Gibs., 116.

Habitat.—Collected from Nalgonda, also common elsewhere.
Flowering season.—Aug.
Uses.—*Medicinal* (Kirtikar).

67. **Oldenlandia dichotoma** Koen; H.F.B.I., iii, 67; Cooke. F. Pres. Bomb., iii, 590; Gamble. F. Pres. Mad., iv, 601.

Syn.—*Hedyotis dichotoma* W. & A. 416 *in part. Hedyotis Heynei* Bedd. Icon. Pl. Ind. Or. t., 33.
Habitat.—Nalgonda, in moist places.
Flowering season.—July-Sept.

68. **Randia dumetorum** Lamk. Tab. Encyc., ii (1793), 227; H.F.B.I., iii, 110; Dalz. & Gibs., 119.

Syn.—*Randia longispina* DC. Prodr., iv, 386; Dalz. & Gibs., 119; Cooke. F. Pres. Bomb., iii, 600.
Indian Names.—Mainphal (Urdu); Arar, Mainphal (Hindi); Gehela (Deccan); Galay, Ghela, Madan (Mar.); Madanamu (Tel.); Kadudam, Karai (Tam.).
Habitat.—Common in the Mulug and Sirnapalli forests.
Flowering season.—May.
Uses.—The fresh fruit is roasted and eaten. The wood is used for agricultural implements and for fuel. The plant is sacred amongst Hindus. Medicinal (Watt.).

69. **Gardenia latifolia** Ait. Hort. Kew., i (1789), 294; H.F.B.I., iii, 116; Cooke. F. Pres. Bomb., iii, 602; Dalz. & Gibs., 120; Wt. Icon. t., 759; Trim. F. Ceyl., ii, 332.

Habitat.—Very common in Mulug, Sirnapalli, and Vikarabad.
Flowering season.—April-June, fruit in Aug.
Uses.—The wood is used in making combs.

70. **Canthium parvifolium** Roxb. Hort. Beng., 15; Fl. Ind., i, 534; H.F.B.I., iii, 135.

Habitat.—Vicinity of Adigmet.
Flowering season.—Collected in the fruiting condition in Aug.

71. **Pavetta indica** Linn. (Indian Pellet Shrub) Sp. Pl. (1753), 110; H.F.B.I., iii, 150; Cooke. F. Pres. Bomb., iii, 612; Dalz. & Gibs., 112; Wt. Icon. t., 148.

Syn.—*Ixora Pavetta* Roxb. Fl. Ind., 385.
Indian Names.—Kankra, Papari (Hindi); Pappadi (Canarese); Papadi (Mar.); Nallapapidi; Tapra (Tel.); Pavaltai (Tam.); Papat (Bomb.); Kukurachura (Beng.).
Habitat.—Common in hills in the Mulug forest.
Flowering season.—April-May.
Uses.—Medicinal (Kirtikar).

72. **Hamiltonia suaveolens** Roxb. Hort. Beng. (1814), 15; H.F.B.I., iii, 197; Cooke. F. Pres Bomb., iii, 621.

Syn.—*Hamiltonia mysorensis* Wt. & Arn. Prodr., 423; Dalz. & Gibs., 115.
Indian Names.—Gidasawa, Gidesa (Bomb.); Mahabal (C.P.); Fisauni, Gohinla, Kanera (Punjab).
Habitat.—Collected from the hills in Khuldabad (Aurangabad District).
Flowering season.—Feb. Fruit in June.
Uses.—Medicinal.

73. **Spermacoce stricta** Linn. f. Suppl. (1781), 120; H.F.B.I., iii, 200; Cooke. F. Pres. Bomb., iii, 623.

Habitat.—Common at Adigmet and elsewhere.
Flowering season.—Aug.-Oct.

XXXII. COMPOSITAE.

74. **Vernonia cinerea** Less. in Linnaea, iv (1829), 291; H.F.B.I., iii, 233; Dalz. & Gibs., 121; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 10.

Indian Names.—Dandotpala, Sahadevi (Hindi); Osari, Sadodi, Sahadevi (Mar.); Garitikamma (Tel.); Puvamkurundal, Sahadevi (Tam.); Sadodi, Shedardi (Guj.); Puvankuruntal (Malayalam); Sahadevi (Punjab); Dandotpala, Devasasha, Devika (Sans.).

Habitat.—A common weed.

Flowering season.—Dec.- Feb.

Uses.—Medicinal.

75. **Ageratum mexicanum** Sims., Bailey, Cycl. Hort. 239.

Habitat.—A much-cultivated annual.

Flowering season.—Winter, about Dec. and Jan.

76. **Blumea Wightiana** DC. in Wt. Contrib. (1834), 14; H.F.B.I., iii, 261; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 19; Dalz. & Gibs., 125.

Habitat.—Common in waste places round about Adigmet and elsewhere.

Flowering season.—Dec.-Feb.

77. **Helichrysum** sp. (Everlasting Straw Flower).

Habitat.—A hardy annual grown for its beautiful flowers.

78. **Pulicaria angustifolia** DC. Prodr., v, (1836), 479; H.F.B.I., iii, 299; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 34; Clarke, Comp. Ind., 129.

Syn.—*Callistephus concolor* Dalz. in Kew Jour. Bot., ii, 344.

Habitat.—Common at Adigmet and elsewhere.

Flowering season.—Nov.

79. **Lagasca mollis** Cav. in Anal. Cienc. Nat., vi (1803), 332; H.F.B.I., iii, 302.

Habitat.—Common in grass lands.

Flowering season.—Almost throughout the year.

80. **Acanthospermum hispidum** DC., Gam. F. Pres. Mad., Pt. iv, No. 4. 704.

Habitat.—A South American plant spreading rapidly here.

Flowering season.—Aug.

81. **Sclerocarpus africanus** Jacq. Icon. Pl. Rar., (1782), 17; H.F.B.I., iii, 305; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 39; Dalz. & Gibs., 129; Clarke, Comp. Ind., 134.

Habitat.—Common in the Dominions in hilly regions.

Flowering season.—July-Aug.

82. **Tridax procumbens** Linn. Sp. Pl. (1753), 1900; H.F.B.I., iii, 311; Clarke, Comp. Ind., 142; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 45.

Habitat.—Although a native of Central America, it is found as a common weed throughout the Dominions.

Flowering season.—Almost throughout the year.

83. **Flaveria australasica** Hook., Benth. Fl. Aust., iii, 546; Gamb. F. Pres. Mad., Pt. iv, No. 4, 711; Mayuranathan, Fl. Plts. Mad. City., 152.

Habitat.—A herb introduced from Australia, now common in moist places.

84. **Gynura nepalensis** DC. Prodr. vi, 300; H.F.B.I., iii, 333; Clarke, Comp. Ind., 171.

Habitat.—Much grown for its handsome foliage and flowers.

85. **Emilia sonchifolia** DC.; H.F.B.I., iii, 336; Gamble, F. Pres. Mad., iv, 716.

Habitat.—Common in rice-fields.

86. **Notonia grandiflora** DC. in Wt. Contrib. (1834), 24; H.F.B.I., iii, 337; Clarke. Comp. Ind., 176; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 50; Dalz. & Gibs., 133.

Indian Names.—Gaidar (Bomb.); Wander-roti (Mar.); Kunde-lucheviyaku (Tel.).

Habitat.—Not wild. Often grown in gardens.

Uses.—Medicinal (Kirtikar).

87. **Tricholepis radicans** DC. Prod., vi (1837), 564; H.F.B.I., iii, 381; Clarke, Comp. Ind., 239; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 56; Dalz. & Gibs., 131.

Habitat.—Nalgonda.

Flowering season.—Dec.-Jan.

88. **Dicoma tomentosa** Cass. in Bull. Soc. Philom (1818), 47; H.F.B.I., iii, 387; Clarke, Comp. Ind., 245; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 58.

Syn.—*Dicoma lanuginosa* DC. in Wt. Contrib. (1834), 26; Dalz. & Gibs., 132.

Indian Names.—Navananjichapala (Belgaum); Gholoharnacharo (Gujerati).

Habitat.—Common on gravelly soil.

Flowering season.—Dec.-Feb.

Uses.—Medicinal.

89. **Cichorium Intybus** Linn. (Chicory), Sp. Pl. (1753), 813; H.F.B.I., iii, 391; Kirt. Ind. Med. Plts., ii, 1433.

Indian Names.—Kasani (Urdu, Pers. and Gujerati); Kasni (Hindi); Kasini (Tel.); Kashini (Tam).

Habitat.—It is rather strange that Abdus Salam found it growing wild near a canal at Himayathnagar. Since then its development and distribution is under observation.

Flowering season.—Feb.

Uses.—Medicinal.

90. **Sonchus oleraceus** Linn. Sp. Pl. (1753), 794; H.F.B.I., iii, 414; Cooke. F. Pres. Bomb., ii, 61. *Sonchus ciliatus* Lam. F. Fr., ii, (1778), 87; Wt. Icon. t. 1141.

Indian Names.—Ratrinta (Tel.); Mhatara (Bomb.).

Habitat.—Apparently wild in cultivated lands and gardens, also on road-sides. Probably an introduction.

Flowering season.—Oct.-Jan.

Uses.—Medicinal.

91. **Launaea pinnatifida** Cass. in Ann. Sc. Nat. Ser. 1, xxiii (1831), 85; H.F.B.I., iii, 416; Cooke. F. Pres. Bomb., ii, Pt. i, 64; Kirt. Ind. Med. Plts. ii, 1447.

Syn.—*Microrhynchus sarmentosus* DC. Prodr., vii, 181; Wt. Ill. t., 131; Clarke, Comp. Ind., 277; Dalz. & Gibs., 132. *Prenanthes sarmentosa* Willd. Sp. Pl., iii, 1540; Grah. Cat., 94.

Indian Names.—Bankan (Hindi); Bhonpatri, Pathradi (Mar.); Pathri (Bomb.); Bhonpatri (Gujerati).

Habitat.—A common sandbinder.

Flowering season.—Nov.-Dec.

Uses.—Medicinal.

XXXIII. EBENACEAE.

92. **Maba nigrescens** Dalz. & Gibs. Bomb. Fl. (1861), 142; H.F.B.I., iii, 551; Cooke. F. Pres. Bomb., ii, Pt. i, 97.

Indian Name.—Rakta-rora (Bomb.).

Habitat.—Common in Mulug forest.

Flowering season.—Nov.-Feb.

Uses.—The wood is used in making rafters.

XXXIV. OLEACEAE.

93. **Jasminum auriculatum** Vahl. Symb. Bot., iii (1794), 1; H.F.B.I., iii 600; Cooke. F. Pres. Bomb., ii, Pt. i, 113; Kirt. Ind. Med. Plts., ii, 1524.

Indian Names.—Adavimolla (Tel.); Hurinaballi (Canarese); Mullaikkodi (Tam.); Ambashtha, Jai (Sans.).

Indian Names.—Dandotpala, Sahadevi (Hindi); Osari, Sadodi, Sahadevi (Mar.); Garitikamma (Tel.); Puvamkurundal, Sahadevi (Tam.); Sadodi, Shedardi (Guj.); Puvankuruntal (Malayalam); Sahadevi (Punjab); Dandotpala, Devasasha, Devika (Sans.).
Habitat.—A common weed.
Flowering season.—Dec.- Feb.
Uses.—Medicinal.

75. **Ageratum mexicanum** Sims., Bailey, Cycl. Hort. 239.
Habitat.—A much-cultivated annual.
Flowering season.—Winter, about Dec. and Jan.

76. **Blumea Wightiana** DC. in Wt. Contrib. (1834), 14; H.F.B.I., iii, 261; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 19; Dalz. & Gibs., 125.
Habitat.—Common in waste places round about Adigmet and elsewhere.
Flowering season.—Dec.-Feb.

77. **Helichrysum** sp. (Everlasting Straw Flower).
Habitat.—A hardy annual grown for its beautiful flowers.

78. **Pulicaria angustifolia** DC. Prodr., v, (1836), 479; H.F.B.I., iii, 299; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 34; Clarke, Comp. Ind., 129.
Syn.—*Callistephus concolor* Dalz. in Kew Jour. Bot., ii, 344.
Habitat.—Common at Adigmet and elsewhere.
Flowering season.—Nov.

79. **Lagasca mollis** Cav. in Anal. Cienc. Nat., vi (1803), 332; H.F.B.I., iii, 302.
Habitat.—Common in grass lands.
Flowering season.—Almost throughout the year.

80. **Acanthospermum hispidum** DC., Gam. F. Pres. Mad., Pt. iv, No. 4. 704.
Habitat.—A South American plant spreading rapidly here.
Flowering season.—Aug.

81. **Sclerocarpus africanus** Jacq. Icon. Pl. Rar., (1782), 17; H.F.B.I., iii, 305; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 39; Dalz. & Gibs., 129; Clarke, Comp. Ind., 134.
Habitat.—Common in the Dominions in hilly regions.
Flowering season.—July-Aug.

82. **Tridax procumbens** Linn. Sp. Pl. (1753), 1900; H.F.B.I., iii, 311; Clarke, Comp. Ind., 142; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 45.
Habitat.—Although a native of Central America, it is found as a common weed throughout the Dominions.
Flowering season.—Almost throughout the year.

83. **Flaveria australasica** Hook., Benth. Fl. Aust., iii, 546; Gamb. F. Pres. Mad., Pt. iv, No. 4, 711; Mayuranathan, Fl. Plts. Mad. City., 152.
Habitat.—A herb introduced from Australia, now common in moist places.

84. **Gynura nepalensis** DC. Prodr. vi, 300: H.F.B.I., iii, 333; Clarke, Comp. Ind., 171.
Habitat.—Much grown for its handsome foliage and flowers.

85. **Emilia sonchifolia** DC.; H.F.B.I., iii, 336: Gamble, F. Pres. Mad., iv, 716.
Habitat.—Common in rice-fields.

86. **Notonia grandiflora** DC. in Wt. Contrib. (1834), 24; H.F.B.I., iii, 337; Clarke. Comp. Ind., 176; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 50; Dalz. & Gibs., 133.

Indian Names.—Gaidar (Bomb.); Wander-roti (Mar.); Kunde-lucheviyaku (Tel.).

Habitat.—Not wild. Often grown in gardens.

Uses.—Medicinal (Kirtikar).

87. **Tricholepis radicans** DC. Prod., vi (1837), 564; H.F.B.I., iii, 381; Clarke, Comp. Ind., 239; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 56; Dalz. & Gibs., 131.

Habitat.—Nalgonda.

Flowering season.—Dec.-Jan.

88. **Dicoma tomentosa** Cass. in Bull. Soc. Philom (1818), 47; H.F.B.I., iii, 387; Clarke, Comp. Ind., 245; Cooke. F. Pres. Bomb., Vol. ii, Pt. i, 58.

Syn.—*Dicoma lanuginosa* DC. in Wt. Contrib. (1834), 26; Dalz. & Gibs., 132.

Indian Names.—Navananjichapala (Belgaum); Gholoharnacharo (Gujerati).

Habitat.—Common on gravelly soil.

Flowering season.—Dec.-Feb.

Uses.—Medicinal.

89. **Cichorium Intybus** Linn. (Chicory), Sp. Pl. (1753), 813; H.F.B.I., iii, 391; Kirt. Ind. Med. Plts., ii, 1433.

Indian Names.—Kasani (Urdu, Pers. and Gujerati); Kasni (Hindi); Kasini (Tel.); Kashini (Tam).

Habitat.—It is rather strange that Abdus Salam found it growing wild near a canal at Himayathnagar. Since then its development and distribution is under observation.

Flowering season.—Feb.

Uses.—Medicinal.

90. **Sonchus oleraceus** Linn. Sp. Pl. (1753), 794; H.F.B.I., iii, 414; Cooke. F. Pres. Bomb., ii, 61. *Sonchus ciliatus* Lam. F. Fr., ii, (1778), 87; Wt. Icon. t. 1141.

Indian Names.—Ratrinta (Tel.); Mhatara (Bomb.).

Habitat.—Apparently wild in cultivated lands and gardens, also on roadsides. Probably an introduction.

Flowering season.—Oct.-Jan.

Uses.—Medicinal.

91. **Launaea pinnatifida** Cass. in Ann. Sc. Nat. Ser. 1, xxiii (1831), 85; H.F.B.I., iii, 416; Cooke. F. Pres. Bomb., ii, Pt. i, 64; Kirt. Ind. Med. Plts. ii, 1447.

Syn.—*Microrhynchus sarmentosus* DC. Prodr., vii, 181; Wt. Ill. t., 131; Clarke, Comp. Ind., 277; Dalz. & Gibs., 132. *Prenanthes sarmentosa* Willd. Sp. Pl., iii, 1540; Grah. Cat., 94.

Indian Names.—Bankan (Hindi); Bhonpatri, Pathradi (Mar.); Pathri (Bomb.); Bhonpatri (Gujerati).

Habitat.—A common sandbinder.

Flowering season.—Nov.-Dec.

Uses.—Medicinal.

XXXIII. EBENACEAE.

92. **Maba nigrescens** Dalz. & Gibs. Bomb. Fl. (1861), 142; H.F.B.I., iii, 551; Cooke. F. Pres. Bomb., ii, Pt. i, 97.

Indian Name.—Rakta-rora (Bomb.).

Habitat.—Common in Mulug forest.

Flowering season.—Nov.-Feb.

Uses.—The wood is used in making rafters.

XXXIV. OLEACEAE.

93. **Jasminum auriculatum** Vahl. Symb. Bot., iii (1794), 1; H.F.B.I., iii, 600; Cooke. F. Pres. Bomb., ii, Pt. i, 113; Kirt. Ind. Med. Plts., ii, 1524.

Indian Names.—Adavimolla (Tel.); Hurinaballi (Canarese); Mullaikkodi (Tam.); Ambashtha, Jai (Sans.).

Habitat.—Common at Anantgiri Hill (Vikarabad).
Flowering season.—May-Aug.
Uses.—Medicinal.

94. **Ligustrum robustum** Blume Mus. Bot. i, 313; H.F.B.I., iii, 614.

Habitat.—Cultivated.

XXXV. SALVADORACEAE.

95. **Salvadora persica** Linn. (The Tooth-brush Tree) Sp. Pl. (1753), 122; H.F.B.I., iii, 619; Cooke. F. Pres. Bomb., ii, Pt. i, 121.

Syn.—*S. indica* Wight Ill. t. 181. *S. Wightiana* Planch. in Thw. Enum., 190; Bedd. Flor. Sylvat. t. 247.
Indian Names.—Pilu, Pilva (Mar.); Khakan (Bomb.); Waragarwenki (Tel.); Pilu (Sans.); Arak (Arab.); Darakhti-misvak (Pers.).
Habitat.—Probably a cultivated tree.
Flowering season.—Dec.-Feb.
Uses.—Fruits are eaten. Wood is employed for making tooth-brushes. Medicinal.

XXXVI. APOCYNACEAE.

96. **Rauwolfia serpentina** Benth. ex Kurz For. Fl. Brit. Burma, ii (1877), 171; H.F.B.I., iii, 632; Cooke. F. Pres. Bomb., ii, Pt. i, 127.

Syn.—*Ophioxylon serpentinum* Linn. Sp. Pl. (1753), 104; Dalz. & Gibs., 143; Roxb. Fl. Ind., i, 694.
Indian Names.—Chhotachand (Hindi); Chandrike (Canarese); Dumparasna, Patalagandhi (Tel.); Harkaya, Harki (Mar.); Sovannamilbori (Tam.); Chandra (Beng.); Amelpodi, Chandra, Chhotachand, Harkai (Bomb.).
Habitat.—Collected from Mulug forest.
Flowering season.—Dec.
Uses.—Medicinal.

XXXVII. ASCLEPIADACEAE.

97. **Calotropis procera** R.Br. in Ait. Hort. Kew. ed. 2, ii (1811), 78; H.F.B.I., iv, 18; Cooke. F. Pres. Bomb., ii, Pt. i, 152; Dalz. & Gibs., 149; Wt. Ic. t. 1278.

Indian Names.—Ak, Madar, Safedak (Hindi); Mandara (Mar.); Jilledu, Mandaramu, Nallajilledu (Tel.); Vellerukku (Tam.).
Habitat.—Common in dry situations, throughout the Dominions.
Flowering season.—Nov.-Dec.
Uses.—Medicinal.

98. **Pergularia pallida** Wt. & Arn. in Wt. Contrib. (1834), 42; H.F.B.I., iv, 38; Wt. Icon. t. 585; Cooke. F. Pres. Bomb., ii, Pt. i, 164.

Habitat.—Collected from Adigmet.
Flowering season.—Feb.

99. **Pergularia extensa** N. E. Br. in Fl. Cap. iv, i, 758; Gamble. F. Pres. Mad., v, 837; Kirt. Ind. Med. Plts., iii, 1616.

Syn.—*Daemia extensa* R. Br., H.F.B.I., iv, 20; Wt. Icon. t. 596.
Indian Names.—Jutuk, Utran (Hindi); Utarana, Amaradudheli (Mar.); Dushtupatige, Guruti (Tel.); Belihatti (Canarese); Achanimuli, Kudagaram (Tam.); Veliparutti (Malayalam); Amaradudheli, Nagaladudhi (Gujerati); Utarni (Bomb.); Chagulbanti (Beng.); Karial (Punjab).
Habitat.—Common in Nalgonda District.
Flowering season.—Dec.
Uses.—Medicinal.

100. **Tylophora macrantha** Hook. f.; H.F.B.I., iv, 40; Gamble. F. Pres Mad., v, 842.

Habitat.—Collected from Mulug forest.
Flowering season.—Dec.

101. **Tylophora asthmatica** W. & A. in Wt. Contrib. (1834), 51; H.F.B.I., iv, 44; Wt. Ic. t. 1277; Cooke. F. Pres. Bomb., ii, Pt. i, 164.

Indian Names.—Antamul (Hindi); Kakapala, Kukkapala (Tel.); Pitakari (Mar.); Adumuttada (Canarese); Vallippala (Malayalam); Antomul (Beng.).
Habitat.—Common at Adigmet and elsewhere.
Flowering season.—Aug.-Nov.
Uses.—Medicinal.

102. **Ceropegia pusilla** W. & A. in Wt. Contrib. 31; Wight Icon. t. 1261; H.F.B.I., iv, 66; Gamble F. Pres. Mad., v, 856.

Habitat.—Collected from Adigmet from a grassy hillock.
Flowering season.—July.

103. **Ceropegia spiralis** Wt. Ic. t. 1267; H.F.B.I., iv, 66; Gamble. F. Pres. Mad., v, 856.

Habitat.—A common herb in dry, hilly situations.
Flowering season.—May-June.

104. **Ceropegia hirsuta** W. & A. in Wt. Contrib. (1834), 30; H.F.B.I., iv, 71; Cooke. F. Pres. Bomb., ii, Pt. i, 177; Gamble F. Pres. Mad., v, 859.

Indian Name.—Hamana (Bomb.).
Habitat.—Collected from the Mananur forest.
Flowering season.—Feb.

105. **Stapelia grandiflora** Masson, Stapel (1796), 13, t. 11; Cooke. F. Pres. Bomb., ii, Pt. i, 180.

Habitat.—A native of S. Africa, kindly presented by Dr. Gravely to the Botanic Garden, Osmania University.
Flowering season.—Summer, about April-June.

106. **Stapelia variegata** Linn. Sp. Pl. 217.

Habitat.—A native of S. Africa. Kindly presented by Dr. Gravely to the Botanic Garden, Osmania University.
Flowering season.—Summer—April to June.

XXXVIII. GENTIANACEAE.

107. **Canscora diffusa** R. Br. Prodr. (1810), 451 in Obs.; H.F.B.I., iv, 103; Cooke F. Pres. Bomb., ii, Pt. i, 191; Gamble F. Pres. Mad., v, 878; Kirt. Ind.. Med. Plts., iii, 1759.

Syn.—*C. Lawii* Wt. Ic. t. 1527 (not of C. B. Clarke).
Habitat.—A common herb at Adigmet and elsewhere.
Flowering season.—Jan.-April.
Uses.—Medicinal.

XXXIX. HYDROPHYLLACEAE.

108. **Hydrolea zeylanica** Vahl Symb. Bot. ii (1791), 46; H.F.B.I., iv, 133; Cooke F. Pres. Bomb., ii, Pt. i, 197; Gamble F. Pres. Mad., v, 884; Kirt. Ind. Med. Plts., iii, 1672.

Indian Names.—Langali (Sans.); Cheruvallel (Malayalam); Ishangulya, Kasschra (Beng.).
Habitat.—A common marsh herb.
Flowering season.—Dec.
Uses.—Medicinal.

XL. BORAGINACEAE.

109. **Coldenia procumbens** Linn. Sp. Pl. (1753), 125; H.F.B.I., iv, 144; Cooke F. Pres. Bomb., ii, Pt. i, 205; Dalz. & Gibs., 171; Kirt. Ind. Med. Plts., iii, t. 1683.

Indian Names.—Tripungki (Hindi); Tripunkhi (Mar.); Hampadi (Tel.); Serupadi (Tam.); Basriookharad (Guj.); Tripakshi (Sans. & Bomb.).
Habitat.—Found in moist places.
Flowering season.—Sept.-Oct.
Uses.—Medicinal.

110. **Heliotropium brevifolium** Wall. Cat. 914. *H. strigosum* var. *brevifolia* Clark; H.F.B.I., iv, 151.

Indian Names.—Chitiphul, Safedbhangra (Hindi); Gorakh-pamo (Punjab).
Habitat.—A common herb.
Flowering season.—Aug.-Sept.
Uses.—Medicinal.

XLI. CONVOLVULACEAE.

111. **Argyreia cymosa** Sweet Hort. Brit. ed. ii, 373; H.F.B.I., iv, 190; Wt. Ic. t., 839; Cooke F. Pres. Bomb., ii Pt. ii, 257; Gamble F. Pres. Mad., v, 908.

Habitat.—Found in hedges and scrub jungles.
Flowering season.—May.

112. **Ipomaea chryseides** Ker in Bot. Reg. t., 270; H.F.B.I., iv, 206; Wt. Ic. t., 157.

Syn.—*Convolvulus chryseides* Spreng. Syst., i, 598. *Convolvulus dentatus* Vahl Symb., iii, 25.
Habitat.—Collected from Mulug forest.
Flowering season.—Dec.

113. **Ipomaea Turpethum** Br. Prodr., 485; H.F.B.I., iv, 212; Dalz. & Gibs., 165.

Syn.—*Ipomaea triquetra* Roem. & Sch. Syst., iv, 231. *Convolvulus turpethum* Linn.; Roxb. Hort. Beng., 14.
Habitat.—Common in Mulug.
Flowering season.—Dec.

114. **Ipomaea Horsfalliae** Hook. Bot. Mag. (1834) t., 3315; Cooke F. Pres. Bomb., ii, Pt. ii, 252.

Habitat.—A native of W. Indies, grown for its beautiful crimson flowers.
Flowering season.—Almost throughout the year.

XLII. SOLANACEAE.

115. **Solanum pubescens** Willd. Phyt. (1794), 5; H.F.B.I., iv, 230; Wt. Ic. t., 1402; Cooke F. Pres. Bomb., ii, Pt. ii, 263.

Habitat.—Cultivated.
Flowering season.—Aug.-Nov.

116. **Solanum torvum** Swartz Prodr., 47; H.F.B.I., iv, 234; Dalz. & Gibs., 175; Cooke F. Pres. Bomb., ii, Pt. ii, 269.

Indian Names.—Kondavust (Tel.); Chunta (Malayalam); Titbaigum (Beng.).
Habitat.—Collected from the city environs.
Flowering season.—July.
Uses.—Fruits are eaten as vegetables, also medicinal.

117. **Solanum trilobatum** Linn. Sp. Pl. (1753), 188; H.F.B.I., iv, 236; Cooke F. Pres. Bomb., ii, Pt. ii, 267; Kirt. Ind. Med. Plts., iii, 1762.

Indian Names.—Alarkapatramu (Tel.); Ambusondeballi, Kakamunji (Canarese); Achuda (Sans.).
Habitat.—Common in Mulug.
Flowering season.—Dec.
Uses.—Medicinal.

118. **Solanum Seaforthianum** Andr. Bot. Rep. t. 504. (Blue Potato Creeper).

Habitat.—A native of Tropical America. Grown for its pretty white and blue flowers.

XLIII. SCROPHULARIACEAE.

119. **Celsia coromandeliana** Vahl Symb. Bot. iii (1794), 79; H.F.B.I., iv, 251; Cooke F. Pres. Bomb., ii, Pt. ii, 281; Kirt. Ind. Med. Plts., iii, 1807.

Indian Names.—Gadartambaku, Kokshima (Hindi); Kolhala, Kutki (Mar.); Kohhal (Bomb.); Kalhara (Guj.); Koksima (Beng.).

Habitat.—Collected from Khuldabad.
Flowering season.—June.
Uses.—Medicinal.

120. **Limnophila racemosa** Benth. Scroph. Ind. (1835), 26; H.F.B.I., iv, 271; Dalz. & Gibs. 177; Cooke F. Pres. Bomb., ii, Pt. ii, 291; Wt. Ic. t. 861.
Indian Name.—Mahaka (Bomb.).
Habitat.—Common in marshy places in Mulug and elsewhere.
Flowering season.—Dec.

121. **Bonnaya veronicaefolia** Spreng. Syst. Veg., i (1825), 41; H.F.B.I., iv, 285; Cooke F. Pres. Bomb., ii, Pt. ii, 298; Dalz. & Gibs., 178.
Indian Names.—Shewal (Bomb.).
Habitat.—Common in moist places towards Vikarabad, Mulug and elsewhere.
Flowering season.—Nov.-Dec.

122. **Angelonia grandiflora** C. Morr. in Ann. Soc. Hort. Gand, iii, 93, t. 119.
Habitat.—Extensively cultivated in gardens.
Flowering season.—Winter.

XLIV. BIGNONIACEAE.

123. **Bignonia venusta** Ker—Gawl. in Bot. Reg. t. 249.
Habitat.—Cultivated for its beautiful flowers.
Flowering season.—Dec.-March.

124. **Tecoma jasminoides** Lindl. Bailey, Encyc. Hort. 3317.
Habitat.—Cultivated.
Flowering season.—Almost throughout the year.

XLV. ACANTHACEAE.

125. **Thunbergia fragrans** Roxb. Cor. Pl., i (1795), 47, t, 67; H.F.B.I., iv, 390; Cooke F. Pres. Bomb., ii, Pt. ii, 342; Dalz. & Gibs., 183.
Indian Name.—Chimine (Bomb.).
Habitat.—A common garden escape.
Flowering season.—Almost throughout the year.
I agree with Cooke that the specific name is a misnomer. I have examined many flowers from several plants, and have satisfied myself that there is absolutely no fragrance.

126. **Thunbergia grandiflora** Roxb. Hort. Beng. (1814), 45; H.F.B.I., iv, 392; Cooke F. Pres. Bomb., ii, Pt. ii, 343.
Habitat.—Commonly grown in gardens.

127. **Thunbergia mysorensis** T. Andres. in Jour. Linn. Soc., ix (1867), 448; H.F.B.I., iv, 393; Cooke F. Pres. Bomb., ii, Pt. ii, 342; Dalz. & Gibs., 183.
Habitat.—Cultivated.
Flowering season.—Dec.

128. **Elytraria crenata** Vahl Enum., i, 106; H.F.B.I., iv, 394; Dalz. & Gibs., 183.
Habitat.—Collected from the Mulug forest.
Flowering season.—Dec.-March.

129. **Hygrophila polysperma** T. Andres, in Jour. Linn. Soc., ix (1867), 456; H.F.B.I., iv, 406; Cooke F. Pres. Bomb., ii, Pt. ii, 353.
Syn.—*Hemiadelphis polysperma* Nees. in Watt. Pl. As. Rar., iii, 80; Wt. Ic. t. 1492.
Habitat.—Common in marshy places throughout.
Flowering season.—Nov.-Dec.

130. **Hygrophila spinosa** T. Andres. in Thwaites Enum. 225, and in Jour Linn. Soc., vii, 22; H.F.B.I., iv, 408.
Habitat.—Common in ditches near tanks and fields.
Flowering season.—Feb.

131. **Ruellia longifolia** T. Andres. in Jour Linn. Soc., ix (1867), 460; H.F.B.I., iv, 412; Watt. Dict. Econ. Prod. I., vi, Pt. i, 589.
Syn.—*Dipteracanthus longifolius* Stocks, in Kew Jour., Bot., iv (1852), 177.
Habitat.—Vicinity of Adigmet.
Flowering season.—Undated sheet in Herbarium Hyderabadense.

132. **Ruellia tuberosa** Linn. Sp. Pl. 635.
Habitat.—Collected from Adigmet, a cultivated plant.
Flowering season.—Undated sheet in Herbarium Hyderabadense.

133. **Phaylopsis parviflora** Willd. Sp. Pl., iii, 342; H.F.B.I., iv, 417.
Habitat.—Collected from Mulug forest.
Flowering season.—Dec.

134. **Strobilanthus Kunthianus** T. Andres. in Jour. Linn. Soc., ix, 465; H.F.B.I., iv, 434.
Habitat.—Common in the vicinity of Adigmet.
Flowering season.—Nov.-Dec.

135. **Blepharis bœrhaaviæfolia** Pers. Syn., ii (1807), 180; H.F.B.I., iv. 478; Cooke F. Pres. Bomb., ii, Pt. ii, 349; Dalz. & Gibs., 192; Wt. Ic. t., 458.
Habitat.—Collected from Mulug.
Flowering season.—Dec.

136. **Barleria cuspidata** Heyne; Nees in Wall. Pl. As. Rar., iii, 93 and in DC. Prodr., xi, 239; H.F.B.I., iv, 483; Cooke F. Pres. Bomb., ii, Pt. ii. 380; Wt. Ic. t. 451.
Habitat.—Common at Adigmet.
Flowering season.—Dec.

137. **Barleria strigosa** Willd. Sp. Pl., iii (1800), 379; H.F.B.I., iv, 489; Cooke F. Pres. Bomb., ii, Pt. ii, 384; Kirt. Ind. Med. Plts., iii, 1880.
Syn.—*Barleria terminalis* Nees in DC. Prodr., xi (1847), 225; Dalz. & Gibs., 188. *B. coerulea* Grah. Cat., 161.
Indian Names.—Nilam baramu (Tel.); Nilambaram, Nili (Tam.); Nilakurinni (Malayalam); Wahiti (Bomb.); Dasi (Beng.); Nilakurantaka (Sans.).
Habitat.—Collected from Mulug forest.
Flowering season.—Dec.
Uses.—Medicinal.

138. **Phlogacanthus curviflorus** Nees in Wall. Pl. As. Rar. iii, 113 and in DC. Prodr., xi, 320; H.F.B.I., iv, 511; Cooke F. Pres. Bomb., ii, Pt. ii, 417.
Habitat.—A native of khasia mountains, cultivated for its showy brick-red flowers.

139. **Rhinacanthus communis** Nees in Wall. Pl. As. Rar. iii, 109, and in DC. Prodr., xi, 442; H.F.B.I., iv, 541.
Habitat.—Doubtfully indigenous.

140. **Peristrophe bicalyculata** Nees in Wall. Pl. As. Rar. ii, 113 and in DC. Prodr. xi, 496; H.F.B.I., iv, 554; Cooke F. Pres. Bomb., ii, Pt. ii, 415; Dalz. & Gibs., 197.
Indian Names.—Atrilal, Itrelal, Masi (Hindi); Ghatipittapapada, Rankirayat (Mar.); Chebira (Tel.); Pitpatra (Sans.); Nasabhaga (Beng.).
Habitat.—Common in Mulug and elsewhere.
Flowering season.—Nov.-Dec.
Uses.—Supposed to be medicinal.

141. **Fittonia argyroneura** E. Coem. in Fl. des Serres, xvi (1865), 103.
Habitat.—A native of Peru, grown in gardens.

XLVI. VERBENACEAE.

142. **Vitex Negundo** Linn. (Indian Privet) Sp. Pl. (1753), 638; H.F.B.I., iv, 583; Cooke F. Pres. Bomb., ii, Pt. ii, 428.

Syn.—*Vitex bicolor* Willd. Enum. Hort. Berol, 660 (in note); Dalz. & Gibs., 201; *Vitex trifolia* Grah. Cat., 155 (not of Linn.).

Indian Names.—Nirgandi (Hindi); Shamalu, Shambalu (Deccan); Nirgunda, Lingur (Mar.); Nallavavili (Tel.); Nochi (Canarese); Nirkkundi (Tam.); Banjangasht, Sisban (Pers.); Aslag, Fanjangasht (Arab.); Indrani, Nilapushpa (Sans.); Nirgundi (Bomb.); Bankhu (Punjab).

Habitat.—A common large shrub along roadsides near villages.

Flowering season.—Almost throughout the year.

Uses.—Medicinal.

143. **Clerodendron phlomidis** Linn. f. Suppl. (1781), 292; Cooke F. Pres. Bomb., ii, Pt. ii, 431.

Syn.—*Clerodendron phlomoides* Willd. Sp. Pl., iii (1800), 386; H.F.B.I., iv, 590; Dalz. & Gibs., 200; Wt. Ic. t. 1473.

Indian Names.—Arnl, Piran (Hindi); Talaki, Tekkali (Tel.); Sayandi, Takkari (Tam.); Arni, Irun (Guj.); Tirutali (Malayalam); Arani, Agnimantha, Gandhapushpa (Sans.).

Habitat.—Common in Mulug and elsewhere, growing in hedges in dry situations.

Flowering season.—Nov.-Feb.

Uses.—Medicinal.

144. **Clerodendron serratum** Spreng. Syst. Veg., ii (1825), 758; H.F.B.I., iv, 592; Wt. Ic. t. 1472; Cooke F. Pres. Bomb., ii, Pt. ii, 432; Dalz. & Gibs., 200.

Indian Names.—Barangi (Hindi); Bharangi (Urdu and Bomb.); Barangi, Bhramaramari (Tel.); Bharangi (Mar.); Gantubarangi (Canarese); Cherutekku (Malayalam); Bharangi Bhargavi, Bramhi (Sans.).

Habitat.—Common on the Telangana side.

Flowering season.—Sept.

Uses.—Medicinal.

145 **Verbena chamaedryfolia** Jus. in Ann. Mus. Par., vii (1806), 73; Cooke F. Pres. Bomb., ii, Pt. iii, 437.

Habitat.—A native of S. America, several hybrids of which are grown largely in gardens.

146 **Holmskioldia sanguinea** Retz. Obs. fasc., vi (1791), 31; Cooke F. Pres. Bomb., ii, Pt. iii, 437; Watt. Dict. Econ. Prod. I., iv, 260.

Habitat.—A native of the subtropical Himalaya. Its large rounded red calyx is remarkable. Commonly grown in gardens.

XLVII. LABIATAE.

147. **Coleus spicatus** Benth. in Wall. Pl. As. Rar., ii (1831), 15; H.F.B.I., iv, 624; Wt. Ic. t. 1431; Cooke F. Pres. Bomb., ii, Pt. iii, 449.

Syn.—*Coleus Zatarhendi* Dalz. & Gibs., 206.

Habitat.—A strongly scented herb. Collected from Mananur. It was growing among bushes on stony ground.

Flowering season.—Dec.-Feb.

148. **Hyptis suaveolens** Poit. in Ann. Mus. Par., vii (1806), 472; H.F.B.I., iv, 630; Cooke F. Pres. Bomb., ii, Pt. ii, 476; Kirt. Ind. Med. Plts., iii, 2032.

Habitat.—A native of Tropical America, has become naturalized in many parts of India. Collected from Mulug.

Flowering season.—Dec.

Uses.—Medicinal.

149. **Dysophylla myosuroides** Benth. in Wall. Pl. As. Rar., i (1830), 30; H.F.B.I., iv, 638; Cooke F. Pres. Bomb., ii, Pt. iii, 456.

Habitat.—Collected from a rocky place in Mananur forest.

Flowering season.—Jan.-Feb.

150. **Meriandra bengalensis** Benth. (Bengal sage) Lab. 189; H.F.B.I., iv, 653; Cooke. F. Pres. Bomb., ii, Pt. iii, 475; Kirt. Ind. Med. Plts., iii, 1996.

Indian Names.—Kafur-ka-patta (Deccan and Bomb.); Kafurkapat (Hindi); Simakarpuramu (Tel.); Sayayilai (Tam.).

Habitat.—A native of Abyssinia—cultivated in gardens.

Flowering season.—Almost throughout the year.

Uses.—Medicinal.

151. **Leucas mollissima** Wall. Pl. As. Rar., i (1830), 62; H.F.B.I., iv, 682; Cooke F. Pres. Bomb., ii, Pt. iii, 469; Watt, Dict. Econ. Prod. I., iv, 634.

Habitat.—Common in the vicinity of the city. First collected from Umberpet from a hedge.

Flowering season.—Oct.-Dec.

XLVIII. NYCTAGINACEAE.

152. **Boerhaavia repanda** Willd. Sp. Pl., i (1797), 22; H.F.B.I., iv, 709; Dalz. & Gibs., 213; Wt. Ic. t. 1766; Cooke F. Pres. Bomb., ii, Pt. iii, 480.

Indian Names.—Punarnava, Pungali (Bomb.).

Habitat.—Collected from Mahboobnagar.

Flowering season.—Dec., but it is in flower more or less throughout the year.

XLIX. AMARANTACEAE.

153. **Alternanthera echinata** Sm., in Rees, Cycl. Suppl. n. 10.

Habitat.—Common at Adigmet.

Flowering season.—Aug.-Jan.

L. POLYGONACEAE.

154. **Polygonum glabrum** Willd. Sp. Pl. ii (1799), 447; H.F.B.I., v, 34; Dalz. & Gibs., 214; Wt. Ic. t., 1799; Cooke F. Pres. Bomb., ii, Pt. iii, 514; Watt Dict. Econ. Prod. I., vi, Pt. i, 318; Kirt. Ind. Med. Plts., iii, 2098.

Indian Names.—Sheral, Raktarohida (Bomb.); Atalari (Tam.).

Habitat.—Found in ditches and wet places.

Flowering season.—Oct.-Feb.

Uses.—Leaves are medicinal.

155. **Polygonum tomentosum** Willd. Sp. Pl., ii (1799), 447; H.F.B.I., v, 30; Trim. F. Ceyl., iii, 411; Cooke F. Pres. Bomb., ii, Pt. iii, 515; Gam. F. Pres. Mad., vii, No. vii, 1189.

Habitat.—Common in wet places at Adigmet and elsewhere.

Flowering season.—Dec.-April.

156. **Muehlenbeckia platyclados** Meissn. in Bot. Zeit., xxiii (1865), 313; Cooke F. Pres. Bomb., ii, Pt. iii, 519; Gam. F. Pres. Mad., vii, No. vii, 1192.

Syn.—*Coccoloba platyclada* F. Muell. in Bot. Mag., xix (1863), t. 5382.

Habitat.—A native of Solomon Islands, often grown in gardens.

LI. PIPERACEAE.

157. **Piper nigrum** Linn. (Pepper)) Sp. Pl. (1753), 28; H.F.B.I., v, 90; Dalz. & Gibs. Suppl., 84; Cooke F. Pres. Bomb., ii, Pt. iii, 526; Gam. F. Pres. Mad., vii, No. vii, 1206; Wt. Ic. t. 1935; Watt Dict. Econ. Prod. I., vi, Pt. i, 260.

Syn.—*Piper trioicum* Roxb. Fl. Ind. i (1832), 151.

Indian Names.—Kalimirch (Urdu); Golmirch, Kalimirch, Safedmirch (Hindi); Filfilesiyah (Pers.); Filfiluswud (Arab.); Marichamu (Tel.); Kalimirch (Mar.); Agutlam (Tam.); Kalimari, Kalimirich (Guj.); Menasu (Canarese); Golmorich (Beng.); Golmirich (Punjab).

Habitat.—Cultivated. Kindly presented to the Botanic Garden, Osmania University by Mr. Chacko of Cocanada.

Uses.—Economic and medicinal.

LII. EUPHORBIACEAE.

158. **Euphorbia pycnostegia** Boiss. Cent. Euphorb. (1860), 9; H.F.B.I., v, 246; Gam. F. Pres. Mad., vii, 1274; Cooke F. Pres. Bomb., ii, Pt. iii, 565.

Habitat.—Collected from Mulug.
Flowering season.—Dec.

159. **Euphorbia Clarkeana** Hook. f. F. B. I. (1887), 253; Cooke F. Pres. Bomb., ii, Pt. iii, 570.

Habitat.—Collected from Adigmet.

160. **Euphorbia tortilis** Rottler, ex Wight Ic. t. 898; H.F.B.I., v, 256; Gam. F. Pres. Mad., vii, No. vii, 1277.

Indian Name.—Pedda jamadu (Tel.).
Habitat.—Common in dry situations in some of the districts.

161. **Bridelia montana** Willd. Sp. Pl. iv (1805), 978; Kirt. Ind. Med. Plts., iii, 2214.

Indian Names.—Geia, Khaja (Hindi); Asana (Mar.); Gundu bigalu, Pantangi (Tel.); Vengaimaram (Tam.); Asano (Guj.).
Habitat.—Common in the hilly tracts in Mulug.
Flowering season.—Sept.-Nov.
Uses.—Medicinal.

162. **Phyllanthus simplex** Retz. Obs. Bot. fasc. v (1789), 29; H.F.B.I., v, 295; Dalz. & Gibs., 234; Cooke F. Pres. Bomb., ii, Pt. iii, 587; Kirt. Ind. Med. Plts., iii, 2224.

Indian Names.—Bhuiavali (Mar.); Uchchiyusirika (Tel.); Motibhonyaanmali (Guj.).
Habitat.—Common at Adigmet.
Flowering season.—Aug.-Nov.
Uses.—Medicinal.

163. **Phyllanthus nanus** Hook. f.; H.F.B.I., v, 298.

Habitat.—Collected from the vicinity of Adigmet.

164. **Phyllanthus debilis** Herb. Ham. ex Wall. Cat. (1828) sub n. 7892; H.F.B.I., v, 299; Cooke F. Pres. Bomb., ii, Pt. iii, 588.

Habitat.—Collected from Adigmet.

165. **Pedilanthus tithymaloides** Poit., Gam. F. Pres. Mad., vii, No. vii, 1346.

Habitat.—An American shrub cultivated in gardens.

166. **Plecospermum spinosum** Trecul, in Ann. Sc. Nat. ser. iii, Vol. viii (1847), 124; H.F.B.I., v, 491; Wt. Ic. t. 1963; Cooke F. Pres. Bomb., ii, Pt. iv, 642; Gam. F. Pres. Mad., Pt. viii, No. viii, 1352.

Indian Names.—Koriti (Tel.); Achingudi, Daiyal (Tam.); Bendaka (Canarese).
Habitat.—Cultivated.
Flowering season.—April-June.

LIII. URTICACEAE.

(MORACEAE).

167. **Ficus tomentosa** Roxb. Hort. Beng. (1814), 103; H.F.B.I., v, 501; Wt. Ic. t. 647; Cooke F. Pres. Bomb., ii, Pt. iv, 646.

Indian Names.—Jivi, Juvi (Tel.); *Kallu-goli* (Bomb.); Ichchi, Kal-ichchi (Tam.); Kal-al (Malayalam); Kallatti (Canarese).
Habitat.—A common tree in the hilly tracts in Mulug.
Flowering season.—April.

168. **Holoptelea integrifolia** Planch. in Ann. Sc. Nat. Ser. iii, Vol. x (1848), 266; H.F.B.I., v, 481; Dalz. & Gibs., 238; Wt. Ic. t. 1968; Cooke F. Pres. Bomb., ii, Pt. iv, 629.

Syn.—*Ulmus integrifolia* Roxb. Corom. Pl. I. (1795), 56, t. 78; Kirt. Ind. Med. Plts., iii, 2293.

Indian Names.—Dhamna, Kumba, Papri (Hindi); Kaladri, Tapsi (Canarese); Papara, Vavli (Mar.); Aval (Malayalam); Avali (Tam.); Nevili, Tapasi (Tel.); Chirabilva (Sans.).

Habitat.—Grown in gardens, doubtfully indigenous.

Uses.—Medicinal.

(URTICACEAE PROPER).

169. **Pilea microphylla** (Gun-powder or Artillery Plant). Liebm. in Vidensk. Skr. ser. v, Vol. ii (1851), 296; Cooke F. Pres. Bomb., ii, Pt. iv, 659; Gam. F. Pres. Mad., Pt. viii, No. viii, 1379.

Syn.—*Pilea mucosa* Lindl. Coll. Bot. (1821) t. 4; H.F.B.I., v, 551.

Habitat.—A native of S. America, extensively cultivated as a border herb.

An interesting feature about the pollen is that, when ripe, it is discharged in clouds from the anthers when the plant is slightly shaken.

170. **Pellionia Daveauana** N. E. Brown, in Gard. Chron. (1880), Pt. ii, 262; Cooke F. Pres. Bomb., ii, Pt. iv, 659.

Habitat.—A native of Cochin-China, grown in baskets as an ornamental plant, and also in rockeries.

Regarding the ejection of pollen the same remark applies to this plant as to *Pilea microphylla*.

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EXPLANATION OF PLATE.

Fig. 1.—Photograph of a moist forest near Salvoy in Mulug. In the foreground is a river—Dayyum Mudgo, in the background are lofty trees.

Fig. 2.—A panoramic view of a part of the Ajanta Hills where the forest is of the Monsoon type.

Fig. 3.—Photograph of a thicket of *Calamus Rotang* Linn. near the Ramappa tank in Mulug.

REVIEW

THE BOOK OF INDIAN BIRDS by Sálim Ali. With 171 coloured, 18 black and white plates, 3 line plates and a map. Bombay Natural History Society, Bombay, Rs 14.

Every one enjoys birds. The beauty of their forms and colouring, the vivacity of their movements and the sweetness of their songs make bird-watching past time for the out-of-doors that for fascinating is without equal.

In spite of the wealth and variety of birds, closer acquaintance with them has hitherto been difficult due to the scarcity of a handy, well illustrated and simply written volume which every one could conveniently carry into the field and which at the same time would be within the reach of the modest purse.

Such a book has now appeared and will, we are sure, be welcomed. It contains 171 full page coloured plates and descriptions of 181 of the commoner birds to be met with about cultivation, towns, and villages, jheels and scrub jungles in the plains of India and about the seabound.

The coloured plates, while they do not as a whole claim to reach a high artistic standard, will certainly serve the purpose for which they are intended namely to enable the reader to name his bird. They are the same as were used in the Bird Charts the Society issued some years ago, and with which most people interested in Indian Birds must by now be familiar.

Opposite each coloured plate is the description of the bird illustrated. This is subdivided into the following sections: Size, Field Characters, Distribution, Habits, Nesting. In addition the book contains a number of chapters of general interest including an Introduction to bird study, nesting, migration, economics and bird watching.

What we consider to be a feature of the book is the keys to identification by prominence of crest or bill and by colour which should prove of great help to the beginner and the layman.

Another detail we are glad to see is that the size of the bird is indicated not in inches as is customary, but by comparison with a standard of size which must be familiar to most people such as crow, sparrow, bulbul, myna and so on. As the author points out size given in inches for a bird in the field means little to the layman and may be even misleading where abnormal necks, bills or tails have to be dealt with.

All the latest information gained in the various ornithological surveys carried out in India during recent years, as regards distribution, habits, taxonomy and other branches of bird study have been embodied in the text.

The 18 odd black and white plates, reproduced from the author's own photographs and from those of such well-known bird photographers as E. H. N. Lowther and R. S. P. Bates add considerably to the attractiveness of the volume and the migration map specially prepared for the book is of much interest.

The Society are to be congratulated on this their latest effort to popularise natural history and we feel that this is decidedly a book that must be on the shelf of every bird lover be he young or old.

MISCELLANEOUS NOTES

I.—RIVERS AS BARRIERS TO THE DISTRIBUTION OF GIBBONS.

With reference to my note on Gibbons published on page 434 of volume xlii of the *Journal*, I have now had an opportunity of investigating the status of this animal at Sadiya and have found one small party in the jungle to the north of the station. This means that these animals are present east of the Dibang River, but not west of it, thus further defining the area mentioned in my previous note where they are quite definitely absent. I still have to obtain information with regard to the area west of the Subansiri River.

DIBRUGARH,
LAKHIMPUR DISTRICT,
ASSAM, *August* 31, 1941.

R. E. PARSONS,
Indian Police,
F.R.E.S.

II.—WHERE A TIGER SHARPENED HIS CLAWS.

(*With a photo*).

I enclose two photos I found when going through my collection which you might like to publish. The tree was on the side of a jungle

road, along which a particularly large tiger used to promenade. The tree is an Arjan (*Terminalia Arjuna*). The fire-watcher is standing on a slightly lower level than the ground at the near edge of the tree; the top claw mark was 10′ 6″ from ground level. The deeply scored claw marks indicate the energy put into the process, and if one pictures the tiger standing against the tree in the position indicated by the marks, one gets a vivid idea of the might of the tiger. It is a good illustration of paragraph 1 on page 63 of Dunbar Brander's 'Wild Animals in Central India'.

BETUL, C. P.,
August 3, 1941. C. E. HEWETSON, I.F.S.

[The passage from Dunbar Brander book reads as follows:—

'Another habit of tigers, which they occasionally practise, is to sharpen or clean their claws on trees. This habit seems to be more an individual peculiarity constantly practised, rather than a general habit occasionally practised; as where the marks on trees are seen they are usually numerous and made by the same animal, whereas miles of jungle containing tigers may be devoid of all signs of the habit. I knew a particular Mohwa tree in a certain valley in the Melghat where a tiger regularly scraped his claws every three weeks or so. He evidently stood up on his hind legs and pulled his claws down, making deep incisions in the bark. This practice had been going on for years, but no other tigers for miles round indulged in it.'—EDS.]

III.—ON THE HEIGHT AND AGE OF AN ELEPHANT.

(*With a plate*).

The fine tusker, Chandrasekharan, belonging to H. H. the Maharaja of Travancore, died last year of old age.

He was a magnificent animal standing 10′ at the shoulders. Captain S. S. Flower (later Major), Director, Egyptian Government, Zoological Service, who visited Travancore in 1913, described him in his Report on a Zoological Mission to India (p. 14) as the 'tallest male elephant' that he 'saw actually measured in India'. After death, the Museum Taxidermist deputed to prepare the animal's skin, reported his height as 10′ 7″. Major Stanley in the Report quoted above mentions three instances of elephants going over 10′ in height—a male 'measured by Sanderson as 10′ 7½″'; Col. Hamilton's record of Sir Victor Brooke killing one of 11′ and a skeleton in the Indian Museum of Mr. W. M. Smith's Bilkandi Elephant, measuring 11′ 3″—which would indicate that the animal must have been nearly 12′ high in the flesh, if the skeleton was properly mounted. Regarding his skeleton, Mr. W. T. Blanford has a footnote in his *Fauna of British India*—Mammalia—(p. 464) which explains that he was told by Mr. Sanderson that the femur of the mounted skeleton and of another elephant known to have been less than 10′ high, on comparison, showed only a difference of 1/8″.

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The elephant Chandrasekharan died on 10-4-1115 M.E., i.e., A.D. 1940. The records about his age vary and are conflicting. From his appearance he must have been past 95 at the time of death. He was taken over to the Royal Stables on 15-8-1058 (A.D. 1883) from the Travancore Forest Department. His tusks were symmetrical and graceful and swept up in a semicircular curve. The weight of the tusks is 142½ pounds.

Major Stanley writing on the age of Chandrasekharan in the same report, says that he had an ascertained minimum age of twenty-five and a supposed approximate age of forty years in 1913. This would mean that the animal might have been between 52 and 67 years of age at the time of death. This is considerably low, compared with Mr. W. T. Blanford's statement that an 'elephant is fully grown, but not fully mature, at 25 years of age, and individuals have been known to live over 100 years in captivity; in a wild state their existence probably extends to 150 years', and the evidence furnished by 'Ortela' the famous 170-year old elephant of Ceylon described on p. 619, Vol. xxxix of the *Journal of the Bombay Natural History Society*. Major Stanley's study on the duration of life in vertebrate animals which appeared in the *P. Z. S.*, 1931, based on actual observations for a number of years brings out 50 as the average life of elephants. It is interesting to note that the thirteenth century Jain Zoologist, Hamsadeva, has said in his 'Mrigapakshi-sastra' that the maximum age attained by elephants in captivity is 100.

The elephant was particularly remarkable for his sagacity, gentleness and almost human intelligence. He never harmed a living creature till his death. Various stories are current evidencing one or other of his qualities, an authentic one being his refusal to erect a pillar in one of the pits dug for the purpose in connection with one of the Murajapam festivals in Trivandrum. Usually the elephant was a very willing worker and his refusal to hoist the pillar which he held still with his tusk and trunk surprised the mahout who on looking into the pit found that a dog which had strayed in had got into the pit had fallen asleep. It was only after the dog was roused and driven away that Chandrasekharan lowered the pillar into the pit.

The death of an animal so remarkable for his size and intelligence, was a personal loss to H. H. the Maharaja, whose kindness to animals is proverbial. As a tribute to this mighty pachyderm, its head is set up and given a prominent place in the Royal Art Gallery, 'Ranga Vilas' at the Fort, Trivandrum.

TRIVANDRUM,
August 22, 1941.

N. G. PILLAI,
Curator, State Museum, Trivandrum.

IV.—THE MALAYAN ELEPHANT.

There are four points in Mr. Theodore Hubback's excellent article under the above caption (August 1941 *Journal*—Vol. xlii, No. 3) I should like to touch on.

' Chandrasekharan ' in a placid mood

—and in ' Musth '

Firstly the description of the young of Malayan Elephants having sometimes . . . 'a thick coat of black, and in part, bristly hair' . . , in the *Proceedings of the Zoological Society*, 1914, may well apply to the young of Indian Elephants also. Mr. Hubback just describes the appearance of a two-day old elephant calf I saw, and filmed, a few yards from me, in 1936—in the North Coimbatore jungles. I have never seen any other young calf so covered with black 'bristly' hair as this was.

2. The Malayan idea that the 'pengasoh' (foster-mother) is the more aggressive when both female elephants are with the calf may not be far wrong. Some years ago I was out in the Minchiguli Valley of North Coimbatore with a friend, and we came on a herd of elephants—a bit separated from which were 2 cow-elephants and a small calf. While we were watching the calf's antics with its mother the wind suddenly changed, betraying our presence. The mother-elephant shuffled off with the calf between its legs: while the other cow swung round and made a determined charge on us. We had to run for it!

3. I found about 18 inches of an elephant's tusk embedded in a tree once: it was a clean break: and the tree was split.

4. Elephants bite each other's tails when fighting: the loser on turning to flee, is 'speeded on' by having a portion of its tail bitten off.

5. I am particularly interested in Mr. Hubback's description of an elephant using a waterfall as his trail (*vide* last para on page 503). In 1929, while following a rogue elephant on the Baragur Hills, I was amazed to find that the elephant had climbed the face of a small dry waterfall—in a ravine—leaving a good path to do so. Had I not personally verified this I would never have believed it to be possible. Further, there was no apparent reason for the climb—which was quite 12 feet, possibly more.

6. I once watched a bull elephant with most abnormal tusks (quite 6 feet long outside and so wide apart that they must have been almost useless to him in a fight) standing on the outskirts of a herd, in which there were two other fine tuskers, and spending his whole time trumpeting loudly. I think he was made to keep his distance from the herd: and was furious! On another occasion a bull elephant, after being disturbed by three successive flash-lights in a nulla (set with trip-wires) vented his wrath on the trees in the vicinity of the third camera, laying them all flat!

Reinforcement Camp,
Bombay,
September, 15, 1941.

R. C. MORRIS,
Captain.

V.—AN ALBINO NILGHAI

(*With a photo*).

I enclose a snapshot of a fawnish white Nilghai (male) shot by His Highness the Thakore Saheb of Palitana the other day in the State, which may interest your readers,

It was shot in open country about ten miles from the Capital and is the first of its kind ever seen this side.

The animal was in very good condition, about 5 to 6 years old, with $6\frac{3}{4}$" horns and had an orangeish-coloured mane and tassel.

THE PALACE,
PALITANA,
KATHIAWAD,
August 9, 1941.

T. R. TRIVEDI,
Private Secretary to H. H. Palitana.

VI.—MEASUREMENTS OF A FINE HEAD OF THE INDIAN GAZELLE.

I am sending you by passenger train the head of a Chinkara or Indian Gazelle (*Gazella bennetti*) which has been shot by my brother Sardar Gurbachan Singh and shall be obliged if you will kindly have it measured and the measurements recorded in your *Journal*.

NABHA,
August 20, 1941.

SARDAR SHIVDEV SINGH,
Prime Minister,
Nabha State, Nabha (Punjab).

[The measurements of the Chinkara head sent to the Society by the Prime Minister, Nabha State, are recorded by us as follows:—

Length on front curve.	Circumference.	Tip to tip.
15"	4"	$6\frac{1}{8}$"

The measurements of the record head given in Rowland Ward's *Records of Big Game are*:—

Length on front curve.	Circumference.	Tip to tip.
$15\frac{5}{8}$"	$4\frac{3}{4}$"	$5\frac{1}{2}$"

This animal was shot at Bhalinda? (Punjab) and the trophy is in the possession of Major-General Sir P. C. Palin. 'Bhalinda' is probably a misprint for Bhatinda.—Eds.]

VII.—KING CROW BULLYING TERNS.

An interesting incident was witnessed by several of us at Ferozepur on 26-2-1941, and as I have not noticed an account of such behaviour in any of the publications to which I have had access, it may be worth recording.

The scene was one of the canals which still held a few stretches of shallow water wherein a number of small fry (fish) attracted a gathering of some dozen or so River Terns (*Sterna aurantia*). Seated on a small tree on the canal bank was a King Crow (*D. macrocercus*) which, as soon as one of the Terns had made a successful plunge, gave chase and forced the latter to drop its prey which was then caught in mid-air, taken to its perch and devoured piece-meal by the King Crow, the fish being held down by the latter's feet and torn to pieces much as a Falcon does with its prey.

SIMLA, A. E. JONES.
April 1941.

VIII.—PRESUMPTIVE EVIDENCE OF THE NIDIFICATION OF THE INDIAN CUCKOO (*CUCULUS MICROPTERUS* GOULD).

(*With a plate*).

Six years ago while staying at Dehra Dun I visited the late O. C. Ollenbach on several occasions when we used to talk 'Natural History'. During one of these visits our conversation turned to the question of cuckoos' eggs and he asked me if I had ever found a cuckoo's egg in the nest of a king-crow, or drongo. I had to admit that I hadn't, neither had I heard of it but I made a mental note of it.

That same year, or the next, I forget which, my friend Mr. Edwin Hotz, who is a keen naturalist, up in Simla on a bit of leave from Delhi, voluntarily told me he had seen a young cuckoo being fed by a king-crow. Here was confirmatory evidence of some member of the genus cuculus victimizing some of the Dicruridae.

Looking through the list of victims of *Cuculus canorus* and its subspecies in both the *Fauna* (2nd edition) and *Nidification* I found no mention of any of the members of the Dicruridae being victimized.

Now taking in order the other cuckoos, as per the '*Fauna*' we have *Cuculus optatus*, and *C. policephala* we find the eggs of both are well known, moreover the eggs of both species are considerably smaller than the egg of *C. canorus*.

Next in rotation comes *C. micropterus* Gould, the Indian Cuckoo, and here we find that except for (a) the remains of an oviduct egg obtained by La Touche which he described as 'pinkish-white marked with rich red and carmine, *very much like some eggs of the Dicruridae*, and (b) the record of a complete oviduct egg obtained by Stewart in Travancore, which is described as 'all blue, of rather a grey shade'. Finally we have Rattray's assumption (*Nidification*, vol. iii, p. 347) that blue eggs which

he found in nests of *Trochalopteron lineatum, Hodgsonius phœnicuroides, Larvioora brunnea* and *Saxicola torquata indica* all of which birds lay blue eggs pertained to *C. micropterus*. About these Stuart Baker remarks; 'They are *probably* correctly identified as those of the present bird, but in appearance are not distinguishable from those of the Common Cuckoo.' Besides this evidence we have the case of Major R. E. Skinner's collector who 'saw one of these Cuckoo's sitting on the nest of a Paradise Flycatcher, and waiting until it flew away, examined the nest and took a Cuckoo's blue egg and two eggs of the owner from it.' How this man could identify the species of cuckoo in the field except from the call of the male is beyond me. Even in the hand the identification of *C. canorus, C. optatus* and *C. micropterus* is difficult. The 'Water-bubbling' notes of the females of all three are practically the same.

Now for my own evidence. For the last three or four years we have been used to hearing the mellow call '*kyphul pukka*' (as we syllabalize it up here) of *C. micropterus* during April and May mostly, but occasionally in June, at elevations between 5,000 ft. and 7,000 ft., while at lower altitudes, i.e. 3,000 ft. to 4,000 ft., its call may be heard as late as September.

Personally I have not taken a nest of a king-crow (*Dicrurus longicaudatus*) for a number of years, but this year my elder son has taken two, both of which call for notice. The first was taken on May 18 and contained *five* eggs but due to an accident three of these had been broken. However, on examining the two remaining eggs it was obvious that one was a cuckoo's of some species. On the 30th he found another king-crow's nest this time containing one more or less normal egg of the rightful owner while the second egg was *exactly like the Cuckoo's egg taken on the 18th.*

Next, a young friend of ours, David Cotton, an extraordinary good field naturalist, hearing about these presumed cuckoos' eggs looked up the three clutches which he had taken this year in the same locality as the two nests above mentioned and brought two of them to me for critical examination. Here again each of these nests contained *one egg exactly like the two cuckoos' taken by my son*, and all five eggs evidently, so alike are they, laid by the same bird.

A most extraordinary feature with regard to four clutches of the king-crows' eggs is that they are pure white without a mark and slightly rough in texture as are also the Cuckoos'.

The colouring of the supposed five cuckoos' eggs is dead white ground, sparcely marked with blotches and spots of pale brick red scattered evenly all over the surface of the shell. In size they are slightly smaller than the drongos'.

At these elevations we find *Cuculus canorus* victimizing *Lannius S. erythronotus, saxicola t. indica, Enicurus maculatus* and, rarely, *Oreocorys sylvanius* and know all the various types of this cuckoo's eggs fairly well, having on three separate occasions actually witnessed it lay its egg in the nest of the Stone Chat (*S. torquata indica*). The five eggs in question are like no cuckoo's eggs previously seen by me.

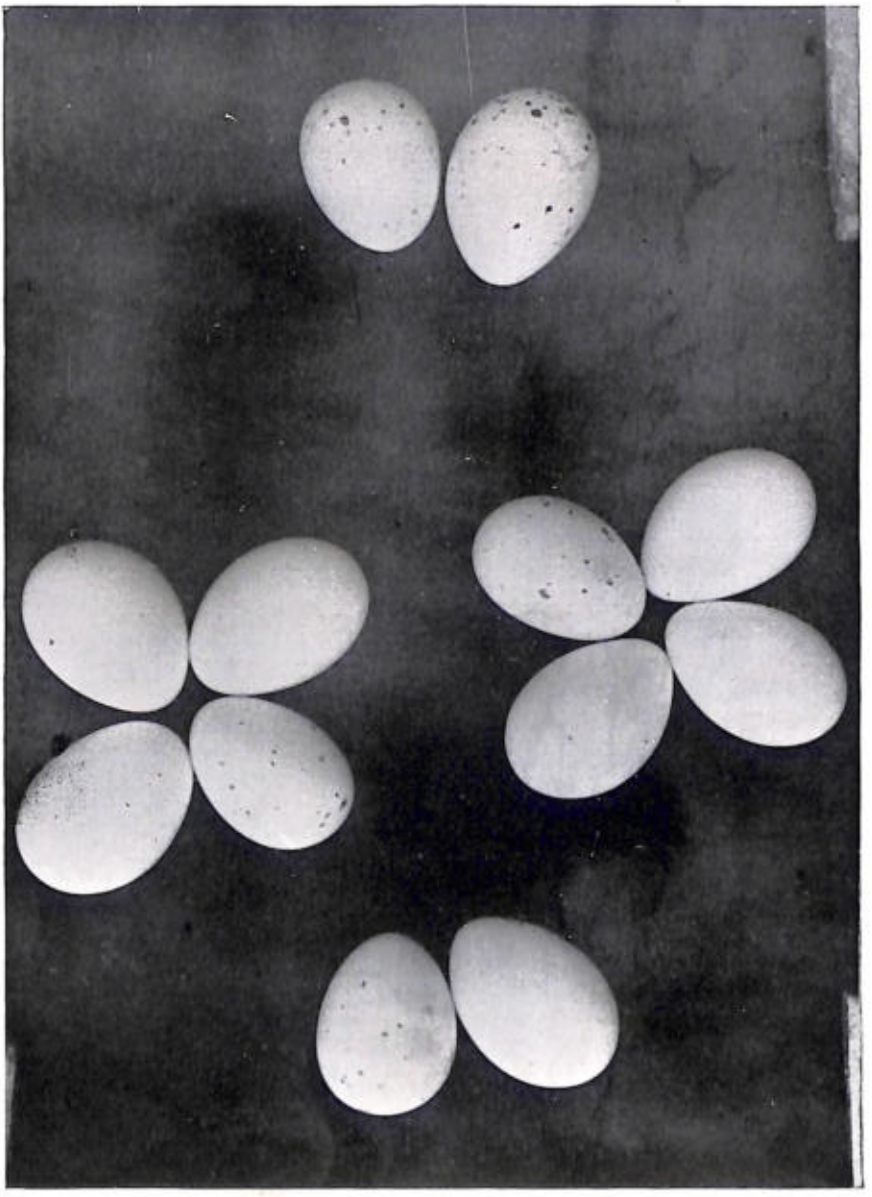

Photo : *Col. E. A. Glennie*

Nidification of the Indian Cuckoo (*Cuculus micropterus*)

For explanation see end of note.

To sum up, we have:—

1. Two independent accounts, i.e., Hotz and Ollenbach of King-Crows being cuckolded by some species of Cuckoo.

2. Five cuckoos' eggs, taken in one circumscribed locality, all from nests of *Dicrurus longicaudatus*.

3. No record either in the *Fauna* (2nd ed.) nor in *Nidification* of the eggs of *Cuculus canorus* ever having been taken (among thousands of records of other victims) from drongos nests, but the record of fragments of an oviduct egg from *C. micropterus* obtained, as previously cited, by La Tuche, described by him as resembling some eggs of the Dicruridae. Now these five eggs (the cuckoos) might easily have been passed over for poorly marked king-crows' had it not been for the fact that the eggs of the latter happened to be unmarked in four cases (nests) out of five.

4. Detection was due to there having been five eggs in the first nest taken by my son, this being a most unusual number laid by any of the Dicruridae.

5. The cuckoo, whatever its species, had taken up its breeding quarters amidst a 'pocket' of king-crows (four out of five of them) whose eggs are quite abnormal, being un-marked, pure paper-white. This we must however allow is purely fortuitous, but I mention it because had these king-crows' eggs been normally poorly-marked ones (at times one finds very handsomely marked ones) it would have been more than likely that the eggs of the interloper would have been overlooked.

6. The dates on which four of these nests were taken are May 14th e/4, 18th e/5, 21st e/4, and 30th e/2. Elevations between 5,500 ft. and 6,000 ft.

SIMLA, A. E. JONES.
July 1941.

The photograph, for which I am once again extremely indebted to Col. E. A. Glennie, shows the four sets of eggs. Of the top pair the right-hand egg is the more or less normal type of drongo or king-crow egg, while the one alongside it is one of the supposed cuckoos' eggs, which will also be seen (one in each) in the other three clutches. The photograph shows the actual size of the eggs. The photograph is also valuable in showing the rather unusual type, unmarked, of drongo or king-crow (*Dicrurus*) egg.

IX.—THE GREAT BLACK WOODPECKER IN THE NEIGHBOURHOOD OF BOMBAY

On the 1st June, 1941, I was out at Suriamal (45 miles north of Bhiwandi, along the Wada Road on the southern border of the Nasik District), with Messrs. C. McCann and Dinshah Panday. During the course of a morning's tramp through mixed moist deciduous forest along a hill-side, we saw a Great Black Woodpecker (*Macropicus javensis* subps.) at very close quarters.

This woodpecker is large and unmistakeable, and this record extends the known range considerably northwards. In flight it has a grotesque resemblance to a cross between a hornbill and a crow! The white patch on the lower back is distinctive. A loud cackling laugh appears to be commonly uttered. A pair seen near Sirsi (Dharwar Dist.) on the 8th Sept. 1939, also kept in touch in a similar manner. The female of this pair was shot and had dormant ovaries. Her stomach contained a mass of large black ants, as well as slivers of wood ½ in. to ¾ in. long.

Among other birds seen around Suriamal, Grey Tits (*Parus major*) were common, and one of them was observed carrying nesting material. The Little Sunbird (*Leptocoma minima*) was also common. Both these species are unrecorded from the immediate neighbourhood of Bombay.

HUMAYUN ABDULALI.

BOMBAY,
June 21, 1941.

X.—THE BOOMING BITTERN [*BOTAURUS STELLARIS STELLARIS* (LINN.)] IN LOWER BENGAL.

Recently, the Director, Zoological Survey of India, received from Mr. D. J. McMullin, Assistant Superintendent, Coaching, East Indian Railway (Calcutta), a beautiful female specimen of the Booming Bittern. Mr. McMullin writes that he shot the bird on the afternoon of January 7, 1940, among *hugla* grass in a *bhil* (lake) about two miles south-west of Barasat (Barasat Sub-Division, 24-Parganas District, Lower Bengal), and adds that 'it was accidentally shot as it was taken for a Bengal florican when it rose'.

The measurements of the bird are as follows:—Body-length, 485 mm.; Wing, 300 mm.; Tail 120 mm.; Tarsus, 90 mm.; Culmen, 66 mm.; and Mid-toe with claw, 120 mm.

The Booming Bittern is a palaearctic bird resident in the temperate areas from Western Europe to Manchukuo and Japan. It migrates in winter largely to the countries around the Mediterranean and to South-West Asia, and in much smaller numbers to India, Burma and Southern China. Within Indian limits it occurs in small numbers throughout Northern India and as far south as Bombay, the Deccan and even, it is said, Bangalore. It does not breed in India. (Curiously enough, Hartert in his standard work *Die Vögel paläarktischen Fauna*, vol. II (1920), pp. 1262-1263, does not mention India, Burma and Southern China within the over-wintering range of this bird.)

Owing to its rarity, the bird is seldom encountered in India and I have, therefore, thought it fit to record a recent instance of its occurrence in Bengal. Apart from rarity, its capture is made difficult by the fact that it is a nocturnal bird, hiding by day in long, dense beds of rushes and reeds in swamps,

Intimation of any future Indian records of this bird, as well as skins of it, will be welcomed by the Zoological Survey of India, Calcutta.

CALCUTTA,
10th April, 1941.

M. L. ROONWAL,
M.SC., PH.D. (*Cantab*).
Zoological Survey of India, Calcutta.

XI.—BIRD 'BATHING' IN ANTS.

I wonder if the following note on the 'anting' habit of the Common Mynah will be interesting to the readers of your esteemed *Journal*.

On the morning of December 14, 1940, I saw a pair of Common Mynahs (*Acridotheres tristis*) 'anting' themselves on the lawn in front of the Museum. The birds were seen to hop about in the midst of a colony of Red Ants (*Oecophylla smaragdina*) picking them in their beaks one after the other, rubbing them against the underparts of their wings and tail and finally dropping them. After being thus engaged for about three minutes, they flew away. On the scene of their activities, I found a number of red ants strewn about, dead and dying. All had their abdomens flexed and crushed at the pedicel and were reeking of formic acid recently liberated.

Again, on June 28, 1941, at the same spot, I saw a pair of mynahs engaged in the same act. This time I had noticed the birds at a distance feeding among the grass and working their way in the direction of the ants. As my curiosity was roused, I took my stand nearby to watch. On seeing the ants they at once set to pick them up in their beaks and behave exactly as before, spreading and quivering the tail during the act. They did this for nearly a minute and then moved on. Soon, a pair of White-headed Babblers (*Turdoides striatus*) feeding in another part of lawn came that way, but took no notice of the ants, and hopped clear of them to the adjoining lawn. I made an examination of the spot as soon as the birds had left, but there was no sign of the shambles I expected to see, save for a disabled ant which I removed to my table. Under a lens, the legs appeared intact and though the abdomen was bent over on its stalk, it was free from rupture and presented no trace of any body juice. At first the ant could hardly move, but soon it recovered and was able to get about as vigorously as ever, so I had it restored to its comrades.

According to the notes previously published on the subject in this *Journal*, the following birds have been observed to pick up and press on their plumage insects with obnoxious effluvia:—

(1) *Dryonastes coerulatus* and the nestlings of *Trochalopterum nigrimentum* and *erythrocephalum*, *Dendrocitta baylei*, (Rhynchota)—B. B. Osmaston.

(2) Jerdon's Chloropsis—(Red Ants)—Humayun Abdulali.
(3) Song thrush—(Red Ants)—Major R. S. P. Bates.
(4) Drongo—(Ants—Red?)—T. B. Fletcher.

In all the above cases, the insects were swallowed afterwards, but in (3), as well as in the instances described above, the birds were observed to drop them.

Besides these, the Magpie (*Pica pica*), Jay (*Garrulus glandarius*), Starling (*Sturnus vulgaris*), the crow (*Corvus corone* and *cornix*), *Leiothrix lutea*, *Lioptila capistrata* and *Garrulus* species, the Thrushes (*Turdus musicus* and *philomelos*) and Dipper (*Cinclus cinclus*) are also known to indulge in this habit, using in addition to ants, cigar ends, mealworms and Floh-Kerbs (?) and many acid fluids such as lemon juice and vinegar.

N. G. PILLAI,
Govt. Museum, Trivandrum.

TRIVANDRUM,
August 12, 1941.

XII.—SURVIVAL OF BIRDS AFTER INJURY.

Mr. W. P. Keelan's note in this *Journal* (Vol. xlii, No. 1, p. 191) on a Mallard which lost portions of the web and toes, the latter being mere stumps, the cause of which he attributes to frost-bite or a jaw-trap, reminds me of the injuries to one of my pets, a Baya (*Ploceus philippinus*), which survived in spite of the total loss of a leg.

Early in 1940 I was living in a small village, but the house I was occupying was comparatively good as it was the property of the State. One morning one of my pets, a bulbul, was missing. I found its feathers under its cage which lay on a shelf. The cage had a wire netting, but the door had a slit $\frac{1}{2}$ by $3\frac{1}{2}$ inches and I suspected the marauder had dragged out its victim through this slit, but left the other bulbuls untouched. Worried for the safety of my other pets, I took them to another room. I was afraid the unknown visitor might come from the roof, so I placed the half a dozen cages on a cot until better arrangement could be made. My pets included parrakeets, bulbuls, munias, larks, a pair of koels, a grey partridge, a Nepal mynah and a cockatoo. Nothing untoward happened for some days. Then one night I was awakened by the alarmed twittering and calls of my birds. My wife and I rushed to the room which had no access to cats. We shuddered at the horrible carnage we saw in one of the cages occupied by White-backed Munias, Spotted Munias, Red Amadavats, larks and a baya. The victims were bleeding profusely. Some were already dead, some were dying. A pair of Spotted Munias was unscathed. The baya had lost its left leg entirely. Nothing was left of its leg except a blood clot on the belly. No time was lost to reach and search the room, but no trace of the enemy was found. Wire-mesh of the cage hardly allowed entry of the tip of one's first finger. The cage measured $1\frac{1}{2}$ by $1\frac{1}{2}$ by $1\frac{3}{4}$ ft. Near the top of the cage, on one side, some feathers were clinging and there were blood stains indicating where the enemy had unsuccessfully tried to draw out

its victims. No bird was missing. The only survivors in the cage were the pair of the Spotted Munias and—to my extreme surprise and pity—the one legged Baya. I cannot yet imagine the author of this carnage. The other cages on the cot were untouched.

Next night I placed the one legged baya in the same cage on the same cot and lay in wait in the adjoining room for the enemy. Nothing happened; only a musk rat was heard chirping. I had seen it the previous night when I searched the room, but I had not suspected it of the crime.

The Baya with its one leg lived many months in quite good health. The loss of one leg hampered its movements, but it could support itself on the perch and at night it perched quite firmly. When I returned home I had, due to circumstances, no alternative but to set it free in a garden.

Can you suggest the name of the mysterious enemy? Could it have been the musk rat?

PORBANDER,
August 14, 1941.

V. M. VASU.
Advocate.

[The common musk shrew is insectivorous—insects, cockroaches in particular being the object of its entry into houses—but these shrews have been known to eat meat and may attack small birds or mammals—this taste for meat-eating may be more developed in a particular individual; or the culprit may have been an ordinary house rat. The attacker undoubtedly seized its victim from outside, the frantic fluttering of the birds against the wire-mesh giving it the opportunity to seize them.—EDS.]

XIII.—FURTHER OBSERVATIONS ON THE EGG-LAYING HABITS OF THE LIZARD, *CALOTES VERSICOLOR* (BOULENGER).

In a paper (Asana '31) published in this *Journal* the writer has given an account of some natural activities of this lizard including his observations on the egg-laying habits of this creature and the number of eggs normally laid. Subsequent to the publication of this paper there appeared in the year 1935 in the well known series *The Fauna of British India*, a work by Malcolm A. Smith, entitled 'Reptilia and Amphibia, Vol. II—Sauria'. In this work is included a short account of the breeding habits of the species, *Calotes versicolor*, in which reference is made to some of the observations made by the present writer in his paper (Asana '31) mentioned above. In this connection Malcolm A. Smith ('35) on page 193 of his work says, 'These observations are not in accordance with my own, made in Indo-China or with those of Deraniyagala made in Ceylon. I have never known them to be buried more than a couple of inches below the earth, and the number deposited may vary from 4 to 12. They vary in size from 14-15 mm. long by 8-9 mm. broad'.

On July the 20th of this year an excellent opportunity luckily came my way to confirm those of my observations in which

Malcolm Smith differs from me, barring one observation, the depth of the hole in the soft earth in which the creature lays her eggs. On this occasion I have been fortunate enough to watch at close quarters in the compound of my bungalow a female performing all her operations for laying the eggs, almost from the beginning to the end of her effort, literally under my very nose.

On the morning of the date mentioned above, my wife, while returning from the garden, accidentally caught sight of a calotes digging a small pit in the somewhat moist earth on the surface of the ground. The hole, the animal was making, was quite close to the wall of the low-plinth verandah, not even two inches distant from it. When my attention was first drawn to it, it was about 15 minutes past 10 o'clock in the morning. I could watch the creature from a very favourable position without disturbing it in the least. Myself bending low on the window-sill I could see her working directly below me on the ground hardly 4 feet away.

She was intensely preoccupied and had nearly completed digging the pit. While she was shovelling out the scraped earth from the bottom of the pit, employing only her fore feet in both these operations, more than half the length of her body was inside the hole. Noting the rate at which she worked one could estimate that she must have started digging the hole somewhere between 9-30 and 9-45 *that morning* working without a break. I intentionally use the words, *'that morning'*, because I infer that she had been working continuously the previous 30 to 45 minutes. The reasons for this inference are that (1) the earth that had been scraped out looked quite fresh, moist and granular, and (2) during her subsequent operations, when I was watching her closely and continuously, she never left the spot and worked continually.

The colour of her fore feet and that of 1½ inches length of the spines-bearing ridge on the dorsum just behind the occiput was dull crimson or brick red. She worked all the time with her fore-feet using each limb alternately one after the other. The scraping and throwing out of the soil, both these operations, were performed by the fore feet alone, never by the hind limbs, which simply rested on the brink of the hole supporting her body. At intervals she would rest for a few seconds. The hole was made ready to receive the eggs at about 34 to 35 minutes past 10 o'clock, she having taken nearly an hour to complete it. The completed hole, as observed later, was about 3 inches broad at the rim outside, narrowing down below to the depth of about 3½ to 4 inches.

Having finished this part of her job, she took her head and body out of the hole and sitting on the pit turned towards the east in a direction opposite to that when she was digging. She rested for a while, her hind limbs stretched over and across the hole. Then she began to eject out of her body and cloaca the eggs, which dropped one after the other down the pit, the process starting at about 10-36 a.m. During this time she lay almost motionless, across the pit her fore limbs pressed back on either side of the anterior part of the trunk. A few seconds before an

egg dropped out of the vent, a wave of contraction would pass over the abdominal wall pressing the egg outwards. In the early stages of the process, the interval between two successive eggs was about 45 to 55 seconds. Later it increased to about 60 to 70 seconds.

Twenty-one eggs were counted as they dropped into the hole, the actual egg-laying operation lasting for about 23 to 25 minutes. All this time the creature lay entirely motionless across the pit, except for the periodic contraction of her abdomen, the head and anterior half of the body pressed against the ground. The last egg laid she rested for about a minute and a half, then turned round over the hole, her head again directed towards the south.

Then she lowered the anterior part of her body and her fore limbs again into the hole. Resting these fore limbs against the opposite sides of the pit, she began spreading out and pressing the egg heap with her snout as if to arrange the eggs inside. About two minutes were devoted to this part of her work, the operation of scraping the earth for covering the eggs commencing at about 11 a.m.

Bringing her fore feet again into use she began to scrape out the earth from the sides of the pit, throwing it all on the eggs. After collecting a certain quantity she would beat the loose, granular earth with her snout and press it hard on the egg mass, resting at intervals. She toiled and laboured in this way for about half an hour, gradually filling in the hole. During this time she never changed her position, nor did she bring her hind limbs ever into play. The pit was completely filled in at about 11-32 in the forenoon. During this half hour too she was continually at it and never left the spot. After the hole was filled in she levelled the disturbed area, again with her fore feet, stayed there for a couple of minutes and left the spot.

If we presume that she first commenced marking out the area near the wall and scraping the earth for a hole some time between 9-30 to 9-45 a.m., she took about 2 hours to finish the job. During this period she worked almost continuously, taking little or no rest, and she never left the spot, certainly from about 10-15 to 11-35 a.m. and most probably from 9-30 or 9-40 a.m. to the end. This seems to be a remarkable feat in more ways than one for a creature so small.

I examined the spot after waiting for about half an hour for her return. If the creature had not been seen working there, it would have been difficult to say that a hole had been dug out in that little area, so cleverly it had been filled in and all traces of disturbance removed. The eggs were unearthed and counted again in the presence of our assistant, Mr. R. G. Kharadi, B.Sc. There was no mucous on them and they were not glued together and were quite clean, spotlessly white and exactly 21 in number. In size they did not differ from those mentioned in my previous paper (Asana '31), being about 10-11 by 4-5 mm. But they were found laid in fairly soft, moist earth the female calotes had raked up not more than 2½ to 3 inches below the earth.

It was a most interesting experience watching this fascinating phenomenon of nature at such close quarters. If it could have been reproduced in a film the mother *Calotes* might have well proved a star performer. One regrets having missed the opportunity.

GUJARAT.
20th July, 1941.

J. J. ASANA,
Gujarat College,
Ahmedabad.

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XIV.—REMARKABLE FEEDING HABITS OF AN INDIAN CARP [*BARBUS* (*PUNTIUS*) *DOBSONI* DAY].

The following observation may prove of interest to fellow fishermen and naturalists.

On repeated occasions I found the stomach and intestine of the Carp, *Barbus* (*Puntius*) *dobsoni* caught in rivers around Poona, much distended with a mass of finely disintegrated vegetable matter in appearance like chewed-up grass.

The source of this diet intrigued me greatly, as I could not detect much aquatic vegetation in the gravelly pools, where the fish were caught.

The explanation came forth, when I noticed a number of large carp disporting themselves close to a herd of village buffaloes wallowing in a pool of the Nira river. Observation with field glasses from an elevated point disclosed fish approaching the posteriors of the ruminants and gorgeing themselves on their freshly produced dung, thus obtaining this predigested diet so to say 'straight from the horses mouth' or rather the reverse.

My observations were confirmed by Mr. McCann, who had noticed a similar occurrence near the Pinjrapole at the Ulhas river.

The fish weighed from 4 to 14 lbs. and tallied with the particulars given in books of reference for *Barbus dobsoni*, a common carp in our parts.

Nearly all of them were caught on an unshelled groundnut used dry fly fashion.

116, KOREGAON PARK,
POONA.
22nd July, 1941.

M. SUTER,

XV.—A MANTIS-BLOODSUCKER TRAGEDY.

While watering my garden on the evening of the 28th July I spotted a Mantis (*Deiphobe ocellata*) making a meal of a young Bloodsucker (*Calotes versicolor*) almost as large as itself. The

mantis was facing earthwards with the lizard firmly secured in its fore legs. It had eaten the greater part of it. About six inches below, a large bloodsucker was seated on the same pole watching the proceedings. I watched carefully for quite a while when suddenly the large bloodsucker rushed at the mantis. The mantis immediately dropped its prey and assumed a defensive attitude with the forelegs outstretched and ready to strike. The wings were also wide spread. The large bloodsucker snapped up the remains of the little one as they fell and swallowed them, but did not dare to attack the menacing mantis. The bloodsucker then went away. The mantis remained in the defensive attitude for a considerable time after the event.

Those who have handled one of the larger mantids can well appreciate the painful results of a grip of its well-armed pincer-like forelegs, no wonder the bloodsucker was not anxious to tackle the insect. Bloodsuckers do take mantids when they can get them at a disadvantage, but I have on several occasions seen a bloodsucker drop its captive soon after it caught it. *D. ocellata* is not uncommon in Salsette, and there is a good figure of it in Lefroy's *Indian Insect Life*.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
29th July, 1941. C. McCANN.

[That the larger mantids sometimes hunt 'bigger game' is certain. In the Society's Museum there is a specimen of a Purple Sun Bird taken in the grip of a mantis. The bird was partly scalped when captor and prey were secured.—EDS.]

XVI.—PARASITIZATION OF LARVA OF THE HAWK MOTH (*OXYAMBULYX SUBOCELLATA*) BY FLIES.

Mr. Sevastopulo's note on the parasitization of *Rhyncholaba acteus* Cr. by Tachinid flies on page 449 of vol. xlii of the *Journal*, and Mr. McCann's previous note on a similar subject but dealing with *Theretra lycetus* Cr., has reminded me of a case in which I found a larva of the Hawk Moth (*Oxyambulyx subocellata* Feld.) parasitized by flies of the genus *Blepharipoda;* but in this instance no caking of the soil was noticed. The pupae of the parasites were distributed in various parts of the breeding cage.

DIBRUGARH,
LAKHIMPUR DISTRICT,
ASSAM.
28th June, 1941. R. E. PARSONS,
F.R.E.S.,
Indian Police.

XVII.—EFFECTS OF THE BITE OF THE LARGE MYGALOMORPH SPIDER (*CHILOBRACHYS* SP..).

I have today despatched under a separate cover a large spider of the tarantula type and shall be pleased to have your opinion on it. I have never seen such a large spider or one of this hairy type

in this part of the world and it would be of interest to know if it is of a species commonly found in India.

It was disturbed in a stack of fire-wood which was inside the house of one of the labourers on the Keyhung Division of this Company. A girl aged eight years took some firewood from the stack and in doing so dislodged the spider which bit her on the hand causing a very painful swelling.

A report on the case has been drawn up by Dr. K. P. Hare, the Medical Officer of this District, from particulars given him by our Indian Assistant Medical Officer.

Dr. Hare unfortunately was not able to examine the case as it was not reported to him. His report is now given.

REPORT ON CASE OF SUPPOSED SPIDER BITE AT KEYHUNG T.E.

'*First day.*—A female child aged 8 years came in contact with a large spider which was said by the parents to have bitten her on the dorsum of the left hand. She was seen by the A.M.O. 2-3 hours later when the dorsum of the hand was swollen and red all over. The swelling was not hot. In the centre of the swelling there was a black mark, circular in outline, about ¼ inch in diameter but no puncture could be seen.

Second day.—The swelling had increased and had become hot. The black centre was unchanged.

Third day.—The black centre had become vesicular and burst, exuding a serous discharge. There was no slough in the base of the ulcer.

Fourth day.—The main swelling was subsiding but the central ulcer had increased to a diameter of about 1 inch. There was some slough in the base but the exudate was still serous.

Fifth day.—The size of the ulcer was increasing, and sloughing was more marked. The exudate was still serous.

Sixth day.—The ulcer had further increased in size, and suppuration had commenced.

The condition remained fairly stationary until :—

Tenth day.—The slough separated and the exudate again became serous and the inflammatory swelling subsided.

From this day granulation commenced with slow healing.

Throughout the course there was no rise of temperature.'

TINGRI TEA CO., LTD.,
HOOGRIJAN P.O. & T.O., T. WOOLY SMITH.
11th June, 1941.

[The spider has been identified as *Chilobrachys* sp. (probably *fumosus*). These large hairy spiders are commonly called Tarantulas —though the true Tarantula takes its name from the town of Tarentum in Italy and is confined to the Mediterranean littoral. All spiders possess a pair of poison glands opening near the tip of the fangs, but few seem to have the power of injecting their poison into human beings. It is believed that the poison is not automatically ejected whenever the fang is used, but is under the spider's control. Dr. Gravely in his interesting article on Indian Spiders

(*Journ., B.N.H.S.*, vol. xxviii, p. 1045) gives a few instances of poisoning by large Mygalomorph spiders. The bite may be attended with pain and swelling which may extend up the bitten limb and may persist for 24 hours.—EDS.]

XVIII.—A CENTIPEDE EATING ITS EGGS.

It is well-known that the centipedes display a certain amount of parental care; brooding their eggs and coiling round their young till they are able to fend for themselves. The centipede (*Scolopendra* sp.) in question is a small metalic bluish-black species found very commonly in the Ghats. On the 20th July, at Khandala I found one coiled round her creamy coloured eggs under a stone. I put her, together with her eggs, into a tube. In the tube she also coiled round the egg mass. On the 25th morning I found that she had devoured all her eggs. This eating of the eggs was evidently occasioned by hunger as I had put nothing into the tube for her to eat, and is, of course, not habitual, especially in an animal that displays parental care. However, it points to one thing, namely, that under normal conditions the parent periodically leaves her eggs or young to feed.

This centipede breeds commonly between the months of July and September during which period I have frequently found it with either eggs or young.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY.
29th July, 1941.

C. McCANN.

XIX.—A NOVEL WAY OF COLLECTING BOTANICAL SPECIMENS.

(*Wayside Trees of Malaya* by E. J. H. Corner, Hongkong Naturalist, vol. x, Nos. 3 & 4, 1941.)

Anyone who has ever visited a stretch of jungle in any State in Malaya will have realized that it is by no means easy to study and to know the trees. When a tree is 150 feet high and has no branches for the first 60 or 80 feet it is difficult to collect specimens of leaves, or flowers or fruits for determination and study. Mr. Corner uses a telescope, not binoculars, to bring the foliage nearer but specimens are essential. One method is to use a .12 bore shotgun and to hope that a lucky shot will bring down enough fragments to be of value. But Mr. Corner evolved a new technique. He recruited, as an experiment, a berok monkey, *Macacus nemestrina*, the well-known Pig-tailed Monkey which is widely used in the East by Malayas for gathering coconuts. Merah, as it was named, proved a great success. 'On one occasion in Johore, for instance, it worked in the crown of a Wild Chempedak at the height of 170 feet: on another day it collected specimens from 24 trees, all of which were over 100 feet in height.' 'At the end

of his days, Merah was able to find in the trees flowers and fruits which had been shown him on the ground: and he knew the meaning of 18 words of Malay.' It took a genius to think of training monkeys to collect botanical specimens but it took a man of infinite patience and equipped with a rubber-neck to use them successfully. Monkeys so often behave like mischievous children and the effort of gazing up at the crown of a tall tree, minute after minute, whilst shouting directions to a disobedient monkey in an atmosphere like a Turkish-bath and attended by swarms of thirsty mosquitoes, requires considerable strength of character and calls for physical fitness of a high order. Unfortunately Merah developed an obscure disease and had to be put away but he was followed by two others, Jambul and Puteh, which were purchased by the Department and probably were the first two monkeys ever to enter Government service! In this book Mr. Corner has limited his attention to wayside trees and the study of these in only rare instances necessitated the assistance of his monkeys, but we have mentioned them as an illustration of the thoroughness and enthusiasm with which he carries out his researches on the flora of the country.

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ERRATA

VOL. XLII, No. 2.

Pages 320–322. Wherever '*Coleus vettiveroides*' occurs read as '*Coleus Vettiveroides*'.

VOL. XLII, No. 4.

Page 839, line 4 from top. Add *Rhodocleptria incarnata.* Flies in spring.

Page 841, line 42 from top, For 'classes' read 'class'.

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Conservator of Forests, The Senior	Darjeeling
Conservator of Forests	Orissa.
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Cox, C. E. C. (C.I.E., I.F.S., F.Z.S.)	Nagpur.
Coyajee, Miss Ratanbai H.	Bombay.
Craker, P. W. (O.B.E.)	London.
Crawford, William G. (I.F.S.)	Naini Tal.
Crofton, R. M. (C.I.E., I.C.S.)...	Hyderabad, Dn
Croix, O. H. de St.	Nagpur.
Crombie, A. D. (C.I.E., I.C.S.)	Madras.
Culshaw, Miss K. H.	Aler.
Currie, A. J.	London.
Currie, M.M.L. (I.C.S.)	,,
Dabholkar, Lt.-Col. A. Y. (I.M.S.)	Poona.
Dalal, Merwanji Bomanji	Bombay.
Dalal, M. P. M.	,,
Danta State, H. H. The Maharanaji Sahib Bahadur (K.C.S.I.)	Danta-Bhavangadh.
Darjeeling, The Curator, Nat. Hist. Mus. ...	Darjeeling.
Daver, Framroze A.	Bombay.
Davies, T. G. B. (A.R.S.M., ST.M.I.P.T.)	Khaur.
Davies, Major V. K. N. (I.A.)	Bombay.
Davis, D. (I.F.S.)	,,
Davis, The Hon'ble Sir Godfrey (*Kt.*, I.C.S.) ...	Karachi.
Davis, P. W. (I.F.S.)	Coimbatore.
Davis, Capt. T. A. W. (R.A.S.C.)	Jullundur Cantt.
Dee, Lionel	Travancore.
De Haas, C. P. J.	Java.
Delacour, Mons Jean	France.
Deo, Raja Sri Balavadra Narayan Bhunj	Keonjhargarh.
DeRhe Philipe, G. W. V. (F.E.S.)	London.
Dewas Sr., H. H. Maharaja Vikram Singrao (K.C.S.I.)	Dewas Sr.
Dewas Junior, Shreemant Capt. Y. B. Pawar Yuvaraj, of	Dewas Jr.
Dickins, Lt. M. J.	Bombay.
Dickson, Lt.-Col. H. R. P. (C.I.E.)	Persia.
Dinajpur, Maharaja Jagadish Nath Ray	Dinajpur.

Director of Museums, S. S. & F. M. States ... Kuala Lumpur.
Dods, W. K. ... ... Calcutta.
Donald, C. H. (F.Z.S.) ... ... Dharmsala.
Donald, Capt. J. O. S. ... ... N.W.F.P.
Donavan, Lt.-Col. C. (I.M.S.) ... ... England.
Douglas, J. A. (D.S.P., Retd.) ... ... Dehra Dun.
Douglas, Miss Margaret ... ... Jalna.
Drake-Brockman, Major, R. F. H. (R.A.) ... Bombay.
Dubash, J. K. ... ... ,,
Duke, A. H. ... ... Bangkok.
Duke, Bt. Lt.-Col. C. L. B. (M.C., R.E.) ... ... Roorkee.
Dunbar-Brander, A. A. (O.B.O., I.F.S.) ... ... Scotland.
Dunbar, U. B. H. ... ... India.
Duncan, Lt.-Col. D. L. ... ... Colombo.
Dunlop, S. W. C. (I.C.S.) ... ... Bezwada.
Dunsdon, A. C. ... ... Calcutta.
Durand, C. H. S. ... ... Bombay.
Dyson, R. A. ... ... London.
East India Railway European Institue ... ... Allahabad.
Eates, K. R. (I.P., F.Z.S., M.B.O.U.) ... ... Karachi.
Edwards, M. Vincent (I.F.S.) ... . New Delhi.
Eliot, John N. ... ... London.
Eliott-Lockhart, Major Wm. ... ... Bombay.
Ellis, Ralph ... ... California.
Emerson, C. A. ... ... England.
Emerson, Gerald H. (I.C.S.) ... . Waziristan.
Emerson, Major J. ... ... Bombay.
Etaiyapuram, The Rajah of ... ... Etaiyapuram.
Evans, Col. G. H. (C.I.E., F.L.S.) ... ... London.
Evans, Brigadier W. H. (C.S.I., C.I.E., D.S.O.) ... England.
Ezra, Sir Alwyn, *Kt.* (F.R.G.S., F.Z.S.) ... ... Bombay.
Fawcus, L. R. (I.C.S.) ... ... Calcutta.
Featherstone, Gordon B. ... ... Assam.
Ferrar, Lt.-Col. M. L. (I.A., O.B.E., C.S.I.) ... England.
Finnis, N. D'O ... ... Secunderabad.
Fischer, C. E. (R.H.) ... ... Fatehgarh.
Fisher, J. Barling (Bar-at-Law, F.R.G.S.) ... Tellicherry.
Fletcher, Thos. Bainbrigge (F.R.E.S., F.L.S.) ... England.
Fooks, H. A. ... ... Calcutta.
Foot, A. E. ... ... Dehra Dun.
Forrington, Arthur ... ... Bombay.
Fountaine, Miss Margaret (F.R.E.S.) ... ... London.
Fraser, Capt. A. G. L. (I.M.D.) ... ... Wellington.
Fraser, Duncan ... ... London.
Fraser, K. H. ... ... Tellicherry.
Fraser, Capt. L. J. D. (I.A.) ... ... India.
French Indo-China, His Majesty S. M. Bao-Dai, Emperor of Annam ... ... F. I. China.
Frend, G. V. R. ... ... Kadur.
Frome, N. F. (D.F.C., M.Sc., M.I.E.E.) ... ... New Delhi.
Fyzee, A. A. A. (M.A., LL.B., Bar-at-Law) ... Bombay.

Gabb, H. B. ... ... Calcutta.
Gardiner, J. E. ... ... Nasirabad.
Garthwaite, P. F. (I.F.S.) ... ... India.
Garbett, Sir Colin (K.C.I.E., C.M.G., C.S.I., F.R.G.S., I.C.S.) ... ... Lahore
Geddis, A. ... ... Bombay.
Gee, E. P. ... ... Badlipar
Gemmell, G. W. ... ... Calcutta.
George Hugh S. (I.F.S.) ... ... Nagpur.
George, J. ... ... Bombay.
Ghosh, S. K. (I.C.S.) ... ... Shillong.
Gibbon, Herbert ... ... Vandiperiyar.
Gibbons, J. M. B. ... ... Bombay.
Gibson, Sir Edmund (K.C.I.E., I.C.S) ... ... Dehra Dun.
Gill, E. H. N. (F.Z.S.) ... ... Sitapur.
Gill, H. A. C. (I.C.S.) .. .. Delhi.
Gimson, C. (I.C.S.) ... ... Imphal.
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Glennie, Lt.-Col. E. A. (D.S.O., R.E.) ... ... Dehra Dun
Goodwin, F. W. ... ... Simla.
Gordon, Major J. W. ... ... Jodhpur.
Gough, Lt.-Col. W. ... . Dehra Dun.
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Director of Agriculture, Baghdad ... ... Iraq.
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Hall, J. E. ... ... Roorkee.
Hambly, R. L. ... ... Calcutta.
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Hancock, Lt.-Col. C. P. (C.I.E.) ... ... New Delhi.
Harman, A. C. ... ... Bettiah.
Harper, Lt.-Col. A. Forrest ... ... London.
Harper, William ... ... Cawnpore.
Hartnoll, E. S. (I.F.S.) ... ... Srinagar.
Harvey, Lt.-Col. C. W. L. (M.C., C.B.E.) ... Indore.
Hasted, Major J. S. Holy ... ... Dehra Dun.

Hate, Prof. Vinayak N. (B.Sc.) ... ... Bombay.
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Headly, Derek ... ... Palestine.
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Heslop-Harrison, Dr. G ... ... Bombay.
Hessling, F. ... ... ,,
Hewetson, C. E. (I.F.S.) ... ... ,,
Hewitt, Walter A. ... ... Gonda.
Heysham, R. K. ... ... Bombay.
Hickin, S. B. (M.B.E.) ... ... Sukkur.
Higgins, J. C. (C.I.E., I.C.S.) ... ... Bombay.
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Hillyer, R. A. N. ... ... Haiti.
Hindmarsh, Lt.-Col. J. H. L. ... ... Bombay.
Hislop, Lt.-Col. J. H. (M.C., I.M.S.) ... ... ,,
Hocking, Brian (I.A.O.C.) ... ... Cawnpore.
Hodson, G. A. (B.F.S.) ... ... London.
Hodson, Lt. R. V. E. ... ... Sialkot.
Hoey, Capt. C. F. ... ... New Delhi.
Holland, Major G. M. ... ... Bombay.
Holmes, H. R. ... ... England.
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Hopkinson, A. J. (C.I.E., I.C.S.) ... ... Kalat.
Hora, Dr. Sunder Lal (D.Sc.) ... ... Calcutta.
Hoshang, N. E. Dinshaw ... ... Karachi.
Hotz, Edwin ... ... Delhi.
Howard-Bradshaw, Comdr. C. T. (R.N.) ... ... England.
Howell, Sir Evelyn (K C.I.E., C.I.E., I.C.S.) ... London.
Howey, A. J. E. ... ... England.
Hubback, Theodore R. ... ... Pahang.
Hughes, Capt. A. R. ... ... India.
Hughes, Mrs. M. A. ... ... Kalimpong.
Hunt, L. E. ... ... Bombay.
Hyderabad, Dn., Economic Botanist to Government, C. A. Library ... ... Himayatsagar, Dn.
Hyderabad, Dn., Supdt. of Fisheries ... ... Hyderabad, Dn.
Hyderabad, Dn., Inspector-General of Forests ... ,,
Imperial Council of Agricultural Research ... New Delhi.
Iron, C. S. ... ... Bombay.
Irwin, Lt. H. R. H. F. ... ... India.
Isaacs, Miss Mozelle (M.A., M.Sc., B.T.) ... ... Poona.
Ishwardas Lakshmidas Sir (*Kt.*) ... ... Bombay.
Ismail, P. M. (I.C.S) ... ... Simla.
Jackman, Capt. R. C. ... ... Fort-Sandeman.
James, E. R. Sherman .. .. Assam.
James, J. N. A. ... ... Ajmer.
Jamsetji, M. Doctor (F.Z.S., C.M.Z.S.) ... ... Bombay.

Jaora, H. H. Col. Sir Iftikhor Alikhan (K.C.I.E.) Nawab of	Jaora.
Jarman, Mrs. S. F.	Bombay.
Jawhar State, H. H. the Raja of Jawhar	Jawhar.
Jenning, E.	India.
Jephson, Lt.-Col. M. D.	England.
Jhalawar, H. H. The Maharaja Rana Sir Rajendra Singh Bahadur (K.C.S.I.)	Brijnagar.
Johnson, Kay	Moran.
Joly, Dr. B. M.	New Delhi.
Jones, A. E.	Simla.
Jones, A. J. Turnley	Naini Tal.
Jubbal, Rajkumar Digvijaichandra, Heir Apparent of.	Jubbal.
Junagadh, The Dewan of	Junagadh.
Karve, Prof. Janarden Nilkanth (M.Sc.)	Poona.
Keatinge, H. A.	Calcutta.
Keelan, W. P.	Dehra Dun.
Kefford, H. Kingsley	Raipur.
Kermode, C. W. D. (I.F.S.)	London.
Kerr, F. S.	Bombay.
Kerr, J. S.	Calcutta.
Khan, Sahebzada Sardar Mahamed (J.P.) ...	Junagadh.
Khareghat, M. P. (I.C.S.)	Bombay.
Kiernander, Major O. G.	England.
Kirwan, Noel G. B.	Mangalore.
Koechlin, E. L.	Nilgiris.
Kohli, P. N.	Kashmir.
Kothavala, T. T.	Bombay.
Laborda, Dr. F.E.R. (M.R.C.S., L.R.C.P., D.P.H.) ...	Calcutta.
Laing, A. S.	Bombay.
Lalkaka, Mrs. Mehra K. A.	,,
Lamb, Sir Thomas (*Kt.*)	Calcutta.
Landells, W. J.	India.
Langdale, A. H.	Bombay.
Latif, Sarhan C.	Karachi.
Launey, Capt. Paul de	Khargpur.
Leach, Hon'ble Justice Sir Lionel (*Kt.*)	Madras.
Leakey, R, D.	Bombay.
Leathart, P. S.	Dehra Dun.
Lehner, E. (M.A., Ph.D.)	Lahore.
Leland, A. J.	England.
LeMarchand, A. E. M.	,,
Leonard, D. G.	Cochin.
Leonard, G. R.	Pahang.
Lewin, Major F. H. W. Ross	Bombay.
Lewis, E. S. (P.C.S.)	Rohtak.
LIBRARIES—	
Annamalai University Library	Annamalainagar.
Hyderabad, The State Library	Hyderabad, Dn.
Imperial Library, The	Calcutta.
Lahore, University of Punjab, The Librarian ...	Lahore.

LIBRARIES—*continued*

Lytton Library, Muslim University	Aligarh.
Madras, Connemara Public Library, The Principal Librarian	Madras.
Public Library, Museums and National Gallery of Victoria, The Chief Librarian	Melbourne.
Public Library, Museum and Art Gallery, Adelaide.	S. Australia.
United Service Library, The Honorary Secretary ...	Poona.
Lightfoot, Capt. G. S. (I.P.)	Assam.
Lindsay-Smith, Capt. J.	,,
Lockhart, J.	Belgaum.
Lodge, Geo. E.	England
Loke, W. T.	Bombay.
Lord Reay Industrial Museum	Poona.
Loucatos, G.	Bombay.
Love, Major S. W. A.	India.
Low, Francis (Jr.)	Bombay.
Lowe, Lt.-Col. J. H. B. (R.E.)	Naini Tal.
Lowman, Major Stephen (R.I.A.S.C)	Peshawar.
Lowndes, R. C.	Bombay.
Lowther, E. H. N. (F.Z.S , M.B.O.U.)	Allahabad.
Lucknow, Provincial Museum, The Curator ...	Lucknow.
Lunawada, H. H. Maharana Shri Virbhadrasinhji ...	Lunawada.
Lushington, Mrs. C. G.	Ceylon.
Lutyens, F. M. B.	Calcutta.
Macdonald, A. St. J.	Bhowali.
Macdonald, A. A. (I.C.S.)	Lahore.
Mackenzie, J. M.	Calcutta.
Mackett, H. J.	Delhi.
MacLachlan, D (I.C.S., C.I.E.)	Poona.
MacLachlan, R. B. (C.I.E.)	Ireland.
MacLeod, Major A. J. W.	India.
Macnaghten, Sir Henry (*Kt.*)	London.
Madan, F. R. (I.F.S.)	Ootacamund.
Madras, H. E. The Governor of	Madras.
Mahendra, B. C. (M.Sc.)	Agra.
Malden, F. R. E.	Khaur.
Maltby, Major-Genl. C. M. (I.A., M.C.)	Kotagiri.
Mankapur Raj, Raja Ambikeshwar Pratap Singh Saheb (M.L.A.)	Mankapur.
Marine Biological Laboratory	Mass, U.S.A.
Martin, Carr A.	India.
Matthews, W. H.	Rungli-Rungliot.
Maxwell, Capt. H. A. (I.F.S.)	Dehra Dun.
Maxwell, Hon'ble Sir Reginald (K.C.S.I., C.I.E., I.C.S.)	Delhi.
McFarlane, J.	Calcutta.
McGusty, H. M.	Bombay.
McLeod, Major-Genl. D. K.	India.
McPherson, James	England.
MaSwiney, Capt P. M. (I.M.S.)	India.
Mehta, Sir Hormasji (*Kt.*, K.B.E.)	Bombay.

Mehta, Jamshed N. R. ... ... Karachi.
Mehta, K. M. ... ... Bhavnagar.
Meiklejohn, W. (I.F.S., C.I.E.) ... ... Shillong.
Meinertzhagen, Lt-Col. R. ... ... London.
Menesse, N. H. (I.S.E.) ... ... Karachi.
Merrill. Major W E., (I.A.) ... ... Dehra Dun.
Meston, D. C. ... ... Assam.
Michael, J. D. ... ... Delhi.
Milburne, W. ... ... Barjuli.
Miller, G. D. L. ... ... Assam.
Mills, J. P. (C.I.E., I.C.S.) ... ... ,,
Mirchandani, B. D. (I.C.S.) ... ... Surat.
Mirchandani, T. K. (M.B.E.) ... ... Dharwar.
Mirchandani, U. M. (I C.S.) ... ... Poona.
Mistri, Dr. J. D. ... ... Bombay.
Mitchell, H. J. (B.F.S.) ... ... Delhi.
Moles, S. (I.C.S.) ... ... Pindigheb.
Montmorency, Sir Geoffrey de (K.C.V.O., K.C.I.E., C.B.E., I.C.S.) ... ... England.
Mooney, H. F. (I.F.S.) ... ... Ranchi.
Moore, Mrs. A. B. B. ... ... Naini Tal.
Moore, Lt.-Col. A. C. (I.A.) ... ... India.
Moore, John ... ... London.
Moore, R. J. Arthur ... ... Travancore.
Morehead, F. T. (O.B.E., B.SC., I.F.S.) ... ... India.
Morgan, Vernon ... ... Allahabad.
Morris, Major Ralph C. (F.Z.S., F.R.G.S.) ... ... Attikan.
Morton, Sir George (*Kt.*) ... ... Calcutta.
Moses, Dr. S. T. ... ... Baroda.
Mulroney, J. T. ... ... Kurseong.
Murray, Miss M E. Wolfe ... ... Lovedale, Nilgiris.
Mustill, F. J. .. .. India.
Mysore, Government Museum, The Superintendent ... Bangalore.
Mysore, Chief Conservator of Forests ... .. ,,
Nagpur, Central Museum, The Curator ... ... Nagpur.
Naik, Dr. R. N. (G.B.V.C.) ... ... Bombay.
Needham, F. M. ... ... Assam.
Nevill, Capt. T. N. C. ... ... London.
Newcome, Lionel ... ... Somwarpet.
Nicholas, Major R. C. ... ... Belgaum.
Nichols, Rev. Edward G. ... ... Madura.
Nicholson, Lt.-Col. M.A. (I.M.S., C.I.E.) ... ... India.
Nicolaus, G. R. (F.R.G.S., F.Z.S.) ... ... London.
Nicholls, Frank. ... ... Borgang.
Nilgiri, Game Association ... ... Ootacamund.
Nilgiri, H. H. The Raja Saheb of ... ... Raj-Nilgiri.
Nilsson, D. ... ... Bombay.
N.-W. F. Province, His Excellency the Governor of .. Peshawar.
Ogden, F. C. D. ... ... Bombay.
Ogilvie, C. S. ... ... London.
Oliver, A. W. L. ... ... ,,
Olmstead, Williams ... ... Delhi.

Orchha State, H. H. The Sawai Mahendra Maharaja Bahadur ... ... Tikamgarh.
Ormerod, H. E. ... ... Delhi.
Orissa, H. E. The Governor of ... ... Orissa.
Ortcheson, J. (I.C.S.) ... ... Rawalpindi.
Osborne-Jones, M. T. ... ... Trichinopoly.
Osmaston, B. B. (C.I.E., I.F.S.) ... ... England.
Osmaston, F. C. (I.F.S.) ... . Chaibassa.
Oxley, Lt.-Col J. C. S. (I.M.S.) ... ... Srinagar.
Palairet, Lt.-Col. E. J. (R.E.) ... ... Lahore.
Palanpur, H. H. Sir Nawab Saheb Taley Mahomed, Khan Bahadur of (K.C.I.E., K.C.V.O.) ... Palanpur.
Palmer, R. W. V. ... ... Calcutta.
Panday, Mrs. J. L. ... ... Bombay.
Parker, Mrs. M. ... ... ,,
Parr, C. Ivan. ... ... Samastipur.
Parsons, R. E. (I.P., F.R.E.S.) ... ... Shillong.
Partabgarh, H. H. Maharawat Sir Ramsinhji Bahadur (K.C.S.I.) ... ... Partabgarh.
Paterson, E. A. ... ... Calcutta.
Paterson, Hon'ble Mr. J. J. ... ... Hongkong.
Patna State, Maharaja Rajendra Narayan Singh Deo ... ... Balangir.
Patten, Hugo J. ... ... Edinburgh.
Patterson, A. ... ... London.
Patterson, Lt.-Col. C. R. (I.A.) ... ... Ambala.
Patuck, B. F. ... ... Bombay.
Pazze, Peter P. ... ... ,,
Peart, Major J. F. ... ... India.
Penberthy, W. J. ... ... Calcutta.
Perfect, E. ... ... Madras.
Petit Institute, J. N., Honorary Secretary ... Bombay.
Petit, F. C. ... ... ,,
Petit, S. C. D. ... ... ,,
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Phillips, W. W. A. ... ... Ceylon.
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Picton, Major F. C. (R.A.) ... ... Abbottabad.
Pizey, R. M. ... . Assam.
Porteous, A. B. ... ... Bhilad.
Potter, F. ... ... Bombay.
Proud, Mrs. Desirée ... ... Simla Hills.
Pudukottai, State Museum, The Curator ... ... Pudukottai.
Pullan, A. U. ... ... Dooars.
Quicke, H. J. B. B. ... ... Bombay.
Rahman, Q. F. (I.S.E.) ... ... Howrah.
Ralston, Lt.-Col. W. H. (D.S.O., I.A.) ... ... London.
Ramadhyani, R. K. (I.C.S.) ... ... Nagpur.
Ransford, Mrs. A. J. ... ... Bombay
Raptakos, A. ... ... ,,
Rawlins, Mrs. J. W. ... ... New Delhi.
Rawlins, Major J. W. ... ... ,,

Rawson, John H. S. ... ... London.
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Reynolds, K. P. ... ... Ireland.
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Rishworth, Dr. H. R. (I.M.S.)... ... ... Bombay.
Ritchie, Lt.-Col. W. D. (I.M.S.) ... ... Borjuli.
Robertson, Lawrence (C.S.I., I.C.S.) ... ... England.
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Rondano, Rev. A. (S.J.) ... ... Mangalore.
Rosenthal, V. ... ... Bombay.
Ross, Brig. E. J. (O.B E., M.C.) ... ... India.
Rossel, Lt.-Col. H. G. (I.A.) ... ... ,,
Row, Dr. R. (M.D.) ... ... Bombay.
Rowland, J. W. (I.P.) ... ... Ahmednagar.
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Royal Deccan Horse, Mess Committee ... ... Mardan.
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Saker, Capt. R. K. M. ... ... Gyantse.
Sanders, D. F. ... ... Calcutta.
Sandeman, Lieut. A. G. ... ... India.
Sanderson, P. M. D. (F.Z.S.) ... ... London.
Sandur State, Raja Shrimant Yeshwantrao Ghorpade. Sandur.
Sant, Maharana Shri Jarwar Singji, Raja Saheb of ... Sant-Rampur.
Sarangarh, Raja Bahadur Jawahir Singh (C.I.E.) ... Sarangarh.
Sarawak Museum, The Curator ... ... Kuching.
Sassoon, Ralph ... ... Calcutta.
Satya Churn Law, Dr. (M.A., B.L., Ph.D , F.Z.S., M.B.O.U.) ... ... ,,
Sayed Jawad Ali Shah ... ... Gorakhpur
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Scott, C. W. (I.F.S.) ... . India.
Scott, Lt.-Col. F. B. (I.A.) ... ... England.
Scott, James E. ... ... Scotland.
Scrimgeour, F. H. V. (I.O.S.) ... ... Cawnpore.
Seagrim, Lieut. G. N. ... ... Fort Sandeman.
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Page 901, Misc. Note No. XV, line 2 *for* 'Palasbani' *read* 'Palasbari'.

VOL. XLII, No. 2.

Page 270, line 5 from bottom *for* 'Muni' *read* 'Mini'.
Misc. Note No. I, p. 434, line 10 *for* 'Subansini' *read* 'Subansiri'.
" " " line 17 *for* 'Rangdoi' *read* 'Rongdoi'.
" " " line 17 *for* 'Kenua' *read* 'Kerua'.
" " " line 18 *for* 'Rongdoi-Laikoaghat' *read* 'Rongdoi-Saikoaghat'.
Page 452, line 12, *for* 'Bhauddin' *read* 'Bahauddin'.
" " line 13, *for* 'Ahmedabad' *read* 'Junagadh'.

VOL. XLII, No. 3.

Page 476, line 18, *for* '(3000 ft.) in coll. m.' *read* 'Holo-type, 0, 27-x-40, Sineh Safid ; in coll. m.'.
" " line 20, *for* 'Subsp. n. and sp. dist.' *read* 'Subsp. n. an sp. dist'.
" 477, line 18 *for* 'but curved slightly based' *read* 'but curved slightly basad'.
Misc. Note No. XIV. p. 668, in the heading of the note *for* 'Assam' *read* 'North Bengal'.
" " " p. 668, in line 1, after list of species *for* 'Specimens' *read* 'Specimen'.

VOL. XLII. No. 4.

Page 762, Plate III, facing the page, Fig. 2 *for* the word 'Dhoby' *read* 'Dhoti'.
" 903, Wherever 'Fig. 1' appears on the Plate and the letterpress *read* 'Fig. 2', likewise in the place of 'Fig. 2' *read* 'Fig. 3'. Fig. 1 was not published.

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