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The Breeding Biology of the Forest
Wagtail, *Motacilla indica* Gm.¹

BY

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(With four plates)

INTRODUCTION

The Forest Wagtail, *Motacilla indica* Gm., the most peculiar member of the family Motacillidae, is well known in India as a winter visitor but very little has been published about the breeding biology of this interesting bird. During her two expeditions to Amurland the authoress has had a welcome opportunity of studying the Forest Wagtail during its breeding season. The present article, based for the most part on observations made by the authoress, cannot be considered as a detailed monograph as the observations were made simultaneously with numerous other duties.

RANGE

For want of the necessary information the range of the Forest Wagtail cannot be exactly delimited. In the Soviet Union the Forest Wagtail inhabits only the south-eastern part of the country. It is widely distributed in Amurland in the narrow belt of oak forests

¹ Communicated by Dr. Sálím Ali.

along the Amur River, extending eastward from Kumara village $51^{\circ} 36' N.$, $126^{\circ} 41' E.$, (see Neufeldt, 1960) to the east of the city of Khabarovsk. In Ussuriland it is known in nearly all the districts of the Ussuri plain and in the Khanka Lake depression; also in the suburbs of Vladivostok (the Muraviev-Amurski peninsula) and Askold Island and, lastly, from the south-eastern foothills of the Sikhote-Alin Range northward to Tetyukhe village (Shulpin, 1931a; Spangenberg, 1949, Vorobiev, 1954). Gizenko (1955) recorded it in the south-eastern part of Sakhalin Island, north of the town of Starodubsk (approximately $47^{\circ} 25' N.$).

In the Korean peninsula the Forest Wagtail is distributed in all suitable biotopes (Austin, 1948). In China this bird occurs in the north-eastern provinces (Manchuria) and in the provinces of Hopei (Kansu) and Anhwei (La Touche, 1930; Wilder, 1938). The distribution range shown on the map in Cheng's LIST OF CHINA BIRDS (1958) includes also the provinces located south of the Yangtse River: Chekiang, Kiangsi, and Human, but the authority for this is unknown.

It is not at all certain whether any separate breeding range exists in India. Stuart Baker (1926) includes Assam and adjacent parts of Burma within the range of the Forest Wagtail, because of two nests of the bird received by him from N. Cachar. The authenticity of these two nests is evident from the detailed description published by Stuart Baker (1934), but no more records come from that region. Furthermore, Smythies (1953) pointed out that this species is not to be found in summer in the northern parts of Burma. For this reason I agree with C. Vaurie (1959) in considering these cases of the breeding of this bird as exceptional.

Everywhere within its breeding range the Forest Wagtail is a migratory species, wintering in S. Asia. Only in mild winters it stays the year round in S. Korea (Austin, 1948). In winter it is common in SE. China in the provinces Kwangsi, Kwantung, S. and W. Yunnan, and Hainan Island (Caldwell & Caldwell, 1931). It is recorded as a rather rare bird from the Riu-Kiu Islands (Kuroda, 1933), winters in all the countries of Indo-China, and is well known from the plains of S. Burma (Smythies, 1953) and Thailand (Deignan, 1945). According to Jerdon (1863), Stuart Baker (1926), Sálím Ali (1953) it has been recorded nearly everywhere in Hindustan east of a line drawn from the Sutlej Valley to the Gulf of Cambay. It has been regularly observed in Mysore, Travancore, and Cochin, and along the Malabar coast to the northern extremity of the Western Ghats. More sporadically the Forest Wagtail occurs in other parts of the peninsula. Since it is absent from the Eastern Ghats, Sálím Ali (1952) thinks

that the Forest Wagtail probably reaches its winter quarters in SW. India and Ceylon by way of the Andamans¹. Ceylon is the southwestern extremity of the winter range of the species, where the birds were recorded sporadically in many parts of the island. The winter quarters of the Forest Wagtail are known also from the Andamans, the Malay peninsula, and the adjoining islands such as Penang, Singapore, etc. (Robinson, 1927), and from a number of islands of Malaysia, namely Sumatra, Java, Borneo, and others (Legge, 1880; Kuroda, 1933; Delacour, 1947). In N. Philippines, many islands of Japan, and in some provinces of China (Hupeh, Fukien, Szechwan, and N. Yunnan) it is a straggler only (Caldwell, 1931; Delacour, 1946; Anonymous, 1958).

THE SPRING ARRIVAL

The spring movement of the Forest Wagtail from its winter quarters to the breeding range starts in March. The birds leave the Malay peninsula in the middle of March; a little later date has been recorded for their departure from the northern parts of the peninsula (Robinson, 1927). Forest Wagtails leave Ceylon about the end of March (Legge, 1880). The latest spring records of these birds in Burma were made at Martaban Bay on May 1st (Hume & Davison, 1878), and in Thailand near Doi Langka on May 2nd (Deignan, 1945). According to data obtained in different parts of India, Forest Wagtails leave the country in May. And the same can be said of S. China: Kwantung, Kwangsi, W. and S. Yunnan (Caldwell & Caldwell, 1931).

From what has been said above it is evident that the distances between the two seasonal areas are not very great, and the main routes of migration are within the limits of the winter and summer areas of the species.

Forest Wagtails arrive rather late at their breeding places (in the first half of May) and all within a very short space of time. In Nanking (China) Forest Wagtails were recorded in 1944 on 30th April and in 1946 on 3rd May (Hoffman, 1952). In N. China (Hopei) their arrival was noticed at the middle of May (Shaw, 1936), in Peking in 1946 on 22nd May and in 1947 on 18th May (Hoffman, 1952). Among the birds listed by Austin (1948) from Korea the earliest birds were taken in Kyonggi, Do province on May 2nd and in the more

¹ Recently it has been recorded on passage near Madras in both spring and autumn (Sanjiva Raj, *J. Bombay nat. Hist. Soc.* 57 : 220 ; 58 : 269).

north-western Pyongan Pukto province on May 9th. In the collection of the Zoological Institute of the Academy of Sciences of the USSR in Leningrad there are the skins of birds collected near Blagoveshchensk (Amurland) on May 12th.

In a tardy cold spring the arrival can be delayed to the end of May. For instance, in 1945 the first Forest Wagtails were noticed in a region of the Kedrovaya River (Ussuriland) only on 25th May (Vorobiev, 1954). This was also the case in 1959 on the upper Amur; in that year the first small flock of Forest Wagtail's was recorded by the authoress near Simonovo village (NW. of Blagoveshchensk) on 26th May. The weather was cloudy with short periods of clear sky and there was a weak north-east wind. The night temperature went down to 3 or 4° C. below zero, and during the day rose to +8° C. or more. On arrival the birds settled on the ground and on trees in a thin Dahurian Birch (*Betula dahurica*) forest which had been burnt that spring. They did not sing but flew from one place to another uttering a very characteristic *ping-teng*. Next day (27th May) the birds were very common in oak forests on the plateau. The arrival of the Forest Wagtails in forests of the upper Amur in 1959 coincided with the time when oaks were covered with young leaves and small fresh leaves began to come out on Dahurian birches. Many birds living in the same biotopes as Forest Wagtails had already arrived and occupied their nest-territories. They were: Spotted Tree Pipits (*Anthus hodgsoni*), Yellowbacked Flycatchers (*Muscicapa narcissina*), Grey Minivets (*Pericrocotus divaricatus*), Needletailed Swifts (*Hirundapus caudacutus*), and Owlets (*Otus sumia*).

During migration Forest Wagtails prefer to keep in forest biotopes of different kinds, but at that period there is much more possibility than at other times to meet them out of forests. On the Amur-Zeya plateau the incoming birds keep in very sparse and light parts of the forests. In particular they readily occupied the parts of forests where recently (approximately one month ago) a forest fire had taken place and where the forest litter and dry twigs were burnt by fire. Just after arrival, Forest Wagtails could be seen in small flocks of 15-20 birds usually in the outskirts of a forest, or near rides and forest roads. They spent nearly all the clear portions of the day on the ground, running in the short spring grass in search of food. On being disturbed they would fly to the lower branches of the trees and there continue their pursuit of insects. The males were extremely animated and sang intensively from 27th May. It seemed that in these noisy flocks females were absent till at least the end of May.

Unfortunately, owing to the absence of sex dimorphism in the coloration of the plumage and the calls of these birds, it was impossible to judge about the sex ratio in the early spring flocks of Forest Wagtails.

BREEDING BIOTOPE

In Amurland the males usually secure their nest-territories by the end of May. As a rule the nest-territory is a part of the territory where the flocks of feeding birds stayed after their arrival from the south. In the region we have explored, only some of the Forest Wagtails were migrants. At the beginning of June the difference between the local birds, which had had nest-territories, and the migrant ones was especially noticeable. In 1959 before 6th June no migrant birds had left. The relations between the local birds and the migrants were absolutely peaceful; so also between the local Forest Wagtails themselves, and between the Forest Wagtails and other small passerine birds breeding near by. No sign of quarrelling was noticed. It was only when man or any large animal intruded into the nest-territory that the male and female raised an alarm. In the upper Amur area, which is nearly the north-western limit of the range, the density of the Forest Wagtail population in suitable biotopes was rather high. For instance, on the narrow strip of the Amur-Zeya plateau covered with oak forests (approximately 3 sq. km.) six pairs of breeding Forest Wagtails were recorded in June 1959, the least distance between the nests noticed being 250-300 m. The territory occupied by each pair was not large; on the contrary the territories were often close to each other or even overlapped. An observer standing near one nest could see one or two other nests and hear simultaneously as many as four singing males. Forest Wagtails are very attached to their territory, which is not only their breeding place but is also the main feeding biotope from the time of pair formation till the nestlings leave their nests.

Forest Wagtails are real forest birds. In the south-western portion of the Amur-Zeya plateau these birds breed mainly in the Mongolian Oak forests, and show a preference for Mongolian Oak with underbrush of Lespedeza or of Lespedeza and Dahurian Rhododendron. Such oak-groves usually occupy flat elevations on the plateau (approximately 280-300 m. above sea-level). This is the north-western limit of the range of the Mongolian Oak, and the trees here are poorly developed. The oldest are only 140-150 years old and are never

taller than 25-27 m. More typical of this part of the plateau are trees 10-12 m. in height, with a trunk diameter of 20-25 cm., and a badly-developed crown; most of the branches extend horizontally, the lowest a short distance above the ground. Admixture of other kinds of trees in the oak-groves is insignificant. More common are birches (*Betula dahurica*), larches (*Larix dahurica*), and sometimes pines (*Pinus sylvestris*). The trees stand far from each other, and the forest looks like an orchard. The underbrush comprises mainly low bushes (70-100 cm.) of Lespedeza (*Lespedeza bicolor*). Here and there, thickets of the Dahurian Rhododendron (*Rhododendron dahurica*) of 1-1.5 m. height are common too. Solitary bushes of the hazel (*Corylus heterophylla*) and Dahurian Rose (*Rosa dahurica*) form only an insignificant admixture in the very rich dense undergrowth. Due to plenty of light in such sparse forests the ground is covered with an excellent carpet of herbs, nearly 60 species, for instance *Atractylodes ovata*, *Adenophora latifolia*, *Vis uniflora*, *Vicia pseudorobus*, *Lathyrus humilis*, *Carex nanella*, etc. Bare parts of the ground and near-by bases of oak-trunks are usually covered with mosses.

In undersized Amurland oak-groves Forest Wagtails find very favourable conditions for breeding: the trees stand far from each other, the peculiar structure of the crown of the Mongolian Oak is very convenient for nest construction, the large oak leaves provide the nests with excellent camouflage, there is plenty of building material everywhere, and plenty of insects and other small invertebrata for food. It is necessary to note that only the Grey Minivet (*Pericrocotus divaricatus*), among other small passerine birds living in oak-groves, finds optimal living conditions there. No birds breeding on bushes live in the underbrush of the Mongolian Oak groves. The reason is that the structure of Lespedeza and Dahurian Rhododendron is inconvenient for nest construction. In Amurland near the Simonovo village, besides the birds mentioned above (the Spotted Tree Pipit, Yellowbacked Flycatcher, Grey Minivet, Needle-tailed Swift, Owlet), a few more species were recorded by me in the oak-groves: the Great and Lesser Spotted Woodpeckers (*Dryobates major* and *D. minor*), the Willow Titmouse (*Parus atricapillus*), the Nuthatch (*Sitta europaea*), the Goshawk (*Accipiter gentilis*), and the Siberian Capercaillie (*Tetrao parvirostris*). If we exclude the Goshawk and the Siberian Capercaillie as non-characteristic of such biotope, only ten species of birds can be considered as typical inhabitants of the Forest Wagtail's biotope. In comparison with other types of

local forests the upper Amur oak-groves have the poorest population of birds, as regards both number of species and density of population. Many oak trees are rotten inside, and hollow trees are very common. Owing to this the hollow-breeding birds are predominant over other species of birds there.

According to Spangenberg's observations (1940, 1949) at the Iman River in Ussuriland, Forest Wagtails are inhabitants of sparse oak-groves on slanting hill slopes. Shulpin (1931a) considers oak forests with an admixture of birches (*Betula costata* and *B. dahurica*), lime trees (*Tilia amurensis*), and an undergrowth of Lespedeza and hazel bushes as a main biotope in south Ussuriland. Oak groves are also the breeding biotope of this species in Sakhalin Island (Gizenko, 1955).

Such conservatism in the selection of breeding biotopes is the main cause of the unevenness of the distribution of the species within the limits of its breeding range. For instance, large territories along the lower course of the Iman River in Ussuriland are covered with oak forests, and the Forest Wagtails are widely distributed there. Contrary to this these birds occur sporadically along the middle course of the river where there is a spotted distribution of the oak-groves (Spangenberg, 1949). In the upper Amur area the authoress never met Forest Wagtails in small isolated oak groves, though the birds were abundant near by in oak groves occupying large territories.

It is interesting to note that in the territory investigated by the authoress the density of population of Forest Wagtails was rather high, and some pairs lived in Dahurian Birch forests covering terraces in glens. In appearance these Dahurian Birch forests are very similar to oak-groves due to the same construction of the crown of the trees. Like in the oak-groves there is, under the foliage canopy, dense underbrush composed of Lespedeza and hazel bushes, and rich herbage of *Convallaria majalis*, *Thalictrum minus*, *Aster scaber*, *Iris uniflora*, *Adenophora latifolia*, *Atractylodes ovata*, etc.

BEHAVIOUR AND SONG¹

Males sing regularly throughout the breeding period. In 1959 the authoress recorded their songs from 27th May to 10th July. They sang especially intensively before the beginning of nest-building, i.e. from 27th May to 7th June. They were active during daytime, a

¹ The song of the Forest Wagtail was described in detail by Hoffman (1952).

little more in the morning, less at midday. According to observations made in the environs of Simonovo village on 28th May 1959 males began to sing at five in the morning, and on 5th June at five past four in the morning. They became silent only at sunset, i.e. in June approximately at half past twenty hours. According to Hoffman (1952) in Nanking (China) the Forest Wagtails at the beginning and at the middle of May began to sing approximately at 6 in the morning; on 28th May at 5.40 a.m.; on 1st June they sang with intervals from 5.35 a.m. till 8 p.m.; on 4th June males began to sing at 5.30 a.m., and on 9th June at 5.15 a.m.

The song is very simple but rather sonorous, and can be heard from far away. It is somewhat like the song of the Great Tit (*Parus major*), being composed of the disyllabic strophe *tsi-fee*. Usually the male repeats its *tsi-fee* four or five times without a break; sometimes, as if in haste, it includes in its song only two or even only one strophe. The same male may use different variations of the song, usually the long song, very seldom a short one. The male has no favourite place for singing in its breeding territory where it could be seen. Early in the morning at the time of maximal activity some males sing perched on a dead twig at the very top of a high tree (usually birch or aspen). The rest of the time they usually keep at a moderate height in the crowns of oaks or Dahurian Birches. At the period of highest excitement males do not cease singing even while they fly from one tree to another. The authoress has not seen any song-flight in the Forest Wagtails. In spring, at the end of May, males in migrant flocks sang intensively while running on the ground in search of insects. At intervals between songs males emit a call *clink, clink*. Both males and females utter this call as an alarm when frightened and also as a signal to the others when beginning a flight. Many ornithologists who have had the opportunity to observe Forest Wagtails either in the breeding season or in their winter quarters compare this call with the well-known call of the Chaffinch: *chwink, chwink*. In Sálim Ali's (1953) opinion this call of the Forest Wagtail resembles very much the call of the Crested Bunting (*Melophus lathamii*). When very much alarmed, Forest Wagtails utter another, more prolonged call: *tsee-lee-ten*.

With the beginning of nest-building (in the south-western portion of the Amur-Zeya plateau after 7th June in 1959) the intensity of males' songs markedly diminished. They could be heard all day, but at long intervals especially towards evening. Males continued to sing near their nests after the full clutches were completed and even



Above. Nest of Forest Wagtail (*Motacilla indica*) in oak tree

Left. Forest Wagtail (*Motacilla indica*) running along inclined branch of Dahurian Birch

(Photos : Irene Neufeldt)



Above. Two-weeks-old nestling of Forest Wagtail (*Motacilla indica*)

Left. Forest Wagtail (*Motacilla indica*) at rest

(Photos : Irene Neufeldt)

when the nestlings hatched out, but very irregularly. Singing ceased with the end of the nestling period.

Among mimicking birds in Amurland, the Brown Shrike (*Lanius cristatus confusus*) very often and very well reproduces the Forest Wagtail's calls and song. Several times in 1959 the authoress heard a male Brown Shrike which included in its own song phrases adopted from seven species of birds: the Spotted Tree Pipit (*Anthus hodgsoni*), Whitethroated Rock Thrush (*Monticola gularis*), Blacktailed Hawfinch (*Eophona migratoria*), Radde's Bush Warbler (*Phylloscopus schwarzi*), Wryneck (*Jynx torquilla*), Indian Cuckoo (*Cuculus micropterus*) and, distinctly and loudly, the Forest Wagtail.

The singing male, whether running or standing in one place, sways as if in time with its song. To every syllable of the song corresponds the inclination of the bird's body, to one side or the other. Such lateral pivoting of the body is also habitual with females, and even with young birds recently fledged. This peculiarity was the reason of the Japan name of the bird, *Jokofury-sekirei*, i.e. Sideways-swinging Wagtail (Austin, 1948). Unlike other wagtails and pipits the Forest Wagtails never swing their tails in the same way¹.

The Forest Wagtail is the only member of the large family Motacillidae which builds its nest in trees. At the first acquaintance with this very graceful and lively bird the observer is struck by the wonderful ability of the bird to run very fast and easily along horizontal branches of different thicknesses. Without any visible difficulty they can climb or descend steep inclined branches (Plate I). Within their small nest-territory they usually move on foot, flying only from one tree to another, or between a tree and the ground. Unlike woodpeckers, tree creepers, and nuthatches, Forest Wagtails have no special adaptations for tree-living. In comparison with other wagtails, the legs are a little shorter and the claws, including those of the hind toe, are sharp and strongly curved.

At breeding time Forest Wagtails spend plenty of time in the crown of the trees. Numerous and prolonged observations showed that the birds can run with ease along comparatively narrow and steeply inclined branches when the bark is very rough, but not if it is very smooth. In Amurland, as in other parts of the range, oaks and Dahurian Birches serve excellently for this purpose, as well as for nest building.

As far as is known from literature, on migration and in winter quarters Forest Wagtails keep mainly on the ground. Only when

¹ except very slowly up and down while pivoting from side to side on a branch.
—S.A.

disturbed they fly on to the nearest tree, run some distance along a thick horizontal branch, and fly down very soon. No preference for any definite kind of trees has been noticed at that period of its life.

NEST

In Amurland in the region of the authoress's study in 1959 the majority of Forest Wagtails had begun to construct their nests by 6th June. On 7th were met birds which had just started nest building, and on 8th and 9th June were recorded five pairs whose nests were nearly complete. At the same time (on 9th June) there were full clutches in two nests. The female alone builds the nest, with building material which she collects from the ground. Usually she visits many times a selected place which abounds in building material. At the beginning of June in Amurland oak forests one frequently comes across a number of Forest Wagtails flying in the same direction with large bunches of moss, rotten leaves, or grass in their beaks. Cautiously tracing such a bird it is easy to find a nest in course of building. The male takes no part in nest building, but is constantly somewhere near by; he accompanies his mate when bringing the building material, and is the first to notice and warn her of danger. The female is very cautious and never flies directly to the nest, even when it is building; she perches on a lower branch of a near-by tree and only after an assuring 'all clear' call from her mate does she fly to the nest-tree, running inconspicuously along the branches to the nest.

If disturbed at an early stage of nest building, the female abandons the nest and, soon after, begins to look for a new site. Later, when the nest is nearly completed, the birds become less shy and do not stop building even after a short visit by the observer.

At breeding time, as in the early period after their coming back from winter quarters, Forest Wagtails prefer the marginal and lightest parts of the forest and avoid the inner dense and high-standing parts. In all the cases known to the authoress the nests were built on medium-sized trees (5-17 m. high) growing near forest ways and vistas.

From Table I the preference given to oaks for nest building is evident. The same took place in Ussuriland (Spangenberg, 1948; Vorobiev, 1954) and east China (La Touche, 1930).

TABLE I
Position of the Nests

Serial No. ¹	Kind of tree	Height above the ground	Distance from the main trunk	Diameter of the branch supporting the nest
1	oak	7-8 m.	2.5 m.	69 mm.
2	oak	5-6 m.	3.0 m.	87 mm.
3	oak	6 m.	1.5 m.	66 mm.
4	oak	10 m.	2.0 m.	66 mm.
5	Dahurian Birch	5 m.	0.0 m.	62 mm.
6	oak	6.5 m.	0.0 m.	68 mm.
7	oak	4.5 m.	0.0 m.	..
8	oak	5.5 m.	2.5 m.	..
9	oak	4 m.	1.5 m.	..

¹ We retain these numbers throughout the text.

Horizontal branches not very thick (66-68 mm. in diameter) are very convenient for nest building. The birds usually select for building the distal part of the branch 1.5-3.0 m. away from the main trunk. A horizontal branch a little thicker than the internal diameter of the nest-cup (Table II) is a safe support, and ensures a firm position for the rather friable nest. Short additional twigs of the branch support the nest from the sides (Plate III, fig. *a, b, c*). Most of the known nests were located in the same way. Sometimes the birds use vertical verticils, either at the end of thick inclined branches at a significant distance from the trunk (Plate IV, fig. *d*) or at the top part of the trunk (Plate IV, fig. *e, f*). The nests observed in Amurland were built at a height of 4 to 10 m. above the ground. In some cases Forest Wagtails build their nests at smaller height, only 3 or even 1.5 m. above the ground.

For the construction of the nest walls the Forest Wagtails in Amurland use dry blades of grass, dead leaves, small pieces of bark or separate fibres of bark, small roots, and sometimes wool of rodents (*Pteromys volan.* and *Microtus* sp.). On the outside the nests were faced with stems of green mosses, cocoons of spiders covered with small particles of soil, dead leaves, and slender little stalks. The nest built in the Dahurian Birch was decorated with numerous small papery pieces of the Asian White Birch bark. The second nest, built near the expedition camp, was ornamented with cotton wool.

The nests are so carefully and skilfully incrustated with these materials that they are hardly visible against the background of the dark bark covered with light spots of lichens. Sometimes, even at a very short distance, it is impossible to recognise the limit between the branch and the nest wall (Plate I). The cup is usually plentifully lined with thin roots and wool of the Roe Deer (*Capreolus capreolus*). Besides that, there are inside nearly each nest one or two feathers of the Hazel Grouse (*Tetrastes bonasia*), or the Ussurian Scops Owl (*Otus sunia stictonotus*), or any small passerine bird. Horse-hair, the very common lining of Forest Wagtail nests in Ussuriland and China, was recorded by the authoress in one nest only. The reason for this is the remoteness of the area of observation from human settlements. The measurements of the nests taken by the authoress appear in Table II.

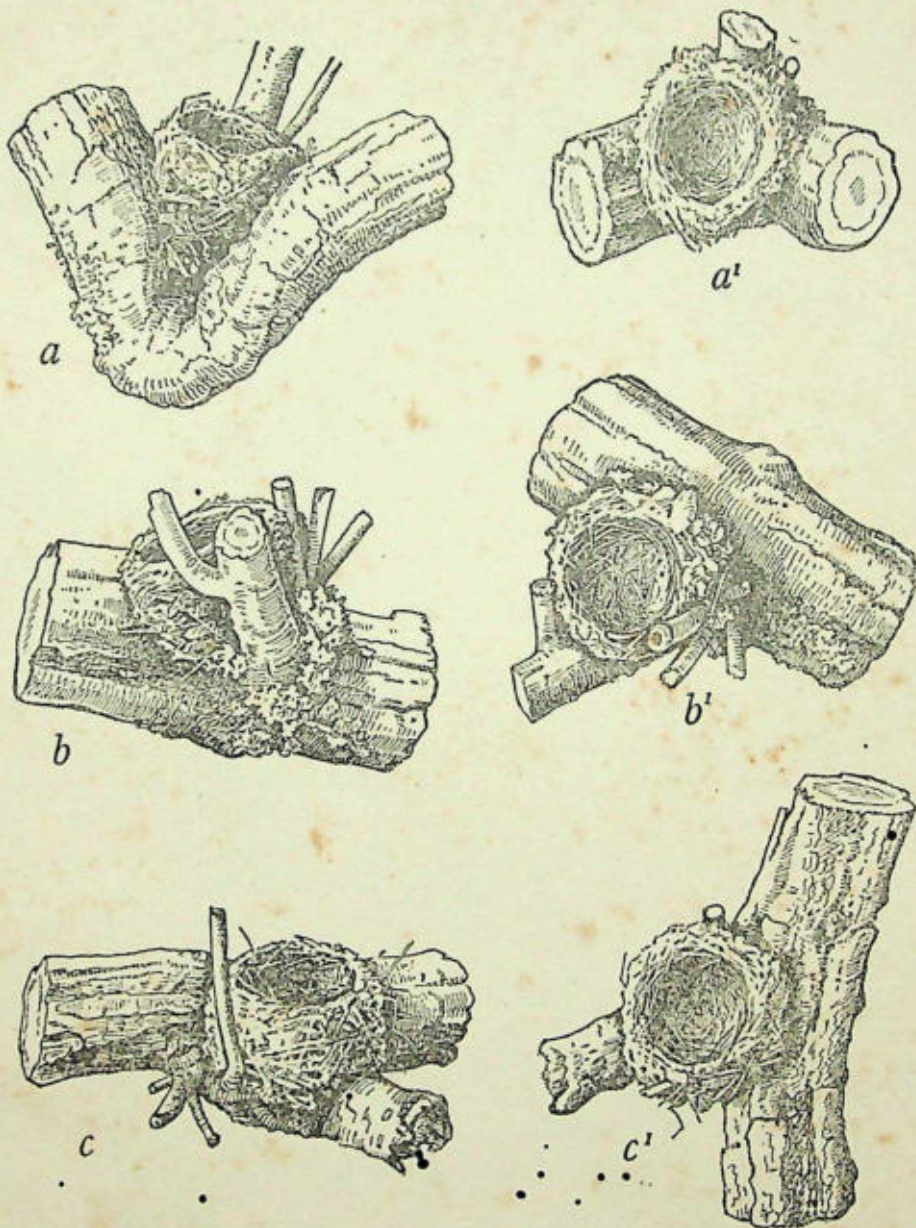
TABLE II
Nest Measurements

Serial No.	External height in mm.		External diameter in mm.	Internal diameter of cup in mm.	Internal depth of cup in mm.
	max.	min.			
1	74	34	86	51	34
2	70	45	91	60	40
3	80	75	88	51	40
4	62	30	91	65	40
5	89	82	84	52	42
6	61	50	87	63	35
7	60	48	90	58	33

These measurements coincide with the measurements given by Spangenberg (1949) and Vorobiev (1954) for Ussuriland. Only the external height is more variable, in accordance with the position of the nest. For instance, before the birds were able to build the nest No. 5, they had to fill with material the narrow space between the bases of the twigs in order to prepare the basement for the nest proper.

BREEDING SEASON AND EGGS

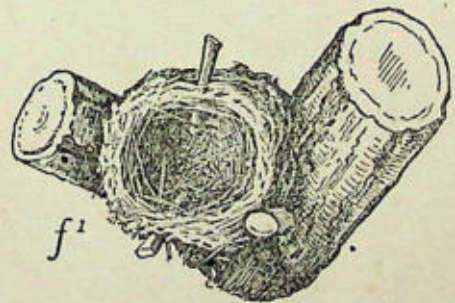
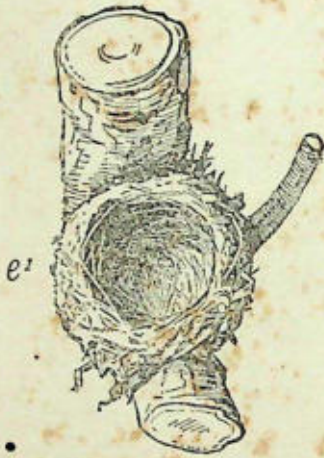
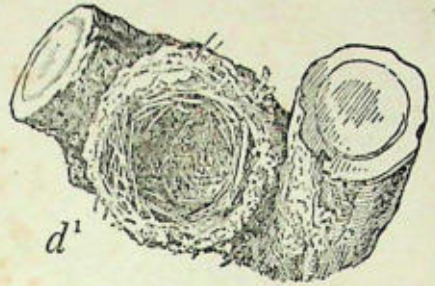
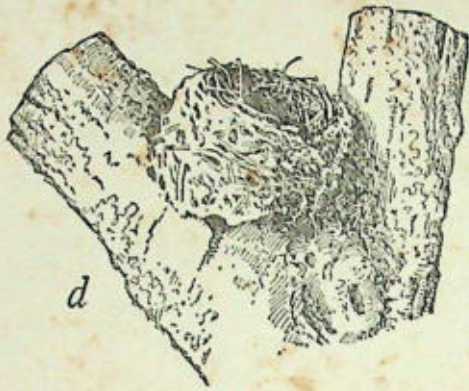
Arriving late in their breeding range the Forest Wagtails have time to breed only once. In most parts of the breeding range they



Nests of Forest Wagtail (*Motacilla indica*) on horizontal branches of oak

a, b, c: from side; a', b', c': same nests from above

(Drawn from nature by V. Rozhdestvenskaya)



Nests of Forest Wagtail (*Motacilla indica*)

d : on end verticil of inclined branch of oak ; e : on vertical fork of main trunk of Dahurian Birch ; f : on vertical fork of main trunk of oak ; d', e', f' : same nests from above

(Drawn from nature by V. Rozhdestvenskaya)

begin to lay the eggs in the first half of June. According to the literature the following can be said about the breeding season. In the suburbs of Peking on 2nd July the young were leaving their nests. In Anhwei province on 8th June 1910 was found a nest with four eggs, and on 21st June with two eggs (La Touche, 1930). In Korea (Pyongan Namdo) Won collected on 3rd June 1938 a nest with five eggs (Austin, 1948). In southern parts of Ussuriland fresh eggs were recorded on 8th June 1939 (Spangenberg, 1949), and on 10 and 11th June 1946 (Vorobiev, 1954). In the collection of the Zoological Institute of the Academy of Sciences in Leningrad there are seven nestlings (14-15 days old) collected by Shulpin in the Pkhusun river valley (Ussuriland) on 5-9th July 1927. In the nests we found in Amurland the first eggs were laid: in two nests on 6th June, in two nests on 9th June, in four nests on 11-12th June, and in one nest on 17th June. The last was a case of second laying after the first slightly incubated clutch was destroyed. Spangenberg's record (1949) of nestlings on 6th June 1948 in the Iman river valley (Ussuriland) seems doubtful. It would only be possible in case the eggs were laid not later than 19th May, i.e. at an extremely early date.

The interval between nest-completion and egg-laying is one or two days. In one nest which was kept under permanent observation, attendance at the nest by the egg-laying female was recorded from 4.20-4.30 hours and again from 6-7 hours. After the egg was laid, the bird stayed at the nest for some time and then flew away till the next morning. Incubation begins after the last but one egg is laid. In a case with a full clutch of six eggs the female began incubation after the fourth egg was laid. The normal clutch consists of 4 or 5, and seldom of 6 eggs. In cases of late (repeated) laying the clutch consists of 3, or even only 2 eggs.

Variation in size of eggs in the same clutch as well as in different clutches and from different parts of the range is very small. This is evident from the comparison of data from Ussuriland and Amurland (Table III), China (La Touche, 1930), and Assam (Stuart Baker, 1934).

In coloration Forest Wagtail eggs closely resemble a very common European variation of Chaffinch eggs, and sometimes the eggs of the Spotted Tree Pipit (*Anthus hodgsoni*). They have a dirty-bluish ground coloration with very sparse large grey spots concentrated principally near the blunt end of the egg. Small grey spots are distributed evenly all over the surface of the egg. Besides this, dark brown speckles, sometimes with vague rusty margins and roundish

black-violet surface spots, cover the shell surface irregularly. In only one clutch were the eggs of another type of coloration: light greenish-blue ground covered with comparatively small, very indistinct brownish-grey spots, more dense near the blunt end.

The behaviour of incubating females on approach by man to the nests was varied. In some cases the female silently flew down nearly brushing the man, and then began to attract the enemy away by flying low above the ground and imitating the movements and voice of a wounded bird. In other cases the female sat in the nest very firmly and left it only when the observer began to climb up the tree and shook it. Thereafter it perched somewhere in the lower part of the crown of the tree and gave an alarm call, whereupon it was joined by its mate and sometimes other Forest Wagtails living near by.

The male always feeds its mate in the nest. Now and then the hen leaves its nest in search of food. Silently and unobtrusively it comes back to the nest, running the last part of its way along branches among dense foliage.

NESTLINGS, THE LIFE OF BROODS, AUTUMN MIGRATION

The incubation period of Forest Wagtails is 13 days. As incubation begins before the clutch is completed, the hatching of all the nestlings of the brood is not simultaneous. In fact, the female incubates for 14 or even 15 days, and the last nestling hatches one or two days later than the first ones. In nests examined in the upper Amur Valley the hatching took place from 26th June to 4th July. No addled eggs were recorded. All 39 eggs in these nests were fertilised; from 36 the nestlings hatched safely, and 3 were stolen from the nest probably by Chipmunks (*Tamias sibiricus*).

Immediately on hatching the young are blind, acoustic ducts closed, and body naked with sparse golden-grey neossoptiles above the eyes and on eyelids, nape, back, femurs, shanks, vent, shoulders, forearms (humeral region), and inner side of hand (carpal region). It is necessary to note that the nestlings of no other Motacillidae have neossoptiles on their hands. The skin on the body of a recently hatched nestling is yellowish pink, the mouth is orange-yellow, and the tongue is yellow with a grey fringe near its base. The bill is greyish with light yellow side protuberances. The weight of the hatchling is 1.7-1.9 grammes.

At the end of the first day of the nestlings' life the pterylae or feather tracts can be noticed in the form of dark areas on the dorsal

TABLE III
Egg Measurements

Locality	Serial No. of Nest	Egg Number	Absolute size (in mm.)		Average size of eggs belonging to clutch (in mm.)
			Length	Breadth	
Amurland, Neufeldt (1960)	1	I	19.2	15.0	19.1 × 14.7
		II	19.2	14.7	
		III	19.2	14.5	
		IV	19.0	14.7	
	2	I	21.5	15.0	20.6 × 14.8
II		20.7	15.0		
III		20.2	14.8		
IV		20.0	14.5		
3	I	21.5	15.3	20.9 × 15.6	
	II	20.7	15.5		
	III	20.6	16.0		
4	I	19.3	15.0	18.9 × 14.9	
	II	19.2	15.2		
	III	19.0	15.0		
	IV	19.0	15.0		
	V	18.5	14.3		
	VI	18.3	14.6		
5	I	19.5	14.7	19.2 × 14.9	
	II	19.0	15.0		
	III	19.0	15.0		
	IV	19.3	14.8		
	V	19.3	14.8		
Ussuriland, Spangenberg (1949)	I	21.0	15.0	21.0 × 14.8	
	II	21.1	14.8		
	III	21.2	14.8		
	IV	20.6	14.7		
	V	21.1	14.5		
Ussuriland, Vorobiev (1954)	I	19.1	14.2	19.5 × 14.4	
	II	19.0	14.4		
	III	19.3	14.4		
	IV	20.0	14.4		
	V	20.3	14.6		

and partly on the ventral sides of the body. Sometimes on the second day appear the tiny needles of growing remiges. In three-day-old nestlings the acoustic ducts open, the eyes are like narrow slits, the growing primaries are about 1 mm. long, needle-like ends of growing rectrices are faintly visible, and the first feathers appear on the dorsal side of the neck. On the fourth day the feathers on the shoulders and neck begin to unfold. Next day unfold the feathers

of the back, breast, and secondary coverts. In five-day-old nestlings the eyes are nearly entirely open, and their second primaries are 5-8 mm. long. On the sixth day nearly all contour feathers unfold, as far as the ends of the primaries and secondaries. The week-old nestling weighs eight times more than a newly hatched one.

In the first days of their life nestlings of the same age and of the same brood can have slight individual differences in their weight. Some days later the differences become less noticeable. For instance, in one brood the weights of three hatchlings were: 1.7, 1.9, and 1.9 gr. The weights on subsequent days were as follows:

1 day old :	3.0,	3.0,	3.2 gr.
2 days old :	4.9,	4.9,	5.5 gr.
3 days old :	6.3,	6.4,	6.9 gr.
4 days old :	8.3,	8.5,	8.6 gr.
5 days old :	10.2,	11.0,	11.2 gr.
6 days old :	11.0,	11.7,	11.6 gr.
7 days old :	14.3,	14.5,	14.5 gr.
10 days old (just before leaving nest):	17.0,	17.0,	17.2 gr.

It is evident that the differences in weight become progressively less noticeable.

The case is somewhat different with nestlings hatched one or two days after other nestlings of the same brood. For instance, in one nest the fourth nestling hatched one day later than others. Just after hatching it weighed 1.7 gr., when it was one day old 3.0 gr., two days old 3.8 gr., four days old 6.5 gr., five days old 8.0 gr., six days old 9.7 gr., seven days old 12.5 gr., ten days old 15.3 gr. On the first two days of its life this nestling was of the same weight as its brood-mates. But it was younger, and it is common in birds that elder nestlings receive more food than the younger ones. For this reason the difference in weight between it and its brood-mates sometimes rose to 3.2 gr. It is necessary to note that in none of the nests which were under everyday observation was there registered any influence of such difference in weight upon development of feathers, acquirement of sight, etc.

Sometimes on the ninth, and as a rule on the tenth, day of their life, nestlings begin to jump out of the nest on being disturbed by the observer. In normal conditions they leave their nest on the eleventh or even on the twelfth day. Owing to difference in age the younger nestlings may leave the nest one day later than the elder ones.

The total nesting period, from the laying of the first egg to the leaving of the nest by the last nestling, is 28-30 days.

Nestlings, just after they leave the nest, are rather well feathered. To the age of 14 days solitary down feathers can still be noticed on the head and the back. Nestlings which have just left the nest weigh 17.2-18.0 gr., i.e. the same as their parents ($\sigma\sigma$ 17.2-18.4 gr., $\text{♀}\text{♀}$ 17.7-18.9 gr.).

During the first two or three days the brood remains at a very short distance from its nest in spite of the young being able to flit rather easily from one branch to another. From the age of 17-18 days the young birds become able to fly fairly strongly. Like the adults they spend much time in the crown of the trees, where they run without any difficulty along horizontal and inclined branches of different thicknesses. A tame young Forest Wagtail, which lived in our camp in 1959, preferred to climb to the shoulder of a sitting man 'on foot' in spite of being able to fly quite well. On its way it made full use of all creases in the cloth. Frequently the young birds descend to the underbrush following their parents searching for food on the ground. But very often, before they begin to search for their food independently, they keep themselves in the lower parts of the crown of the trees. Fully plumaged young birds are on the whole similar to the adults. The difference is in the predominance of greyish and brownish shades on the upper parts of young birds; moreover the double band across the breast is not so distinct and broad as in adults (Plate II).

For some time after leaving the nest young birds keep in families, but very soon they become independent and broods disintegrate (from the middle of July on the upper Amur). Adult birds keep in pairs or solitary in oak groves, and the young belonging to two or three broods unite in small flocks and migrate to the outskirts and thinned-out parts of the wood. Here, Spotted Pipits, nuthatches, and tits are often seen in company with flocks of young Forest Wagtails. Being very silent, the Forest Wagtails are hardly noticeable at that period.

Males and females take an equal share in feeding the young. Spiders, small grasshoppers, butterflies, beetles, and large cicadas were recorded as food at that time. In Amurland during nearly all the summer, cicadas and their moulting nymphs predominated in the diet of the adult birds. They search for food preferably on the ground, picking up insects from grass, forest litter, bases of tree trunks, lower branches and leaves of bushes. According to the literature, in other parts of the area and in winter quarters Forest Wagtails pick up

not only insects, but small snails, molluscs, and worms. In Ceylon in search of maggots they very often peck at cattle dung. Owing to this habit the Singalese call them *Gomarita*, i.e. dung-spreader (Jerdon, 1863). At the end of July and in August in Amurland they collected their food mainly in crowns of trees. According to Stuart Baker (1926) they can pursue insects in the air.

Forest Wagtails spend a little more than three months in their breeding range. The birds breeding at the northern limit of the area begin movement to the south even at the end of August. In China (Hopei province) they disappear at the beginning of September (Shaw, 1936; Wilder & Hubbard, 1938). They stay much longer in Korea, and some of them, as stated above, winter there. Among the birds examined by Austin (1948) were specimens collected in Kyonggi Do province on 13th October.

According to the literature Forest Wagtails appear in their winter quarters on the following dates. In the western and southern parts of Yunnan in September, in Kwantung and Kwangsi in August (Caldwell & Caldwell, 1931), in Hupeh in October (La Touche, 1930). In Thailand between Wiang Pa Pao and Chieng Mai in 1914 the earliest birds were recorded on 23rd August (Gyldenstolpe, cited by Deignan, 1945), in Burma near Thandaung probable migrant birds were noticed on 24th September (Smythies, 1953), in the Malay peninsula they appear at the end of September (Robinson, 1927), and in Ceylon in the first week of October (Legge, 1880). In Java the first specimen in 1909 was taken on 29th September (Bartels, 1910).

In their winter quarters Forest Wagtails keep to different kinds of forest, especially jungles thinned out by felling, and openings, ways, and paths in tropical forests. Shady parks and orchards are also visited. In Travancore-Cochin they are commonly seen in the coffee and cardamom plantations (Ali, 1953). In Ceylon according to Legge (1880) they are rather common under tamarind trees and banana plants in small Singalese jungle villages. According to the majority of literature data only solitary birds or pairs were recorded at the non-breeding time. As an exception, Robinson (1927) observed in the Malay peninsula large flocks of Forest Wagtails after storm and heavy rain.

THE MOULT

Even the very scanty materials we have had at our disposal show the marked difference in the process of the moult between young

Forest Wagtails and young White Wagtails. According to Heinroth (1926) the White Wagtail acquires the complete juvenile dress (including all small feathers, remiges, and rectrices) at the age of one month and, only 1.5 weeks after the juvenile dress is completed, they start a partial post-juvenile moult. Contrary to this, in the Forest Wagtails the partial post-juvenile moult begins long before the growth of remiges and rectrices is completed. So, even in 11- or 12-day-old nestlings at the edges of the pteryla gastralis and somewhere on the neck and sides of the upper breast can be noticed apices of feathers of the dress that is to follow. The pteryla gastralis (on the abdominal region), very small in nestlings, becomes somewhat larger due to the appearance of new feathers. At the two-weeks-old stage many contour feathers of the juvenile plumage moult and are substituted by feathers of the first-winter plumage. The lesser wing coverts and the feathers on the sides of the upper breast are the first to moult. By the 20-22nd day large bunches of new feathers appear on the breast and scapulars. The median wing coverts and the small feathers on the head and throat are still in quill at that time. Four or five days later the upper and under tail coverts moult. In Forest Wagtails 30-36 days old the growth of the remiges and rectrices is completed; in contrast to this, White Wagtails of this age have very few juvenile contour feathers in their plumage. Only the secondary coverts and a few feathers on the sides of the upper breast are still growing at that time. In 45-day-old birds the moult is completed (in Amurland at the end of July or the beginning of August). From that age young birds wear the complete first-winter plumage, practically indistinguishable from the fresh autumn dress of adult birds. In the following autumn the young birds have the first complete moult, when they change all contour feathers, remiges, and rectrices.

In the upper Amur area the complete autumn moult of adult birds begins in the second half of July, i.e. simultaneously with the end of the nesting period. The contour feathers and the primaries moult at the same time, the direction of the moult of the primaries being from the 10th to the 1st, including the rudimentary one. The moult of the secondaries (from the 1st to the 9th) and the rectrices (from the outer to the central ones) begins a little later. The moult of the adult birds is very intensive, as can be seen from the following description of moulting birds, taken in Amurland in 1959:

1. 22nd July, adult female: contour feathers on the back and breast and all secondary coverts are in sheath or the tips of some feathers have started to emerge from their sheaths; primaries of the

right wing: 10th= $\frac{7}{8}$ of the normal length, 9th= $\frac{1}{3}$, 7th is in sheath; primaries of the left wing: 9th= $\frac{4}{5}$, 8th= $\frac{4}{5}$, 7th= $\frac{1}{2}$, 6th is in sheath.

2. 25th July, adult male: all the contour feathers are moulting, the secondary feathers sheathed; primaries (symmetrically in both wings): 10th are full-grown, 9th= $\frac{5}{6}$, 8th= $\frac{1}{2}$, 7th= $\frac{1}{3}$ of the normal length, 6th are in sheath.

3. 25th July, adult female: contour feathers are moulting; primaries: 10th= $\frac{1}{2}$, 9th= $\frac{1}{5}$ of the normal length, 8th started to emerge from their sheaths, 7th are in sheath, 6th recently sheathed.

4. 7th August, adult female: more than 50% of all the contour feathers are intensively moulting; all the secondary coverts are in sheath; 1-7th secondaries renewed and grown up to the normal length, 8th= $\frac{2}{3}$ of the normal length, 9th are in sheath; primaries: 10 and 9th are new ones, 8th= $\frac{6}{7}$, 7th= $\frac{4}{5}$, 6th= $\frac{1}{2}$ of the normal length, 5th started to emerge from their sheaths; the primary coverts are at the same stage; rectrices: 1st (external pair) are in sheath, 2nd started to emerge from their sheaths, 3rd= $\frac{1}{4}$ of the normal length, 4th sheathed.

Due to absence of seasonal dimorphism in Forest Wagtails and the lack of bird skins from winter quarters, we cannot answer the question about the number of moults every year in this species. In spring all the birds arrived at their breeding places have rather faded plumage without the olive shade characteristic of the fresh autumn plumage. For this reason it is possible to conjecture that Forest Wagtails have only one complete autumn moult. But Deignan (1945) said that the specimen taken in Thailand on 19th March 'is under-going prenuptial moult'!

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A Redescription of the Indian Termite, *Odontotermes bellahunisensis* Holmg. & Holmg., with Description of a new Subspecies from Rajasthan

BY

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(With 2 plates, 2 text-figures, and 5 tables)

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I. INTRODUCTION

The original description of the Indian termite *Odontotermes bellahunisensis* (Isoptera, family Termitidae, subfamily Metatermitinae) as given by Holmgren & Holmgren (1917, pp. 150-151) is extremely meagre and is unaccompanied by any illustrations, so that it is virtually impossible to recognise the species from the description alone. Fortunately, the cotype material, consisting of all the castes (alates, soldiers, and workers), is present with the Zoological Survey of India. We, therefore, take this opportunity to redescribe the species more fully and to give adequate illustrations for easy recognition. One of the cotype soldiers has been selected as the lectotype.

The species was hitherto known only from the original locality, viz. Bellahunisi (in the Bellary District) and Bangalore, both in the Mysore State, southern India. Recently, we found it from the arid zone of Rajasthan (western India) and Sind (West Pakistan), but these specimens constitute a new subspecies which we describe below.

This paper is a part of the work done under the Termite Research Scheme (Taxonomy), financed by the Indian Council of Agricultural Research.

II. REDESCRIPTION OF *Odontotermes bellahunisensis*

HOLMGREN & HOLMGREN

Odontotermes bellahunisensis Holmgren & Holmgren
(Plates I & II; Text-fig. 1; Tables 1-3; and Appendix)

1917. *Odontotermes bellahunisensis* K. Holmgren & N. Holmgren, *Mem. Dept. Agr. India*, Calcutta 5 (3), pp. 150-151 (imagos, soldiers, and workers). *Type-localities*: INDIA: Mysore State: Bellahunisi (Bellary District), and Bangalore.

(a) MATERIAL

Two imagos, 6 soldiers, and 5 workers (1 major and 4 minor), all cotypes, in spirit in a vial, Z.S.I. Reg. No. 5616/20, from Bellahunisi, Bellary District¹, Mysore State, India, coll. *T. B. Fletcher*, 30-viii-1912, 'issuing from hole in gravelly soil at dusk. No mound at all.'

(b) DESCRIPTION

1. IMAGO (Table 1; and Plate 1).

General. Head-capsule and mandibles brownish yellow, apices of mandibles darker; clypeus labrum, and antennae pale yellowish white; eyes black with pale ocular sclerites; thorax and abdomen brownish yellow. Head and body densely covered with fine hairs. Total length (without wings and antennae) c. 11.6-12.3 mm.

Head. Head-capsule subcircular, broader than long (width with eyes 2.20-2.25 mm.; length 1.75-1.80 mm.); sides convex, posterior margin rounded; frons slightly sloping in front. *Fontanelle.* Small, rounded, not prominent; lying a little above the middle of head. *Eyes.* Present as a pair of large, subround compound eyes, one on either side, protruding laterally; maximum diameter 0.60-0.63 mm. *Ocelli.* Two lateral oval ocelli present, one on either side; separated from the eyes by a little more than half their long diameter. *Antennae.* With 18 segments; segment 1 cylindrical, longest; 2 more than half as long as 1; 3 subequal to 2 and partially subdivided into a proximal and a distal half; 4 shortest; 5 slightly longer than 4; 6-11 increasing in size in that order; 12-14 subequal, slightly longer than 11;

¹ Bellary District was formerly in the Madras State but was transferred to the Mysore State during the reorganisation of States in 1957.

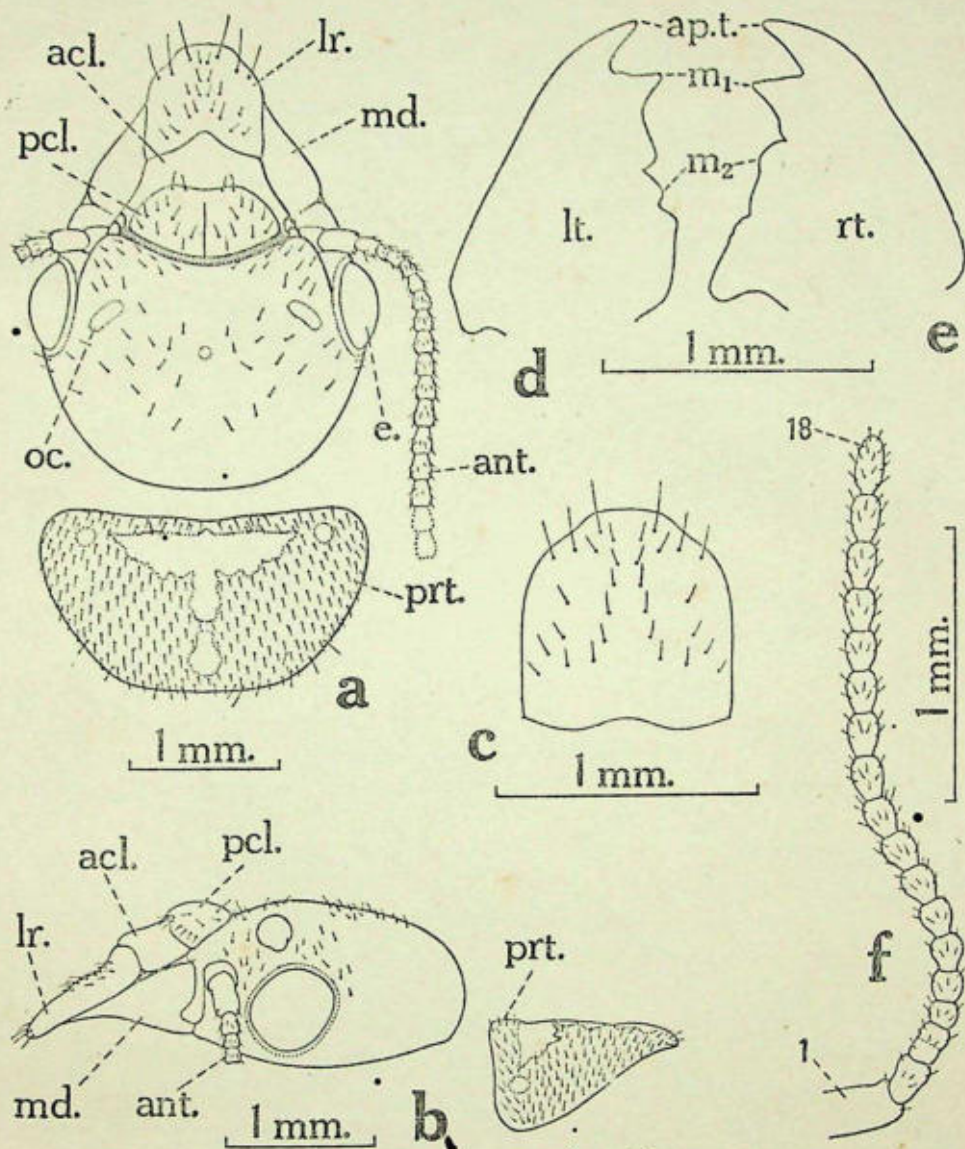
15-17 subequal, slightly longer than 14; apical (18) ovate, more slender and longer than the penultimate one. (In another specimen with an incomplete antenna, with 15 segments; segment 3 and 4 subequal; 5-14 increasing in size in that order; and 15 shorter than 14.)
Labrum. Tongue-shaped, broader than long; tip broadly rounded;

TABLE I

Body-measurements (in mm.) of imagos of *Odontotermes bellahunisensis* Holmgren & Holmgren : (Cotype lot)

Body-parts	Range (2 specimens)
I. GENERAL	
1. Total body-length (without wings) <i>e.</i>	11.6-12.3
II. HEAD	
2. Length of head to lateral base of mandibles	1.75-1.80
3. Max. width of head (with eyes)	2.20-2.25
4. Max. height of head (including ocellus)	1.00-1.10
5. Median length of labrum	0.60-0.65
6. Max. width of labrum	0.65-0.70
7. Max. diameter of compound eye (including ocular sclerite)	0.60-0.63
8. Max. diameter of lateral ocellus	0.23-0.25
9. Min. diameter of lateral ocellus	0.20-0.23
10. Min. eye-ocellus distance	0.13-0.15
11. Min. eye-antennal distance	0.23-0.25
12. Min. ocellus-antennal distance	0.25-0.28
III. THORAX	
13. Max. length of pronotum	1.15-1.23
14. Max. width of pronotum	2.10-2.25
15. Length of forewing scale	1.10-1.13
16. Length of hindwing scale	1.00-1.03

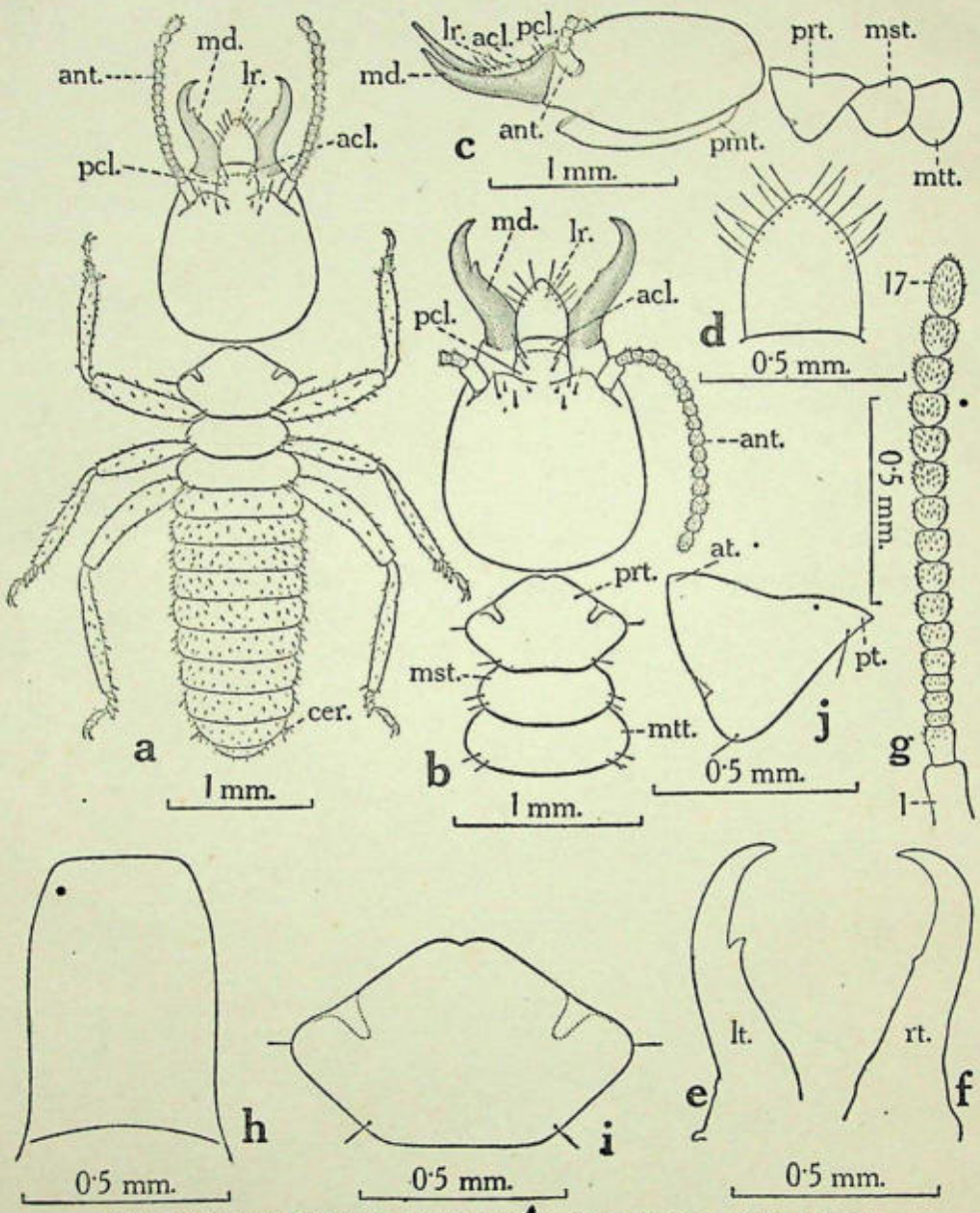
with a few hairs on tip and on body. *Clypeus*. Divided into an ante- and a postclypeus. Anteclypeus narrow, pentagonal, with a small pointed median tip; apilose. Postclypeus distinctly separated from



Odontotermes bellahunisensis Holmgren & Holmgren. Imago caste

Fig. a. Head and pronotum, in dorsal view; Fig. b. Head and pronotum, in lateral view; Fig. c. Labrum; Fig. d. Left mandible; Fig. e. Right mandible; Fig. f. Antenna
 acl., anteclypeus; ant., antenna; ap.t., apical tooth; e., eye; lr., labrum; lt. left; m₁, m₂, first and second marginal teeth of mandibles; md., mandible; oc., ocellus; pcl., postclypeus; prt., pronotum; rt., right

(All drawings are from the cotype imagos; see text)



Odontotermes bellakuisensis Holmgren & Holmgren. Soldier caste.

Fig. a. Whole soldier, in dorsal view; Fig. b. Head and thorax, enlarged, in dorsal view; Fig. c. Head and thorax, enlarged, in lateral view; Fig. d. Labrum; Fig. e. Left mandible; Fig. f. Right mandible; Fig. g. Left antenna; Fig. h. Postmentum; Fig. i. Pronotum, in dorsal view; Fig. j. Pronotum, in lateral view
 acl., anteclypeus; ant., antenna; at., anterior; cer., cerci; lr., labrum; lk., left; md., mandible; mst., mesonotum; mtt., metanotum; pcl., postclypeus; prt., pronotum; pt., posterior; rt., right

(All drawings are from the lectotype soldier, from the cotype collection from Bellahunisi, Bellary District, Mysore State, India, present in the Zoological Survey of India, Calcutta)

frons by a semicircular demarcation, strongly swollen and divided into right and left halves by a median suture. *Mandibles*. Of the *Odontotermes*-type. Right mandible with an apical and 2 marginal teeth; apical long, bluntly finger-like; 1st marginal triangular, slightly shorter than apical; 2nd short and blunt. Left mandible with an apical and 2 marginal teeth; apical long, finger-like; 1st marginal triangular, almost as long as apical; 2nd very short and blunt and widely separated from the 1st.

Thorax: Pronotum. Trapezoidal, broader than long (width 2.10-2.25 mm.; length 1.15-1.23 mm.); either narrower or subequal to head-width (with eyes); with a T-shaped apilose mark in the centre, and indistinct shoulder spots on antero-lateral corners; anterior margin slightly upturned, with a weak median notch; anterior and posterior angles rounded; posterior margin straight, without a median notch. *Wings*. Broken in the specimens available to us; only wing-scales present. *Forewing scale*. Triangular, 1.10-1.13 mm. long. *Hindwing scale*. Also triangular; shorter than forewing scale (length 1.00-1.03 mm.). *Legs*. Long, tubular, densely pilose; tibial spur formula: 3 : 2 : 2. *Abdomen*. Elongate, densely pilose. *Cerei* 2-jointed; 0.15 mm. long. *Styli*, single-jointed; 0.05 mm. long.

2. SOLDIER (Table 2; and Plate II)

General. Head-capsule, antennae, thorax and body pale yellowish-white. Mandibles light reddish-brown. Head and body sparsely pilose. Total length (including mandibles but excluding antennae) c. 3.95-5.03 mm.

Head. Head-capsule rectangularly oval; longer than broad (length to base of mandibles 1.18-1.33 mm.; maximum width 1.03-1.15 mm.), converging anteriorly; rounded at posterior end; frons slightly sloping in front. *Fontanelle*. Indistinct. *Eyes and ocelli*. Absent. *Antennae*. With 16-17 segments; segment 1 cylindrical, longest; 2 cylindrical, a little more than half of 1; 3 shortest in the 17-segmented antenna, and 4 shortest in the 16-segmented antenna; 5 to the penultimate one progressively increasing in size; apical oval, longer than penultimate one. *Clypeus*. Separated into an ante- and a postclypeus. Anteclypeus narrow, hyaline, apilose. Postclypeus indistinctly separated from frons and with a few long hairs. *Labrum*. Tongue-shaped, basally broad, apically converging to a slightly pointed tip; several long and short hairs present near tip and on body. *Mandibles*. Short, stout, basally broad; sickle-shaped and strongly incurved at apex. Right mandible with a minute tooth above the

TABLE 2

Body-measurements (in mm.) and indices of soldiers of
Odontotermes bellahunisensis Holmgren & Holmgren :
(Cotype lot)

Body-parts	Range (6 specimens)	Lectotype
I. GENERAL		
1. Total body-length (without antennae) c. ..	3.95-5.03	4.65
II. HEAD		
2. Head-length up to base of mandibles ..	1.18-1.33	1.20
3. Max. width of head ..	1.03-1.15	1.05
4. Max. height of head ..	0.60-0.65	0.60
5. Head Index I (Width/Length) ..	0.86-0.89	0.88
6. Head Index II (Height/Width) ..	0.52-0.61	0.57
7. Head Index III (Height/Length) ..	0.47-0.52	0.50
8. Head Index IV (Mandible length/Head-length) ..	0.52-0.57	0.57
9. Median length of labrum ..	0.30-0.35	0.30
10. Max. width of labrum ..	0.28	0.25
11. Min. length of mandible ..		
(a) Left mandible ..	0.65-0.73	0.69
(b) Right mandible ..	0.65-0.73	0.70
12. Distance of tooth from apex of mandible (left) ..	0.2-0.25	0.23
13. Min. median length of postmentum ..	0.63-0.70	0.65
14. Max. width of postmentum ..	0.45-0.55	0.48
15. Width of postmentum at anterior margin ..	0.28-0.35	0.30
III. THORAX		
16. Max. length of pronotum ..	0.50-0.53	0.50
17. Max. width of pronotum ..	0.75-0.90	0.80
18. Max. width of mesonotum ..	0.65-0.78	0.70
19. Max. width of metanotum ..	0.78-0.93	0.85
20. No. of antennal segments ..	16-17	17

middle on its inner margin. Left mandible, with a large blunt tooth at its distal third (index Tooth distance/Mandibular length 0.29-0.34). *Postmentum*. Parallel-sided, longer than broad (length 0.63-0.70 mm.; width 0.50-0.55 mm.), slightly converging anteriorly.

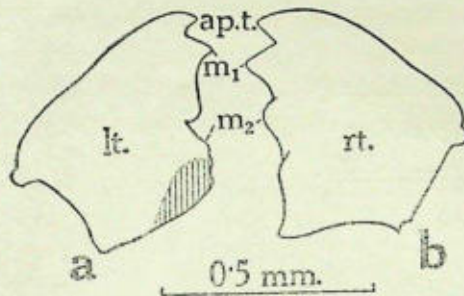
Thorax: Pronotum. Weakly saddle-shaped, broader than long (width 0.75-0.90 mm.; length 0.50-0.53 mm.); anteriorly sharply narrowing; anterior margin with a median notch; posterior margin substraight. *Mesonotum*. Suboval, broader than long; narrower than pronotum; sides rounded; posterior margin weakly convex. *Metanotum*. Suboval; broader than pronotum; much broader than

long; sides rounded; posterior margin substraight. *Legs.* Long, pilose; apical tibial spur formula 3 : 2 : 2.

Abdomen. Oblong, elongate, moderately pilose. Cerci 2-jointed, 0.05 mm. long. Styli one-jointed, 0.05 mm. long.

3. WORKER MAJOR (Table 3; and Text-fig. 1)

General. Head-capsule pale yellowish white; apices of mandibles and mandibular teeth dark brown. Thorax and abdomen pale yellowish-white. Head and body moderately pilose. Total length (without antennae) c. 3.7 mm.



TEXT-FIG. 1. *Odontotermes bellahunisensis* Holmgren & Holmgren. Mandibles of worker major. (From the cotype lot)

ap.t., apical tooth; lt., left; m₁, m₂, first and second marginal teeth of mandibles; rt., right

Head. Head-capsule subsquarish, broader than long (width 1.13 mm.; length 1.08 mm.), flattened on top; sides straight; posteriorly rounded. *Fontanelle.* Indistinct. *Eyes and ocelli.* Absent. *Antennae.* With 17 segments; segment 1 longest, cylindrical; 2 cylindrical, more than half as long as 1; 3 shortest; 4-17 (apical) progressively increasing in size; apical (17) ovate, club-shaped, longer than the penultimate one. *Labrum.* Short, broad, tongue-shaped, with a broad tip; with a few long hairs near tip and on body. *Clypeus.* Divided into an ante- and a postclypeus. Anteclypeus an apilose, narrow, strip, with a short pointed tip. Postclypeus swollen; with a few short hairs; separated from frons by a semicircular demarcation; divided into right and left halves by a median suture. *Mandibles.* Of the typically *Odontotermes* type; teeth rather blunt and short. Right mandible with an apical and 2 marginal teeth; apical short, finger-like, 1st marginal broadly triangular, longer than apical; 2nd short, blunt, with the posterior margin longer than the anterior. Left mandible with an

TABLE 3

Body-measurements (in mm.) of workers (major and minor of)
Odontotermes bellahunisensis Holmgren & Holmgren : (Cotype lot)

Body-parts	Range (mm.)	
	Worker Major (1 specimen)	Workers Minor (4 specimens)
1. Total body-length (without antennae) c. . . .	3.70	3.00-3.60
2. Length of head to base of mandibles ..	1.08	0.70-0.75
3. Max. width of head	1.13	0.78-0.85
4. Max. height of head	0.53	0.35-0.40
5. Max. length of pronotum	0.40	0.35-0.40
6. Max. width of pronotum	0.63	0.53-0.60
7. Max. width of mesonotum	0.58	0.53-0.58
8. Max. width of metanotum	0.85	0.70-0.75
9. No. of antennal segments	17	16-17

apical and 2 marginal teeth; apical short, finger-like; 1st marginal triangular, slightly longer than apical; 2nd marginal minute, only slightly demarcated from margin and widely separated from 1st marginal.

Thorax: Pronotum. Saddle-shaped, broader than long, (width c. 0.63 mm.; length c. 0.40 mm.); anterior lobe strongly upturned, slightly notched medially; anterior angles narrowly, and posterior angles broadly, rounded; sides and posterior margin straight. *Mesonotum.* Suboval; much broader than long; narrower than pronotum; posterior margin straight. *Metanotum.* Suboval; much broader than long; broader than pronotum; posterior margin straight. *Legs.* Slightly swollen, moderately pilose; apical tibial spur formula 3 : 2 : 2.

Abdomen. Oblong, moderately pilose. Cerci 2-jointed; 0.05 mm. long. Styli one-jointed; 0.08 mm. long.

4. WORKER MINOR (Table 3)

Generally resembles worker major, but is smaller. *Head* sub-squarish with straight sides, converging posteriorly to rounded margin.

Antennae with 16-17 segments; segment 3 varying—either shorter, or longer than, or subequal to 4.

(c) TYPE-SPECIMENS AND TYPE-LOCALITY

Cotypes. The following cotype material is present in spirit, in a vial, with the Zoological Survey of India, Calcutta: 2 winged imagos (wings damaged), 6 soldiers, and 5 workers (1 major and 4 minor). Bellahunisi (Bellary District, Mysore State¹, India), coll. *T. B. Fletcher*, 30-viii-1912.

Lectotype etc. Out of the above, we select one soldier (now placed in a separate vial, under Z.S.I. Reg. No. 2651/H8) as the *lectotype* and the remaining 5 soldiers in a vial, Z.S.I. Reg. No. 2661/H8, as the *paralectotypes*. The remaining cotype material (2 imagos and 5 workers) is in the original vial, Z.S.I. Reg. No. 5616/20.

Type-locality. Bellahunisi (southern India), as above.

(d) GEOGRAPHICAL DISTRIBUTION

The typical species is confined to southern India (Bellahunisi and Bangalore), but we have recently found a new subspecies further north, from the arid areas of western Rajasthan (India) and Sind (W. Pakistan). The new subspecies is described below.

(e) COMPARISONS

Odontotermes bellahunisensis is very close to the Indian species *O. obesus* (Rambur) and *O. redemanni* (Wasmann), from which, however, it is distinguishable as follows:

(a) IMAGOS

1. From *O. obesus* (the type-specimen of *O. obesus*, lodged in the Hope Collection, Oxford, was examined): (i) Head-capsule shorter and narrower (head-length to base of mandibles 1.75-1.80 mm. v. 2.00 mm., head-width with eyes 2.20-2.32 mm. v. 2.66 mm.). (ii) Eyes smaller (maximum diameter 0.60-0.65 mm. v. 0.70 mm.).

¹ See footnote above, p. 581.

(iii) Ocelli smaller (maximum diameter 0.23-0.25 mm. v. 0.30 mm.); separated from eyes by a distance of more than half its maximum diameter (v. less than half its maximum diameter in *obesus*). (iv) Pronotum smaller (length 1.14-1.23 mm. v. 1.47 mm.; maximum width 2.10-2.25 mm. v. 2.50 mm.).

2. From *O. redemanni*: (i) Head-capsule narrower (head-width with eyes 2.20-2.32 mm. v. 2.66 mm.). (ii) Ocelli separated from the eye of its side by more than half its (i.e. of ocellus) diameter (in *redemanni*, by half its diameter).

(b) SOLDIERS

1. From *O. obesus*: (i) Mandibles shorter, stouter, and more incurved (ratio Mandible-length/Head-length to lateral base of mandibles, 0.52-0.57 v. 0.59-0.70 in *obesus* (vide Roonwal & Sangal, 1960)). (ii) Pronotum without a median notch (a weak depression present in one subspecies) in posterior margin (v. with a well-marked notch).

2. From *O. redemanni*: (i) Mandibles shorter and more strongly incurved. (ii) Pronotum differs as in *O. obesus* above.

III. DESCRIPTION OF NEW SUBSPECIES, *O. b. guptai*

Odontotermes bellahunisensis guptai subsp. nov.

(Text-fig. 2; and Tables 4 & 5)

(a) MATERIAL

LOT (A): 2 tubes with 6 soldiers and several workers, coll. S. D. Gupta, near Bikaner, Rajasthan, India, as follows:

- (i) No. T-21/16-7-52, Shivbari, Bikaner, 16-vii-1952, ex 'ground';
- (ii) No. T-23/16-7-52, Ratanbai Quarters, Bikaner, 16-vii-1952.

LOT (B): 2 tubes with 6 soldiers and several workers, coll. S. Biswas, western Rajasthan, India, as follows. (iii) No. 1/24-10-58, Gudha near Sambhar Lake (Nagaur Dist.), 24-x-1958; (iv) No. 3/15-11-58, Sayadpura Salt Colony, near Sambhar Lake (Nagaur Dist.), 15-xi-1958.

LOT (C): 4 tubes with several soldiers and workers, West Pakistan, as follows: (v-vi) Karachi Air Port, near wireless station, coll. A. Khan, 13-ix-1960, ex 'cowdung'; (vii-viii) Behind 'Federal Capital Area', c. 10-12 km. from Karachi, coll. *Sohrab Ali*, 13-ix-1960, ex 'rotten wood'.

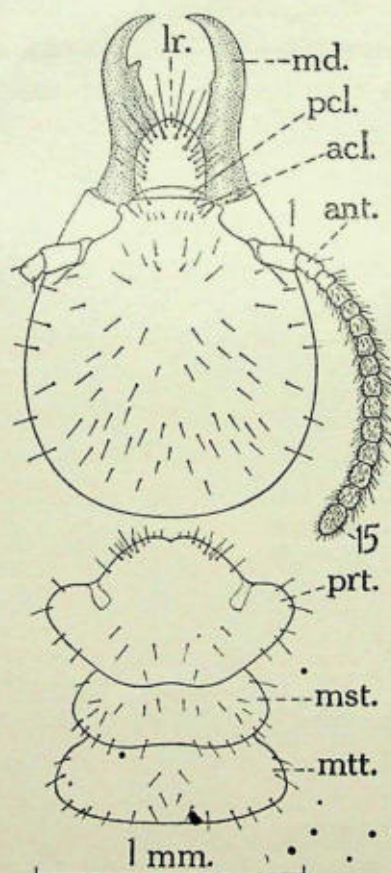
(b) DESCRIPTION

1. IMAGO

Unknown.

2. SOLDIER (Table 4; and Text-fig. 2)

General. Head-capsule deep golden brown to dark brown; antennae basally pale yellow, apically deep brownish yellow; anteclypeus whitish, hyaline; mandibles basally pale, apically reddish brown; thorax and abdomen yellowish white. Head and body moderately pilose. Total length (with mandibles but without antennae) c. 3.86-4.93 mm.



TEXT-FIG. 2. *Odontotermes bellahunisensis guptai* subsp. nov.

Head and thorax of soldier, in dorsal view (From a paratype, near Gudha village, Nagaur District, Rajasthan)

acl., anteclypeus; ant., antenna (with segments 1-15); lr., labrum; md, mandible; mst., mesonotum; mtt., metanotum; pcl., postclypeus; prt., pronotum.

TABLE 4
Body-measurements (in mm.) of soldiers of
Odontotermes bellahunisensis guptai subsp. nov.

Body-parts	Range (10 specimens)	Holotype
I. GENERAL		
1. Total length (including mandibles and excluding antennae) c.	3.86-4.93	3.86
II. HEAD		
2. Head-length to base of mandibles ..	1.08-1.20	1.08
3. Max. width of head ..	0.98-1.08	0.98
4. Max. height of head ..	0.60-0.63	0.60
5. Head Index I (Head-width/Head-length) ..	0.87-0.95	0.90
6. Head Index II (Head-height/Head-length) ..	0.50-0.56	0.55
7. Head Index III (Head-height/Head-width) ..	0.56-0.61	0.61
8. Head Index IV (Mandible-length/Head-length) ..	0.52-0.57	0.55
9. Median length of labrum ..	0.25-0.28	0.25
10. Max. width of labrum ..	0.23-0.28	0.23
11. Min. median length of mandibles :		
(a) Right mandible ..	0.60-0.65	0.60
(b) Left mandible ..	0.58-0.65	0.60
12. Distance of tooth on left mandible from apex of mandible ..	0.15-0.20	0.20
13. Tooth Index. (Distance of tooth from apex/Mandible-length) ..	0.25-0.33	0.33
14. Median length of postmentum ..	0.63-0.65	0.63
15. Max. width of postmentum ..	0.45-0.48	0.45
16. Width at anterior margin of postmentum ..	0.33-0.35	0.33
III. THORAX		
17. Max. length of pronotum ..	0.48-0.55	0.48
18. Max. width of pronotum ..	0.73-0.85	0.73
19. Max. width of mesonotum ..	0.63-0.73	0.63
20. Max. width of metanotum ..	0.78-0.88	0.78
21. No. of antennal segments ..	15-16	15

Head. Head-capsule suboval; longer than broad (length 1.08-1.20 mm., breadth 0.98-1.08 mm.); converging anteriorly, posteriorly rounded. *Fontanelle.* Indistinct. *Eyes and ocelli.* Absent. *Antennae.* With 15-16 segments; segment 1 longest; 2 about two-thirds of 1; 3 generally shortest, or sometimes 4 shortest; 4 longer than 3 but sometimes subequal to or even shorter than the latter; 5 longer than 3 or 4; 6 onwards gradually increasing in size in that order; apical (15 or 16) ovate, longer than the penultimate one. *Labrum.* Tongue-shaped, longer than broad, with strong hairs bordering the sides and 2 pairs of long ones near the tip. *Clypeus.* Divided into an ante- and a postclypeus. Anteclypeus, a narrow, subtrapezoidal, apilose strip, distinctly separated from postclypeus. Postclypeus indistinctly separated from frons; with 2 prominent hairs on anterior margin. *Mandibles.* Short, stout and deeply curved inwards to a sharp tip. Left mandible with a strong tooth lying at one-third the length of mandible from the apex. Right mandible with a minute tooth a little below the distal third from apex. *Postmentum.* More or less parallel-sided; longer than broad (length 0.63-0.65 mm.; width 0.33-0.35 mm.), slightly converging anteriorly; with a few hairs near and on the anterior margin; anterior margin substraight; posterior margin concave.

Thorax: Pronotum. Saddle-shaped, broader than long; anterior margin semicircular, slightly notched in middle; sides straight, converging to a deeply-notched posterior margin.

Mesonotum. Subovate; broader than long; with a weak median notch in posterior margin. *Metanotum.* Suboval, much broader than long; posteriorly weakly concave; posterior margin with a weak median notch. *Legs.* Long; femora slightly swollen; sparsely pilose; apical tibial spur formula 3 : 2 : 2.

Abdomen. Elongate, oval. Cerci 2-jointed; 0.08 mm. long. Styli single-jointed; 0.08 mm. long.

3. WORKER (Tab'e 5)

Similar to that of the typical form *O. b. bellahunisensis*, described above, with minor differences as follows: It is not possible to separate 'major' and 'minor' workers. The number of antennal segments is usually 17, but sometimes 16.

(e) TYPE-SPECIMENS

Holotype. One soldier, in spirit, in a vial, Z.S.I. Reg. No. 2652/H8, near Gudha village (Nagaur Dist., Rajasthan), coll. S. Biswas (Field

TABLE 5

Body-measurements (in mm.) of workers of
Odontotermes bellahunisensis guptai subsp. nov.

Body-parts	Range (8 specimens)
1. Total length (excluding antennae) c.	2.48 - 3.90
2. Head-length to base of mandibles	0.98 - 1.20
3. Max. width of head	1.08 - 1.30
4. Max. height of head	0.50 - 0.60
5. Max. length of pronotum	0.33 - 0.53
6. Max. width of pronotum	0.53 - 0.70
7. Max. width of mesonotum	0.60 - 0.68
8. Max. width of metanotum	0.75 - 0.90
9. No. of antennal segments	16 - 17

Coll. No. 1/24-10-58), 24-x-1958; deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

Morphotype. One worker in spirit in a vial, Z.S.I. Reg. No. 2653/H8, from the holotype lot and with the same data. Deposited in the Zoological Survey of India, Calcutta.

Paratypes and *Paramorphotypes*. Deposited as follows: (i) Four paratype soldiers and four paramorphotype workers, in spirit in a vial, Z.S.I. Reg. No 2654/H8, from the holotype lot and with the same data, in the Zoological Survey of India, Calcutta. (ii) One paratype soldier and two paramorphotype workers, in spirit in a vial, from material No. T-21/16-7-52, Shivbari, Bikaner, coll. *S. D. Gupta*, with Prof. A. E. Emerson, Department of Zoology, Chicago University, Chicago, U.S.A. (iii) One paratype soldier and one paramorphotype worker, from same material as (ii), in the Entomological Collections, Forest Research Institute, Dehra Dun.

(d) TYPE-LOCALITY

INDIA. Rajasthan: Near Gudha village (approx. 26° 55' N. lat. and 75° 25' E. long.), Nagaur District.

(e) GEOGRAPHICAL DISTRIBUTION

This subspecies seems to be confined to the arid areas of western Rajasthan (India) and Sind (W. Pakistan), as follows:

INDIA. Rajasthan: Bikaner and vicinity (Bikaner Dist.); and near Gudha village (the type-locality) and Sayadpura Salt Colony (both in Nagaur Dist.).

WEST PAKISTAN. Sind: Karachi and vicinity.

(f) COMPARISON

Soldiers of *O. b. guptai* subsp. nov. differ from the typical form as follows: SOLDIERS: (i) Head and body more hairy (v. very sparsely pilose). (ii) Head more rounded. (iii) Antennae with 15-16 segments (v. 16-17 segments). (iv) Mandibles somewhat stouter. (v) Pronotum with a weak median depression in the posterior margin (v. without a depression). (vi) Anterior margin of pronotum more curved, almost semicircular (v. almost triangular).

IV. SUMMARY

1. The original description of the Indian termite *Odontotermes bellahunisensis* (Termitidae, Metatermitinae) as given by Holmgren & Holmgren (1917) was very meagre and was not accompanied by illustrations, so that it is impossible to recognise the species from that description alone.

2. The species is redescribed from the cotype material consisting of all the castes, viz. alates, soldiers, and workers.

3. A new subspecies, *O. b. guptai*, is described from the arid zone of western Rajasthan (N. India), and Sind (W. Pakistan).

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APPENDIX

Original description, in full, of *Odomotermes bellahunisensis*, as given by K. Holmgren & N. Holmgren in the following paper (1917, pp. 150-151):

HOLMGREN, K. and HOLMGREN, N. (1917, August). Report on a collection of termites from India. *Mem. Dept. Agric. India* 5 (3), pp. 2+137-171. Calcutta.

Odomotermes bellahunisensis, n. sp.

IMAGO. Smaller than *O. obesus*.

Dark-brown. Post-clypeus somewhat tinged with brown but anterior margin of the transverse band scarcely lighter than the remainder of the head. Pronotum with a yellow T-shaped mark. Shoulder-spots indistinct. Posterior part of the T detached from the anterior. The anterior part of meso- and meta-notum also brown. Wings grey-brown with yellowish 'subcostal streak'.

Hairs moderate.

Head and antennae as in *O. obesus*. Ocelli separated from the eye by their diameter, relatively small.

Length with wings	..	..	..	24.00 mm.
„ without „	..	..	..	14.50 mm.
Breadth of head	..	..	..	2.32 mm.
„ „ pronotum	..	..	..	2.16 mm.
Length „ „	..	..	..	1.14 mm.

SOLDIER. Morphologically scarcely distinguishable from *O. obesus*. Mandibles perhaps very slightly shorter and stouter.

Length of body	..	..	..	3.5-4.00 mm.
Head with jaws	..	..	..	1.95 mm.
„ without jaws	..	..	..	1.15 mm.
Breadth of head	..	..	..	1.10 mm.
„ „ pronotum	..	..	..	0.80 mm.

Worker. Perhaps slightly smaller than the worker of *obesus* but otherwise indistinguishable.

Localities:

(1) Madras; Bellary District, Bellahunisi; 30th August 1912. 'Issuing from hole in gravelly soil at dusk. No mound at all.'

(2) Mysore State; Bangalore; 17th July 1912. 'Issuing from hole in ground alongside road (no mound at all) just before heavy rain. Only one hole of exit noticed.'

Critical Notes on the Orchidaceae of Bombay State

VII. *ERIA* LINDL. & *PORPAX* LINDL.

BY

H. SANTAPAU, S.J., F.N.I., AND Z. KAPADIA, Ph.D.

(With three plates)

[Continued from Vol. 58 (2) : 350]

ERIA Lindl.

ERIA Lindl. Bot. Reg. t. 904, 1825, nom. cons. ; Endl. Gen. Pl. 192, 1837; Benth. & Hook. f. Gen. Pl. 3 : 509, 1883; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 175, 1889; Hook. f. Fl. Brit. Ind. 5 : 785, 1890; Kleg & Prantl. in Ann. R. Bot. Gard. Calcutta 3 : 115, 1898; Duthie, ibid. 9 (2) : 110, 1906; J. J. Smith, Fl. Buitenz. 6 : 375, 1905; Kränzl. in Engl. Pflanzenr. 50 : 15, 1911; Schltr. Orchid. 278, 1927; Holtum, Rev. Fl. Malaya 1 : 353, 1953. *Pinalia* Buch.-Ham. ex D. Don, Prodr. Fl. Nep. 31, 1825, pro syn. ; O. Kuntze, Rev. Gen. Pl. 2 : 678, 1891.

The generic name *Eria* is derived from the Greek word '*erion*' = 'wool', referring to the inflorescence and flowers which are woolly-tomentose in many of the species.

Epiphytic herbs. Each branch of the sympodium with a creeping basal portion; the erect part pseudobulbous, 1- to several-noded, one-leaved near the apex only or leafy throughout, the basal portions sheathed. *Racemes* lateral or apparently terminal, with one to many flowers. *Rachis*, *ovary*, and *flowers* externally often densely woolly, rarely the leaves and the inner side of the flowers also. *Dorsal sepal* and *petals* similar, free; lateral sepals produced at the base, connate with the foot of the column to form a more or less prominent mentum. *Lip* affixed to the foot, slightly or not at all mobile, erect, simple, or \pm deeply 3-lobed; the base of lip never forms a spur but unites with the edges of the foot; disc 2-callate, or in the form of 2 elevated lines. *Column* free, with an elongate foot. *Anther* 2-celled, each cell again falsely 4-celled; pollinia 8, pyriform, united in 2 groups of 4, with slender membranous caudicles. *Capsules* oblong, fusiform.

A large and varied genus of over 400 species, distributed throughout the East. It occurs in India, Ceylon, Malaya, Java, Pacific Islands, and New Guinea.

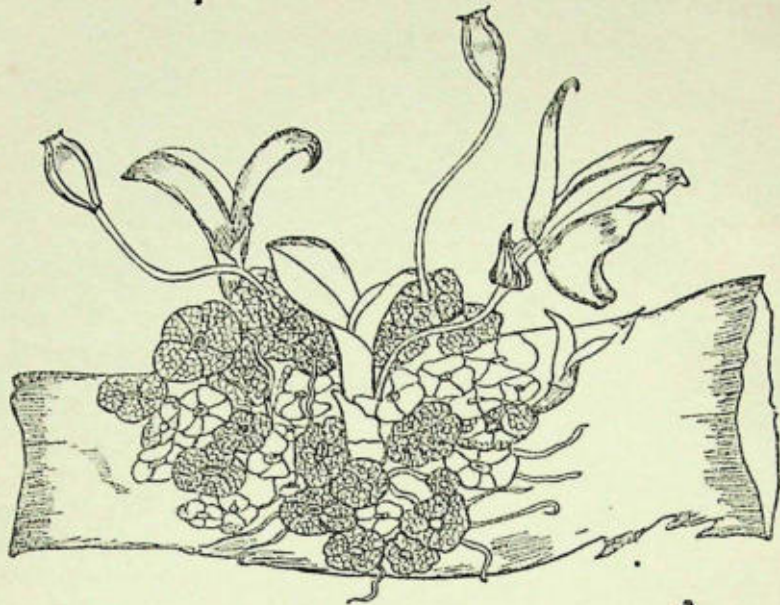
In the list of *Nomina Conservanda*, *Eria* is marked with a sign indicating that conservation is unnecessary. This is correct only as far as *Pinalia* Buch.-Ham. is concerned. O. Kuntze lists *Dendrolirium*, *Myrcanthus*, *Trichotomia*, *Ceratium*, *Cylindrolobus* of Blume, July 1825, as earlier names for *Eria* Lindl., Aug. 1825. Conservation against these names is certainly necessary.

Eria Lindl. has been variously divided into sections by different authors. The 5 Bombay species belong to the following 3 sections of Hooker, f.: *Eria* sect. *Conchidium* (*E. reticosa* Wt.); *Eria* sect. *Bryobium* (*E. dalzellii* Lindl., *E. microchilos* Lindl., *E. exilis* Hook. f.); and *Eria* sect. *Hymenaria* (*E. mysorensis* Lindl.).

Type species: *E. stellata* Lindl.

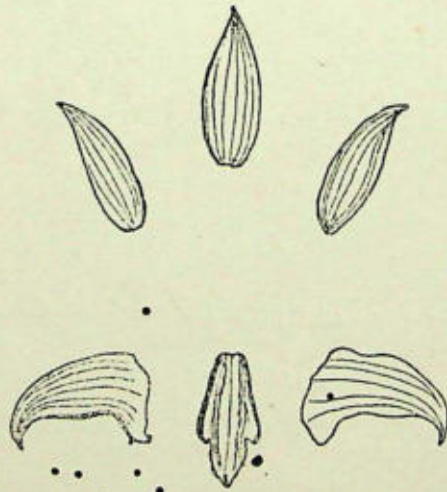
KEY TO THE SPECIES OF *ERIA* OF BOMBAY

1. Pseudobulbs discoid; flowers 20-30 mm. long, solitary *reticosa*
1. Pseudobulbs discoid or conical-ovoid; flowers under 12 mm. long, in racemes:
 2. Pseudobulbs conical-ovoid, 3 × 1.2 cm.; leaves 5-13 cm. long; scapes shorter or rarely equalling the leaves; pedicels and ovary puberulous *mysorensis*
 2. Pseudobulbs discoid, 4-15 mm. in diam.; leaves up to 8 cm. long; scapes longer than leaves; pedicels and ovary glabrous:
 3. Scape usually without (rarely with) leaves, zig-zag, 1-4 cm. long; flowers 2 mm. long, greenish-white *exilis*
 3. Scape always with leaves, straight, 3-9 cm. long; flowers 7-9 mm. long, pale yellow:
 4. Flowers secund; bracts up to 3 times longer than ovary; sepals and petals fringed with capitate glands, acute; lip panduriform without callosities at the base *dalzellii*
 4. Flowers usually not secund; bracts slightly longer than ovary; sepals and petals entire, without glands, acuminate; lip narrowly obovate-lanceolate, base with 2 callosities, apex tapered, distinctly crenulate *microchilos*



A

0 1 2 3 4 5 CM



C

0 1 2 3 4 CM

Eria reticosa Wight

A. Plant with support ; C. Sepals and petals dissected.

ENUMERATION OF THE SPECIES OF *ERIA* OF BOMBAY STATE

1. *Eria reticosa* Wight, Icon. 5 (1) : 4, t. 1637, 1851 ; Hook. f. 787 ; Gammie in Journ. Bombay nat. Hist. Soc. 17 : 36, 1906 ; Blatt. & McC. ibid. 35 : 272, 1931 ; Cooke, Fl. Pres. Bomb. 2 : 690, 1907 ; Santapau in Rec. Bot. Surv. Ind. 16 (1) : 300, 1953. *E. uniflora* Dalz. in Hook. Journ. Bot. 4 : 111, 1852. *E. braccata* Dalz. & Gibs. Bomb. Fl. 262, 1861 (non Lindl. 1859) ; Kränzl. in Engl. Pflanzenr. 50 : 18, f. 1 A-B, 1910 ; Fyson, Fl. Nilg. Puln. Hill-Tops 2 : 386, t. 243, 1915 ; Fischer in Gamble, Fl. Pres. Madr. 1425, 1928 (an Lindl. ?). *Pinalia reticosa* (Wight) O. Kuntze, Rev. Gen. Pl. 2 : 679, 1891. *Eria rupestris* Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35 : 270, f. 6, 1931. (See Plate XXXIV).

Epiphytes or *lithophytes*. Pseudobulbs 7-15 mm. across, discoid, covered with a reticulate sheath, which becomes loose on drying. Shoots 1-2, arising from the base of the pseudobulb, sheathed at the base ; sheaths 2-3, each 7-13 mm. long, cylindric, oblique at the mouth, denticulate, mucronate, greenish below, dingy purple above. Leaves 2, appearing together with the flowers, 2-7 × 0.8-2 cm., ovate, broadly oblong or oblong-lanceolate, tapered at base, acute, mucronulate, entire, dark green, often tinged with brownish purple. Buds boat-shaped, pale greenish purple. Scapes 1-flowered, arising from the upper sheath, generally from the side, about 1 mm. thick, 2-4 cm. long, purplish, curved by the weight of the flower. Flowers white, variable in size, sweetly and strongly scented. Pedicels with ovary 4-5 mm. long, slightly curved, white within the bract, light brown on emergence. Bracts 9 × 3-5 mm. membranous, pale brown-purple, almost orbicular in outline, cordate, mucronate, sheathing pedicel and ovary to a little more than half their length ; margins frilled, wavy, slightly turned outwards ; midrib and 2 lateral veins distinct. Sepals subequal, white or often suffused with pale pink, broadly oblong-lanceolate, mucronate, entire, glabrous, 9-nerved ; dorsal sepal 20-37 × 5-7 mm. ; lateral ones 19-34 × 5-7 mm., somewhat broadly falcate ; mentum 8-11 mm. long, curved, oblong-conical, white, emarginate. Petals 18-32 × 5-7 mm., white, often suffused with pink, oblong-lanceolate, acute or submucronulate, 7-nerved, glabrous. Lip 19-23 mm. long, oblong-obovate in outline, sessile on foot of column, 3-lobed ; lateral lobes 5-7 × 1-2 mm., narrowly oblong, ± ear-like, acute or rounded, entire, red-margined, with 2 orange-yellow crests running from base of lip to beyond lateral lobes ; tips of lateral lobes and area in between orange-yellow ; midlobe 8-10 × 4 mm., oblong, often slightly dilated in apical half, rounded or tapering at apex, crenulate. Column short, white, tinged with green ; foot 10 × 3 mm., curved, narrowly oblong, yellow with reddish purple margins and parallel purple veins on inner face, paler towards apex. Anther 3 × 3 mm., white above,

reddish inside, obovate-oblong, produced into \pm conical apiculum in front, subconcave at back; pollinia 8, yellow, the upper 4 ovoid-oblong, lower 4 minute, all attached to short granular membrane. *Stigmatic surface* pale green with stellate marking in centre. *Capsules* 12×8 mm., oblong to obconical, truncate at apex, erect, with 6 strong ridges.

Flowering : June to July. *Fruiting* : August to March.

Occurrence in Bombay State : KONKAN : Woodrow, W. GHATS : Dalzell; Khandala, Blatter ex Santapau; Lonavla, Gammie; Panchgani, Blatter 228-229; May Langham; Kapadia 1348-1349, 2052-2053; Mahableshwar, McCann; Sedgwick 7631; Santapau 13225; Kapadia 610, 615, 1198, 1200, 2094-2095; Ramghat, Ritchie. N. KANARA : Castle Rock, Bell 4336; Kapadia.

Distribution : Konkan, W. Ghats, southwards to Nilgiris and High Wavy Mountains.

Notes : On perpendicular rocks or tree trunks in open situations, always directly facing the monsoon currents.

We have examined Blatter 228, 229, 'Co-types' of *E. rupestris* Blatt. & McC., and have collected fresh material from its type locality. Blatter & McCann distinguish their *rupestris* from *reticosa* Wt. by the presence of a bilobed mentum. But Wight's Icon of *E. reticosa* shows the mentum emarginate, and in appearance bilobed. After careful examination of fresh flowers we can see no difference by which to keep the two species apart. There are, however, considerable variations in the size of the floral parts, the Panchgani flowers being considerably smaller than those collected from Mahableshwar.

2. *Eria mysorensis* Lindl. in Journ. Linn. Soc. 3 : 54, 1858; Hook. f. 793; Gammie 37; Cooke 692. *E. pubescens* Wight, Icon. 5 (1) : 4, 1851; Hook. f. 793; Kränzl. 64; Fischer 1425; Blatt. & McC. 275 (non Lindl. 1825). *E. polystachya* Wight, Icon. t. 1634, 1851 (non A. Rich. 1841). *Pinalia mysorensis* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 679, 1891.

Pseudobulbs 3 cm. long, about 1.2 cm. broad at the base, conico-ovoid, sheathed; the older ones dry, rugose, irregularly and longitudinally furrowed. *Leaves* 3-5, arising \pm from apical portion of pseudobulb, $5-15 \times 1.2-2$ cm., oblong-lanceolate or elliptic-lanceolate, acute, distinctly tapered, glabrous or sparsely pubescent. *Scapes* shorter than the leaves, rarely equal to them, 1-2 per plant; peduncles slender, glabrous or sparsely puberulous, terete. *Flowers* 12-16 mm. long. *Bracts* about $8 \times 3-4$ mm. ovate or ovate-lanceolate, often reflexed, entire, glabrous, acute. *Pedicel* with ovary 10 mm. long, slender, curved, sparsely puberulous. *Sepals* and petals linear-lanceolate, broad at base, falcate, subacuminate, glabrous, entire, 3-nerved; dorsal sepal $11-13 \times 3$ mm.; lateral ones $10-11 \times 3$ mm. *Petals* $9-10 \times 2$ mm. *Lip*

7-8 mm. long, minutely clawed, arcuate, subcordate at base, oblong, subpandurate, about 4 mm. across the lateral lobes; midlobe 2-3 mm. long, obovate-triangular, acute or apiculate, finely irregularly crenulate; the base of the lip with 2 arched, slightly thickened ridges. *Column* 4 mm. long, slender, \pm straight; foot at right angles to column, about 2.5-3 mm. long, narrow. The colour of the flowers is given in the literature as white tipped with pink; lip with purple blotches at the base, apical part yellow.

Flowering: July.

Occurrence in Bombay State: KONKAN: *Stocks*. W. GHATS: Mahableshwar, *Hallberg ex Blatter & McCann*. DECCAN: Koina Valley, below Mahableshwar, *Cooke*. N. KANARA: LAW.

Distribution: Konkan, W. Ghats, Deccan, N. Kanara, western slopes of the Nilgiris.

Notes: Our description has been made from specimens examined in the herbarium of the Bot. Surv. Ind. (West. Circle), Poona, with the kind permission of the Regional Botanist.

There is a certain amount of confusion in the literature about the present and related species. The identity of *E. pubescens* Wt. with *E. mysorensis* Lindl. seems to be beyond doubt; some of the confusion seems to have arisen with Hooker f. who assigned to the former species some of the characters of *E. polystachya* A. Rich.

In *E. polystachya* A. Rich. pedicel and ovary are densely pilose, sepals densely pilose on the outer side, lip entire, ovate-lanceolate, flowers pale yellow. *E. mysorensis* Lindl. has pedicel and ovary sparsely puberulous, sepals glabrous, lip oblong constricted in the middle, flowers white. The true *polystachya* does not seem to occur in Bombay.

3. *Eria exilis* Hook. f. Fl. Brit. Ind. 5: 788, 1890, et Icon. Pl. t. 2074, 1891; Kränzl. 21; Fischer 1425; Blatt. & McC. 274. *Pinalia exilis* (Hook. f.) O. Kuntze, Rev. Gen. Pl. 2: 679, 1891. *Eria microphyton* Schltr. in Fedde, Repert. 2: 170, 1906. *E. minima* Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35: 274, f. 2, 1931.

Minute epiphytes. *Pseudobulbs* 3-12 mm. across, flat, irregularly orbicular, usually in 3's forming a chain on tree trunks; veins usually running the whole length of the pseudobulbs, rarely branching. *Leaves* sessile, appearing usually before the flowers, often persistent till flowering, 2-3, arising from a pseudostem 2-3 mm. high, lamina 2-25 \times 2-11 mm., obovate-elliptic or oblong to obovate, glabrous, 7-9-nerved, tapering to the sheathing base, rounded apiculate at apex, margins entire, minutely papillate. *Scape* 1-4 cm. long, from between the leaves, sheathed at base, flexuose, capillary, bracteate at every bend. *Bracts* 1-2 mm. long, broadly ovate, cordate, cymbiform, acute or

apiculate or acuminate, semi-amplexicaul, hyaline, entire, about as long as the ovary. *Flowers* up to 12 in a raceme, each 2 mm. long, subsessile, bracteate, translucently greenish white; generally only 1-2 flowers mature at a time. *Sepals* \pm equal; dorsal one 2×1.25 mm., oblong, entire, obtuse, 1-nerved; lateral sepals 2 mm. long, 1.5 mm. broad at base, subfalcate, obtuse or apiculate; midnerve prominent, lateral pair of nerves indistinct. *Mentum* stout, saccate, about equaling the upturned tips of the sepals. *Petals* 1.25×0.75 mm., shorter than sepals, 1-nerved, narrowly oblong or sublanceolate, acute, broadest about the middle, entire. *Lip* 1.5 mm. long, very slightly stipitate, arcuate, oblong-ligulate, apiculate, \pm equal to petals, fleshy, olive-green, enclosed within the much longer sepals. *Column* very small with 2 small hook-like arms; foot 1.25 mm. long, curved, stout. *Ovary* about 1 mm. long, oblong, with a very short pedicel. *Capsules* 5×1.5 mm., broadly ovoid, green, faintly ribbed.

Leaves: June to October. *Flowering*: October to December. *Fruiting*: October to May.

Occurrence in Bombay State: W. GHATS: Mahableshwar, Cooke; Blatter & Hallberg 1683; Sedgwick 7631; Ezekiel; McCann; Santapau 11873, 11919, 13133; Bole 329; Kapadia 583, 606, 611, 902, 937, 1210, 1917. N. KANARA: Anmod, Sedgwick; Bell; Siddhapur, Sedgwick; Jog, Sedgwick; Gersoppa Falls, Hallberg & McCann 34855; Castle Rock, Santapau 17695.

Distribution: India: W. Ghats, N. Kanara, Travancore. World: India, Siam.

Notes: Blatter & McCann give *E. exilis* Hook. f. for Bombay Presidency on the evidence of Cooke's sheet from Mahableshwar, preserved in the National Herbarium, Calcutta.

Santapau in his MSS notes points out that the type of *E. exilis* Hook. f. in Kew Herbarium (Travancore, Johnson, Herb. R. Wight Propr.) has a bracteate scape. Hooker f. in his *Icones* refers to this specimen, from which the Icon was drawn; the latter remarkably fits Blatter & McCann's description of *E. minima*.

In our specimens from Mahableshwar the petals vary slightly, being more or less half as long as the sepals; the lip more or less equalling the petals.

Blatter & McCann describe the floral bracts of *E. exilis* Hook. f. as lanceolate; but Hooker f. in his original description notes them as large and cymbiform, (this is exactly like in *E. minima* Blatt. & McC.). Actually Blatter & McCann's description of *E. exilis* Hook. f. seems to be more or less completely based on Schlechter's description of *E. microphyton* (which has been reduced to a synonym of *E. exilis* Hook. f. by Kränzlin).

The flowers of *E. exilis* Hook. f. as given by Blatter & McCann are 3 mm. in length; on the other hand, *Sedgwick* 7631, identified by Blatter & McCann as *E. minima*, has flowers up to 3 mm. long.

It is clear, then, that *E. minima* Blatt. & McC. is identical with *E. exilis* Hook. f. and cannot stand as an independent species.

4. *Eria dalzellii* Lindl. in Journ. Linn. Soc. 3: 47, 1858 (nom. et syn. tantum, non descr.). *Dendrobium dalzellii* Hook. in Hook. Journ. Bot. 4: 292, 1852. *D. fimbriatum* Dalz. ibid. 4: 292, 1852, nom., pro syn. (non Hook. 1825, nec Lindl. 1830). *Eria microchilos* Lindl. in Journ. Linn. Soc. 3: 47, 1858; Dalz. & Gibs. 262; Gammie 36; Cooke 691; Blatt. & McC. 273 (excl. syn. *D. microchilos* Dalz.); (omnes descr. tantum, non nom.). *E. dalzellii* Hook. f. Fl. Brit. Ind. 5: 789, 1890; Kränzl. 19 (partim). *E. dalzellii* var. *fimbriata* Hook. f. Fl. Brit. Ind. 5: 789, 1890; Kränzl. 20; Fischer 1425. (See Plate XXXV).

Epiphytes. *Pseudobulbs* 0.8-1.5 cm. in diam., discoid, the principal veins white and flabellate. *Leaves* 3-5, sessile, sheathing at the base, 1.7 × 0.7-1 cm., elliptic to oblanceolate, obtuse, minutely micronulate, olive-green, paler, entire, minutely papillate at the margins, the midnerve depressed above, prominent below with 2 to 4 faint lateral nerves. *Racemes* 3-9 cm. tall, erect, generally secund or subsecund; peduncle 3 cm. long, 0.5-1 mm. thick, greenish yellow, terete, glabrous, ebracteate, usually slightly curved. *Flowers* faintly perfumed, pedicellate, bracteate. *Bracts* 3-6 mm. long, 0.5-1 mm. broad at base, erect, pale greenish yellow, lanceolate, subacuminate, entire, curved at apex. *Sepals* and *petals* 6 × 1.5-3 cm., pale creamy yellow, triangular-ovate to lanceolate, acute or subacuminate, 3-nerved; the margin entire with hyaline, stalked glands. *Mentum* about 0.5 mm. long, rounded, pale orange-yellow. *Petals* slightly narrower than sepals and rounded at base. *Lip* 3-4.5 × 1.5 mm., falcate, concave in basal half, straight upwards, minutely papillate, panduriform on spreading, the basal part broad, ovate with edges entire incurved, and 2 fairly thick yellowish orange ridges, which unite in the middle of lip and pass as one furrow into the white, much smaller, rounded apical lobe; the latter has the edges somewhat crenulate and slightly decurved. *Column* about 1 mm. long, pale yellowish, oblong, broad at base; foot 2 mm. long, ± at right angles to column, broad at base, pale yellow, tinged with orange at the obtuse apex. *Anther* ovate, yellow; pollinia yellow, waxy, 8, in 4 pairs, each pair consisting of one broadly pear-shaped pollinium and another smaller narrowly linear. *Stigmatic surface* minute, yellowish. *Ovary* and *pedicel* 2 mm. long, curved, greenish yellow. *Capsules* 5 × 1.5 mm., elliptic to obovate.

Flowering: July to August. *Fruiting*: August to October.

Occurrence in Bombay State : KONKAN : Stocks : Gammie ; Wari Country, Dalzell & Gibson. W. GHATS : Khandala, Hallberg ; Sedgwick ; Santapau 233.9, 233.13, 582, 624, 720, 1036, 2244, 2451, 4613-4614, 4706, 4743, 4894, 5050, 6828, 6829, 12903, 14488, 15688 ; Kapadia 522, 556, 580 ; Mahableshwar, Cooke ; Santapau 13164, 13167 ; Bole 408 ; Kapadia 602-603. DECCAN : Koinanagar, Kapadia 2885, 2901. N. KANARA : Devimane, Hallberg & McCann 34466.

Distribution : Konkan. W. Ghats of Bombay and south peninsular India, Deccan, N. Kanara.

Notes : There is great confusion in our botanical literature about *Eria dalzellii* Lindl. and *E. microchilos* Lindl. These species are based respectively on *Dendrobium dalzellii* Hook. and *D. microchilos* Dalz. Some authors have actually fused the two species into one. We are convinced that the two species are quite distinct, and may be separated by the following characters.

E. microchilos

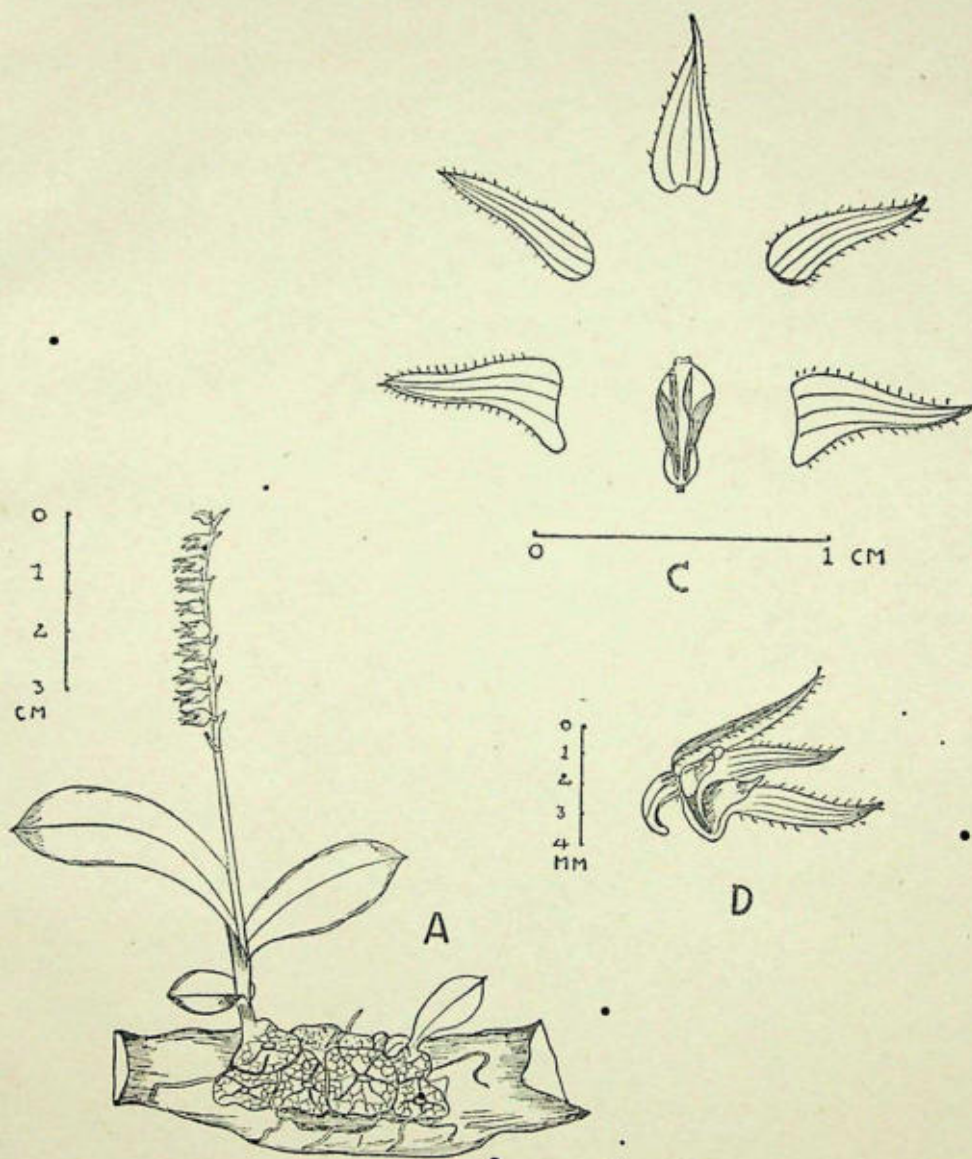
Slender herbs
Peduncle \pm filiform
Racemes not secund or subsecund
Floral bracts just longer than ovary
Sepals and petals longer, acute.
Margins without glands
Lip \pm fleshy, scarcely lobed, ovate-lanceolate, with 2 clear callosities at base, apical portion distinctly crenulate

E. dalzellii

More robust herbs
Peduncle \pm stout
Racemes secund or subsecund
Floral bracts up to 3 times longer than ovary
Sepals and petals shorter, acute.
Margins with capitate glands
Lip thin, pandurate, without callosities at base, apical portion subcrenulate

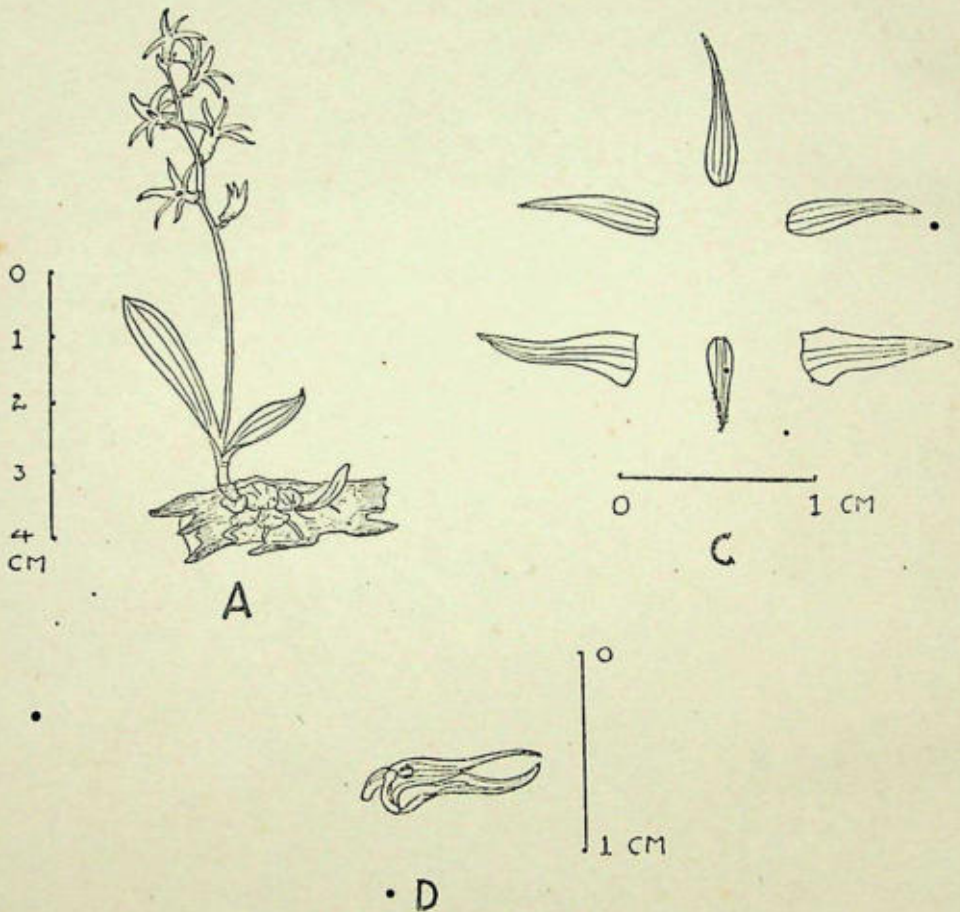
5. *Eria microchilos* Lindl. in Journ. Linn. Soc. 3 : 47, 1858 (nom. et syn. tantum, non descr.). *Dendrobium microchilos* Dalz. in Hook. Journ. Bot. 3 : 345, 1851. *Eria dalzellii* Lindl. in Journ. Linn. Soc. 3 : 47, 1858 ; Dalz. & Gibs. 262 (partim) ; Gammie 36 ; Blatt. & McC. 273 ; Cooke 691 ; Fischer 1425 ; (omnes descr. tantum, non nom.). *E. dalzellii* Hook. f. Fl. Brit. Ind. 5 : 789, 1890 ; Kränzl. 19, f. 2 A-C (partim). *E. filiformis* (Wt.) Reichb. f. in Walp. Ann. 6 : 268, 1891 (partim). (See Plate XXXVI).

Epiphytes. *Pseudobulbs* 4-10 mm. across, pale dull green, discoid, principal veins reticulate. *Leaves* 2-5, sessile, 1.5-8 \times 0.2-0.6 cm., oblong lanceolate or narrowly linear-oblong, distinctly tapered to the base, rounded mucronulate at apex, entire, 1-nerved. *Scape* slender, often filiform, 2.5-8 mm. long, ebracteate, pale yellow. *Flowers* usually not secund, pale yellowish white, pedicellate. *Bracts* about 3 mm. long,



Eria dalzellii Lindl.

A. Plant with support ; C. Sepals and petals dissected ; D. Side view of single flower with lateral sepal and petal removed.



• D
Eria microchilos Lindl.

A. Plant with support ; C. Sepals and petals bisected ; D. Side view of single flower with lateral sepal and petal removed.

longer than ovary, narrowly lanceolate, acute, entire. *Sepals* and *petals* pale yellowish, spreading, often slightly reflexed at apex, narrowly lanceolate-acuminate, thin, 3-nerved, margins entire without capitate glands. *Sepals* 8 mm. long, 1.5 mm. broad at base; mentum 1.5-2 mm. long, obtuse, slightly curved, somewhat saccate. *Petals* 7 mm. long, about 1.5 mm. broad at base. *Lip* 4 mm. long, narrowly oblong-lanceolate, hardly divided; basal half about 1 mm. broad with 2 thickened yellow ridges throughout entire length; apical half very narrow, margins crenulate, much tapered to acute apex. *Column* minute, broad; foot 1.5 mm. long, slightly curved. *Anther* more or less quadrately-orbicular with a rounded apiculum on top; pollinia 8, in 4 unequal pairs. *Ovary* with *pedicel* 1.5-2 mm. long. *Capsules* 3-3.5 x 2 mm. long, ribbed; stalk 1 mm. long.

Flowering : July to August. *Fruiting* : August to October.

Occurrence in Bombay State : KONKAN : *Stocks*. W. GHATS : Igatpuri, *Kapadia* 1386; Khandala, *Hallberg*; *Blatter*; *McCann*; *Santapau* 623, 2450, 4604, 4707, 4895, 6903; *Kapadia* 505, 533, 2297; Lonavla, *Chibber*; Mahableshwar, *McCann*; *Kapadia* 2099. DECCAN : Bhimashankar, *Kapadia* 1461; N. KANARA; Yellapur, *Bell* 3909; Karwar, *Bell*; Jog, *Sedgwick* 7171.

Distribution : Konkan, W. Ghats of Bombay, Mysore, Madras, and Kerala States, Deccan, N. Kanara.

Notes : In the field, this species stands out from *E. dalzellii* on account of the type of inflorescence; it is not secund as in the latter species.

PORPAX LINDL.

PORPAX Lindl. in Bot. Reg. 31 : misc. 66, 1845; Pfitz. in Engl. & Prantl, Pflanzenf. 2 (6) : 176, 1889; King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 113, 1898; Kränzl. in Pflanzenr. 50 : 162, 1911; Holttum, Rev. Fl. Malaya 1 : 393, 1953. *Eria* sect. *Porpax* Benth. & Hook. f. Gen. Pl. 3 : 509, 1883. *Aggeianthus* & *Lichenora* Wight, Icon. 5 (1) : 18, 1851.

The generic name *Porpax* is derived from a Greek word meaning 'the handle of a shield' probably referring to the shape of the lip of the flower. According to E. Cooper (in *Dict. Gard.* 3 : 1646, 1951) the generic name refers to the form of the flower.

Minute epiphytic herbs. *Pseudobulbs* close together form a short rhizome, nearly flat, discoid, covered with reticulately nerved sheaths. *Leaves* 2, usually deciduous. *Flowers* solitary, sessile, terminal, large for the plant. *Sepals* more or less connate below into a tube, free and

spreading above or the dorsal sepal occasionally connate up to half its length; lateral sepals somewhat oblique and prominent at the base, adnate to the column-foot, glabrous or pilose. *Petals* free, short, more or less included within the tube and inserted on the dorsal side of the column. *Lip* short, fleshy, entire or somewhat 3-lobed, loosely articulated on the foot of the column, rarely very minute. *Column* short, terete, extended into a long foot. *Anther* opercular, semi-globose or depressed, 2-celled, each of the loculi falsely 4-celled; pollinia 8, cohering in pairs, one mass in each pair being usually smaller than the other, more or less pyriform. *Capsules* small, ovoid-orbicular.

This is a small genus of about 6 species, distributed through the Malayan Peninsula and tropical Himalayas to south peninsular India and Ceylon.

The genus *Porpax* approaches nearest to *Eria*, but has the habit of *Trias* and the calyx of *Masdevallia*, as has been pointed out by Lindley. It differs from *Eria* in its habit and in the sepals which are formed into a tube.

Type species: *P. reticulata* Lindl.

KEY TO THE SPECIES OF *PORPAX* OF BOMBAY STATE

- Leaves developing after the flowers, obovate-elliptic or spatulate, minutely papillate, more so on margins;
flowers tubular, deep red-brown, glabrous outside,
papillate or pilose within *reticulata*
- Leaves appearing with the flowers, oblong-orbicular,
ciliolate, tessellated; flowers 2-lipped, dirty orange-
brown, densely setulose, almost tomentose outside,
glabrous and smooth within *jerdoniana*

ENUMERATION OF THE SPECIES OF *PORPAX* OF BOMBAY STATE

1. *Porpax reticulata* Lindl. in Bot. Reg. 31: misc. 66, 1845; Cooke 689; Kränzl. 165; Fischer 1422; Blatt. & McC. 268. *Aggeianthus marchantioides* Wight, Icon. 5 (1): 18, t. 1737, 1852, (Hook. f. et Kränzl. *A. reticulatus* per sphalm.). *Eria reticulata* (Lindl.) Benth. & Hook. f. Gen. Pl. 3: 509, 1883; Hook. f. 786; Gammie in Journ. Bombay nat. Hist. Soc. 17: 35, 1906. *Pinalia reticulata* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2: 679, 1891. *Porpax papillosa* Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35: 268, f. 4, 1931; Santapau in Rec. Bot. Surv. Ind. 16 (1): 300, 1953.

Pseudobulbs about 2 cm. across, whitish green, button-like, orbicular, covered with white lacy sheaths of reticulate nerves. *Shoot* 0.5-1 × 0.2-0.3 cm., slightly dilated at the base or not, sheathed; sheath

5 × 3-4 mm., light brown, membranous, crisped, broadly oblong-suborbicular, acute, entire, minutely papillate, glabrous, gland-dotted, many-nerved. *Leaves* very small at flowering, about 5 × 3-4 mm. becoming 5-5.5 × 1.5 cm. later, sheathing, sessile, broadly oblong or obovate-elliptic or spatulate, entire, minutely papillate (papillae more prominent in young leaves), acute or rounded with a minute blackish mucro; both surfaces minutely papillate; the papillae often disappearing in old and mature leaf-surfaces. *Flower* solitary, arising from below the pseudo-bulb from a tube-like structure formed by the young leaves and the sheaths surrounding them; tubular, deep red-brown ("Brazil Red" [Ridg. I, 5-i] according to Santapau), very shortly pedicellate. *Pedice*l with *ovary* 3-4 mm. long, deep red-brown. *Bract* 6 × 7 mm., pale dirty brown, membranous, ± flabellate, suborbicular, retuse, irregularly denticulate, gland-dotted, 1-nerved. *Sepals* united to form a subcampanulate tube, 14 × 6-8 mm., deep red-brown, saccate at base, 3-lobed at the apex, glabrous outside, densely and minutely papillose in regular rows inside; lobes broadly ovate, rounded, mucronulate. *Petals* 8 × 3 mm., deep red-brown, parallel, reaching the sinus of the calyx-tube spatulate, subfalcate, acute, densely and minutely papillose, 3-nerved, rarely indistinctly 5-nerved. *Lip* 5 × 4 mm., panduriform, somewhat arcuate, 3-lobed, toothed at the base, shortly clawed; tooth about 2 mm. long, subulate, acute, entire, rounded at back, shallowly grooved in front; nerves of lip 3; lateral lobes 3 × 2 mm., parallel, erect, broadly triangular, rounded, entire or slightly wavy, minutely and sparsely papillose; midlobe 2 × 3 mm., broader than long, suborbicular, obtuse or subentire, irregularly denticulate, densely papillose. *Column* 2 × 1 mm., oblong, produced below into foot 2 mm. long, curved; clinandrium ± square with 2 longitudinally parallel ridges. *Anther* 1 × 1 mm., broadly oblong with a rounded apiculate apex, seated on top of column and articulated at back. *Stigmatic surface* broad, rounded, oblong; *Capsules* 10 × 6-8 mm., obovoid-orbicular, pale green, ribbed, tumid; stalk 3-4 mm. long.

Leaves: July to October. *Flowering*: June. *Fruiting*: August to October.

Occurrence in Bombay State: W. GHATS: Khandala, Hallberg; Blatt. Herb. 27629; Santapau 743, 823, 2150, 2252, 2620, 2808, 4516, 6930; Kapadia 525; Lonavla, Kapadia 549, 1168-1170. DECCAN: Koina Valley, Kapadia 296. N. KANARA: Chandwar, Ritchie; Yellapur, Kapadia 2237-2239; Sirsi, Sedgwick & Bell 7002; Kumbharwada, Bell 6040; Castle Rock, Kapadia 2822-2823; Anmod, Kapadia 1896-1897; Guddehalli Hill near Karwar, Bell & Sedgwick.

Distribution: Throughout the Western Ghats, Deccan, N. Kanara, Iyamalai Hills, and South Malabar.

Notes : Khandala on the W. Ghats is the type locality of *P. papillosa* Blatt. & McC. We have examined numerous flowers of this plant, and cannot see how we can maintain it separate from *P. reticulata* Lindl. It is true that in the literature we find no reference to the papillate leaves, on which Blatter & McCann lay much stress. Such papillae are quite clear in young fresh plants, but seem more or less to disappear in old, especially dry plants. The lip is said to be ligulate, not panduriform in *papillosa*; but in our collections from Khandala we have always found the lip to be distinctly panduriform when properly spread out. We consider *P. papillosa* to be conspecific with *P. reticulata* Lindl.

2. *Porpax jerdoniana* (Wt.) Rolfe in Orch. Rev. 16: 18, 1908; Kränzl. 163; Fischer 1422; Blatt. & McC. 269, f. 5. *Lichenora jerdoniana* Wight, Icon. 5 (1): 18, t. 1748, 1851. *Eria lichenora* Lindl. in Journ. Linn. Soc. 3: 46, 1859; Hook. f. 787; Gammie 35. *E. jerdoniana* (Wt.) Reichb. f. in Walp. Ann. 6: 247, 1861. *Pinalia jerdoniana* (Wt.) O. Kuntze, Rev. Gen. Pl. 2: 679, 1891. *Porpax lichenora* (Lindl.) Cooke, Fl. Bomb. Pres. 2: 689. 1907.

Epiphytes or lithophytes. *Pseudobulbs* about $10 \times 3-6$ mm., variously shaped, often discoid with reticulately veined sheaths, olive-green. *Leaves* 2, appearing with the flowers, opposite, sheathing at the base, about $1-2 \times 1-2$ cm., oblong-orbicular, retuse or mucronulate, ciliolate; midnerve depressed above, prominent below, lateral ones whitish, beautifully tessellated on a deep green background. *Flowers* 2 or 3 from the centre of the leaves, dirty orange-brown, almost sessile, clearly 2-lipped, densely setulose, almost tomentose, bracteate. *Bracts* about 3×5 mm., transversely oblong-orbicular, membranous, translucent, sparsely gland-dotted, ciliolate. *Sepals* unequal, glabrous and deep reddish brown inside, fleshy, densely setulose almost tomentose, dirty orange-brown outside, with thick margins; dorsal sepal 7×5 mm., broadly obovate-oblong to almost orbicular, obtuse, 3-nerved, concave and forming the upper lip of the flower, united at the base with the lower lip; lateral sepals united to form the lower lip, which is 9×5 mm., concave, connate along the foot of the column, slightly produced below to form a small globular sac. *Petals* $5-6 \times 1-2$ mm. pale yellowish orange, parallel, narrowly linear-oblong, \pm sinuately curved and \pm dilated at obtuse apex, entire, 3-nerved minutely papillate. *Lip* minute, 3 mm. long, subarcuate, \pm mobile on the column-foot, minutely clawed, shallowly lobed, yellowish orange, sides erect; limb very obscurely pandurate-oblong, about 1.5 mm. broad, apical part minutely papillate, with a small obtuse apiculum which is also minutely papillate. *Column* minute, pale yellowish, foot 2-3 mm. long, slightly curved and upturned at apex. *Anther* 1×1.5 mm.,

broadly orbicular, with a minute apiculum; pollinia 8, waxy, narrowly pyriform, apiculate, all equal. *Ovary* shortly pedicellate, densely setulose, about 3-4 mm. long.

Flowering : June to July. *Fruiting* : July.

Occurrence in Bombay State: KONKAN: *Stocks*; *Law*; Tungar Hill, N. Y. Das. DECCAN: Koina Valley, *Kapadia* 2917-2919. N. KANARA, Belgaum Ghats, *Spooner*; Kadra, *Bell*; Anshi, *Bell*.

Distribution : Konkan, W. Ghats of Bombay State, Deccan, N. Kanara: Bababudan Hills, Malabar and Travancore.

Notes : Our plants were found about 2 metres high on a tree trunk; they were directly exposed to the strong monsoon blasts. It may be of interest to point out that Cooke remarks that this species is very poorly represented in Kew herbarium, there being but one specimen with imperfect flowers.

We include this species within the genus *Porpax* with some hesitation. In 1845, Lindley erected the genus *Porpax* with the type species *P. reticulata* wherein the sepals are united in a tube, the lip has a distinct erect slender tooth at the base, and each pollinium pair consisting of an obpyriform and a very narrow linear mass. In this species (*P. jerdoniana* Rolfe) the sepals are 2-lipped, the dorsal and lateral ones united at the very base only; the lip is without a tooth and the 8 pollinia masses are all equal in size and shape.

Lately we have seen very abundant material of this species collected by N. Y. Das on tree trunks at Tungar Hill, at an altitude of approx. 300 m., and 1-3 m. from the ground.

A New Genus, eight New Species, seven New Forms, and Notes on the Lepidoptera of Saudi Arabia, Bahrain, and Iran¹

BY

E. P. WILTSHIRE

(With 4 plates and 3 text-figures)

The previous article in this taxonomic series dealt mainly with Afghanistan and appeared in *Beitrage zur Naturkundlichen Forschung in Sudwestdeutschland* (Karlsruhe) (Bd. 19. H. 3, 1961). The present deals with Lasiocampidae, Nolinae, Lymantriidae, and principally Noctuidae-Quadrifinae from Arabia, Bahrain, and Iran.

The Saudi-Arabian material was mostly collected in Riyadh by Dr. E. Diehl (ED) or in the Eastern Province by A. S. Talhouk (T) for the Bavarian State Zoological Museum (ZM). (In brackets are the abbreviations by which these names will be referred to below.) Some material from Kuwait in my own collection (EW) and from Saudi Arabia in the British Museum (BM) taken by Messrs. D. V. Fitzgerald (DVF), S. Gibbons (SG), McEwan (McE), A. R. Waterston (ARW) and H. St. J. Philby (P), has also been included, together with a few forms from the Hadramaut taken by Mr. G. Popov (GP).

The Bahrain material has been quite recently collected in the island-state of Bahrain, which is only separated by a sea-strait of about twenty miles from the Eastern Province of Saudi Arabia, by L. Aircraftsman D. Rush (DR) and myself (EW). This appears to be the first material from this island, which lies north of the Tropic.

The Iranian material was in part collected by me between ten and twenty-five years ago, and partly more recently for the Stuttgart State Museum (SM), by Herren Richter and Shauffele (RS) or Richter alone (R).

I am particularly grateful to Mr. D. S. Fletcher of the British Museum and to Monsieur Charles Boursin for their aid to me in my researches; also to Messrs. W. H. T. Tams, P. Viette, also Dr. B.

¹ This is the XVIth article in this taxonomic series on the Middle East Lepidoptera. Part XVth appeared in the *J. Bombay nat. Hist. Soc.* 55 (2) : 228-37.

Alberti, and the Stockholm Natural History Museum for the kind loan of some important types.

Family LASIOCAMPIDAE

Beralade gibbonsi Wilts. (comb. nov.)

Lambessa gibbonsi Wilts., 1947, *Bull. Soc. Fouad ler Ent.* 31, Plate Fig. 1.

This species, usually pure white, must be transferred to *Beralade* (which is closely related to *Chilena*); a good series (P) exists in the BM., all except one having the hindwing nervures 4 and 5 stalked as in these two genera, but one having them connate as in *Lambessa*. The interesting aberration described below reveals clearly the affinity to *Beralade* rather than *Lambessa* as its grey markings are oblique as in the former genus. Of the white forms from Arabia in the BM., only one example reveals traces of this oblique forewing stripe; the original *gibbonsi* type did not show it. However, a ♂ labelled Riyadh 1-iii-58 (ED) shows traces of it. The species resembles *pura* Roths. superficially.

grisescens ab. nov. (Plate I, Fig. 4)

Forewing, with a faint grey-brown oblique straight line from the apex to the middle of the hind margin, but reaching neither, and a second, similar but fainter line from the margin below the apex to near the tornus, and with very slight grey powdering along the costa and termen; on the hindwing, a weakly-defined, grey broad marginal border runs from below the apex to the anal angle. Forewing underside, with a grey-brown marginal shade, and with the termen weakly (but more strongly than on the upper side) defined in grey; hindwing, with a similar but less extensive marginal shade, absent from the costa.

Holotype: ♂, Saudi Arabia, Hayir, 27.i-60, ED, ZM.

Note on affinities of *gibbonsi*: Mr. W. H. T. Tams has kindly examined the genitalia of *gibbonsi* from Arabia and of *pura* Roths. from N. Africa and found differences justifying considering them distinct species.

Family ARCTIIDAE

Subfamily NOLINAE

Celama harouni Wilts. *dilmuna* subsp. nov.

The Bahraini race, here named after the ancient name of this island (Dilmun) in Sumerian times, has a more grey-infused, cooler

brown hue than the typical form of Iraq (described in *J. Bombay nat. Hist. Soc.* 49 (4) : 653-4, 1951); the latter extends into Lebanon and Persia. In some Bahraini examples, especially those flying in the desert, where however it is rarer than on oasis-ground, the forewing ground-colour is more whitish and contrasts strongly with the dark bands and scale-patches; this has not been noted in the typical form, but occurs in some examples from Saudi Arabia, Nejd, Riyadh (ED) which have the warmer brown coloration of the typical form.

Holotype: ♂, allotype ♀, and three paratypes ♂ ♀, Bahrain (oasis), 12-ii-61, EW.

Other paratypes: same locality, different dates: 26-xii-59, 9-i-60, 26-i-60, 23-ii-60, 16-iii-61, 16-iv-61, and seven examples bred ex ovo hatched 11-14-v-61 (EW); also other examples from Bahrain (DR) in BM.

The larvae ex ovo fed on *Prosopis stephaniana* and on one or two species of trefoil; fuller details will be given in a later article devoted to larval descriptions and photographs.

The humid maritime climate, with negligible rainfall but heavy dews, of the island of Bahrain may be responsible for a tendency for the lepidoptera there to form races distinguished from the mainland forms by cooler, darker colouring, often verging on melanic, and in some cases smaller size. The melanic tendency is very marked in the Bahrain race of the Noctuid *Cerocala sana* Stgr., and the small size characterises the desert Noctuid *Scotia sardzeana* Brandt the Bahrain form of which is not different in colouring from the typical.

I refrain however from giving these island races new names in the present article, because, in the first case, *sana* is very variable both on the island and on both shores of the Persian Gulf, and in the second case, because I have never thought fit to name a form whose only distinction from others is its small size.

Family LYMANTRIIDAE

Euproctis cervina Moore

Synonyms: *E. pusilla* Moore

E. pygmaea Moore, praecoccupatum by *pygmaea* Walker

dana Swinh., syn. nov.

(nec *pygmaea* Walker)

This species is widespread in N. India and is now proved to occur north of the Tropic in the Persian Gulf. According to Mr. D. S. Fletcher, who has kindly examined the BM. material for me, it is distinct from *E. varians* Walker which is widespread in SE. Asia.

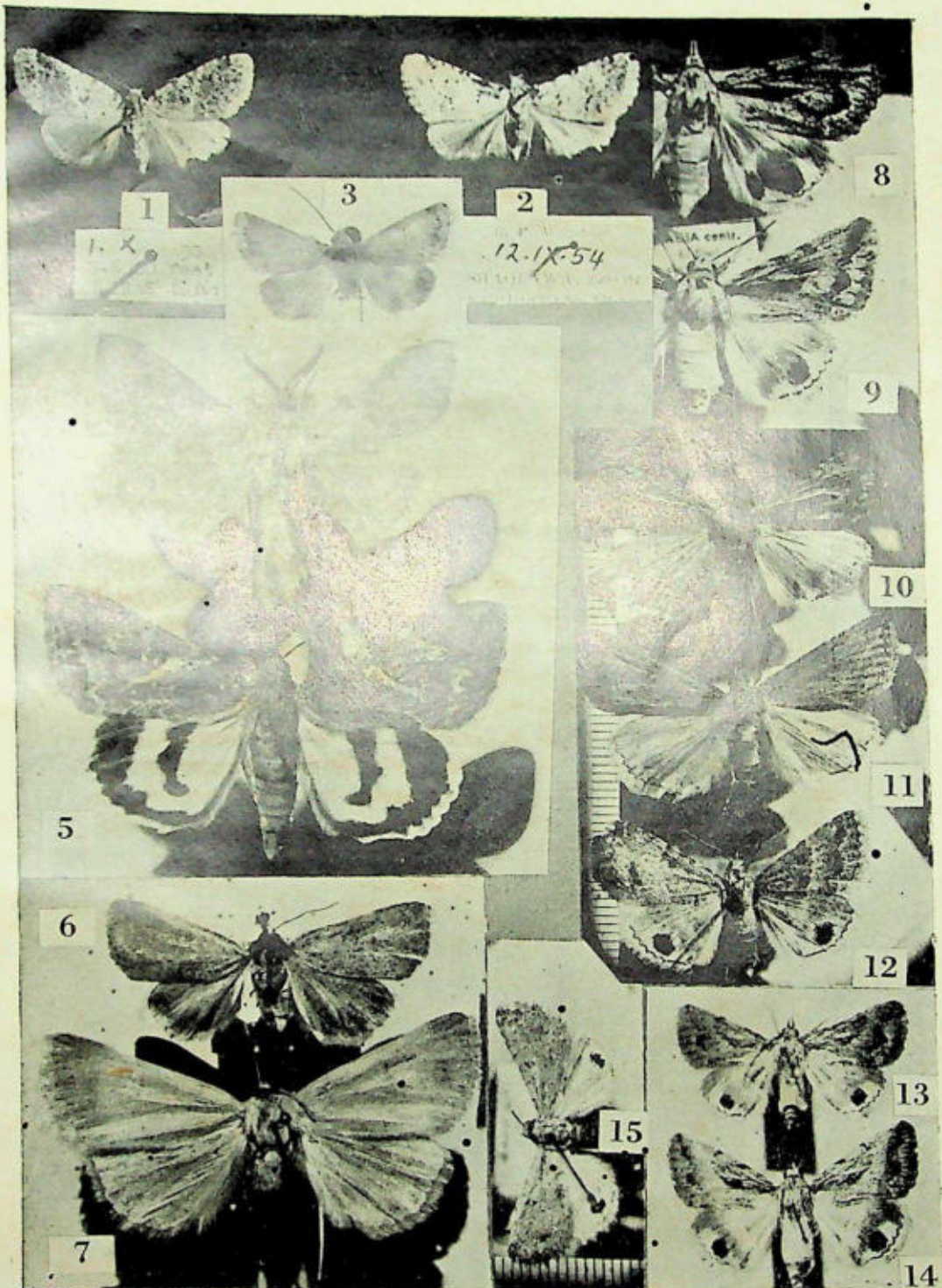


Fig. 1. *Vietrix sassanica* sp. nov. (SW. Iran); Fig. 2. *Vietrix tabora* Stgr. (N. Iraq); Fig. 3. *Armada fletcheri* sp. nov. (SW. Iran); Fig. 4. *Beralade gibbonsi* Wilts. *grisescens* ab. nov. ♂ (Arabia); Fig. 5. *Catocala timur* B.-H. *richteri* subsp. nov. (S. Iran); Fig. 6. *Cryphia polyphaenooides* sp. nov. ♀ (Bahrain); Fig. 7. *Lygephila fereidum* sp. nov. ♂ (N. Iran); Figs. 8, 9. *Anumeta asiatica* sp. nov. (8: S. Iran, 9: Arabia); Figs. 10, 11. *Anumeta arabiae* sp. nov. (Arabia); Fig. 12. *Anumeta sabulosa* Roths. (Arabia); Figs. 13, 14. *Anumeta asiatica* sp. nov. (Arabia) ($\times 5/7$); Fig. 15. *Anumeta atosignata* Walker ♂ (Arabia).

(All enlarged except figs. 13 & 14)

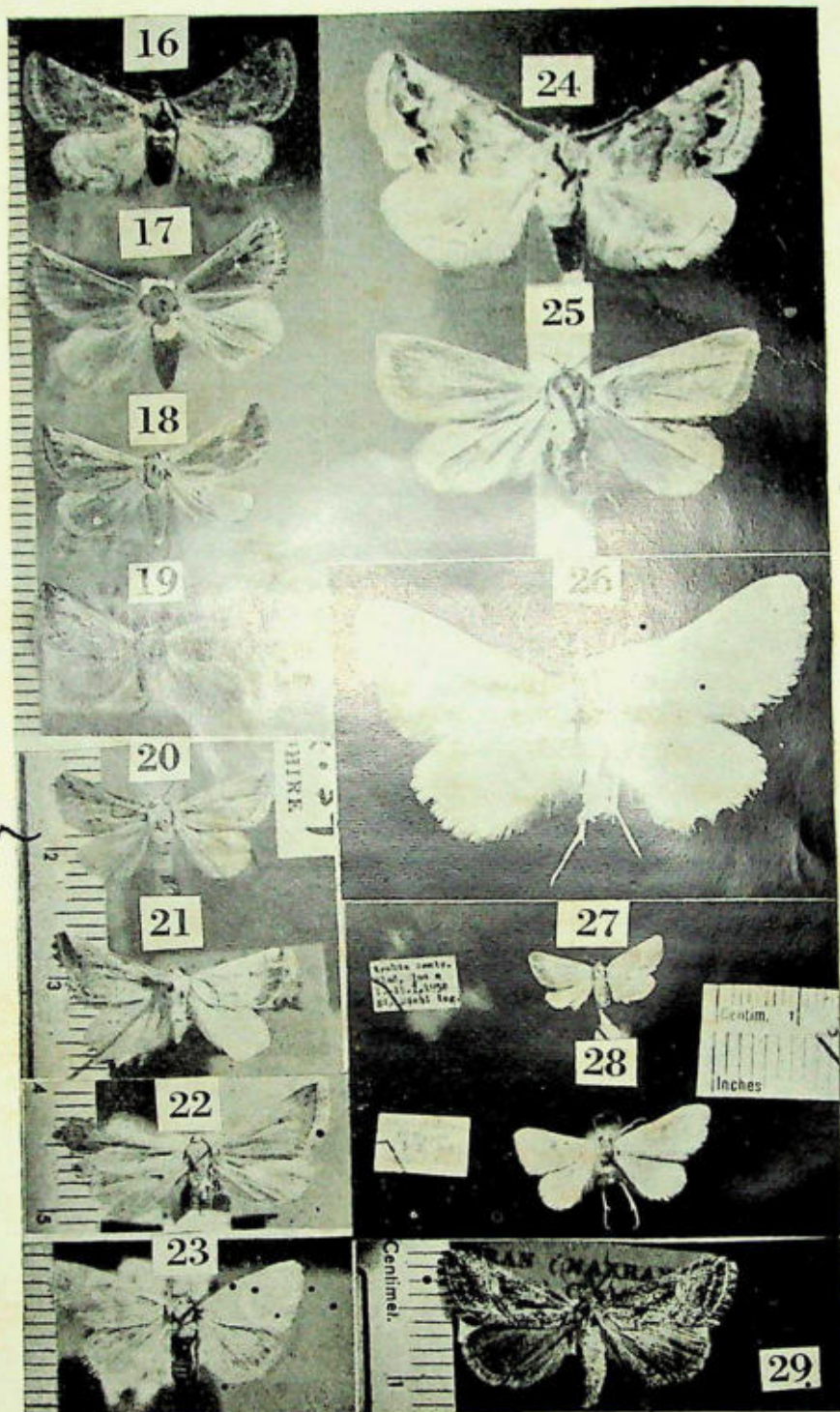


Fig. 16. *Porphyrinia rushi* sp. nov. ♀ (Bahrain); Figs. 17, 18. *Porphyrinia bistellata* sp. nov. (Bahrain); Figs. 19-21. *Porphyrinia pallidula* H.-S. *khalifa* subsp. nov. (Bahrain); Fig. 22. *Porphyrinia pallidula* H.-S. *khalifa* subsp. nov. (SW. Iran); Fig. 23. *Riadhia diehli* sp. nov. ♀ (Arabia); Fig. 24. *Porphyrinia rushi* Wilts. *frigida* ab. nov. (Bahrain); Fig. 25. *Porphyrinia bulla* Swinh. ♀ (Bahrain); Figs. 26, 28 *Antarchaea pyralomima* sp. nov. ♂♂ (28 = holotype) (Arabia); Fig. 27. *Riadhia diehli* sp. nov. ♀ (Arabia); Fig. 29. *Hypenodes orientis* Brandt *richteri* subsp. nov. (S. Iran).

(Figs. 16-23: × 2, 24-26: × 3; 27, 28: × 12/10)

I select as lectotype of *varians* Walker a ♀ from Foo-chow seen by Walker in the British Museum.

Probably *E. charmotanti* Vuillot (Seitz II, Pl. 21, i) is a N. African race, if not a further synonym, of *cervina* Moore.

E. cervina Moore inhabits Bahrain and is there locally common on oasis ground; it may well inhabit the Batina region of Oman and perhaps Qatif and Hofuf, Saudi Arabia.

The first generation flies in Bahrain in mid-March and is larger than the following generations, and often distinguished by grey-infused hindwings; the second flies in late May. A third generation flies in late summer, and is, to judge from a single representative available, the smallest and palest: its span is only 18 mm. No female has been taken yet, but the males are readily attracted to light after dark, or may be taken flying in well-watered date-palm groves at dusk.

The male genitalia of Bahrain *cervina* are illustrated in two figures (Plate III, Figs. 1, 2) herewith, as this may assist students of doubtful *Euproctis* in Africa and Asia; it should however be mentioned that the tail-parts are very three-dimensional and become distorted into variable positions under a cover-glass; this explains the apparent discrepancies between the two figures.

Family NOCTUIDAE

Subfamily TRIFINAE

Vietrix sassanica sp. nov. (Plate I, Fig. 1)

Close to *V. tabora* Stgr. (= *Bryophila tabora*) and more easily distinguished therefrom in the male than the female. The male antenna is more ciliated; the genitalia also differ. Both species have variable but confused markings; the new species is usually darker, with more lead-grey infused forewing than *tabora*; it inhabits the Southern Zagros whereas *tabora* inhabits the Northern Zagros and Anatolia.

Span: 24-29 mm.

Male antenna, with ciliations as long as breadth of shaft; whereas in *tabora* it is only slightly setose.

Male genitalia (see Plate II, Fig. 4): the valve is shorter and slenderer than in *tabora* (Plate III, Fig. 3), but with a more pronounced costal spine at the tip; in the proportionately longer aedeagus, the cornutus is of similar form but slighter than in *tabora*.

Holotype: ♂, (prep. 1133), SW. Iran, Fars, Pireh-Zan, c. 7000 ft. (c. 2100 m.), 1-ix-40, EW. (in coll. m.)

Allotype: ♀, (prep. 1133), SW. Iran, Fars, Kazerun, c. 3000 ft. (c. 900 m.), 4-x-50.

Paratypes: 1 ♂ and 7 ♀♀, same data as holotype; also Fars, Shiraz, 5000-6000 ft. (c. 1500-1800 m.), 18-ix-40, and 30-ix & 1-x-50, EW. (in coll. m.).

This species inhabits hilly steppe and dry mountain sides, whether deforested or wooded, the same is true of its relative *tabora* Stgr. (Plate I, Fig. 2). Both are univoltine autumnal in flight, as is the case with the closely related *marginelota* which inhabits Middle Heights of the Lebanon. Probably this ecology and phenology characterises the whole genus, which has previously been treated as *Cryphia* (*Bryophila*) and *Oedibrya* Hamps. [see Boursin, 1961, *Beitr. naturk. SW-Deutsch.* 19 (3)].

Subfamily QUADRIFINAE

(?) *Cryphia polyphaenoides* sp. nov. (Plate I, Fig. 6)

From all *Cryphia* (*Bryophila*) and related genera easily distinguishable by its coloration: pale grey forewing and dull orange hindwing.

Head and thorax, with neatly adpressed slate-grey, white-edged scales, giving it, under magnification, a smoother aspect than the foregoing and most other *Cryphia* species. Palps otherwise similar. Frons, bulging in a slightly more rectangular form.

♀ antenna, ciliate.

Forewing, comparatively wide and square, but in proportion to the hindwing, similar to other *Cryphia*; pale slate-grey, with faint darker yellowish grey markings mainly in the cell between the stigmata, before the submarginal line, and on the termen. Reniform and orbicular stigmata, vaguely paler; submarginal line, pale and wavy; termen, a series of faint dark spots; other markings, obsolete; fringes grey.

Hindwing, dull orange-brown, infuscated submarginally; fringes dull yellow, chequered with grey.

Undersides, much paler, the forewing being more yellowish than on its upper side and thus less distinct from the hindwing in general colouring.

Span: 30 mm.

In the absence of a male there must remain some doubt whether the generic attribution to *Cryphia* is right.

Holotype: ♀, Bahrain, Adari Pool Gardens, 23-ii-60, EW (in coll. m.)

This appears to be an oasis moth. Lichens and algae (on which *Cryphia* feed) are found on desert vegetation in Bahrain, despite the

low rainfall, doubtless because of the heavy dews and humidity; but no *Cryphia* species has been taken in the desert there.

Porphyria rushi sp. nov. (Plate II, Figs. 16, 24)

A third species in the *P. leucota* Hamps.-*nives* Brandt group, differing from them in habitat and phenology; less white than *leucota*, smaller and with a more crooked but less oblique median-band than *nives*. Probably the Sinai (U.A.R.) form in this group really belongs to *rushi*, not *nives*.

Antenna of ♂, ciliated, with cilia about as long as breadth of shaft; of ♀, simple.

Palp, second joint with pink-brown adpressed scales; third joint, short.

Tongue, fully developed.

Thorax, grey; abdomen, whitish grey.

Forewing whitish marked with slate-grey and orange-brown, or (ab. *frigida* ab. nov.) deep olive-brown. The latter form seems to be due to wet cool weather, and lacks the more normal orange-brown tints; the one example of it which I possess is strongly contrasted, with white and dark grey forewing, rather like *nives*, except that the distal edge of the median band has three irregularly prominent angles; in *nives* these angles are all equally prominent, but in *rushi* the second, on the cell, exceeds the others, thus giving the new species a less straight median band. This band is at right angles to the hind-margin, whereas in *nives* it is oblique. In less strongly marked forms than ab. *frigida* the differences in the median band are not always distinct but in all forms a further criterion is the course of the submarginal line, which in *nives* is acutely inward-angled on nervure 2 only, but in *rushi* is more roundly-indented on both nervures 2 and 3.

There are sometimes two black cell-spots representing the orbicular and reniform stigmata of the forewing; the latter spot is placed distally of the median band.

The basal area of the forewing is mixed with white, grey, and usually orange. The ante-median fascia is grey, suffuse, zigzag, followed immediately by the broad central band which in the normal form is orange-brown. Between it and the wavy, not zigzag, mauve-grey post-median fascia, is a suffused pale slate-grey area; beyond this fascia is an area, wide at the costa, and narrower at the hind margin, orange-brown, or, in ab. *frigida*, deep olive-brown, bordered distally by a wavy white submarginal line, against which, in the bays formed by the mauve-grey submarginal area, are placed a few fine

black spots, variable in number. The grey submarginal area reaches the costa and the hind-margin. Termen, variable, a rather faint pale line, sometimes with a clear wavy brown proximal edge, and always with grey distal spots on the fringe at the nervures, usually producing a grey-chequered fringe with a fine white distal line. Fringe, pale brown distally.

Hindwing, pale whitish, with an almost obsolete grey median band and two parallel distal bands, sharply angled on nervure 2. In ab. *frigida* the cell is infuscated, also nervures 1 and 2 basad. Termen, fine, grey. Fringe, grey, with a white basal line.

Underside, dirty whitish.

Span: 17-22 mm.

Genitalia, ♂, (Plate III, Fig. 5). With uncus and aedeagus as in *leucota* and *nives*. The three species differ in the development of the harpe, which consists of a tongue-like sclerotised projection above a setose angular process, and is widest and longest in *nives*, narrower and shorter but still projecting beyond the process in *leucota*, shorter and hardly projecting in *rushi*.

♀, posterior, apophyses comparatively long and slender, anterior, comparatively short and spatulate; ostium, weak; ductus, chitined above the twist; bursa, with a small field of internal spinules in the central-upper (distal) part, extending over less than half the circumference, (Plate III, Fig. 6)

Holotype: ♂, (Prep. 1064) Bahrain, nr. Amar, southern desert, 27-ii-60, DR. (in coll. EW).

Allotype: ♀, Bahrain, same locality, 24-iv-60 (EW).

Ab. *frigida* type: ♂, Bahrain, Sakhir desert, 14-iii-61 (EW). (Plate II, Fig. 24)

Typical paratypes: ♀, same data as holotype, DR, in BM.

Saudi Arabia, Eastern Province, ♀ (Prep. WM. 139) Hofuf, 25-ii-57, T., and ♂, ditto, 15-iii-57, T. (ZM).

In Bahrain this species is a univoltine vernal species inhabiting limestone desert with a slight sand cover in places, the vegetation consisting of grasses and a rather varied association (*Lycietum-Helianthemetum*).

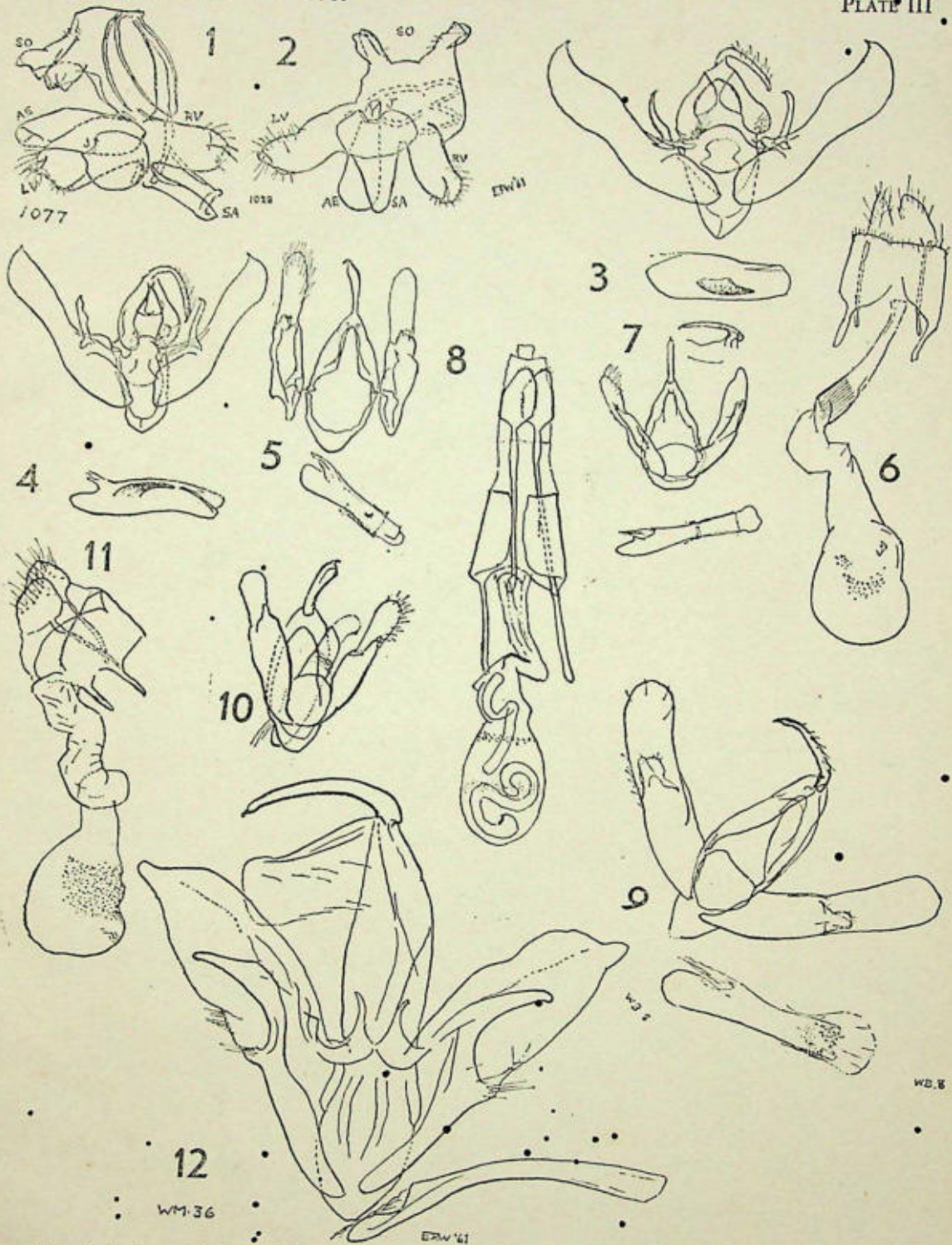
Porphyrinia bistellata sp. nov. (Plate II, Figs. 17, 18)

Antenna, of ♂, strongly ciliated; of ♀, sparsely ciliated.

Tongue, absent or vestigial.

Thorax, grey; abdomen, light grey.

Forewing, with straight costa, fairly pointed apex, and semi-circular outer margin, paler or darker slate-grey, occasionally streaked narrowly



WB.8

Figs. 1, 2. *Euproctis cervina* Moore. ♂ genitalia ($\times 23$) two views: 1: with tegumen viewed laterally, 2: with tegumen viewed ventrally. (AE = aedeagus; LV = left valve; J = juxta; RV = right valve; SA = saccus; SO = socii, on tegumen); Fig. 3. *Vicatrix tabora* Stgr. ♂ genitalia ($\times 15$), open ventral view aedeagus separated; Fig. 4. *Vicatrix sassanica* sp. nov. ♂ genitalia ($\times 15$), open ventral view with aedeagus separated; Figs. 5, 6. *Porphyrinia rushi* sp. nov. genitalia ($\times 15$): 5: ♂, open ventral position with valves semi-detached and aedeagus separated; 6: ♀ ventral view; Figs. 7, 8. *Porphyrinia bistellata* sp. nov. genitalia ($\times 15$): 7: ♂, open ventral position with aedeagus separated, and uncus also shown in lateral position on right; 8: ♀ ventral view; Fig. 9. *Porphyrinia pallidula* H.-S. race *cypriaca* Stgr. Type ♂ genitalia ($\times 23$), open ventral position with aedeagus separated; Figs. 10, 11. *Porphyrinia bulla* Swin. genitalia ($\times 15$): 10: ♂, ventral view, left valve shut, right valve open; 11: ♀, ventral view; Fig. 12. *Catocala timur* B.-H. *richteri* subsp. nov. ♂ genitalia ($\times 15$), ventral open position, with aedeagus separated.

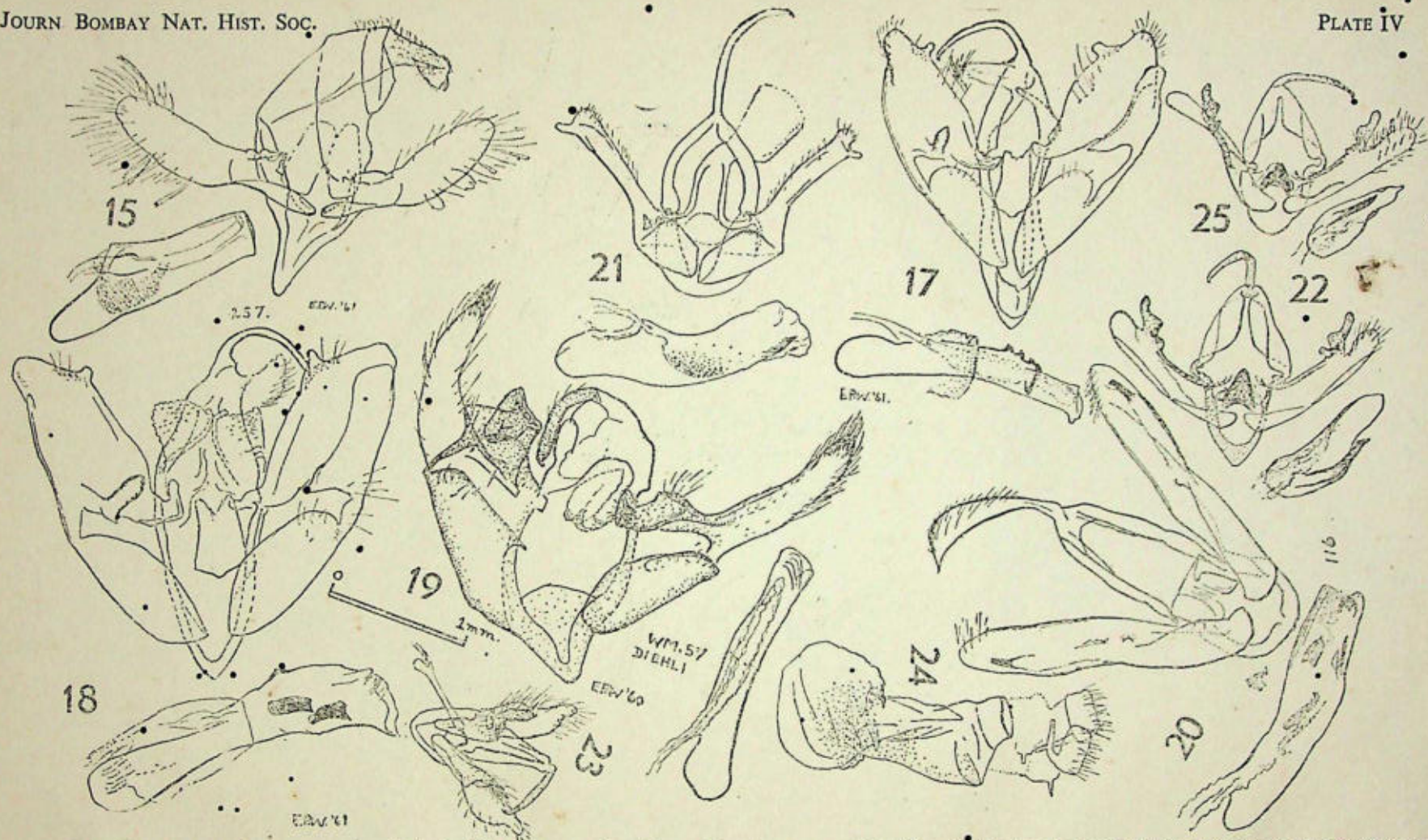


Fig. 15. *Anumeta arabiae* sp. nov. ♂ genitalia ($\times 23$), open ventral position with aedeagus separated; 17: *Armada* ♂ genitalia ($\times 15$), open ventral position with aedeagus separated; 18: *dentata* Sigr. (Type). Fig. 19. *Riadhia diehli* gen. nov., sp. nov. ♂ genitalia ($\times 23$), open ventral position, with aedeagus separated, Fig. 20. *Lygephila fereidun* sp. nov. ♂ genitalia ($\times 15$), open ventral position with aedeagus separated; Figs. 21-25. Hypeninae genitalia ($\times 15$): 22: *Rhynchodontodes orientis* (Brandt) *richteri* subsp. nov. ♂, ventral open position with aedeagus separated; 23: *Hypenodes (Schrankia) balneorum* Alph. ♂, ventral view, with left valve shut, right valve open; 24: *Rhynchodontodes orientis* (Brandt) *richteri* subsp. nov. ♀, ventral view; 25: *R. orientis* (Brandt) Type ♂, open ventral position, with aedeagus separated.

with paler colouring along the costa; in one exceptionally light example (from Hofuf) a light brown tint invades the whole wing replacing the grey, but usually only the submarginal area is light tawny brown. Termen, a brown line, sometimes black-spotted on the nervures, with a white distal edge at the base of the fringe, which is grey-brown. Reniform stigma, represented by two diffuse, whitish star-like points, placed one above the other, and often united. A black oblique apical streak is continued in an almost straight line to near the tornus, sometimes as an interrupted series of black intra-neural spots; even in the pale brown form, this oblique streak is indicated in darker brown.

Hindwing, paler costad and basad, dull grey; fringe, slightly paler. Underside, pale grey with a brassy metallic sheen, more yellowish on the costa; apex and fringe, usually darker brown.

Span: 14-25 mm. (but nine out of ten are between 19-22 mm.).

Genitalia, ♂ (Plate III, Fig. 7): The uncus, in ventral view appears not to taper, having a spine-like tip protruding from an apparently roundly truncated end; but in profile or lateral view (Fig. 7 top right) this character is less pronounced. The aedeagus is without even the smallest cornutus. ♀ (Plate III, Fig. 8): bursa, with two narrow bands of internal spinules, the upper (near the distal end) being narrower and with stronger spinules; the lower (just below the centre) slightly wider, less dense and with weaker spinules.

Holotype: ♂, (Prep. 1069) Bahrain, nr. Amar, southern desert. 21-iii-60, DR. (in coll. EW).

Allotype: ♀, and three paratypes, both sexes, same data, in coll. DR. in BM. & in coll. EW.

Other paratypes: 1 example, Arabia, Marrat, 6-iii-35, P. (BM.); 3 examples, (2 ♂, 1 ♀) Saudi Arabia, Eastern Province; Hofuf, 30-iii-57, T, and Abqaiq, (Prep. WM. 105) 24-iv-57, T. (ZM.). Also 12 examples, same place as holotype, 5-iv-61, and 1 ♀, 5-x-61 (EW), in coll. EW.

This new species may be placed between *pallidula* H.-S. and the African species *arenostrota* Hamps. and *penicillata* Hamps. From all of these it can be superficially distinguished by the two whitish points which none of them possess. From the *pallidula* forms, the male uncus, and the narrow central band of minute spines on the female bursa of *pallidula* subsp. *khalifa* (see below) are structural criteria. *P. pallidula khalifa* actually flies with *bistellata* in Bahrain but is commoner, less local, and has more generations; as well as lacking the

two white points, it lacks the oblique apical streak of *bistellata*. *P. penicillata* may also be distinguished by the blackening of its subcostal field and median area; *P. arenostrota* is also distinguished by a pale suffused tawny streak along its forewing median nervure, spreading as far as the submarginal area.

***Porphyrinia pallidula* H.-S. subsp. *khalifa* subsp. nov.** (Plate II, Figs. 19-22)

From the northern subspecies, comprising the typical *pallidula* H.-S. (Transcaspia) and also the forms *cyprica* Stgr., (Cyprus, S. Turkey, and Lebanon) (the ♂ genitalia of a type of which are shown in Plate III, Figure 9) and *griseola* Ersch. (Central Asian Mountains), I now distinguish a southern subspecies inhabiting Arabia, Bahrain and the lower elevations of south Persia. I no longer consider the latter group of forms representative of typical *pallidula* H.-S. and have renounced my intention of selecting a lectotype from among them. Instead, I propose to describe them under a new name on morphological and distributional grounds.

The new subspecies is smaller than the northern subspecies on the average; the male vesica is less spiculated; its forewing termen is usually an interrupted line. The colouring varies greatly with season and locality. It seems already possible to distinguish two races belonging to the subspecies, and perhaps when a series from more localities collected all the year round is obtained, it may be possible to distinguish more than two. At present fewer examples are available from Saudi Arabia and S. Iran than from Bahrain, which is the typical locality of the new subspecies.

Race *khalifa*: varies from whitish through pale brown and orange-brown to dark slate-grey, the darker forms appearing in winter and spring, the paler in summer and autumn, on the whole. In the darker, the termen remains a clear white line with a dark grey proximal edge interrupted at the nervures; in the paler, the proximal edge consists of a series of light brown spots. The markings are very variable; two dark cell-spots are usually marked, the reniform stigma being represented by a larger circular spot than the fine point-like orbicular; the post-median fascia is often absent even in the darker forms, and is always less clear than these two points; when marked it is outlined in smoky grey and curves round the cell and thence runs straight to about the middle of the hind-margin.

Hindwing: dirty grey-brown, rarely paler.

Span: between 12 mm. and 18 mm., the largest forms usually appearing in winter and early spring and having darker colouring.

Holotype: ♂, (Prep. 1024) Bahrain (desert), 26-ix-59.

Allotype: ♀, Bahrain same date. (Plate II, Fig. 20)

Paratypes: ♂ (Prep. 1071) Bahrain (oasis), 28-ix-59; 2 other examples, same data as holotype; 2 examples, Bahrain (desert), 5-xii-59; 1 ♂, Bahrain, Rifaa, (desert), 1-i-60; 4 examples, Bahrain, Jurdeh (desert) 19-ii-60 (one is shown in Plate II, Fig. 19); 2 examples, ditto, 17-ix-60; 3 examples, ditto, 19-ii-61; all the above were taken by myself and are in coll. m. except two which have been presented to the Zoological Museum, Humboldt University, Berlin; other paratypes with similar data are in coll. m., including ♂, Prep. 1022, Plate II, Fig. 12 in my previous article (1961) and again in this article, Plate II, Fig. 21; others, DR, from Bahrain, are in BM.

Race *nejdi* f. *nova*

This form is slightly larger than typical *khalifa* and is more whitish and pale brown, with a tendency to grey streaking along the cell, and no trace of post-median fascia; the orbicular stigma is not marked by any black point, but the reniform is indicated by a greyish streaky cloud. The hindwing is also paler than the average typical. An oblique apical shade on the forewing is usually defined in light brown with a whitish proximal streak. The termen is light brown.

The hardly spiculated vesica makes this form belong to the Bahrain subspecies rather than the more northerly.

Span: 19-22 mm.

Holotype: ♂, Saudi Arabia, Riadh, 13-ii-60, (ED), (Prep. WM. 79), in coll. ZM.

Paratype: ♂, ditto (Prep. WM. 104) ditto.

Paratype: ♂, ditto, ix-58.

The following may belong to this race or to a third; at present the available material is insufficient for one to be sure: 1 ♂, Iran, Khuzistan, 18 km. north of Shadegan, Jarrâhi River Bank district, 28-iii; 6-iv-56, R.S., in coll. S.M. (Plate II, Fig. 22) (Prep. WM. 74).

For genitalia of both sexes of this new subspecies of *pallidula* H.-S. see Figs. 14 & 18 of my preceding article; also see Plate III, Fig. 9 for *Cyprus* race.

As regards *griseola* Ersch., illustrated in my preceding article, I do not consider it specifically separable from *pallidula* H.-S., despite Erschoff's opinion given in his description; and indeed most European

museums have had difficulty in distinguishing these two. As I explained in the previous article, for years in the British Museum the *pallidula* forms were correctly named but under *griseola* were placed a series of *conistota* Hamps. forms; this error however has now been corrected. In Russia, it is clear, from specimens sent recently to the British Museum as '*griseola*' emanating from Transcaspia, that the name *griseola* is there applied to a species also common in the mountains of Iran (Persia) from Elburz to North Fars; its forewing varies from yellowish unmarked to greyer with post-median fascia marked. My conclusion is that *griseola* Ersch., as originally described from a single grey specimen from the high mountains of Alai (Kokand) and another specimen from N. Persia (Astrabad), is possibly a good race of *pallidula* in Alai but elsewhere in the range of this species is a frequent aberration analogous to the darker forms of Bahrain. I have been informed by Dr. Alberti that the types of *pallidula* H.-S. (described from Syr-Daria Trans-Caspia) are no longer existent, either in Berlin or Halle; and I therefore select as lectotype of *pallidula* H.-S. the yellowish example from Nukus, Transcaspia, sent as '*griseola*' by the Leningrad Museum to the British Museum, London. This selection stabilises the two names as a conspecific unit.

***Porphyrinia bulla* Swin. (= *P. tomentalis* Rebel syn. nov.) (Plate II, Fig. 25)**

The other common *Porphyrinia* species of the desert of Bahrain may be mentioned here, as it occurs elsewhere and its oldest name has been overlooked. It is a true desert moth but sometimes also flies in palm-gardens (oasis). It is widely distributed, as it ranges from near Karachi, whence Swinhoe described it, at least to Egypt, whence Rebel posthumously described it in 1948. The male genitalia were shown in Fig. 39 of the LEPIDOPTERA OF EGYPT (1948, EW); the uncus is characteristic and there are one or two linked minute cornuti in the aedeagus. A larger figure may be useful, and is given herewith (Plate III, Fig. 10): two convergent dorsal ridges on the uncus are responsible for its club-like aspect; their presence is not always easy to discern unless several preparations are made. Swinhoe's type has become dingy with age; however it exists in the BM., and Mr. Fletcher has kindly made a preparation of its genitalia, which are recognisable and agree with those of the Bahraini and Egyptian forms. The ♀ genitalia are characterised by a wide field of small spicules inside the bursa; this field does not, however extend round

Page 618, line 17: for 'lectotype', please read 'neotype'.

the whole circumference; the posterior apophyses also are more than twice as long as the anterior (see Plate III, Fig. 11). The moth varies greatly in size and facies; a few summer and autumn forms may have plain glossy white or yellow forewings; but most commonly, and especially at other seasons, slightly striated forms, of a powdery or sandy appearance are to be taken; these have one or two black spots in the forewing cell usually and sometimes are peppered submarginally with black or grey scales between the nervures. The termen is never defined and there are no cross-lines. Two examples from Riyadh (ED, ZM): ♂, 3-ii-58, Prep. WM. 86 and ♀, 11-iii-58 (Prep. WM. 107) have been taken and show that this moth inhabits Saudi Arabia, as indeed was to be expected once its synonymy with *tomentalis* Rebel from Egypt was established.

Catocala timur B. H. *richteri* subsp. nov. (Plate I, Fig. 5)

The forewing agrees perfectly with British Museum's series of *timur* Bang-Haas (Transcaucasia), but the hindwing is paler pink, with an orange tint, and not (as in typical *timur*) pink as in *C. puerpera* hindwing; another difference in the hindwing is that the apical pale patch (outer edge of the black border) is more pronounced; in fact the hindwing is almost exactly the same as in *C. neglecta* Staud. but the forewing is quite different from that.

The genitalia of the male are shown in Plate III, Fig. 12.

Holotype: ♂, (Prep. WM. 36), allotype ♀, and paratypes 23 ♂♂ and 3 ♀♀, S. Iran. Iranshahr, 800 m., 12-iii-30-iv-54, R. (in coll. S.M., ZM, EW).

Anumeta asiatica sp. nov. (Plate I, Figs. 8, 9, 13, 14)

This large and handsome form is closely related to *spatzi* Roths. 1915 and *major* Roths. 1913 and perhaps is no more than a subspecies of one of them, if in fact they are distinct. Owing to uncertainty on this point, I introduce the new form as a separate species, provisionally.

The type of *major* is a ♀ and there are no topo-typical ♂♂ in the British Museum collections. The type of *spatzi* is a ♂; there is in the Tring Museum a ♀ attributed to *spatzi*; this proves to have similar genitalia to the *major* type, according to Mr. D. S. Fletcher, who kindly investigated the typical material.

The Arabian-Iranian form is very variable; more material of it is available than was ever taken either of *spatzi* or *major*. It resembles *spatzi* in markings, but most examples resemble *major* in size and colour. The markings which appear to me, from my own inspection

of the types, to distinguish Rothschild's two forms from one another are:

	<i>spatzi & asiatica</i>	<i>major</i>
forewing, post-median fascia	bent distally tight round cell	more gently curved distally and inwards to nervure ²
hindwing spot	compact and almost circular	more diffuse, less circular

The differences of thorax-colouring given in Draudt-Seitz do not enable one to consider the Asiatic form as one or the other, but the same author's statement that the black hindwing spot is free in *major* but in *spatzi* merges with the brown band, would indicate that *asiatica* belongs to *spatzi*.

Antenna: ♂, with cilia shorter than breadth of antenna; ♀, simple.

The forewing ground colour is white widely overlaid with yellow-brown and purple-brown scales, less widely with black. The post-median fascia is not always clearly defined. The nervures may be defined with black and white scales, and a series of intra-neural black wedges is usually present on the termen. Fringes, brown. There is a very conspicuous wedge-shaped black basal streak below the median nervure, and sometimes the median area between this and the costa is filled with black. The ante-median fascia is only clear on the costa; usually the costa is sprinkled with white between the black spots marking the post-median fascia, and the apex.

The hindwing is white, but in the ♀ this colour only appears as a 'window', narrow at the anal angle and wide at the middle of the outer margin, on either side of the black spot between the submarginal band and the termen; the rest of the wing in that sex is brown-suffused; in the ♂ the white colour also appears proximally of the wide brown submarginal band to a variable extent. Termen, wavy, brown. Fringes, white in both sexes.

Span: ♂♂, 40-45 mm; ♀♀, 40 mm.

Male genitalia, (see Text-fig. 13): uncus, stout, very slightly arched, of uniform thickness from base to the truncate end from the middle of which projects the typical down-pointed fine tip; valve, without neck, of more or less uniform thickness, with evenly-rounded end; costa of valve, studded with many enlarged setae; near the ventral

border on the inner side, a setose ridge parallel to that border runs to the valve tip. Saccus, short. Aedeagus, sclerotised, cylindrical, the *ductus seminis* entering near the proximal end which is sub-rectangular; of uniform thickness for 2/3 of its length, then narrower for the distal 1/3. Vesica, with a chitinous plate, usually placed obliquely, shorter than diameter of the aedeagus at its broadest.

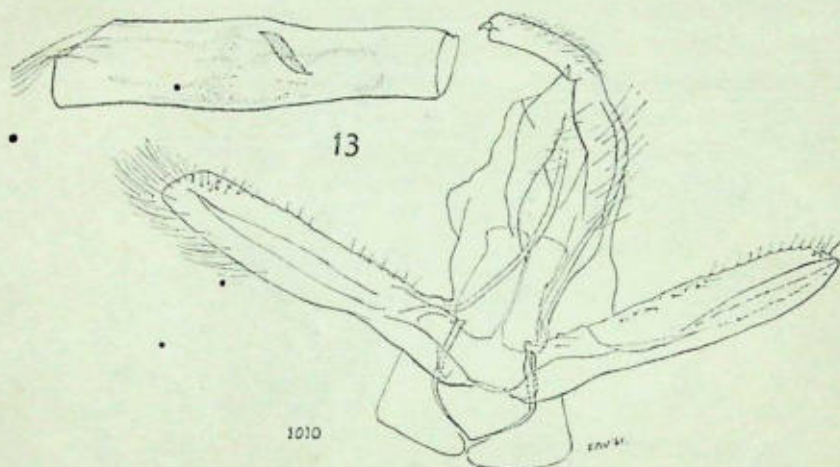


Fig. 13. *Anumeta asiatica* sp. nov. ♂ genitalia ($\times 15$), open ventral position, with aedeagus separated

Female genitalia: anterior and posterior apophyses of about same length; ostium, not sclerotised; ductus, sclerotised and widening from ostium to top of bursa, whence *ductus seminis* leads off; bursa, long, sac-like, lacking internal spines, but uniformly stippled or roughened.

Ovum: To the abdomen of one of the ♀ paratypes adhere a number of ova, due to injury; they are bun-shaped (i.e., circular in horizontal section, and semi-circular in vertical section) with strong sculpture in the form of lines convergent apicad.

Holotype: ♂, S. Iran, Khuzistan, Ahwaz, c. 400 ft., 26-v-38, EW, in coll. m.

Allotype: ♀, Arabia, Nejd, Riadh, xi-58, ED, in coll. Muenchen.

Paratypes: 2 ♂♂, (Prep. 1010) Kuwait, desert, 2-v-43, EW; also one ♀, same data as holotype; all in coll. m.

5 ♂♂, 4 ♀♀, Arabia, Nejd, Riadh, same date as allotype, or 2-14-vii-58, ED, in coll. Muenchen.

1 ♀, (Prep. 1010 L) same data, in coll. m.

2 ♂♂, 2 ♀♀, SE. Iran, Iranshahr, iv-54, R. (in coll. Stuttgart)

Anumeta eberti Wilts. *zaza* subsp. nov.

Of this large species, described and illustrated in the preceding article from the deserts of southern Afghanistan, a more variable form inhabits the most inhospitable wastes of southern Arabia. It resembles the typical in size and pattern elements, also in genitalia (see Text-fig. 14), but the colouring is variable, with apparent sexual dimorphism. The ♀♀ have the forewing suffused completely with sienna-brown; the ♂♂ on the other hand usually have a whitish suffusion beyond the post-median fascia against which the nervures appear darker; the post-median fascia and submarginal line are finely edged distally with paler scales and with a series of isolated white points.

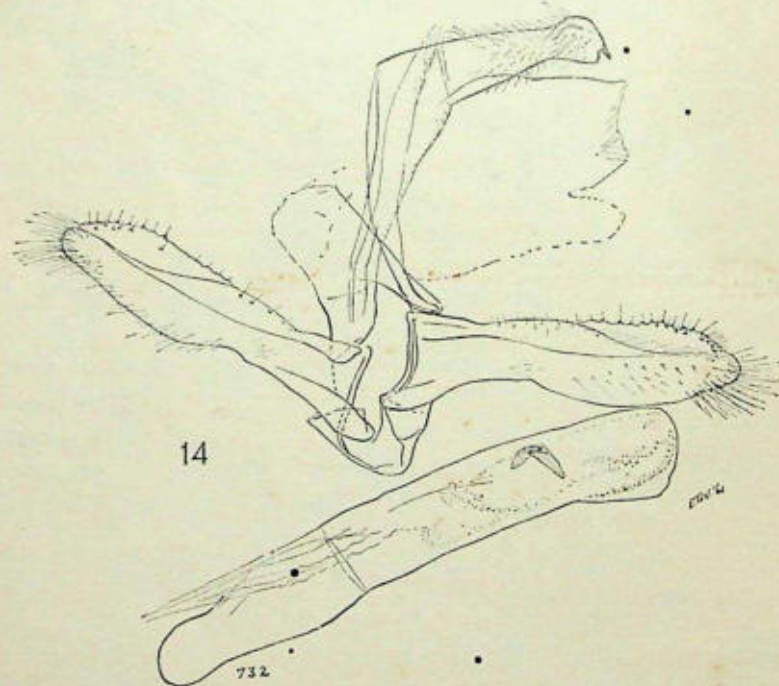


Fig. 14. *Anumeta eberti* Wilts. *zaza* subsp. nov. ♂ genitalia ($\times 15$), ventral open position, with aedeagus separated

Holotype: ♂, (Prep. 732) South Arabia, Sawada, 12-ii-52 (Leg. G. Popov) in coll. m. (EW).

Allotype: ♀, (Prep. BM. 2976) South Arabia, Rub' al Khali, waterless part, Hadhat Hawaya, 28-ii-33, P. (BM).

Paratypes: 1 example, Hadramaut, 17.05 N., 43.30 E., Arq Zaza, ii-52 (Leg. G. Popov) and 3 examples, same as holotype, in coll. m. (EW). Also 5 examples, same as allotype, P. (BM).

Anumeta arabiae sp. nov. (Plate I, Figs. 10, 11)

This form was first taken at Hail in 1944 by A.W. and subsequently in the Dahana in 1946 by others of the Middle East Antilocust Units under Dr. B. P. Uvarov. Examples of this first series were deposited in the British Museum and coll. m. (EW), and I reported in my article on Arabian lepidoptera of 1952 the species under the name *dentistrigata* Stgr. a central Asian species, as its genitalia (Prep. 257) did not seem to differ from Oscar John's figure of the typical *dentistrigata*.

I now feel it should be considered as a distinct species from Staudinger's; it is less robust, and more obscurely marked on the whole than the typical *dentistrigata* or than its dull, pale yellowish race, subsp. *languida* Warren. The long series (ED) shows it is very variable in colouring.

The male is the larger sex. In colour the sexes are not characterised from one another. The ♂ antenna is profusely ciliated (length of cilia twice breadth of shaft), the ♀ antenna barely setose.

Thorax and forewing, yellow-brown more or less suffused with white, black and fuscous scales. In some dull forms the general hue is dull yellow-brown slightly infused with darker grey; in these the forewing fasciae may be distinct but more often are obsolete. The black markings in some forms are concentrated to form costal spots, streaks in the cell, to delineate proximally the ante-median and post-median fasciae (which are often delineated distally with a pale edge), to darken the median area, particularly below the median nervure, to form a sub-marginal shade running from the apex in an irregularly wavy course towards the tornus, and to form a series of intra-neural terminal crescents; in the obscure forms where few of these markings stand out, black scales are scattered generally over the forewing. In some forms whitish or pale grey scales are concentrated along the cell and sub-costally almost to the apex, also to form four white costal spots beyond the post-median fascia; the median nervure in some forms is quite outstandingly pale.

Hindwing, whitish, more or less suffused with smoky brown sometimes on the disco-cellular (to form a crescent cell-spot), more often along the nervures and often also to form a variable submarginal band. Termen, brown, variable; in some forms an inner, finely wavy

dark terminal line can be seen; in others only a series of dark intra-neural spots. Fringes, whitish.

Underside whitish, usually only slightly sprinkled with grey and brown terminad; on both wings the cell-spot is sometimes indicated; termen of hindwing, sometimes marked as in forewing.

Span: ♂, 35-38 mm.; ♀, 31-35 mm.

Male genitalia (see Plate IV, Fig. 15): Proportionately small and characterised by several scent scales attached to each valve, some being remarkably broad. Uncus, short, slightly arched, stout with fine down-turned tip, slightly constricted in the centre, the tip projects from about the middle of the truncate end of the uncus; valve, with a more sclerotised basal neck, thereafter wider and of uniform thickness and less sclerotised, with regularly rounded end. The larger setae of the valves are not concentrated or numerous; two or three widely-spaced enlarged setae are placed along the middle of the inner surface of the valve in a row parallel to the costa; some others, slightly smaller, are on the ventral border. Sacculus, deep, tapering. Aedeagus, cylindrical but enlarged immediately distally of the entry of the *ductus seminis*.

Female genitalia: Posterior and anterior apophyses of about equal length. Ostium, membranous; ductus bursae sclerotised near ostium. Bursa, membranous, long-oval, without signum but with a central field of internal minute spines reaching to the bottom, anterior, end, but not extending over the whole circumference.

Holotype: ♂, (Prep. 257) Arabia, Nejd, Dahana, Awania, 19-ii-46 (McE) in coll. British Museum, London.

Allotype: ♀ central Arabia, Nejd, Riadh, xi-58, ED in coll. Muenchen.

Paratypes: 7 ♂♂ and 4 ♀♀, central Arabia, Nejd, Riadh, xi-57, i, & ii-58, ED, ZM; 1 ♂ & 1 ♀, same place and captor, 27-i and 10-iv-58, coll. mea. Also 2 ♂♂, same place and captor, summer 1958, 700 m., and 1 ♂ Eastern Arabia, Hofuf, 25-ii-57, T; ZM and 2 ♀♀, central Arabia, Riadh, 23-iii-58, & ix-58, ED, ZM. Other paratypes in coll. mea. or BM are labelled: Arabia, Hail, 17-i-44, ARW; Hinna, xi-46, McE.; and Dahana, ii-46, DVF & SG.

Anumeta atrosignata Walker (Plate I, Fig. 15; Text-fig. 16)

I take this opportunity to illustrate this species, which some authors, following Warren-Seitz, have wrongly regarded as synonymous with *spilota* Ersch. and *harterti* Roths. These last two are indeed very close together but *atrosignata* is not like them at all but more

resembles *A. sabulosa* Roths., and *arenosa* Brandt without being identical with them.

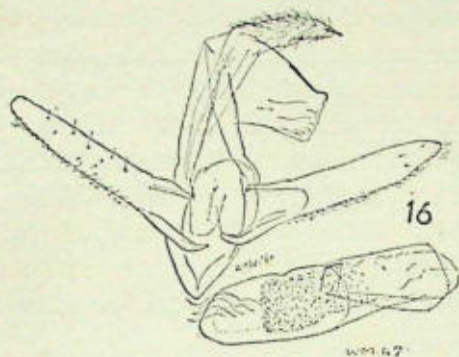


Fig. 16. *Anumeta atrosignata* Walk. ♂ genitalia ($\times 15$), open ventral position, with aedeagus separated.

Walker's type of *atrosignata* from India still exists in the British Museum which also possesses a similar example from Arabia. Now a further Arabian example has come to hand, taken at Riyadh, xi-58, ED, Prep. WM. 47, and is here illustrated.

A. sabulosa Roths., a more strongly marked and darker species, was also taken at Riyadh, 21-vii-58, ED, ZM, (Plate I, Fig. 12).

A revised list, therefore, of the *Anumeta* species of Arabia is as follows:

- A. asiatica* Wilts.
- A. eberti zaza* Wilts.
- A. arabiae* Wilts.
- A. atrosignata* Walker
- A. sabulosa* Roths.
- A. cestis* Men., Nejd & Jebel Shammar, ii-iii-46, DVF & SG, in coll. mea.
- A. straminea* B.-H., Riyadh, xi & xii-59 & 1-i-60, ED, ZM.
- A. surcoufi* Dumont, Riyadh, 28-iv-59, ED, ZM, Hadramaut, leg. Popov, coll. mea.
- A. fractistrigata* Alph., Nejd & Jebel Shammar, ii-iii. 46, DVF, & SG, coll. mea.
- A. spilota* Ersch. (? f. *harterti* Roths.), Riyadh 18-iii-58, ED, ZM ; Abqaiq, 6-iv-57, T, ZM ; Trucial Oman & Bahrain, EPW.

It is not yet possible to give a final opinion on the status of these last two names.

Armada fletcheri sp. nov. (Plate I, Fig. 3)

Smaller, more uniformly rosy-brown than the genotype *Armada dentata* Stgr., to which its male genitalia show it is closely related. Only one example is known, and the forewing of this lacks the infuscated median area, edged with black fasciae and boldly contrasting with the white area on either side, typical of *dentata*, but this criterion may be unreal and due to rubbing. Instead of two fasciae the hind margin shows traces only of a single cross band, apparently representing the median shade. Submarginal line, with black denticulations, much as in *dentata*. Hindwing: similar to *dentata*, but band and cell-spot weaker and more suffused. Until a better preserved example is taken the species must be distinguished principally by its genitalia.

Span: 21 mm.

Male genitalia: the characteristics which *dentata* and *fletcheri* have in common are a normal, slender uncus, with pointed tip; a juxta longer than wide, wider at its base, or proximal border which is obtusely angled; asymmetrical valves of more or less equal size, with a symmetrical small digitus on the costal extremity, and an asymmetrical thumb-shaped harpe (on left valve only); the extension of the sacculus is more developed on the right valve; an aedeagus with a distally sclerotised dorsal wall, the sclerotisation being differently developed in the two species but in both tending to form thorn-like excrescences. The new species differs in the form of the valve end (as illustrated in Plate IV, Figs. 17, 18), in the smaller harpe, and particularly in the aedeagus of which the dorsal sclerotisation forms three thorns close to the tip, while in *dentata* there is only one thorn, further back (i.e. more proximal) and less sharp; in *dentata* there are two internal chitinous plates of equal size, almost of cornutus-form, while in the new species there is nothing of the sort.

Holotype: ♂, SW. Iran, Khuzistan, Ahwaz, [c. 200 ft. (60 m.)], 21-x-38, EW.

A revision of the genus *Armada* and its related genera based on the characters of the male genitalia is in preparation and will, it is hoped, appear shortly. This group of genera may be called a tribe: Armadini, and the new genus described hereunder, *Riadhia*, may be placed in it close to *Armada* and *Asplenia* Hamps. Other genera in the tribe are: *Metoponrhis* Christ., *Acrobyla* Rebel, *Epharmottomena* Johns, and their synonyms.

Riadhia gen. nov.

Frons, with low crater-like round truncated prominence enclosing a vertical process, projecting slightly at its lower end in front of the crater-rim; this keel-like process is variable in form in individuals, and in some is hollowed internally into the form of a U, the base of which is most prominent; it never however approaches the blade-like form of the keel-process inside the truncated cone of such *Armada* species as *maritima* Brandt. The legs are as in *Armada*, with short forelegs and particularly short foretibia. The male genitalia are characteristic of the new genus: the valves are strongly dissymmetrical; there is no cucullus, the valve-tip consisting of a finger-like process thickly clad with adpressed bristles. The uncus is less tapering than in *Armada*, *Metoponrhis*, etc. There is no harpe or digitus on either valve, unless the hypertrophied process projecting from the left-valve costa can be considered a harpe: the sacculus of the left valve is also hypertrophied so that the whole apparatus is twisted; the aedeagus is relatively simple, without internal cornuti or external sclerotisations. Nervulation, as in *Armada dentata* Stgr.

Type: *Riadhia diehli* sp. nov. (below).

Riadhia diehli sp. nov. (Plate II, Figs. 23, 27)

Frons, with a prominence as described above partly covered with white scales and hair.

♂ antenna, missing.

♀ antenna, simple.

Tongue, present, normal. Palp, fine, fairly short.

Thorax, white. Abdomen, yellowish white.

Forewing, white, faintly marked with pale brown, especially the reniform stigma and the submarginal area. Median area, sometimes shaded with pale brown below the cell. Orbicular stigma, sometimes clearly defined, a small brown spot; reniform stigma, fused with median shade. Sometimes a white ill-defined submarginal line can be seen, parallel to the termen, in the wide, brown submarginal area; this area reaches the hindmargin not far from the tornus, but is wider at the costa, and leaves a characteristic clear white broad post-median stripe. Fringes, white.

Hindwing, white, with comparatively large pale brown cell-spot and wide pale brown submarginal border. Fringes, white.

Span: 16-19 mm.

Male genitalia, as described under genus above, and illustrated in Plate IV, Fig. 19.

Holotype: ♂, (Prep. WM. 57) (lacks left wing, all legs, and antennae), and allotype, ♀ (the legs of which are mounted on left side of slide, Prep. WM. 57) (lacks antenna): Saudi Arabia, Riyadh, 18-vii-58, ED, ZM.

Paratypes: 2 ♂♂, 1 ♀, Saudi Arabia, Riyadh, 1-15-vii-58 & 1-v-59, ED, ZM.

***Lygephila fereidun* sp. nov. (Plate I, Fig. 7)**

The pale straw, faintly marked forewing and brown collar distinguish this species from all its congeners; its pattern comes closest to that of the Spanish species *glycyrhiza* Ramb., the genitalia of which, however, I have not yet been able to examine to see whether a real relationship exists.

Palp, pale buff.

Antenna, ♂, ciliated, with ciliations about as long as the breadth of the shaft.

Neck and collar, sienna-brown.

Thorax, abdomen, fore- and hindwings, all pale buff or dull straw, slightly more brown-tinged on the wings terminad. The only marking is the faint brown crescent-formed reniform stigma on the forewing. Vague traces of a light brown median shade appear below it.

Underside, similarly coloured but lacking the forewing stigma; however, the submarginal clouding of both wings is perhaps stronger than on the upperside, and the nervures are slightly infuscated costad and terminad.

Span: 42 mm.

Male genitalia: the thickened uncus and some other characters incline me to place this new species in a group with *lusoria* and remote from *craccae* L. The harpe, longer than that of *craccae*, is nevertheless shorter than that of *lusoria*. The vesica contains similar elements to those of *lusoria* but the proximal scobinated field is shorter and the five or six teeth on the distal chitinous lump are larger and more like cornuti than in *lusoria*. For exact details, see Plate IV, Fig. 20.

I feel obliged to mention that these and other *Lygephila* genitalia show a close relationship to those of the genera *Apopestes* and *Autophila*, transferred to the Trifinae by C. Boursin, in 1940 (*Mitt. Muench. Ent. Ges.* 30, Heft 2, p. 514). However as vein 5 from discocellular mid-way between 4 & 6 on hindwing is well defined, I do not propose that *Lygephila* should be similarly transferred.

Holotype: ♂, (Prep. 116), N. Iran, Elburz Mts. Lar Valley, c. 9000 ft. (c. 2700 m.), 5-13-vii-39 (EW).

(?) *Antarchaea pyralomima* sp. nov. (Plate II, Figs. 26, 28)

As the genitalia do not show marked affinity either to *Antarchaea viridaria* or *A. (Raparna) coniocephala*, this new species is introduced provisionally in this genus. It is a pale sandy species recalling, when well marked, a Pyraustine Pyralid moth. A more scantily marked example (the paratype) was for a time wrongly placed among Sterrhine Geometrids. The neuration is typical of Noctuidae-Quadriinae.

♂ antenna, strongly ciliated; tongue, developed.

Frons, smooth, slightly bulging.

Palp, with laterally compressed scales, prominently upturned.

Tibiae, not spined.; midtibia, with a pair of terminal spurs; hindtibia with two pairs of spurs.

Forewing, neuration: 3, 4, and 5 separate but close together from lower corner of cell; 6 from corner of areole; 7 and (8 and 9) from apical corner of areole, 8 and 9 on a long stalk; 10, 11, and 12 separate.

Hindwing: 3 and 4 on a short stalk, 5 from discocellular near their origin; discocellular, distinct but weak; 6 and 7 on a short stalk.

Forewing, pale biscuit, with brown stigmata sometimes clearly defined and fainter sandy brown streaky infusion along the nervures. Orbicular stigma, a finely outlined dark brown, pale-centred oval, or absent; reniform stigma, larger, less neat, with cloudy brown centre, sometimes obsolete. The post-median fascia is vaguely outlined in sandy brown without reaching either costa or hind margin; there are no other cross-lines, but the paratype shows traces of a brown oblique median shade. Termen, slightly undulate, with six dark brown spots at the nervures, absent in the paratype. Fringe, concolorous.

Hindwing, pale biscuit, slightly more yellow-brown terminad.

Undersides, uniformly pale biscuit, unmarked.

Span: 24-25 mm.

Male genitalia: Uncus, slender, normal, with spiny tip.

Valve, narrowest in centre, basal third at least double the thickness of the rest; valve-tip, bifurcate, the ventral arm being a downward-pointing pollex, the costal portion more rounded, membranous and slightly setose. Juxta, weak, simple. Aedeagus, fairly thick, cylindrical, slightly up-curved, with a small ventral-distal sclerotisation. Vesica, finely scobinated proximally, without any cornutus. (Illustrated in Plate IV, Fig. 21.)

Holotype (Prep. WM. 106): ♂. Saudi Arabia, El Riadh, 23-ii-58 (ED) ZM.

Paratype (Prep. WM. 140): ♂, Saudi Arabia, El Riadh, 4-iii-56 (ED) ZM.

Rhynchodontodes orientis (Brandt) (nov. comb.)

(*Hypenodes orientis* Brandt, 1938)

Rhynchodontodes orientis richteri subsp. nov. (Plate II, Fig. 29)

After examining the type of *Hypenodes orientis* Brandt from Tchurum, Fars, I find it closely related to *Rhynchodontodes sagittalis* Rebel from upper Egypt, and not at all closely related to *Schrankia* (= *Hypenodes*) species such as *costaestrigalis* and *balneorum* Alph. I illustrate the male genitalia of the latter (Plate IV, Fig. 23) and of the *orientis* Brandt holotype (Plate IV, Fig. 22).

Brandt's original description was also rather misleading in describing the palp as 'quite short'; 'shorter than in most *Rhynchodontodes* species' would be more correct.

In Makran (S. Iran) a race occurs which I here distinguish by the name of its captor, Herr Richter.

The median area is less brown and less separated from the rest of the forewing's grey ground-colour; there is a white diffuse lunule distally edging the blackish crescent-formed reniform stigma, which is absent in the holotype and the rest of the typical series illustrated by Brandt.

To compare with the male genitalia of the holotype of *orientis* I illustrate those of *richteri*; the only difference appears to be the proportionately smaller and finer dimensions of the former, but this may be individual rather than racial (Plate IV, Fig. 25).

I also illustrate the female genitalia (Plate IV, Fig. 24).

Holotype: ♀, S. Iran, Makran, Tiz near Putab, 25-iii-54, RS. (SM).

Allotype: ♂ (Prep. WM. 35) and 3 paratypes, ♀♀, S. Iran, Makran, Kahuran, near Putab, 25-iii-54, RS. (SM and coll. EW) (Prep. 1057).

Paratype: ♀, Baluchistan, Iranshahr, 800 m., 28 to 31-iii-54, RS. (SM).

A provisional arrangement of the genus *Rhynchodontodes* based on similarity of facies and development of aedeagus-probe would be as follows:

(i) With probe rudimentary: *antiqualis* Hubn., and *ardinglis* Stgr. (Genitalia illustrated in the preceding article in this series.)

(ii) With probe developed but not longer than aedeagus: *orientis* (Brandt) and probably *sagittalis* Reb. (whose genitalia I have not been able yet to examine).

(iii) With probe longer than aedeagus: *ravalis* Hubn., *ravulalis* Stgr., *revolutalis* Z. (= *syriacalis* Stgr., *eremialis* Walk., *centralis* Stgr.). (Genitalia illustrated in the preceding article.) I have not examined yet the other species in the genus.

REFERENCE

Wiltshire, E. P. (1952): Lepidoptera recently taken in Arabia. *Bull. Soc. Fouad I., Ent.*, 36: 135-174.



On the occurrence of the Spiny Lobster, *Panulirus dasypus* (H. Milne- Edwards) in Bombay waters, with a note on the Systematics of Bombay Lobsters¹

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(With one text-figure)

During their investigations on the biology of spiny lobsters occurring in Bombay, the authors came across three species of lobsters. One of these was thought, at first, to be a colour variation of the Common Lobster *Panulirus polyphagus* (Herbst). Detailed examination, however, revealed that it was a different species, the most significant character for differentiation from hitherto recorded species (at Bombay) being the presence of transverse grooves on the abdominal segments. It was then identified as *Panulirus dasypus* (H. Milne-Edwards).

The record of an additional species necessitated a review of the taxonomy of the lobsters of Bombay. While doing so, it was found that there is considerable confusion in their identification. For example, the *Panulirus fasciatus* of Fabricius and Milne-Edwards is actually *Panulirus polyphagus* (Herbst), while the *Panulirus fasciatus* of De Haan is *Panulirus versicolor* (Latreille). Rai (1933) and Chopra (1939), both of whom have previously recorded these species from Bombay, have given them different names. Thus Rai has recorded them along the Bombay-Sind coast as *Panulirus ornatus* var. *decoratus* Heller cf. *P. versicolor* (Latr.), and *Panulirus fasciatus* (Fabr.) respectively, stating that the former is the more common. Chopra states that the common species of the Bombay coast is *Panulirus ornatus*, while *Panulirus polyphagus* (= *Panulirus fasciatus*)

¹ Communicated by the Director of Fisheries, Maharashtra State, Bombay.

occurs commonly along the eastern coast of India. Actually, *P. polyphagus* is the prevalent species off the Bombay coast, *P. versicolor* being the rarest, although both Rai and Chopra have mentioned otherwise.

Similarly, there is confusion in the identification of *P. versicolor* and *P. ornatus*. Barnard (1950), following de Man (1916), gives as the distinguishing character of *P. versicolor* the presence of a small single-jointed flagellum on the exopodite of the second maxillipede, whereas in *P. ornatus* the exopodite is without a flagellum, being only tipped with a small tuft of setae. Holthuis (1947), on the other hand, states that 'the presence of one or more segments of the flagellum of the exopodite of the second maxillipede in *P. versicolor* and the total absence of a flagellum in *P. ornatus* is rather variable in the former species, where it sometimes is absent too'. As such, dependence on the key devised by Barnard would lead to incorrect identification as regards these two species.

Classification of different species has been based, among other characters, on the relative lengths of the antennular and antennal peduncles and the walking legs. The authors, however, have found these characters to vary in individuals of different sizes, and hence these characters cannot be relied upon. The salient features of the three species of lobsters occurring at Bombay are given below. As stated by Holthuis, however, the most obvious character for identification is the colour pattern, and particular attention has been paid here to prepare a detailed colour description.

KEY TO IDENTIFICATION OF LOBSTERS OF BOMBAY

1. Abdominal somites with transverse grooves (interrupted medianly) ... *P. dasypus* (H. Milne-Edwards)
- Abdominal segments without transverse grooves¹ ... 2
2. Exopodite of second maxillipede with many-jointed flagellum ... *P. polyphagus* (Herbst)
- Exopodite of second maxillipede with either a small single-jointed flagellum, or without a flagellum ... *P. versicolor* (Latreille)

¹ Young specimens of *P. polyphagus* and *P. versicolor* may sometimes show traces of grooves.

DESCRIPTION OF SPECIES

Panulirus polyphagus (Herbst)

Cancer (Astacus) polyphagus Herbst, *Vers. Naturg. Krabben Krebse* 2 : 90 (1793).

Senex ornatus Ortmann, *Zool. Jahrb. Syst.* 6 : 34 (1891).

Palinurus fasciatus Fabricius, *Suppl. Ent. syst.* : 401 (1798).

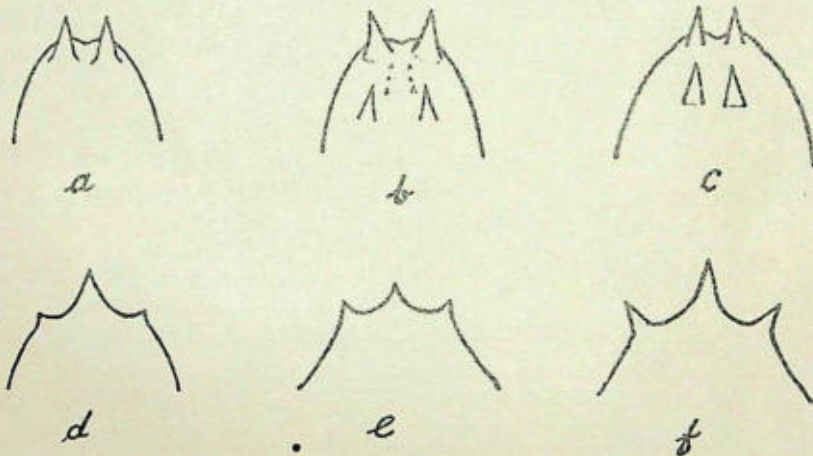
Panulirus orientalis Doflein, *S. B. Bayer Akad. Wiss.* 30 : 130 (1900).

Panulirus fasciatus Milne-Edwards, *Hist. nat. Crust.* 2 : 295 (1837); Gavino, *Viaggio Circumnav. Caracciolo* : 6 (1888); Annandale, *J. Bombay nat. Hist. Soc.* 18 : 927 (1908); Rai, *ibid.* 36 : 893 (1933).

Panulirus polyphagus Nobili, *Boll. Mus. Zool. Anat. comp. Torino* 18 (452) : 14 (1903); Borradaile, *Fauna Geogr. Mald. Laccad.* 2 (3) : 754 (1904); Chopra, *J. Bombay nat. Hist. Soc.* 41 : 223 (1939); Holthuis, *Temminckia* 7 : 136 (1947).

Panulirus Powell, *J. Bombay nat. Hist. Soc.* 18 : 360 (1908).

The antennular plate (text-fig. *a*) bears only one pair of spines, situated far forward. The median spine on the fused coxicerites of the antennae (text-fig. *d*) is much stronger and projects far in front of the two minute lateral ones. All three spines have wide bases.



Text-Figure

Antennular plates of: (a) *Panulirus polyphagus*, (b) *P. dasyopus*, and (c) *P. versicolor*. Fused coxicerites of the antennae of: (d) *P. polyphagus*, (e) *P. dasyopus*, and (f) *P. versicolor*.

The dimensions of a medium-sized individual are:

total length	...	250 mm.
length of carapace	...	110 mm.
length of supra-orbital spine	...	16.5 mm.

The cephalothorax and abdomen have a muddy-brown colour. There is a row of six white spots on each of the lateral regions of

the carapace—the anteriormost spot being larger than the rest. Small spines arise from these spots. From the postero-lateral corner of the carapace to the region of the mouth parts runs a white stripe, terminating in a broad white patch; another white stripe starts from the same place, running along the bases of the legs. The spines on the carapace have a brown base with yellowish tips. The antennular flagella are alternately banded crimson and white.

Each of the abdominal somites has a brown transverse band on the hind margin, with a narrow cream-coloured stripe running through it. This stripe in the first segment may be broken. The hinder third of the telson and uropods has a reddish tinge. The telson, uropods, and abdominal appendages are bordered with cream-coloured lines. The legs are brownish red, cream at the joints.

This lobster is locally known as 'shevand'.

DISTRIBUTION. Mauritius, India, Malay Archipelago, Indochina, Japan, and Polynesia. It has been previously recorded from Bombay by Nobili (1903), Annandale (1908), Powell (1908), Rai (1933), and Chopra (1939).

Panulirus dasyopus (H. Milne-Edwards)

Panulirus dasyopus H. Milne-Edwards, *Hist. nat. Crust.* 2 : 300 (1837).

Panulirus dasyopus Henderson, *Trans. Linn. Soc. Lond., Zool.*, (ser. 2) 5 : 433 (1893); Thurston, *Bull. Madras Govt. Mus.* 3 : 120 (1895); de Man, *Siboga Exped. Rep.* 39a2:48 (1916); Gravely, *Bull. Madras Govt. Mus.* (ser. 2) 1:138 (1927); Holthuis, *Temminckia* 7 : 134 (1947); Barnard, *Ann. S. Afr. Mus.* 38 : 549 (1950).

Senex dasyopus Ortmann, *Zool. Jahrb. Syst.* 6 : 33 (1891).

There are four spines on the antennular plate (text-fig. *b*), the posterior two being about $\frac{2}{3}$ the length of the anterior two and being a little less distant from each other. A double row of spinules is present between them. The three spines on the fused coxicerites of the antennae (text-fig. *e*) are minute, sub-equal, and placed in a line.

The exopodites of the second maxillipedes hardly reach the extremity of the merus. The first pair of legs are much stouter than in the other two species.

Two spines are present in the middle line of the gastric region, just in front of the cervical groove, and placed behind one another. The abdominal pleura end almost horizontally.

The dimensions of a medium-sized individual are:

total length	... 250 mm.
length of carapace	... 112 mm.
length of supra-orbital spine	... 21.5 mm.

The cephalothorax and abdomen are of a bluish grey colour, speckled throughout with minute whitish spots. There is a row of six to seven white spots (from which spines arise) on each of the lateral regions of the carapace, the anteriormost being larger than the rest. From the postero-lateral corner of the carapace to the region of the mouth parts runs a blue line, terminating in a broad white patch; another white line starts from the same place and runs parallel to the bases of the legs. The spines on the carapace are light brown with yellowish tips. The antennular flagella are alternately banded brown and white. There is a blue line between the eyes, on the antennular plate, and on the branchio-cardiac groove.

Two lateral white spots are present on each abdominal segment. The hinder third of the telson and uropods have a reddish tinge. The telson, uropods, and abdominal appendages are bordered with cream-coloured lines. The legs are yellowish brown, blotched with irregular cream spots.

DISTRIBUTION. From the western Indian Ocean to Japan and Malay Archipelago.

Panulirus versicolor (Latreille)

Palinurus versicolor Latreille, *Ann. Mus. Hist. nat. Paris* 3 : 394 (1804).

Palinurus taeniatus Lamarck, *Hist. nat. Anim. sans Vert.* 5 : 211 (1818).

Palinurus fasciatus De Haan, *Fauna Japonica, Crust.* : 159 (1841).

Palinurus (Panulirus) ornatus var. *decoratus* Heller, *Reise Novara Zool.* 2 : 99 (1865).

Panulirus demani Borradaile, *Willey's Zool. Results* 4 : 418 (1899).

Panulirus ornatus Rathbun, *Proc. U. S. Nat. Mus.* 38 : 560 (1910); Chopra, *J. Bombay nat. Hist. Soc.* 41 : 224 (1939); var. *decoratus* de Man, *Siboga Exped. Rep.* 39a2 : 54 (1916); Rai, *J. Bombay nat. Hist. Soc.* 36 : 893 (1933); var. *laevis* de Man, *Siboga Exped. Rep.* 39a2 : 55 (1916).

Panulirus versicolor de Man, *Siboga Exped. Rep.* 39a2 : 55 (1916); Holthuis, *Temminckia* 7 : 142 (1947); Barnard, *Ann. S. Afr. Mus.* 38 : 553 (1950).

Senex ornatus var. *laevis* Lancheester, *Proc. Zool. Soc. Lond.* : 557 (1901).

The antennular plate (text-fig. c) bears two pairs of spines. The posterior pair are slightly smaller and more closely situated than the anterior pair; there are, very rarely, two denticles in front of and between them. The three spines on the fused coxicerites of the antennae (text-fig. f) are large and sub-equal, the median one being slightly in advance of the lateral ones.

The supra-orbital spines are much longer and stronger than in the preceding two species. The spines at the antero-lateral angles

of the carapace have their tips directed slightly outward. The spines between these and the supra-orbital spines are also directed outward, not forward. The three sub-median pairs of spines in front of, and the three pairs behind, the cervical groove form a parallel series. The groove along the posterior margin of the carapace is not of uniform width, but widens in the median part.

The dimensions of a medium-sized individual are:

total length	...	256 mm.
length of carapace	...	108 mm.
length of supra-orbital spine	...	28 mm.

The cephalothorax and abdomen have a green ground colour. The carapace is marbled with confluent black spots and blotches, edged with white. These spots continue on to the supra-orbital spines. The antennules (including the flagella) have alternate black and yellowish-white longitudinal stripes. The antennal peduncles are pink, their spines having black bases with lemon-green tips. The flagella have green and white longitudinal stripes. The walking legs have white stripes on a black background.

Each of the abdominal somites has a black transverse band on the hind margin, with a narrow white stripe running through it. The borders of the telson, uropods, and abdominal appendages are fringed with white, while the abdominal appendages also have a white central stripe. The spinules on the telson and uropods have a green base with golden tips.

This lobster is locally known as 'manjri shevand'.

DISTRIBUTION. From the east coast of Africa to Japan and Polynesia. It has been previously recorded from Bombay by Rai (1933) and Chopra (1939).

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Studies on the Freshwater Oligochaeta of South India¹

I. Aeolosomatidae and Naididae

PART I

BY

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(With three text-figures)

INTRODUCTION

The literature on the freshwater oligochaete fauna of the Indian sub-continent reveals that the group was worked out around Lahore of the North-Western Territory² and Calcutta of the Indo-Gangetic Plain area by Stephenson (1907-1925), Annandale (1905-1906), and Mehra (1920-1922), and around Travancore of the Southern Region by Aiyer (1924-1930). As a result of their work, they have recorded 25, 18, and 17 species of worms belonging to Aeolosomatidae and Naididae for the Southern Region, Indo-Gangetic Plain area, and North-Western Territory respectively. Ceylon, Western Region, Main Peninsular Region, Western Himalayan Region, North-East Frontier Region, and Burma are known to have 4, 5, 4, 5, 0, and 3 species respectively (Table I). After 1930 serious work on the group was not undertaken by anybody in the sub-continent.

This paper deals with taxonomic diagnoses of 35 species of worms belonging to 2 families and 10 genera, including a new subfamily and a new genus, 7 new species, 11 new records for the Southern Region, and 2 new records for the Indian sub-continent. The description of each of the species is made from 2 or 3 typical forms, which will be deposited as holotype and syntypes in the Indian Museum, Calcutta, India. The descriptions of new species include a diagnosis of the species.

Lastockinia gen. nov. is created to receive an aberrant species *Aeolosoma nieznestnovae* Lastockin (1935). Its diagnosis is given. Stephensonianinae nov. is created here for genus *Stephensoniana* Cernosvitov, which is occupying a solitary position under subfamily Naidinae. With the removal of this genus the Naidinae is more limited than it was according to Sperber.

¹ Communicated by the Principal, Govt. Arts College, Cuddapah, in November 1959.

² This and the other regions mentioned are listed by Stephenson in the FAUNA volume on Oligochaeta (1923).

The other 28 species treated here are : 3 species of *Aeolosoma* belonging to the Aeolosomatidae ; and 3 species of *Chaetogaster*, 1 species each of *Nais*, *Haemonais*, *Stylaria*, *Branchiodrilus*, and *Stephensoniana*, 6 species of *Dero*, 3 species of *Aulophorus*, 2 species of *Allonais*, and 6 species of *Pristina*, all belonging to the Naididae. Their re-descriptions are based on 3 or 4 typical forms of each species (except in *Pristina jenkiniae*), which will be deposited in the Indian Museum.

Keys to the subfamilies of Naididae, to all the genera of Aeolosomatidae, to the subfamilies of the Naididae, and to all the known and valid species of the 10 genera treated here are given.

Complete synonymies of the majority of the species of the Naididae are published by Sperber (1948). Wherever the synonymies established by her are accepted, a repetition has been avoided by citing her paper. Only synonymies established by the author are included. Important papers published subsequent to 1948 are referred to. Complete synonymies are given for the 3 species of the Aeolosomatidae.

The descriptions of new species and re-descriptions of known species include details regarding external characters, setal characters, digestive system, septa, coelomocytes, brain, blood vessels, nephridia, budding zones, sex organs, size of worms, etc. The measurements of the setae and the positions of the nodulus are tabulated for most of the species. Sketches of setae of all the species, and of the brain and nephridia of most of the species are included. In addition the habits of many species, and parasites and commensals of a few species are incorporated.

All the 35 species described here were collected from the following freshwater sources in south India during the periods and visits noted against them :

Localities	Period of collection	No. of visits	No. of species
Bugga Stream, Cuddapah	Sept. '52—April '56 Aug. '57—March '58	Numerous	32
Pullalamadugu Stream, Cuddapah	10.9.1955	One	1
Handri River, Kurnool	9.4.1958	One	1
Balaji Tank, Kakinada	April-Dec. 1956	Three	9
Kandakam Tank, Bellary	April-May 1954	Five	11
Brucepattah Tank, Bellary	April-May 1954	Four	3
Miller's Tank, Bangalore	April-May 1958	Two	2
Langford Town Tank, Bangalore	April-May 1958	Six	9
Ulsoor Tank, Bangalore	April-May 1958	Two	8
Sewage canal across Audagodi-Hosur Road, Bangalore	April-May 1958	One	1

The collections were made from Bugga Stream all round the year during the 4½ years, unlike in other localities. During this period it was found that certain species of worms which are abundant in particular months are scarce or nearly absent in subsequent months, their

place having been taken by some other species of worms. Thus, there is a seasonal variation in the density of populations of all the species of worms round the year.

Asexual reproduction by budding is common in all species and occurs throughout the year. Sexual reproduction is rare, occurring only seasonally. Many species of worms develop sex organs from January to June. During the time that sex organs are developed all the species of worms suspend asexual reproduction except *Stylaria fossularis* and *Pristina longiseta longiseta*, which go through asexual reproduction along with the development of sex organs.

In every freshwater source some freshwater oligochaete or other was collected. From Bugga Stream alone, where collections were made intensively, 32 species of Acolosomatidae and Naididae, 5 species of Tubificidae¹, and 1 species of Enchytraeidae¹, were collected. This number is the world record for a single water source. It is possible that many other water sources would provide as many species of freshwater oligochaetes if intensive collections were undertaken. In others only samples of mud and water were taken and casual examination for freshwater oligochaetes was made. Even such casual examination has yielded between 1 and 11 species from them. From this it is evident that freshwater oligochaetes are available in all fresh waters.

II. ACKNOWLEDGEMENTS

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¹ These will be dealt with in a subsequent paper.

III. MATERIAL AND METHODS

Collection: The worms inhabiting the aquatic plants, algae, decaying vegetable matter, etc. were collected either by shaking up decaying leaves, wood, cloth, etc. in water in dissection trays or by leaving the algae and aquatic plants in large quantities of water in beakers for a day or two, thus allowing them to settle on the walls of containers, and pipetting them out. The mud-dwellers were collected by washing samples of mud in trays and pipetting the coiled and moving worms from small quantities of water.

Observation: Observations were made mainly on living worms. Morphological studies were made chiefly on: the shape, number, position, and lengths of setae; the shape of the gut and brain; the position of the dorsal vessel, the number and position of contractile lateral vessels; the shape, structure, and number of nephridia; the number and position of the budding zones; the position, shape, and structure of the sex organs. The modes of locomotion and habits of the worms were also noted. Fresh setal preparations were made by crushing the worms between cover glass and slide for studying the number, shape, and length of setae. Permanent setal preparations were made by crushing the worms between the cover glass and slide and sealing off with Canada balsam. Many sketches were drawn to measurements and others by the use of the camera lucida.

Measurements: All measurements were made using the eye-piece micrometer. The lengths of the setae and the position of the nodulus in the ratio D:P (the length of the shaft distal to the nodulus: the length of the shaft proximal to the nodulus) is given for all the Naididae. When a single measurement is given for the setae, it is the length of the longest seta in the bundle. Needle-setae and hair-setae are referred to as needles and hairs; ventral setae are referred to as crotchets occasionally. When the teeth of needles are equally long, the tooth on the side of the concave curvature is referred to as the inner and the other as the outer. The teeth of the setae are referred to as teeth in needles and as prongs in ventral setae.

IV. AELOSOMATIDAE AND NAIDIDAE OF THE SOUTHERN REGION IN INDIA AND THEIR GEOGRAPHICAL DISTRIBUTION

Stephenson (1923) tabulates only the following six species for the Southern Region: (1) *Nais communis*, (2) *Nais* (= *Allanais*) *pectinata*, (3) *Naidium* (= *Pristina*) *breviseta*, (4) *Pristina longiseta* (= *Pr. longiseta longiseta*), (5) *Branchiodrilus semperi*, and (6) *Br. menoni*. Of these the last named is a synonym of *Br. semperi* (cf. Sperber, 1948). Hence, there were only five valid species of Naididae and no Aeolosomatidae known for the Southern Region till 1923. In Travancore, Aiyer (1925, 1926,

and 1930) recorded 19 more species, Stephenson (1925b) added 2 species, and Sperber (1958) added one species to the region. They are (1) *Aeolosoma bengalense*, (2) *Ae. hemprichii*, (3) *Ae. travancorensis*, (4) *Nais pectinata inaequalis* (= *Allonais inaequalis*), (5) *Naidium* (= *Pristina*) *menoni*, (6) *Pristina aquiseta*¹ (7) *Pr. proboscidea paraguayensis* (= *Pr. proboscidea*), (8) *Stephensonia* (= *Stephensoniana*) *trivandran*, (9) *Slavina appendiculata*, (10) *Dero zeylanica*, (11) *D. limosa* (= *digitata*), (12) *D. austrina* (= *dorsalis*), (13) *D. pectinata*, (14) *D. palmata*, (15) *D. nivea*, (16) *Aulophorus furcatus*, (17) *A. michaelseni*, (18) *A. tonkinensis*, (19) *Nais* (= *Allonais*) *paraguayensis paraguayensis*, (20) *Aulophorus gravelyi*, (21) *Pristina synclites*, and (22) *Pr. foreli*. Thus, the number of species known for the Southern Region was 27 in 1958. With the 18 species mentioned in the next paragraph the number now stands at 45.

The thirty-five species treated here include 7 new species, and 11 new records for the Southern Region. They are *Nais menoni* sp. nov., *Dero indica* sp. nov., *D. plumosa* sp. nov., *Aulophorus hymanae* sp. nov., *A. indicus* sp. nov., *Allonais rayalaseemensis* sp. nov., and *Pristina sperberae* sp. nov.; *Chaetogaster diastrophus* (Gruithuisen), *Ch. langi* Bretscher, *Ch. crystallinus* Vejdovsky, *Stylaria fossularis* Leidy, *Haemonais waldvogeli* Bretscher, *Dero cooperi* Stephenson, *D. sawayai* Marcus, *Allonais gwaliorensis* (Stephenson), *Pristina minuta* (Stephenson), *Pr. aquiseta* Bourne, and *Pr. jenkinsae* (Stephenson). Of these *Dero sawayai* and *Pristina jenkinsae* are new records for the Indian sub-continent. As a result 45 species are known for the Southern Region and 53 species for the Indian sub-continent.

TABLE I
DISTRIBUTION OF AEOLOSOMATIDAE AND NAIDIDAE IN THE NINE GEOGRAPHICAL REGIONS OF THE INDIAN SUB-CONTINENT

	Ceylon	Southern Region	Western Region	Main Peninsular Region	Indo-Gangetic Plain area	North-western Territory	Western Himalayan Region	North-east Frontier Region	Burma
	I	II	III	IV	V	VI	VII	VIII	IX
• AEOLOSOMATIDAE									
1. <i>Aeolosoma bengalense</i> *	..	+			+				
2. <i>Ae. hemprichii</i> *	..	+				+			
3. <i>Ae. viridae</i>	..					+			
4. <i>Ae. travancorensis</i> *	..	+							
5. <i>Ag. tertarium</i> ²	..	+							

¹ This was an incorrect identification. The species was really *Pr. evelinae*.

² Doubtful validity.

• Species treated in this paper.

TABLE I—(contd.)

	Ceylon	Southern Region	Western Region	Main Peninsular Region	Indo-Gangetic Plain area	North-western Territory	Western Himalayan Region	North-east Frontier Region	Burma
	I	II	III	IV	V	VI	VII	VIII	IX
NAIDIDAE									
6. <i>Chaetogaster diastrophus</i> *		+				+			+
7. <i>Ch. langi</i> *		+	+		+				
8. <i>Ch. diaphanus</i>					+	+			
9. <i>Ch. crystallinus</i> *		+			+				
10. <i>Ch. limnei limnei</i>							+		+
11. <i>Ch. limnei bengalense</i>			+		+	+			+
12. <i>Nais communis</i> *		+	+		+	+	+		
13. <i>N. menoni</i> sp. nov.*		+							
14. <i>N. barbata</i>					+				
15. <i>N. elinguis</i>					+				
16. <i>N. raviensis</i>						+			
17. <i>Slavina appendiculata</i>		+			+	+	+		
18. <i>Stylaria fossularis</i> *		+			+	+	+		
19. <i>Haemonais waldvogeli</i> *		+			+	+	+		
20. <i>Branchiodrilus semperi</i> *		+				+			
21. <i>Br. hortensis</i>					+	+			
22. <i>Dero dorsalis</i> *		+							
23. <i>D. digitata</i> *		+	+						
24. <i>D. indica</i> sp. nov.*		+	+						
25. <i>D. zeylanica</i> *	+	+	+						
26. <i>D. cooperi</i> *		+	+		+	+			
27. <i>D. nivea</i> *		+	+						
28. <i>D. sawayai</i> *		+	+						
29. <i>D. pectinata</i>		+	+						
30. <i>D. plumosa</i> sp. nov.*		+	+						
31. <i>D. palmata</i>		+	+						
32. <i>Aulophorus furcatus</i> *		+	+			+			
33. <i>A. michaelsoni</i> *	+	+	+						
34. <i>A. hymanae</i> sp. nov.*		+	+						
35. <i>A. gravelyi</i>		+	+						
36. <i>A. indicus</i> sp. nov.*		+	+						
37. <i>A. tonkinensis</i> *	+	+	+		+		+		
38. <i>Allonais inaequalis</i> *		+	+		+				
39. <i>Al. paraguayensis</i>					+	+			
40. <i>Al. rayalaseemensis</i> sp. nov.*		+		+	+	+			
41. <i>Al. gwaliorensis</i> *		+		+					
42. <i>Al. pectinata</i>		+		+	+				
43. <i>Stephensoniana trivandranensis</i> *		+							
44. <i>Pristina minuta</i> *		+				+			
45. <i>Pr. menoni</i>		+							
46. <i>Pr. jenkiniae</i> *		+							
47. <i>Pr. synclites</i> *		+							
48. <i>Pr. breviseta</i> *		+							
49. <i>Pr. aequiseta</i> *		+			+	+			
50. <i>Pr. evelinae</i> *		+							
51. <i>Pr. longiseta longiseta</i> *		+	+	+	+	+			
52. <i>Pr. proboscidea</i>		+			+				
53. <i>Pr. foreli</i>		+							
54. <i>Pr. sperberae</i> sp. nov.*		+							
	4	45	5	4	19	17	5	0	3

* Species treated in this paper

TABLE II
GEOGRAPHICAL DISTRIBUTION OF AELOSOMATIDAE AND NAIDIDAE

	Australia	Asia	Africa	Europe	America	
					North	South
AELOSOMATIDAE						
1. <i>Aeolosoma bengalense</i> ..		+				+
2. <i>Ae. hemprichii</i> ..		+	+	+	+	+
3. <i>Ae. travancorensis</i> ..		+				+
NAIDIDAE						
4. <i>Chaetogaster diastrophus</i> ..		+		+	+	+
5. <i>Ch. langi</i> ..		+	+	+	+	+
6. <i>Ch. cristallinus</i> ..		+	+	+	+	
7. <i>Nais communis</i> ..		+	+	+	+	+
8. <i>Stylaria fossularis</i> ..		+		+	+	
9. <i>Haemonais waldvogeli</i> ..		+		+	+	+
10. <i>Branchiodrilus semperi</i> ..		+				
11. <i>Dero dorsalis</i> ..		+		+		+
12. <i>D. digitata</i> ..		+	+	+	+	+
13. <i>D. zeylanica</i> ..		+				
14. <i>D. cooperi</i> ..		+	+			+
15. <i>D. nivea</i> ..		+		+		
16. <i>D. sawayai</i> ..						+
17. <i>Aulophorus furcatus</i> ..	+	+	+	+	+	+
18. <i>A. michaelseni</i> ..		+				+
19. <i>A. tonkinensis</i> ..		+	+			+
20. <i>Allonais inaequalis</i> ..		+	+			+
21. <i>Al. gwaliorensis</i> ..		+	?+			
22. <i>Stephensoniana trivandrana</i> ..		+				
23. <i>Pristina minuta</i> ..		+			+	+
24. <i>Pr. synclites</i> ..		+				
25. <i>Pr. jenkiniae</i> ..		+	+			+
26. <i>Pr. aequiseta</i> ..		+	+	+	+	+
27. <i>Pr. evelinae</i> ..		+		+		+
28. <i>Pr. longiseta longiseta</i> ..	+	+	+	+		+
	2	27	13	14	11	19

V. SYSTEMATICS

Family AELOSOMATIDAE

Aeolosomatidae has only three valid genera, viz. *Hystricosoma* Michaelsen, 1926*; *Aeolosoma* Ehrenberg, 1831; and *Potamodrilus* Lastockin, 1935. The very aberrant species *Aeolosoma nieznestnovae* Lastockin, 1935, without setae and with paired lateral tubercles on the body-wall and two post-anal appendages, does not fit into the genus *Aeolosoma* characterised by the presence of setae and by the absence of paired tubercles on the body-wall and post-anal appendages. I agree with the view

of Marcus (1944) that a fourth genus is necessary to receive this aberrant species. As its presence in *Aeolosoma* is incongruous and as it does not fit into either *Hystricosoma* or *Potamodrilus*, the two other genera in the family, a new genus *Lastockinia* after the late Dr. D. A. Lastockin is created to receive it.

Genus *Lastockinia* gen. nov.

Generic type: *Lastockinia nieznestnovae* (Lastockin)

Prostomium not separated by a well-defined groove from the rest of the body, broader than following segments. External segmentation indistinct. Setae absent. Paired lateral tubercles and two post-anal appendages present. Skin glands usually present. Paratomy occurs.

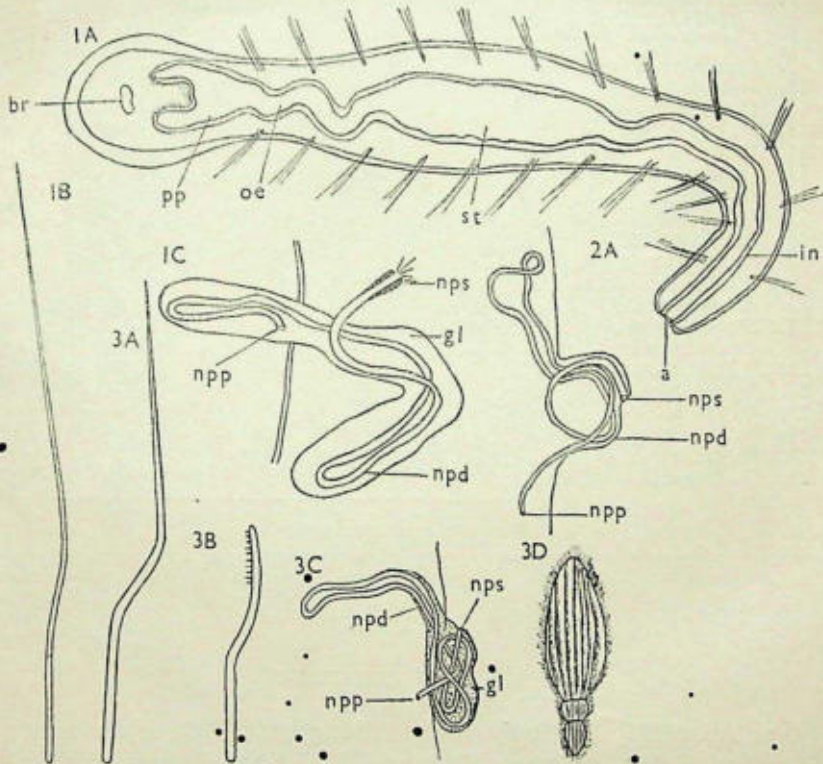


Fig. 1. *Aeolosoma bengalense* Stephenson: A. Entire worm (ventral view); B. Hair seta $\times 705$; C. Nephridium. Fig. 2. *Aeolosoma hemprithii* Ehrenberg: A. Nephridium. Fig. 3. *Aeolosoma travancorensis* Aiyer: A. Hair seta $\times c. 1000$. B. Needle seta $\times c. 1000$. C. Nephridium. D. Holotrichous Ciliate parasite, *Radiophryoides*.

a: anus; br: brain; gl: gland; in: intestine; npd: nephridial duct; npp: nephridiopore; nps: nephrostome; oe: oesophagus; pp: pharynx; st: stomach.

KEY TO ALL THE GENERA OF AEOLOSOMATIDAE

- A-1 Setae present ; paired tubercles absent on body-wall
 B-1 Prostomium separated from the body by a well-defined groove .. **Hystricosoma*
 B-2 Prostomium not separated from body by well-defined groove
 C-1 Body provided with glandular post-anal appendage ; worms attached .. **Potamodrilus*
 C-2 Body without post-anal appendage ; worms not attached .. *Aeolosoma*
 A-2 Setae absent ; paired tubercles present on body-wall .. **Lastockinia* gen. nov.

1. Genus *Aeolosoma* Ehrenberg, 1831

Generic characters : Eyes absent. Prostomium not separated from the body by well-defined groove, semi-circular, flat with or without lateral sensory ciliary pits. Skin glands coloured or colourless. Dorsal and ventral setae from II on, composed of hairs or hairs and needles. Pharynx funnel-shaped, oesophagus thin, stomach conspicuous, gut entirely ciliated ; intestinal anti-peristalsis and ascending ciliary vibration occur. Septa absent. Blood colourless ; dorsal vessel mid-dorsal and contractile ; ventral vessel mid-ventral and non-contractile ; lateral contractile vessels absent. Nephridia paired, start in II or III. Budding zones 1-4 or more ; produce prostomium and some anterior segments to posterior zooid, and some hind segments to anterior zooid, before fission.

KEY TO THE KNOWN AND VALID SPECIES OF *AEOLOSOMA*

- A-1 Secretions of skin glands coloured
 B-1 Secretions of skin glands red, orange or dark garnet
 C-1 Needle setae present
 D-1 Needle setae smooth, present in ventral bundles only ; skin glands red, present dorsally .. **evelinae*
 D-2 Needle setae toothed in dorsal and ventral bundles ; skin glands present dorsally and ventrally, light red .. **corderoi*
 C-2 Needle setae absent
 E-1 All the setae of a bundle are equal in length .. **quarternarium*
 E-2 Setae of bundles are of different lengths
 F-1 Skin glands reddish, occurring only dorsally ; stomach in V-XI .. **gertae*

* Genera not known from the Indian sub-continent

F-2	Skin glands reddish, occurring both dorsally and ventrally; stomach in VI-VII		
G-1	Ciliated pits present on prostomium; skin glands red	..	<i>hemprichii</i>
G-2	Ciliated pits absent on prostomium; skin glands red and green	..	* <i>kashyapi</i>
B-2	Secretions of skin glands yellow, green, lemon, olive or blue-green		
H-1	Needle setae present		
I-1	Needle setae smooth		
J-1	Needle setae present from III	..	* <i>leidyi</i>
J-2	Needle setae present from V	..	* <i>tenebrarum</i>
I-2	Needle setae serrated		
K-1	Skin glands yellowish orange; teeth on convex border of needle setae distally	..	* <i>japonica</i>
K-2	Skin glands bright yellow; teeth on concave border of needle distally	..	* <i>awayai</i>
H-2	Needle setae absent		
L-1	Zone of fission between VII and X		
M-1	Skin glands yellow	..	* <i>flavum</i>
M-2	Skin glands yellowish green		
N-1	Nephridia begin in II	..	<i>viridae</i>
N-2	Nephridia begin in III		
O-1	Nephridial funnel narrow; n=8-9	..	* <i>variegatum</i>
O-2	Nephridial funnel wide; n=10	..	* <i>pointneri</i>
L-2	Zone of fission between XI and XV		
P-1	Stomach upto XI	..	* <i>headleyi</i>
P-2	Stomach upto VIII		
Q-1	Ciliated fields present on dorsal surface of prostomium; body-diameter 0.2-0.3 mm.	..	<i>bengalense</i>
Q-2	Ciliated fields absent; body-diameter 0.06-0.1 mm.	..	* <i>aureum</i>
A-2	Secretions of skin glands colourless		
R-1	Needle setae present		
S-1	Needle setae serrated (under oil immersion)	..	<i>travancorensis</i>
S-2	Needle setae smooth	..	* <i>beddardi</i>
R-2	Needle setae absent	..	* <i>niveum</i>

1. *Aeolosoma bengalense* Stephenson, 1911

Fig. 1, A, B.

Aeolosoma bengalense Stephenson, 1911, p. 204.*Aeolosoma bengalense* Stephenson. Stephenson, 1923, p. 41; 1930, p. 136. Aiyer 1926, p. 131, fig. 1-3. Michaelsen & Boldt, 1932, p. 590. Marcus, 1944, pp. 16-17.

* Species not known from the Indian sub-continent

fig. 5 A, B. Du-Bois Raymond Marcus, 1944, p. 5, fig. 11-12. Yamaguchi, 1953, pp. 280-281, fig. 1.

Aeolosoma sp. 1. Stephenson, 1931b, p. 298.

Material examined: Numerous worms collected from the Bugga Stream, Cuddapah in July 1955, and from Ulsoor Tank, Bangalore, in May 1958.

Worms (Fig. 1 A) whitish and of medium size. Prostomium with sensory hairs, wider than anterior segments, about equal to the widest body-diameter, with ventral ciliation and two small dorso-lateral ciliated sensory pits. Body-wall colourless and transparent with skin glands of larger, variously shaped, dirty yellow or greenish yellow, and of smaller ovoid blue colour.

Dorsal and ventral bundles composed of hairs and needles; hairs (Fig. 1 B) bayonet-shaped, non-serrate, 280-350 μ long, 1-4 per bundle dorsally, and 200-220 μ long, 4-7 per bundle ventrally; needles non-serrate, bayonet-shaped, 140-180 μ long, 3-4 per bundle dorsally; 100-120 μ long, 4-6 per bundle ventrally.

Mouth ventral, V-shaped. Pharynx in II, funnel-like. Oesophagus in III, thin and wavy. Stomach in IV- $\frac{1}{2}$ VIII, fusiform and bright yellow. Intestine thin and wavy.

Brain ovoid with constrictions medially in front and behind.

Dorsal vessel arises in IV, runs dorsally over oesophagus and pharynx, divides into two, descends on either side of the pharynx and unites with non-contractile ventral vessel in II. Blood flows from behind forwards in dorsal and from anterior to posterior in ventral vessels.

First nephridial pair in II, last in IX or X. Nephridium (Fig. 1 C) has a minute funnel with a ciliated nephrostome, followed by a long coiled ciliated duct passing through glandular mass and opening to exterior by nephridiopore ventro-laterally. Cilia in the nephrostome and nephridial duct beat down the lumen.

Worms with 1-4 budding zones common. Some hind segments to the anterior zooid, and prostomium and a few anterior segments to the posterior zooid are budded before fission. As the first budding zone is proliferating segments to both the zooids, second, third, and fourth budding zones are developed, second zone in front of the first, third behind the first, and fourth anterior to the second zone.

Sexual worms not encountered.

l (preserved)=1.0-1.2 mm.; d (preserved)=0.2 mm.; s=12-15;
n=9-10.*

Distribution in Indian sub-continent: Calcutta (N. India); Travancore (S. India). Now recorded from Cuddapah and Bangalore (S. India).

Habits: No swimming. Glides on substratum like Turbellarians.

* l=length; d=diameter; s=number of segments of each worm; and n=number of segments behind which budding zone develops.

2. *Aeolosoma hemprichii* Ehrenberg, 1831

Fig. 2 A

Aeolosoma hemprichii Ehrenberg. Gervais, 1838, p. 14. Beddard, 1895, p. 183. Smith, 1900, p. 443. Michaelsen, 1900, p. 14; 1905, p. 305. Bretscher, 1906, p. 6. Pointner, 1911, p. 627. Piguet, 1913, pp. 112-113. Lastockin, 1918, p. 57; 1924, p. 4; 1927, p. 65. Svetlov, 1926, p. 250. Oye, 1927, p. 359. Ude, 1929, pp. 18-19. Cernosvitov, 1930, p. 9. Kondo, 1936, p. 382. Kenk, 1941, p. 6. Marcus, 1944, pp. 21-22, fig. 7 A, B. Chen, 1944, p. 1. Causey, 1953a, p. 55. Yamaguchi, 1957, pp. 161-163, fig. 1.

Aeolosoma venustum Leidy, 1850, p. 46, pl. II, fig. 8-12.

Aeolosoma pictum Schmarda, 1861, p. 10, pl. XVII, fig. 155.

Aeolosoma stokesii Cragin, 1887, p. 31.

Aeolosoma kashyapi Stephenson. Aiyer, 1926, p. 138.

Aeolosoma hemprichii var. *kashyapi* Stephenson. Chen, 1940, pp. 23-24, fig. 1a.

Material examined: Numerous worms collected from the Bugga Stream, Cuddapah in October and December 1955; from the Balaji Tank, Kakinada in December 1956; from the Kandakam Tank, Bellary in April 1954 and 1956.

Worms minute, transparent, colourless and invisible to naked eye. Integument has numerous spherical and ovoid deep red cutaneous glands, scattered irregularly dorsally and ventrally, with concentration in prostomium and anal segment. Prostomium wider than body diameter, with marginal sensory hairs, ventral ciliation and lateral sensory ciliated pits. Its margin is highly mobile, constantly curling up and down as the worm glides along the substratum.

Each seta-bundle has 3-5 bayonet-shaped hairs only; when 3, central hair longer than others, when 4, alternate ones longer, when 5, 3 longer and 2 shorter. Longer hairs 90-120 μ long.

Mouth semi-circular with a thick ciliated rim. Pharynx in II, short and funnel-shaped. Oesophagus in III, thin. Stomach in IV-VI, barrel-shaped and brown. Intestine thin and sinuous from VII. Food material rotates on its axis during its course through the gut. Coelomocytes translucent, ovoid or spindle-shaped.

Brain dumb-bell-shaped.

Dorsal vessel mid-dorsally attached to gut, divides anteriorly into two, branches unite with non-contractile ventral vessel below the pharynx.

Nephridia two per segment from II or III to IX. Nephridium (Fig. 2 A) is a long coiled ciliated duct with a ciliated nephrostome anteriorly opening into the coelom, the duct traverses glandular mass and ends by nephridiopore.

Worms with 2-4 budding zones common.

l (living)=1.8 mm.; d (living)=0.06 mm.; s=12-14; n=7-8.

Distribution in Indian sub-continent: Travancore (S. India); Lahore (Pakistan). Now recorded from Cuddapah, Bellary, Kakinada (S. India).

Remarks : Stephenson (1909a) identified the Lahore aeolosomatids with deep orange skin glands as *Ae. hemprichii* and separated them as *Ae. kashyapi* (1923) purely on the basis of their small size and the presence of equally long setae in the bundles. Ciliated pits are stated to be absent (Stephenson, 1909a). This important character was overlooked by him in his diagnosis of *Ae. kashyapi* and he created the new species on the differences in size and setae from *Ae. hemprichii*. Aiyer (1926) also failed to observe this important character. Examining both *Ae. kashyapi* and *Ae. hemprichii* in Brazil, Marcus (1944) found ciliated pits absent in the former and present in the latter. He distinguished the two species mainly on the presence and absence of the ciliated pits. He also found a few greenish skin glands among the red ones in *Ae. kashyapi*. Brazilian worms are 2 mm. long, Japanese worms are 1.5 mm. long (Yamaguchi, 1957) and Chinese worms are 3 mm. long (Chen, 1940). Bayonet-shaped hairs and needles observed in the present worms were not pointed out by the previous writers.

Habits : Swimming absent ; gliding occurs. Backward progression by series of jerks.

3. *Aeolosoma travancorensis* Aiyer, 1926

Fig. 3 A-D

Aeolosoma travancorensis Aiyer, 1926, p. 136; 1930, pp. 16-19, fig. 1. Stephenson, 1930, pp. 723, 725. Marcus, 1944, pp. 24-25, fig. 11, 12, 15, 75.

Material examined : Many worms collected from the Bugga Stream, Cuddapah in November 1953, June 1954 and December 1955.

Worms minute, whitish and live in tubes larger than themselves, made of sand, mud and mucus. Integument with colourless ovoid skin glands. Prostomium wider than body diameter and highly flexible. Prostomium and anal segment bear sensory hairs.

Dorsal and ventral bundles composed of hairs and needles. In II all are hairs, from III needles replace hairs, middle segments have 2-3 needles and 2-3 hairs, hind segments have all needles. Hairs (Fig. 3 A) are bayonet-shaped, 63-80 μ long. Needles (Fig. 3 B) are thicker and half as long as hairs, bayonet-shaped, 35-38.5 μ long, with one row of 10-12 teeth in the concave border distally.

Mouth ventral, four-cornered and ciliated. Pharynx in II, funnel-shaped. Oesophagus in III, thin and wavy. Stomach in IV-VII, wide, orange coloured. Intestine thin and ciliated, opening posteriorly in anus. Coelomocytes absent.

Brain dumb-bell-shaped.

Dorsal vessel mid-dorsal and contractile ; ventral vessel mid-ventral and non-contractile. No contractile vascular loops.

First pair of nephridia in III ; nephridium (Fig. 3 C) is a long coiled, ciliated duct with a ciliated nephrostome opening in the coelom, a minute nephridiopore opening to exterior ventrolaterally, and proximal half of the duct compactly coiled and enclosed in gland tissue.

Budding zones 1-3 common ; provide some hind segments to the anterior zooid and prostomium and head segments to the posterior zooid before they separate.

l (living)=1.0 mm. ; d (living)=0.07 mm. ; s=12-13 ; n=7-8.

Distribution in Indian sub-continent : Travancore (S. India). Now recorded from Cuddapah (S. India).

Parasites : In the gut of several worms astomatous ciliates belonging to genus *Radiophryoides* (Fig. 3 D) are harboured as parasites. They are light green in colour in life, with flatly ovoid body, 160-180 μ long, 70-78 μ wide and 35-40 μ thick, with longitudinal rows of cilia. They move slowly rotating on their axes. Several ciliates have 1-2 buds attached posteriorly.

Remarks : Aiyer (1926) states the presence of two rows of very minute teeth in the concave border of the needles. I could see only one row of them under oil immersion. The ciliate parasites have been found by Aiyer (1930) in his worms.

Habits : No swimming. Moves by gliding.

(To be continued)

The Birds of Nepal

PART 5

BY

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[Continued from Vol. 58 (2) : 474]

Family MUSCICAPIDAE

Subfamily TURDINAE

*413. *Brachyteryx stellatus stellatus* Gould. Gould's Shortwing.

Gould's (1868, p. 218) description was based on one of the two specimens obtained by Lieut. Eccles from Nepal, the other specimen was presented to the British Museum. However, both these specimens were stated as coming from Sikkim by Sharpe (1883, p. 31) for reasons best known to him. The only specimen that undoubtedly came from Nepal was taken by Stevens (1925a, p. 356) in the Mai Valley, eastern Nepal, at c. 2135 m. on April 8.

*414. *Brachyteryx leucophrys nipalensis* Horsfield & Moore. Nepal Shortwing.

The Nepal Shortwing is known from Nepal only from four specimens, two of which (types) were presented by Hodgson to the Museum of the East India Company in 1853 when he was living in Darjeeling. It may therefore, be presumed that they came from eastern Nepal. The other two specimens were collected by Stevens (1925a, p. 357) from the Mai Valley, eastern Nepal, at c. 2135 m. in early April.

415. *Brachyteryx montana cruralis* (Blyth). Whitebrowed Shortwing.

BHABAR : Amlekhganj : 2 ♀♀ (March 8). MARKHU VALLEY : Deorali : 2 ♂♂, 1 ♀ (April 29, May 2). CHITLANG VALLEY : Chitlang : 1 ♂ (April 22). NEPAL VALLEY : Thankot : 1 ♀ (April 12).

The Whitebrowed Shortwing is not easily seen due to its habit of skulking in heavy undergrowth. It occurs as a solitary bird.

Scully (1879) and Ripley (1950b) failed to find it in Nepal, but Stevens (1925a, p. 357) took specimens in the Mai Valley, eastern

Nepal, at c. 2895 m. on April 8, and Rand & Fleming (1957, p. 148) reported it from central Nepal in the Nepal Valley and the dun.

All my male specimens are in female plumage. They all have the supercilium as in slaty blue specimens. The supercilium is, however, absent in my female specimens, as in Stevens's (loc. cit.) and Rand & Fleming's (loc. cit.) birds, although it is said to be present in females and is silky white (Baker, 1924, p. 18) or golden brown (Roonwal & Nath, 1949, p. 325) in colour. Stevens had already pointed out that the 'males in many cases breed . . . in the feminine phase of coloration. The white supercilium is present in males only . . .'; then he cited examples of two specimens, male and female 'both in similar plumage, female without supercilium', and stated further: 'All breeding males in female garb have supercilium as in slaty blue specimens.' With this I entirely agree. The descriptions of females given by Baker (loc. cit.), and Roonwal & Nath (loc. cit.) would, therefore, appear to be those of males in feminine plumage.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	68 (2), 69	42+, 45, 47.5	—, 16, 16.5
4 ♀♀ :	64, 66 (3)	43 (2), 44 (2)	15, 15.5, 16 (2)

*416. *Erithacus calliope calliope* (Pallas). Common Rubythroat.

The Common Rubythroat was not come across by us or by Scully (1879). Proud (1949, p. 702) once observed a single example in the Nepal Valley on April 1. Ripley (1950b, p. 386) found it in the Arun Valley, eastern Nepal, at c. 365 m. in February. Rand & Fleming (1957, p. 148) reported it in winter from c. 915 m. in west-central Nepal, and from c. 760 m. in eastern Nepal.

*417. *Erithacus svecicus svecicus* (Linnaeus). Redspotted Bluethroat.

We were unable to find the Bluethroat in Nepal; neither was Ripley (1950b). It was reported from the Nepal Valley in small numbers in winter by Scully (1879, p. 305) and Proud (1955, p. 60), but the latter author found it very common on passage. Rand & Fleming (1957, p. 149) found it throughout the Nepal tarai in winter.

418. *Erithacus pectoralis pectoralis* (Gould). Himalayan Rubythroat.

DUN : Bhimphedf : 1 ♀ (May 10). CHITLANG VALLEY : Chitlang : 1 subad. ♂ (March 14). NEPAL VALLEY : Thankot : 1 ♂, 1 ♀ (March 29, April 9).

The Himalayan Rubythroat is sporadically seen in central Nepal. We found it to be rather shy, keeping usually in or close to dense bushes.

It was reported in winter or spring from the Nepal Valley by

Scully (1879, p. 304), Proud (1955, p. 60) and Rand & Fleming (1957, p. 148). The last-named authors found it also in western Nepal at c. 4570 m. in winter. Lowndes (1955, p. 32) recorded it from Manangbhot, central Nepal, at c. 3960-4570 m. in July-August, obviously breeding.

The breeding altitude for this bird has been given as c. 2745-4570 m. (Baker, 1924, p. 93; Ripley, 1961, p. 496). Unless my May 10 specimen from c. 1280 m. (Bhimphedi), was a late comer from the winter grounds the species perhaps occasionally breeds at elevations lower than c. 2745 m. Unfortunately, no data on the specimen's breeding or the condition of the gonad were kept.

The subadult male specimen is olive-brown on the upper side.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	72 ^a , 74	55 ^b , 64	18 ^a , 18.5
2 ♀♀ :	68, 70	56, 61	17, 18

^a Subadult specimen

According to Ripley (1961, p. 497) the breeding form in Nepal is the eastern subspecies, *E. p. confusus* (Hartert). However, Lowndes's specimens from central Nepal were identified by Kinnear as *pectoralis*. The breeding range of *confusus* probably starts from eastern Nepal (see next form, below).

*419. *Erithacus pectoralis confusus* (Hartert). Eastern Rubythroat.

The only authentic record of the Eastern Rubythroat from Nepal has been made by Biswas (1960a) who found it breeding in Khumbu, eastern Nepal, at c. 4570-4875 m. in April-May.

420. *Erithacus brunneus brunneus* (Hodgson). Indian Blue Chat.

DUN : Hitaura, Bhimphedi : 4 ♂♂, 3 subad. ♂♂, 6 ♀♀ (May 3-11). MARKHU VALLEY : Deorali : 2 ♂♂, 1 subad. ♂ (April 28-30). CHITLANG VALLEY : Chitlang : 5 ♂♂, 1 ♀ (April 22-27).

The Indian Blue Chat is common in central Nepal in dense forests, usually on the ground, but occasionally perching on trees also. Scully (1879) did not include it in his Nepal list. Stevens (1925a, p. 356) found it breeding in the Mai Valley, eastern Nepal, in April-May. It was reported from the Nepal Valley in March-April by Ripley (1950b, p. 386), and Rand & Fleming (1957, p. 149). Proud (1955, p. 60) reported it breeding there at c. 2560 m. in summer. Smythies (1950, p. 515) also made a doubtful record from the Nepal Valley (Phylchauki Danda) at c. 2590 m. in June. Polunin (1955, p. 890) found a single example at c. 2745 m. in the Langtang Valley, central Nepal, in summer.

The subadult birds have brown primaries, and in addition, two of them have the wing coverts with rufescent tips, and one has olive-brown feathers on the posterior crown and nape.

Measurements :

	15 ♂♂	7 ♀♀
Wing :	72.5 ^a , 73 ^a , 73, 74, 75 ^a , 76 ^a , 76, 76.5, 77 (2), 78 (2), 78.5, 79, 80	71, 71.5, 72 (2),—, 73, 74
Tail :	46 ^a , 47 ^a , 47, 48 (3), 49 ^a , 50 ^a , 50 (2), 51 (2), 52 (2), 53	44, 45,—, 46 (2), 46.5, 50
Bill :	15.5 ^a , 16 ^a (3), 16 (5), 16.5 (2), 17 (2),—(2)	15.5, 16 (2), 16.5 (2), 17,—

^a Subadult specimens.

It is said to breed from c. 1525 m. upwards (Baker, 1924, p. 15; Ripley, 1961, p. 497). However, we obtained specimens between c. 455 and 1220 m. in May, but no data on the breeding of these specimens is available.

421. *Erithacus cyaneurus rufiatus* (Hodgson). Redflanked Bush Robin.

CHITLANG VALLEY: Chitlang, Chandragiri above Chitlang: 1 ♂, 1 (♂), 1 juv. ♂, 2 ♀♀ (March 15-18, April 22). NEPAL VALLEY: Thankot: 9 ♀♀ (March 21—April 2).

The Redflanked Bush Robin is not uncommon during March and April on the Chandragiri, sometimes even on trees overhanging the main Kathmandu trail. It usually occurs singly or in pairs and is of rather restless disposition.

Stevens (1925a, p. 354) recorded it from the Singalila Range, eastern Nepal, at c. 3100 m. in March-April. Proud (1949, p. 703) reported it common in the Nepal Valley at c. 1525 m. upwards in winter. Ripley (1950b, p. 386) found it in winter in western and eastern Nepal. Proud (1952a, p. 363) noted it as common in pairs up to c. 3350 m. in the Gandak-Kosi watershed, central Nepal, in spring. Polunin (1955, p. 891) found it in the Langtang Valley, central Nepal, at c. 3960 m. in summer. Lowndes (1955, p. 32) reported it very common in Manangbhot, central Nepal, at c. 3050-3960 m. in summer. Rand & Fleming (1957, pp. 149-150) found it in western, west-central and central Nepal, at c. 1370-2285 m. in winter and spring. Biswas (1960a) reported it preparing to breed in Khumbu, eastern Nepal, at c. 3810-4420 m. in March-May.

My juvenile male specimen appears to be a first year bird. It is in feminine garb, but the rump is blue and the upper breast slaty.

Measurements :

	1 ♂	1 (♂)	11 ♀♀
Wing :	84	81	77, 77.5, 78 (4), 79 (5)
Tail :	68	—	59 (2), 60 (3), 61 (2), 62 (2), 63, 65
Bill :	15.5	15	14, 14.5 (4), 15 (2), 15.5, 16,— (2)

An examination of fresh material from the Himalayas (Kashmir to Sikkim, including topotypes of *pallidior* Baker and *rufilatus* Hodgson) made me diffident to accept Baker's western Himalayan race *pallidior*. The alleged differences in coloration are apparent only when old western Himalayan birds are compared with comparatively recent collections from Nepal or Sikkim. The differences in size as given by Rand & Fleming (op. cit., p. 150) are not borne out in large series. Vaurie (1955b, p. 13) also came to the same conclusion as mine regarding the taxonomic status of *pallidior*. But Ripley (1961, p. 499) has recently upheld *pallidior*.

*422. *Erithacus chrysaeus chrysaeus* (Hodgson). Golden Bush Robin.

NEPAL VALLEY: Thankot: 2 ♂♂, 1 ♀ (March 21-30).

The Golden Bush Robin is scarce in central Nepal. We observed it only on a few occasions up to mid-April on Chandragiri (above Thankot), always on the ground in dense bush or undergrowth.

It was not reported by Scully (1879), or by Ripley (1950b). Stevens (1925a, p. 353) found it in the Mai Valley, eastern Nepal, at c. 2135-2440 m. in early April. Smythies (1948, p. 441) reported it common above tree-line in the Gandak-Kosi watershed, central Nepal, in autumn. Proud (1949, p. 703) found it only on the Sheopuri Range in the Nepal Valley at c. 1830 m. up from November to February. Smythies (1950, p. 515) noted it in the Nepal Valley on Sheopuri and Phulchauki ranges in October. Polunin (1955, p. 391) observed it occasionally at c. 3505 and 4420 m. in the Langtang Valley, central Nepal, in summer. Rand & Fleming (1957, p. 149) found it in west-central and central Nepal (Nepal Valley) at c. 1405 and 1675 m. in winter. Biswas (1960a) recorded it preparing to breed at c. 4625 m. in Khumbu, eastern Nepal, in late April and early May.

A male specimen (March 23) has the central rectrices in moult.

Measurements:

	Wing	Tail	Bill
2 ♂♂:	65, 66	53, —	15, 15.5
1 ♀:	65.5	54	15

*423. *Erithacus indicus indicus* (Vieillot). Whitebrowed Bush Robin.

Neither Scully (1879) nor we found this bush robin in Nepal. Proud (1949, p. 703) reported it as a scarce bird of the Nepal Valley on Nagar Jong in December-January. It was also recorded from eastern Nepal by Stevens (1925a, p. 354) in the Mai Valley, at c. 2440-2745 m. in March; by Ripley (1950b, p. 386) in the Arun Valley at c. 2745 m. in winter; by Rand & Fleming (1957, p. 150)

at c. 3050 m. also in winter; and by Biswas (1960a) in Khumbu at c. 4265 m. in April-May.

*424. *Erithacus hyperythrus* (Blyth). Rufousbellied Bush Robin.

It appears that Hodgson's collection (Gray, 1863, p. 34), probably from eastern Nepal, and Stevens's (1925a, p. 354) single example from the Singalila Range, eastern Nepal, at c. 3595 m. taken on March 2, form the only records of the occurrence of the Rufousbellied Bush Robin in Nepal.

425. *Copsychus saularis saularis* (Linnaeus). Indian Magpie-Robin.

TARAI: Simra: 2 ♂♂ (March 4, 5). DUN: Hitaura, Kusumar, Bhimphe: 2 ♂♂, 1 nestling ♂, 2 ♀♀, 1 nestling ♀ (March 14, May 14, 26, June 2). NEPAL VALLEY: Kathmandu, Thankot: 3 ♂♂, 2 (♂♂), 5 ♀♀ (March 21—April 14).

The Magpie-Robin is one of the commonest birds about human habitation in central Nepal, especially in the Nepal Valley. In the dun it did not appear to be as common.

Rand & Fleming (1957, p. 150) reported it also from western, west-central and eastern Nepal, up to c. 1405 m. in winter. Biswas (1960a) found it from the Nepal Valley east to the Singalila Range up to c. 1525 m. between January and July.

In the third week of March it was singing merrily and was starting its love-play. March and April birds had enlarged gonads.

Measurements:

	7 ♂♂	2 ♀♀
Wing:	101 (2), 101 ^a , 102 ^a , 103 (2), 106	93, 95
Tail:	92, 92 ^a (2), 94 (3), 95	79, 82
Bill:	22, 22 ^a , 22.5, 23, — ^a , —(2)	21.5, 22

^a Unsexed but (♂♂)

426. *Copsychus malabaricus indicus* (Baker). Indian Shama.

BHABAR: Amlekhganj: 1 ♀ (March 6). DUN: Hitaura: 1 ♂ (May 27).

The Shama does not appear to be at all common in central Nepal. It was observed by us only a few times in the forests of the bhabar and the dun. However, Ripley (1950b, p. 388) found it to be common in the tarai forests of central Nepal, while Rand & Fleming (1957, p. 151) recorded it from the western, west-central and eastern tarai where they noted it as common. Scully (1879) did not include it in his Nepal list.

Measurements:

	Wing	Tail	Bill
1 ♂:	96	147	21
1 ♀:	90	118	19.5

*427. *Phoenicurus erythronotus* (Eversmann). Eversmann's Redstart.

The sole record of the occurrence of Eversmann's Redstart in Nepal is based on a single specimen taken at Jomosom (c. 2800 m.), Kali Gandak Valley, west-central Nepal, in December by Rand & Fleming (1957, p. 151).

*428. *Phoenicurus caeruleocephalus* (Vigors). Blueheaded Redstart.

After Hodgson's collection, Stevens's (1925a, p. 355) collection from the Singalila Range, eastern Nepal, at c. 3505 m., and Rand & Fleming's (1957, p. 151) from western to eastern Nepal, form the only records of the Blueheaded Redstart from that country.

429. *Phoenicurus ochruros rufiventris* (Vieillot). Eastern Black Redstart.

NEPAL VALLEY: Thankot: 1 ♀ (April 9).

The Eastern Black Redstart appeared to be rare indeed in Nepal, the above-mentioned specimen being the only one seen by us there.

Neither Scully (1879) nor Ripley (1950b) found it in Nepal. Proud (1949, p. 702; 1955, p. 60) observed very few in the Nepal Valley on passage in spring. In northern central Nepal it was reported in summer by Polunin (1955, p. 891) from c. 3350-4420 m. in the Langtang Valley, and by Lowndes (1955, p. 31) from c. 3655 m. in Manangbhot. Rand & Fleming (1957, p. 152) found it in the eastern Nepal tarai in winter.

Measurements: 1 ♀: Wing 89; tail 65; bill 16.5.

430. *Phoenicurus hodgsoni* (Horsfield & Moore). Hodgson's Redstart.

DUN: Bhimphedi: 1 ♀ (March 13). NEPAL VALLEY: Kathmandu, Thankot: 6 ♂♂, 7 ♀♀, 1 ♀ (March 24—April 10).

Hodgson's Redstart is common in central Nepal, especially in the Valley where during March and the first half of April we found it on boulders in streams, on bushes about streams passing through forests and sometimes even in cultivated fields. It is, however, not so common in the dun.

Ripley (1950b) did not record it from Nepal. Rand & Fleming (1957, p. 152) reported it also from west-central Nepal at c. 915-2805 m. in winter.

All my birds had non-breeding gonads.

Colours of soft parts: Iris dark brown; bill very dark horny to black, sometimes with yellowish on gape; legs, feet and claws very dark horny to black; pads grey, sometimes with a yellowish tinge.

Measurements :

	6 ♂♂	9 ♀♀
Wing :	84, 85 (3), 86, 87	81 (3), 82 (2), 82.5, 83 ^a , 84, 85
Tail :	68, 68+, 69 (3), 71	63, 65 (2), 66 ^a , 66 (2), 67, 68(2)
Bill :	16 (2), 16.5, 17 (3)	15.5 ^a , 16 (2), 16.5(5), 17

^a Unsexed but (♀)

Baker (1924, p. 74) has given the measurements of tail and tarsus in this species as '66 to 68' and 'about 26', respectively. I measure them in 81 examples from all over its range as:

39 ♂♂ :	Tail	66—72 (av. 69.5),	tarsus	22—25 (av. 23.5)
42 ♀♀ :	..	62—71 (av. 66.5),	..	22—24 (av. 23.1)

431. *Phoenicurus frontalis* Vigors. Bluefronted Redstart.

DUN : Bhimphedi : 2 ♂♂, 1 ♀ (March 13, 14). CHITLANG VALLEY : Chitlang : 1 ♀ (April 20). NEPAL VALLEY : Thankot : 2 ♂♂, 1 ♀ (March 22-27).

The Bluefronted Redstart appeared to be a fairly common bird of central Nepal during March-April. It was usually seen perched on bushes in forests or open areas and on rocks, sometimes far away from water.

Ripley (1950b, p. 386) found it in eastern Nepal above c. 2440 m. in winter. In northern central Nepal, it was reported by Proud (1952a, p. 363) in the Gandak-Kosi watershed up to c. 3350 m. in spring, by Polunin (1955, p. 891) in the Langtang Valley at c. 3350 m. in summer, and by Lowndes (1955, p. 31) in Manangbhot at c. 3505-4570 m. in summer. Rand & Fleming (1957, p. 152) found it in west-central, central and eastern Nepal between c. 1370 and 2895 m. in winter. Biswas (1960a) observed it in central and eastern Nepal (Nepal Valley, Chautara, Ramechhap and Okhaldhunga districts) between c. 1220 and 2440 m. in late January and early February, and between c. 3050 and 5335 m. in Khumbu during mid-February to May.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	86, 88, 90, 93	67, 71, 72, 76	15.5, 16 (2),—
3 ♀♀ :	82 (2), 86	64, 66, 68	15, 16 (2)

*432. *Phoenicurus schisticeps schisticeps* (J. E. & G. R. Gray). Whitethroated Redstart.

The Whitethroated Redstart was not found in Nepal either by Scully (1879) or by us. Ripley (1950b, p. 386) reported it from eastern Nepal at c. 2745 m. in winter; Lowndes (1955, p. 32) from Manangbhot, central Nepal, at c. 3050-3960 m. in summer; Rand & Fleming (1957, pp. 152-153) from west-central and eastern Nepal at c. 2745-3050 m.

in winter; and Biswas (1960a) from Khumbu, eastern Nepal, at c. 3810-4875 m. in March-May.

*433. *Phoenicurus erythrogaster grandis* (Gould). *Güldenstädt's Redstart*.

Rand & Fleming's (1957, p. 153) single specimen taken in the Kali Gandak Valley, west-central Nepal, at c. 2805 m. in winter, appears to be the only post-Hodgsonian record of the occurrence of *Güldenstädt's Redstart* in Nepal.

434. *Phoenicurus leucocephalus* Vigors. *Whitecapped Redstart*.

BHABAR : Amlékbganj : 1 ♀ (March 8). NEPAL : ILEY : Thankot : 1 ♂, 1 ♀ (March 23, April 12).

During March-April we found the *Whitecapped Redstart* to be rather uncommon. It may be presumed that the majority of them must have already left by then for their breeding grounds.

From previous reports (Scully, 1879, p. 304; Smythies, 1948, p. 441; Proud, 1949, p. 702; Ripley, 1950b, p. 387; Polunin, 1955, p. 891; Lowndes, 1955, p. 32; Rand & Fleming, 1957, pp. 153-154; Biswas, 1960a) this species occurs in Nepal from west to east at c. 275-2590 m. in winter and spring, but higher up, up to c. 5335 m., in summer.

The forehead is moulting in both my female specimens taken on March 8 and 23, the latter having nearly finished its moult.

Measurements :

	Wing	Tail	Bill
1 ♂ :	94	77	18.5
2 ♀♀ :	87+, 90	70 (2)	19 (2)

435. *Phoenicurus fuliginosus fuliginosus* Vigors. *Plumbeous Redstart*.

DUN : Bhimphedi : 1 ♂ (May 8). MARKHU VALLEY : Kulikhani : 2 ♂♂, 1 ♀ (April 28). CHITLANG VALLEY : Chitlang : 1 ♀ (March 15). NEPAL VALLEY : Burhanilkantha : 1 ♂ (April 30).

The *Plumbeous Redstart* is not uncommon in central Nepal during March-April, but appears to be scarce in May. It is found wherever rapids and boulders occur in hill streams.

In northern central Nepal, Smythies (1948, p. 444) found a single example at c. 2440 m. in autumn; Polunin (1955, p. 891) occasionally observed it in the Langtang Valley at c. 3050-3655 m. in summer; and Lowndes (1955, p. 32) found it up to c. 4420 m. in Manangbhot in summer. In west-central Nepal, it was reported only by Rand & Fleming (1957, p. 154) from the tarai up to c. 2440 m. in winter. In eastern Nepal, Ripley (1950b, p. 387) observed it in the Arun Valley.

between c. 305 and 1525 m. in winter, and Biswas (1960a) recorded it breeding at c. 3050 m. in Khumbu in May.

A male specimen taken April 30 had the testes but a little swollen, measuring R: 4.5×3, L: 5×3 mm.

Colours of soft parts : Iris brown ; bill black ; legs and feet dark horny ; claws black ; pads white.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	73.5, 76, 77, 78	50, 51, 54, 57	14, 15.5, 16, —
2 ♀♀ :	68, 71	48, 50	14.5 (2)

436. *Hodgsonius phoenicuroides phoenicuroides* (J. E. & G. R. Gray).
Hodgson's Shortwing or Whitebellied Redstart.

BIHAR : Amlekhganj : 1 ♀ (March 6). DUN : Bhimphedi : 1 ♂, 1 subad. ♂, 1 imm. ♂ (May 5-7). MARKHU VALLEY : Deorali : 2 imm. ♂♂, 2 ♀♀ (April 29-May 1). CHITLANG VALLEY : Chitlang : 1 imm. ♂ (April 20). NEPAL VALLEY : Thankot : 1 imm. ♂ (April 2).

This shortwing was occasionally observed by us in central Nepal. It appeared shy and always preferred dense bushes.

After Hodgson's collection, it was recorded only in the northern central Nepal in summer by Polunin (1955, p. 890) who found it occasionally at c. 3350 and 3960 m. in the Langtang Valley, and by Lowndes (1955, p. 31) who came across it at c. 2440 m. (once) and c. 3050-4420 m. in Manangbhot.

The subadult male specimen (May 5) is in olive plumage, the feathers of the nape and upper back having blue centres; upper tail coverts freshly grown and with rufous tips, chestnut on tail prominent; otherwise worn.

The immature males (April 2—May 5) are also in olive plumage with traces of chestnut on lateral tail feathers, the one of May 5 being olive-brown with still reduced chestnut on rectrices. Those taken between April 20 and May 5 are moulting on the crown, chin and throat.

The female taken on May 1 has the feathers of the forehead tipped blue.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	72 ^a , 74	77, 79 ^a	18.5, 19 ^a
3 ♀♀ :	69, 71, 71.5	76, 77, 78	18, 18.5 (2)

^aSubadult

437. *Cinclidium leucurum* (Hodgson). Whitetailed Blue Robin.

CHITLANG VALLEY : Chitlang : 5 ♂♂ (April 18-23). NEPAL VALLEY : Thankot : 3 ♂♂ (April 7, 8).

The Whitetailed Blue Robin was found in small numbers by us

only on the Chandragiri, both on Thankot and on Chitlang sides, in the forests near hill streams.

Scully (1879) did not record it from Nepal. Proud (1955, p. 60) found it breeding on Nagar Jong, Nepal Valley, at c. 2440 m. Stevens (1925a, p. 355) observed it in the Mai Valley, eastern Nepal, at c. 2440 m. in April.

It is curious that all the specimens collected by Ripley (1950b, p. 386) from Chitlang, and Rand & Fleming (1957, p. 154) from the Nepal Valley, are, like ours, males.

Measurements: 8 ♂♂: Wing 94, 96, 96.5, 97(2), 98, —, 100; tail —, 78, 79, 80, 81, 82, 84, 85; bill 18, 19(4), 19.5, — (2).

*438. *Cinclidium frontale frontale* Blyth. Bluefronted Callene.

The only Nepali record of the Bluefronted Callene is based on Hodgson's collection (Horsfield & Moore, 1854, p. 396; Gray, 1863, p. 35; Sharpe, 1883, p. 15).

*439. *Grandala coelicolor* Hodgson. Hodgson's Grandala.

The post-Hodgsonian reports of the grandala from Nepal consist of two sight records, viz. Smythies's (1948, p. 441) from the Gandak-Kosi watershed, central Nepal, at c. 4570 m. in autumn, and Biswas's (1960a) from Khumbu, eastern Nepal, at c. 3655-3960 m. in mid-February.

*440. *Enicurus scouleri scouleri* Vigors. Little Forktail.

The Little Forktail was not found in Nepal by us or by Ripley (1950b). It was reported from central Nepal by Scully (1879, p. 311) in the Nepal Valley and Nawakot district; Smythies (1948, p. 441) observed a single specimen on Tadi Khola at c. 3655 m. in autumn; Proud (1949, p. 702) noted a few in the Nepal Valley in winter; and Polunin (1955, p. 890) reported it from the Langtang Valley at c. 2745-3350 m. in summer. In west-central Nepal, Rand & Fleming (1957, p. 154) found it in the Kali-Gandak Valley at c. 915 and 1525 m. in winter. Biswas (1960a) recorded it on Khimti Khola, Ramechhap district, eastern Nepal, at c. 1830 m. in winter.

441. *Enicurus immaculatus* (Hodgson). Blackbacked Forktail.

BHABAR: Amlekhganj: 1 ♂, 2 subad. ♀♀ (March 8, 9). DUN: Hitaura: 1 ♂, 1 subad. ♂, 1 nestling (May 14, 29).

The Blackbacked Forktail was found by us in small numbers in central Nepal on streams between c. 305 and 610 m.

Scully (1879) did not record it in Nepal. Ripley (1950b, p. 386) found it from c. 305 to 1220 m. Rand & Fleming (1957, p. 154) reported it from west-central and eastern Nepal at c. 275-915 m. in winter.

While the adult male specimen of March 8 is in fresh plumage, the subadult female taken on the same day, has brown primaries and worn wing and tail, but fresh body plumage. Another subadult female collected on the next day has brown primaries, is otherwise in fresh plumage. Its crown and back are, however, brownish. The adult male taken on May 29 is very worn, as also the subadult male of the same day. This last example has brown primaries.

The nestling (May 14) has no white on forecrown, is sooty black on the upper side, has the wing patch, rump and upper tail coverts white. Its underside is downy white with traces of brownish spots on the breast and flanks.

Measurements :

	Wing	Tail	Bill
3 ♂♂ :	93, 93 ^a , 96	— ^a , —, 124	20 ^a , 20, 20.5
2 ♀♀ :	89 ^a , 90 ^a	— ^a , 117 ^a	20 ^a (2)

^a Subadult

*442. *Enicurus schistaceus* (Hodgson). Slatybacked Forktail.

Neither Ripley (1950b) nor we found the Slatybacked Forktail in Nepal. Scully (1879, p. 311) noted it as a resident bird of the Nepal Valley where Proud (1949, p. 702) also found it. Rand & Fleming (1957, p. 155) reported it from west-central Nepal at c. 915 m. in winter.

443. *Enicurus maculatus maculatus* (Vigors). Western Spotted Forktail.

DUN : Hitaura : 1 juv. ♂ (May 20). NEPAL VALLEY : Thankot : 3 ♂♂, 1 subad. ♂, 3 ♀♀, 2 subad. ♀♀ (March 22—April 8).

The Western Spotted Forktail is not uncommon in the Nepal Valley during March-April. It occurs on the streams flowing down the hills round the Valley. We observed it also on the smaller streams in the forests of the dun.

Scully (1879, pp. 310-311) reported it from the Nepal Valley down to the dun. Proud (1949, p. 702) observed it in the Valley. Rand & Fleming (1957, p. 155) found it from western to central Nepal between c. 290 and 2285 m. in winter. Biswas (1960a) reported it from Chautara district, central Nepal, at c. 1830 m. in winter.

The subadult specimens are birds of the year, having brown primaries. The juvenile specimen is unspotted but with brown primaries.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	108, 109 ^a , 110, 111	146(2), 148, 150 ^a	24 ^a , 24, 24.5, 25
5 ♀♀ :	99+ ^a , 101 ^a , 102, 103(2)	129(2), 134, 135 ^a , 139 ^a	22.5 ^a , 23 ^a , 23(2), 24

^a Subadult

As with Scully's (loc. cit.) and Rand & Fleming's (loc. cit.), my birds are also somewhat variable in regard to the amount of black and white. This variability prompted Scully to identify part of his collection as representing the eastern form *guttatus*. However, all those specimens had white crescents on the lower back, a characteristic of *maculatus*^a.

*444. *Enicurus maculatus guttatus* Gould. Eastern Spotted Forktail.

There appears to be only a single record of the Eastern Spotted Forktail from Nepal, that is, Stevens's (1924b, p. 68) from the extreme eastern Nepal in the Mai Valley at c. 2195 m. and lower.

445. *Cochoa purpurea* Hodgson. Purple Thrush.

DUN : Bhimphedi : 1 ♂ (May 10).

The only specimen of the Purple Thrush encountered by us in Nepal was in the dense forest east of Bhimphedi. It appeared very shy and was skulking in dense undergrowth. I believe, this is the first specimen of the species taken in Nepal since Hodgson's time. Ripley (1950b, p. 386) probably saw it at Bhimphedi, and Smythies (1950, p. 515) observed it once on Sheopuri Ridge, Nepal Valley, at c. 2135 m.

Measurements : 1 ♂ : Wing 142 ; tail 105 ; bill 24.

*446. *Cochoa viridis* Hodgson. Green Thrush.

The Green Thrush is known from Nepal only through Hodgson's original specimens (Gray & Gray, 1846, p. 96).

*447. *Saxicola insignis* J. E. & G. R. Gray. Hodgson's Bush Chat.

The only report of the occurrence of Hodgson's Bush Chat in Nepal is due to Hodgson's collection (Hodgson, 1844, p. 83; Gray & Gray, 1846, p. 71).

*448. *Saxicola torquata maura* (Pallas). Siberian Stone Chat.

The Siberian Stone Chat was not found by us. It has not been specifically mentioned in any Nepal list, but there are specimens of

^a Vaurie (1959a, p. 419) states that *maculatus* grades into *guttatus* in central Nepal.

this subspecies in the British Museum from Nepal (ex Bailey collection). It is a winter visitor to Nepal and is so similar to the resident form (*indica*) in winter plumage as to be easily confused. It is quite likely that some of the winter records of *indica* refer to *maura*. Ripley (1961, p. 513) has included Nepal within the range of this form.

449. *Saxicola torquata indica* (Blyth)¹. Indian Stone Chat.

DUN: Hitaura, Bhimphedi: 1 ♂, 1 juv. ♂, 2 ♀♀, 1 juv. ♀ (March 11, 12, May 7, June 21). CHITLANG VALLEY: Chitlang: 2 ♂♂, 1 ♀ (March 15, April 19, 23). NEPAL VALLEY: Kathmandu, Godavari, Thankot: 9 ♂♂, 1 (♂), 4 ♀♀, 1 (♀) (March 23—April 12, May 10).

The Indian Stone Chat is common in central Nepal from the Valley down to the dun, singly or in pairs, in open country, cultivated land, scrub or rocky areas.

Ripley (1950b, p. 387) reported it from eastern Nepal. Polunin (1955, p. 890) found a single example in the Langtang Valley, central Nepal, at c. 4265 m. in summer. Rand & Fleming (1957, p. 156) recorded it from western to eastern Nepal.

The two juvenile specimens from Hitaura (June 21) are spotted, the male having in addition the wing patch developed.

Some of my March and April birds were breeding, the earliest I have is dated March 12. A female was laying on March 23. The gonads of some March-April examples were in different stages of development.

Measurements:

	13 ♂♂	8 ♀♀
Wing:	64(2), 64 ^a , 65(2), 65.5, 66.5, 67(3), 67.5, 68, 68.5	62, 64, 64.5, 65, 65.5, 66, 69 ^a (2)
Tail:	46, 47(2), 48(5), 48.5, 49(2), 49.5, 53 ^a	44, 45, 45.5, 46.5, 47, 48.5, 49 ^a , 50 ^a
Bill:	14(4), 14.5 ^a , 14.5(5), 15(3)	14(2), 14.5(2), 15(2), 15 ^a , 15.5 ^a

^a Sexed from plumage

450. *Saxicola torquata przewalskii* (Pleske). Turkestan Stone Chat.

DUN: Bhimphedi: 2 ♂♂, 1 ♀ (March 11, 12). NEPAL VALLEY: Kathmandu, Thankot: 3 ♂♂, 3 ♀♀ (March 20, 29—April 11).

This stone chat is not uncommon in the Nepal Valley and the upper dun in open areas during spring. Like *maura*, this form is also a winter visitor to Nepal.

¹ The type locality of this form was originally given as 'India' by Blyth (1847, p. 129). Baker (1921b, p. 709) restricted it first to Kashmir, and later (1924, p. 28) to Calcutta. The latter seems more reasonable because the Museum of the Asiatic Society of Bengal had specimens from the vicinity of Calcutta, but not from Kashmir, prior to 1847.

Scully (1879, pp. 300-301) rightly suspected that some of his specimens from the Nepal Valley (November to March) entered under *indica* were different from that form. Those specimens are in fact *przewalskii*. Rand & Fleming (1957, p. 156) found it in western, west-central and eastern Nepal.

Some of my specimens are wearing off to the summer plumage.

All my specimens had non-breeding gonads.

Measurements :

	Wing	Tail	Bill
5 ♂♂ :	71, 73(2), 74, 75	53, 54, 55, 56, 57,	16, 16.5(2), 17
4 ♀♀ :	71, 71.5(2), 72	51, 53(2), 54	16(2), 16.5, 17.5

*451. *Saxicola leucura* (Blyth). Whitetailed Stone Chat.

The sole record of the occurrence of the Whitetailed Stone Chat in Nepal is due to Rand & Fleming (1957, p. 156) who reported a single example from the western tarai in January.

452. *Saxicola caprata bicolor* Sykes. Indian Pied Bush Chat.

DUN : Mitaura : 1 ♂, 1 ♀ (May 27).

The Pied Bush Chat is not particularly common in central Nepal. Examples were seen by us from time to time in the dun in open areas such as cultivated fields about villages.

Scully (1879) did not find this species in Nepal. Ripley (1950b, p. 387) obtained specimens in the tarai of western Nepal only; Smythies (1950, p. 515) found it on Sheopuri Range, Nepal Valley; Polunin (1955, p. 890) reported it from the Langtang Valley, central Nepal, at c. 2135 m. in summer; and Proud (1955, p. 60) found only several examples on Sheopuri Range, Nepal Valley, and noted it to be common on the new road west of the Valley at c. 915 m. or lower. Rand & Fleming (1957, p. 157), however, recorded it in western, west-central and eastern Nepal between c. 275 and 1405 m. in winter.

Measurements :

	Wing	Tail	Bill
1 ♂ :	66+	50	15
1 ♀ :	68.5	50	15.5

453. *Saxicola ferrea ferrea* J. E. & G. R. Gray. Dark Grey Bush Chat.

MARKHU VALLEY : Deorali : 3 ♀♀ (April 29—May 1). CHITLANG VALLEY : Chitlang : 6 ♂♂, 2 ♀♀ (April 18—24). NEPAL VALLEY : Thankot, Crest of Chandragiri : 1 ♂, 2 ♀♀ (April 8—16).

The Dark Grey Bush Chat is common in the Nepal and Chitlang valleys in open parts and about fringes of forests, on shrubs and lower branches of trees. It occurs singly, or in pairs or small parties.

In central Nepal, it was reported from the Nepal Valley by Scully (1879, p. 302), Proud (1949, p. 702; 1955, pp. 60-61), Smythies (1950, p. 515) and Rand & Fleming (1957, p. 157); from the Gandak-Kosi watershed at c. 3350 m. in autumn by Smythies (1948, p. 440); from Rapti Valley (Chisapani), Mahabharat Range, by Ripley (1950b, p. 387); from the Langtang Valley at c. 2745-3350 m. in summer by Polunin (1955, p. 890); from Manangbhot at c. 1830 m. in summer by Lowndes (1955, p. 31); and from Chautara district at c. 1830 m. in January by Biswas (1960a). Rand & Fleming (loc. cit.) recorded it also from western and west-central Nepal at c. 275-1405 m. in winter, and Biswas (loc. cit.) from eastern Nepal at c. 1525 m. in February and at c. 3050 m. towards the end of May.

It was breeding in April. Two females taken on April 15 and 16 had ovaries measuring 5.5×4 (with large granular ova) and 9.25×4.75 mm. (with 2.5 and 2 mm. ova), respectively.

Colours of soft parts: Iris dark brown; bill, legs, feet and claws black; pads grey.

Measurements:

	7 ♂♂	7 ♀♀
Wing:	67(3), 68, 69(3)	64.5, —(2), 66, 67(2), 68
Tail:	60, 61, 62(2), 64(2), 65	60, 62, 63(3), 64, 65
Bill:	15(2), 15.5(2), 16(2), —	15(3), 15.5(2), 16(2)

Kinnear (1934, p. 357), Stresemann (1940, p. 225), Mayr (1941, p. 220) and Ripley (1961, p. 516) suggested synonymizing the eastern subspecies *haringtoni* Hartert with the nominate subspecies, but Vaurie (1955b, p. 26) upheld them as separate races.

*454. *Saxicoloides fulicata cambaiensis* (Latham). Brownbacked Northern Indian Robin.

The post-Hodgsonian records of the Brownbacked Northern Indian Robin from Nepal have been provided by Ripley (1950b, p. 387) from the tarai (? western and/or central), and Rand & Fleming (1957, p. 157) from the western, west-central and eastern tarai.

[*Saxicoloides fulicata erythrura* (Lesson). Brownbacked Eastern Indian Robin.

Ripley (1950b, p. 387; 1961, p. 521) suggested that the birds from the eastern Nepal tarai might be *erythrura* which occurs in Bihar and West Bengal.]

455. *Monticola cinclorhynchus* (Vigors). Blueheaded Rock Thrush.

DUN: Bhimphedi: 1 ♀ (May 5). MARKHU VALLEY: Deorali, Kulikhani: 1 ♂, 1 ♀, 1 juv. ♀ (April 28, 29, July 2). NEPAL VALLEY: Thankot: 2 ♀♀ (April 13, 14).

The Blueheaded Rock Thrush is not a common bird of central Nepal. Examples were observed by us singly in dense bush or undergrowth in forests.

It is interesting to note that like ours all the previous post-Hodgsonian Nepali records of this species are from central Nepal, namely Nepal Valley (Scully, 1879, p. 283; Proud, 1949, p. 704, and 1955, p. 61; Ripley, 1950b, p. 389; Rand & Fleming, 1957, p. 158); Langtang Valley (Polunin, 1955, p. 891), and the dun (Ripley, loc. cit.).

My juvenile specimen is in spotted plumage.

Measurements :

	Wing	Tail	Bill
1 ♂ :	105	70	24.5
4 ♀♀ :	97, 97.5, 99, 101	65, 66(2), 66.5	24, 24.5(2), 26

Several recent authors (Meise, 1934, p. 43; Meinertzhagen, 1951, p. 456; Ripley, 1952, p. 36; Biswas, 1953, p. 47; Rand & Fleming, 1957, p. 158) considered this form as a subspecies of *Monticola gularis* (Swinhoe, 1862). However, I prefer to follow Vaurie (1955b, pp. 23-24) in treating them as separate species. Furthermore, even if they are considered conspecific, Vigors's name *cinclorhynchus* being older must be used as the specific name.

456. *Monticola rufiventris* (Jardine & Selby). Chestnutbellied Rock Thrush.

DUN : Bhimphedi : 1 ♂, 1 ♀ (March 12, 14). CHITLANG VALLEY : Chitlang, Chandragiri above Chitlang : 1 ♂, 3 ♀♀ (April 17-26). NEPAL VALLEY : Thankot, Crest of Chandragiri : 2 ♂♂, 2 subad. ♂♂, 1 ♀ (April 1-14).

This rock thrush is not uncommon in central Nepal in open parts or edges of forests where there are dense bushes, especially on Sheopuri Lekh, Phulchauki Danda, Chandragiri (both sides) and the Mahabharat Range.

Stevens (1925a, p. 361) reported it from the Mai Valley, eastern Nepal, breeding at c. 2135 m. upwards. In the Gandak-Kosi watershed, central Nepal, it was found at c. 3350 m. in autumn by Smythies (1948, p. 441) and at c. 2440 m. in spring by Proud (1952a, p. 363). Rand & Fleming (1957, p. 158) recorded it for west-central Nepal at c. 1405 m. in winter.

The two subadult specimens of mine are in worn plumage.

The species was breeding in April. A female taken on April 9 had a much enlarged ovary with the largest ovum measuring 3 mm. A male shot on April 14 had well-developed testes (R: 6×5, L: 8×4.5 mm.), and another female collected on April 21 had a 4.5×5.5 mm. ovary with large granular ova.

Colours of soft parts : Iris dark brown ; bill black but sometimes with greyish on the base of lower mandible ; legs, feet and claws very dark horny to black ; pads grey or yellowish grey.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	121.5+, 124, 126.5, 129	100(2), 101.5, 105	27(2), 27.5, 28
5 ♀♀ :	117, 118, 122(3)	96, 98+, 99, 100(2)	26, 27(3), 27.5

Meinertzhagen (1951, p. 457) followed by Biswas (1953, p. 47) placed this species as a race of *Monticola solitarius* (Linnaeus). They are, however, sympatric in a wide belt on the Himalayas, and indeed should be treated as distinct species.

*457. *Monticola solitarius pandoo* (Sykes). Indian Blue Rock Thrush.

We were not lucky enough to find this rock thrush in Nepal. Scully (1879, p. 282) noted it as a winter visitor to the Nepal Valley occurring in small numbers from October to early March. Ripley (1950b, p. 389) reported it from the tarai in winter. Lowndes (1955, p. 32) recorded it as a rare bird in Manangbhot, central Nepal, at c. 3655 m. in summer. Rand & Fleming (1957, p. 158) found it as an uncommon bird in the Kali Gandak Valley, west-central Nepal, in November.

458. *Myiophonus¹ caeruleus temminckii* Vigors. Himalayan Whistling Thrush.

BHABAR : Amlekhganj : 1 ♂, 1 ♀ (March 7, 8). DUN : Hitaura, Bhimphedi : 2 ♂♂, 2 ♀♀, 1 subad. ♀ (May 10-31, June 10). CHITLANG VALLEY : Chitlang : 1 ♂ (March 18). NEPAL VALLEY : Buhankantha, Godavari, Thankot : 2 ♂♂, 2 ♀♀ (March 26, May 4-11).

The Whistling Thrush is a common bird of central Nepal on rivers and streams in or adjacent to forests, from the bhabar to the Nepal Valley.

It was recorded from western and west-central Nepal by Ripley (1950b, p. 390) and Rand & Fleming (1957, p. 159); from northern central Nepal by Proud (1952a, p. 364) in the Gandak-Kosi watershed up to c. 3505 m. in spring, by Polunin (1955, p. 891) in the Langtang Valley at c. 2745-4265 m. in summer, and by Lowndes (1955, p. 32) in Manangbhot up to c. 3655 m. in summer; from eastern Nepal by Stevens (1925a, p. 362) in the Mechi Valley at c. 2745 m. in February, and by Biswas (1960a) in the Dudh Kosi Valley at c. 1830 m. in early February and in Khumbu between c. 3050 and 5180 m. in March-May.

¹ Vaurie (1959a, p. 415) has reverted back to the spelling *Myophonus*. It is true that on the explanation of pl. 170 of Temminck & Laugier's *Planches color.*, livr. 29 (1822) the generic name is spelt as *Myophonus*, but two pages preceding it, where the genus is described, it is spelt as *Myiophonus*.

The male specimen from Chitlang (March 18) lacks the white tips of the median wing coverts.

The subadult female specimen from Hitaura (June 10), which had fully breeding ovary (with ova as large as 3-5 mm.), is somewhat duller in general coloration, the glistening spots are duller and smaller, and the white tips of the median wing coverts dull white. It is, moreover, smaller in size.

Birds taken in March had the gonads just commencing to enlarge, while those of May were more or less in breeding condition.

Colours of soft parts: Iris dark brown; upper mandible dusky yellow (yellow in the subadult specimen) with blackish on base and culmen, and dark horny tip; lower mandible yellow; legs, feet and claws black, pads yellowish grey.

Measurements:

	6 ♂♂	6 ♀♀
Wing :	167+, 169, 173, 175(2), 184	160, 162, 164, 165, 167, 168+
Tail :	129, —(2), 136, 138, 140	120(2), 121, —, 123, 127
Bill :	33, 33.5, 35(2), 36(2)	33(2), 34(2), 35(2)

The tail length 116-122 as given by Baker (1924, p. 180) is much too small. Delacour (1942, p. 256) has given it up to 141, with which I agree.

459. *Zoothera wardii* (Blyth). Pied Ground Thrush.

CHITLANG VALLEY: Chitlang: 1 subad. ♂ (April 25).

The above-mentioned specimen of the Pied Ground Thrush was the only example of the species observed by us in Nepal, and this incidentally appears to be the only post-Hodgsonian record from that country.

The specimen appears to be a first-year bird. Some feathers of its nape, mantle, lower back and rump are olive brown; primaries brown, median wing coverts tipped rufous, and there are a few black bars on the white of lower breast.

Measurements: 1 subad. ♂: Wing 113; tail 76; bill 26.5.

460. *Zoothera citrina citrina* (Latham). Orangeheaded Ground Thrush.

DUN: Hitaura, Bhimpheedi: 6 ♂♂, 1 ♀ (May 3-17, June 18, 21). NEPAL VALLEY: Thankot: 3 ♂♂, 1 (♂), 3 ♀♀, 1 (♀) (March 22-April 8).

The Orangeheaded Ground Thrush is common in central Nepal in dense undergrowths and bushes, usually feeding on the ground.

It was reported from the Nepal Valley only in summer by Scully (1879, p. 283) and Proud (1949, p. 703). Although Ripley (1950b, p. 389) did not find it in the tarai in winter, Rand & Fleming (1957, p. 159) reported it to be fairly common there in December and February.

March birds are in quite fresh plumage. A few of my May specimens and both the June ones are very worn.

It was breeding in May.

Colours of soft parts : Iris dark brown ; bill very dark horny to black sometimes with greyish on gape, base and sides of lower mandible ; legs fleshy with brownish front or light horny brown with yellowish behind ; feet fleshy to light horny brown ; claws fleshy to horny ; pads fleshy or yellowish fleshy.

Measurements :

	10 ♂♂	5 ♀♀
Wing :	116+, 118, 118+, —(2), 119(2), 120(2), 121	117(2), 120, 121+, 123
Tail :	75, 76, 78, 79, 80(2), 82(3), 83	76, 78, 79(2), 81
Bill :	23, 23.5(2), 24(6), 25	23, —, 24, 24.5, 25

Baker (1924, p. 149) has given 67-69 mm. as the tail length in the male, which is, however, much too small. Fifty-two specimens measure as follows :

37 ♂♂ :	72-83 (av. 76.5)	15 ♀♀ :	72-81 (av. 75.9)
	(once 68)		(once 69.5)

461. *Zoothera mollissima mollissima* (Blyth). Eastern Plainbacked Mountain Thrush.

NEPAL VALLEY : Thankot : 1 ♀ (April 6).

The above-mentioned specimen was the only example of the Plainbacked Mountain Thrush observed by us in central Nepal. It was found in dense forest on the Chandragiri Range above Thankot at about 1830 m.

Neither Scully (1879) nor Ripley (1950b) noticed it in Nepal. Stevens (1925a, p. 362) reported it from the Mai Valley, eastern Nepal, at c. 2135-2240 m. in March-April. Smythies (1950, p. 515) saw it (or ? *Z. dauma*) only once on Sheopuri, Nepal Valley. Proud (1955, p. 61) found it common in the Nepal Valley at c. 2440 m. (occasionally at c. 1525 m.) in winter. Rand & Fleming (1957, pp. 159-160) obtained a single example on the Phulchauki Danda, Nepal Valley, at c. 1890 m. in February. Biswas (1960a) found it in Khumbu, eastern Nepal, at c. 3655 m. in April.

Measurements : 1 ♀ : Wing 134 ; tail 90 ; bill 26.

The size of the tail, 100-130 mm., as given by Baker (1924, p. 163) is indeed much too large for this species. Vaurie (1955a, pp. 2-3) has, however, given correct measurements of specimens studied by him.

As Vaurie (op. cit., p. 7) has pointed out, the specimen under report is indeterminate as to subspecies. However, since Rand & Fleming (loc. cit.) found that Kumaon, Nepal and Sikkim (virtually

topotypical *mollissima*) birds are inseparable, I am listing my specimens under the nominate race. I agree with Vaurie (op. cit., p. 6) that *simlaensis* Baker is best treated as a synonym of *whiteheadi* Baker (see also Ripley, 1961, p. 528).

*462. *Zoothera dixonii* (Seebohm). Longtailed Plainbacked Mountain Thrush.

Geokichla dixonii Seebohm, 1881, Catal. Birds Brit. Mus. 5 : 161. (Himalayas; lists specimens from Nepal and Darjiling; type locality hereby restricted to Darjeeling subdivision, West Bengal.)

This mountain Thrush was not found by us or by Scully (1879) in Nepal. Smythies (1948, p. 441) observed it in the Gandak-Kosi watershed, central Nepal, at c. 3505 m. in autumn. Ripley (1950b, p. 389) obtained a single example in the Arun Valley, eastern Nepal, at c. 2745 m. in February. Rand & Fleming (1957, p. 160) reported a single specimen from the Nepal Valley at c. 1675 m. in January.

463. *Zoothera dauma dauma* (Latham). Smallbilled Mountain Thrush.

Turdus dauma Latham, 1790, Index Orn. 1: 362. (India = Kashmir, according to Baker, 1921b, p. 720.)

BHABAR: Amlekhganj: 1 ♂, 1 unsexed (March 9, 10). DUN: Bhimphedi: 1 ♀ (May 4). MARKHU VALLEY: Deorali: 2 ♀♀ (April 28, 30). CHITLANG VALLEY: Chitlang: 2 ♂♂ (April 17, 19). NEPAL VALLEY: Thankot, Crest of Chandragiri: 6 ♂♂, 2 ♀♀, 1 unsexed (March 22—April 16).

The Smallbilled Mountain Thrush is common in central Nepal usually in dense forests or grassy clearings in or near forests. In the bhabar it was not found by us as common in March, the majority having evidently left for the breeding ground. On the hills around the Nepal Valley, on the Chitlang side of the Chandragiri, and on the Mahabharat Range (both on the southern and northern sides), it was frequently seen from about the middle of March, usually in pairs.

Scully (1879, p. 286) noted it to be rare in the Nepal Valley occurring 'probably only' on passage. Smythies (1950, p. 515) saw it (or ? *Z. mollissima*) only once on Sheopari Range, Nepal Valley. Proud (1952a, p. 363) found a single example in the Gandak-Kosi watershed, central Nepal, at c. 2590 m. in March. Rand & Fleming (1957, p. 160) reported it common in the lowlands of western, west-central and eastern Nepal in winter, and recorded a specimen from the Nepal Valley at c. 1675 m. in January.

Specimens taken in mid-April had the gonads already enlarged to some extent.

Colours of soft parts: Iris very dark brown; upper mandible horny black; lower mandible pale brownish yellow on base, whitish on the middle, gradually turning horny anteriorly until the tip is horny black; legs and feet pale horny brown; claws pale horny, much paler on the tips; pads yellowish white.

Measurements :

	9 ♂♂	5 ♀♀	2 unsexed
Wing :	142, 142+, 143, 144, 145, 147(2), 147.5, 148	138, 139, 141.5, 143(2)	143, 144
Tail :	95, 98, 101, 102, 104, 105(2), 106, 107	97, 98, 100, 102, —	103, 105
Bill :	27.5, 28(3), 29, 29.5, —(2), 31.	28, 28.5, 29(2), —	28, 30

464. *Zoothera monticola mpticola* (Vigors). Large Brown Thrush.

Zoothera monticola Vigors, 1830-31 (1832), *Proc. zool. Soc. Lond.* (1) : 172. (Himalayas=Sikkim, according to Baker, 1921b. p. 721.)

NEPAL VALLEY : Thankot : 1 ♂ (April 5).

The Large Brown Thrush is apparently very rare in Nepal. The only specimen that we came across was collected in dense undergrowth of the forest at Thankot.

Scully (1879) and Ripley (1950b) did not record it from Nepal, but Rand & Fleming (1957, pp. 160-161) reported a single specimen from western Nepal at c. 305 m. in January.

Measurements : 1 ♂ : Wing 145; tail 85+; bill 44.

465. *Zoothera marginata* Blyth. Lesser Brown Thrush.

BHABAR : Amiekhganj : 1 ♀ (March 8). DUN : Bhimphedi : 1 ♂, 1 ♀ (May 5, 10).

This thrush appeared rare indeed in central Nepal. It was observed by us only on a few occasions in dense undergrowths in the forests of the bhabar in spring and the upper dun in summer. The species has recently been recorded for the first time from Nepal by Rand & Fleming (1957, p. 161) who obtained a single example from the western part of the country at c. 290 m. in January.

My male specimen (May 5) is moulting on the crown, but its wings are worn.

Measurements : 2 ♀♀ : Wing 126, 129; tail 76, 78; bill 34,—.

[Scully's (1879, p. 284) record of the Blackbreasted Thrush, *Turdus dissimilis* Blyth, from the Nepal Valley, was probably due to mis-identification of his specimen. No such example was received from Scully at the British Museum (Seebohm, 1881, p. 266) or the Indian Museum, nor has the species ever been known from west of Assam and lower East Pakistan.]

466. *Turdus unicolor* Tickell. Tickell's Thrush.

CHITLANG VALLEY : Chitlang : 5 ♂♂, 2 subad. ♂♂, 3 ♀♀ (April 18-25).

Tickell's Thrush is occasionally found in the Nepal, Chitlang and Markhu valleys from about the end of March. It usually occurs on the edges of forests in pairs or in small feeding parties.

Rand & Fleming (1957, p. 161) reported it also from west-central Nepal at c. 1430 m. in November.

Measurements:

	Wing	Tail	Bill
5 ♂♂:	124 (4), 128	86, 87, 88, 90 (2)	23 (3), 23.5,—
3 ♀♀:	119+, 120 (2)	—, 84, 85	23, 23.5, 24

467. *Turdus albocinctus* Royle. Whitecollared Blackbird.

CHITLANG VALLEY: Chitlang: 1 ♀ (March 15). NEPAL VALLEY: Thankot 1 ♀ (March 22).

The Whitecollared Blackbird occurs singly on moss-covered branches of trees on Chandragiri both above Thankot and above Chitlang from c. 1525 to 2135 m., and on the Phulchauki Danda above Godavari. It does not appear to be common.

It was reported as a winter visitor to the Nepal Valley (Scully, 1879, p. 286), leaving early in April (Proud, 1955, p. 61). Rand & Fleming (1957, p. 161) found it also in eastern Nepal at c. 3050 m. in winter. Ripley (1950b) failed to notice it in Nepal.

My Thankot specimen is somewhat lighter coloured both above and below.

Measurements: 2 ♀♀: Wing 137, 140; tail 108, 111; bill 29, 30.

468. *Turdus bouiboul* (Latham). Greywinged Blackbird.

TARAI: Simra: 2 ♀♀ (March 5). MARKHU VALLEY: Deorali: 1 ♂ (May 3). CHITLANG VALLEY: Chitlang: 2 ♂♂, 1 ♀ (April 16-20). NEPAL VALLEY: Thankot, Crest of Chandragiri: 3 ♂♂, 1 ♀ (April 4-18).

The Greywinged Blackbird is common in the forests of central Nepal above the dun from April onwards. In the dun and tarai only a few examples were observed by us in early March.

In western and west-central Nepal, Rand & Fleming (1957, pp. 161-162) reported it from c. 275 m. up to 1980 m. in winter. In northern central Nepal, Proud (1952a, p. 363) noted it as common up to c. 2745 m. in the Gandak-Kosi watershed during spring. In eastern Nepal, Stevens (1925a, pp. 359-360) recorded it from the Mai Valley up to c. 2745 m. in March-April, and Biswas (1960a) found it around 2745 m. in the Hongu Valley in June.

Of the two specimens taken on March 5, one is in very fresh plumage, while the other is worn all over. Two specimens taken April 16 and 20 are in fresh plumage, the one of April 16 has, however, slightly worn body feathers. The remaining four birds taken between April 13 and 20 are in more or less worn plumage. The May 3 bird has fresh wings and worn body plumage.

A female taken on April 17 was laying, and a male of April 18 had breeding testes.

Colours of soft parts: Iris brown; eyelids lemon yellow; bill orange with dark horny on the tip of upper mandible; legs, feet and claws brownish yellow, pads yellow.

Measurements:

	Wing	Tail	Bill
6 ♂♂ :	141 (2), 142, 143+, 144, 148	110+, 111+, 114, 116 (2), 116+	27 (3), 27.5, 28,—
4 ♀♀ :	136, 138, 142, 148	100+, 110, 111 (2)	25.5, 26.5 (2), 28

469. *Turdus rubrocanus rubrocanus* J. E. & G. R. Gray. Western Grey-headed Thrush.

Turdus rubrocanus J. E. & G. R. Gray, 1846, Catal. spec. drawings Mam. Birds Nepal Thibet pres. Hodgson, p. 81 (Nepal), *nomen nudum*, but validated by Copenhagen Decision 115 (2).

DUN: Bhimphedi: 1 ♂ (March 12). NEPAL VALLEY: Tankot: 1 ♂ (March 28).

The Greyheaded Thrush is quite uncommon in central Nepal. We observed it only on a few occasions when it occurred singly in dense forests.

Scully (1879, p. 236) did not come across it. Ripley (1950b, p. 389) recorded it by sight only in eastern Nepal. Proud (1955, p. 61) reported it as very uncommon in the Nepal Valley, but common on hills north of Pokhara, west-central Nepal. Rand & Fleming (1957, p. 162) secured a single example in the Nepal Valley (Nagar Jong, ♀, February).

My specimen from Bhimphedi is worn.

Measurements: 2 ♂♂: Wing 138, 138+; tail 106+, 107; bill 28, 29.

Baker (1924, p. 133) mentions a specimen also of the eastern race *T. r. gouldiae* (Verreaux) from Nepal in the British Museum.

*470. *Turdus obscurus* Gmelin. Dark Thrush.

The only Nepali record of the Dark Thrush is based on a single skin in the Hodgson Collection, not listed by Gray & Gray (1846) or Gray (1863), but reported by Stevens (1925a, p. 360).

471. *Turdus ruficollis atrogularis* Jarocki. Blackthroated Thrush.

TARAI: Simra: 1 ♀ (March 6). CHITLANG VALLEY: Chitlang: 1 ♂ (April 17). NEPAL VALLEY: Kathmandu, Thakot: 3 ♂♂, 3 ♀♀, 1 unsexed (March 20—April 2).

The Blackthroated Thrush is quite common in central Nepal during March-April. It occurs in pairs or flocks of varying sizes, three to twenty or so, about cultivation, grasslands, edges of forests, etc.

Rand & Fleming (1957, p. 162) reported it also from west-central and eastern Nepal at c. 915-3810 m. in winter. Biswas (1960a) found it in Khumbu, eastern Nepal, at c. 3960 m. in March.

One of my male specimens taken April 17 is somewhat worn.

The gonads of this specimen had just started swelling. Two female birds (March 23 and 27) had finely granular ovaries.

Colours of soft parts : Iris dark brown ; upper mandible dark horny with yellow on gape and sides ; lower mandible yellow with dark horny tip ; legs yellowish or brownish grey with dusky front ; feet yellowish grey to horny brown ; claws horny or dark horny ; p. s. white.

Measurements :

	Wing	Tail	Bill
4 ♂♂ :	131, 133, 134, 137	95 (2), 96, 100	24, —(2), 25
4 ♀♀ :	129, 131 (2), 134	—, 95, 96, 97	22.5, 23.5, 24, 24.5
1 unsexed :	130	96	23

*472. *Turdus naumanni eunomus* Temminck. Dusky Thrush.

The only post-Hodgsonian report of the Dusky Thrush from Nepal is due to Proud (1949, p. 703) who found it in the Nepal Valley on Nagar Jong at c. 1525 m. in winter and spring.

*473. *Turdus viscivorus bonapartei* Cabanis. Himalayan Missel Thrush.

The only record of the occurrence of the Himalayan Missel Thrush in Nepal appears to be based on the single skin in the British Museum ex Hodgson collection (Seebohm, 1881, p. 196).

(To be continued)

Chapters on the History of Botany in India

III: AT THE MIDDLE OF THE 19TH CENTURY

BY

I. H. BURKILL

[Continued from Vol. 54 (1) : 86]

My reader will readily consent that India made such economic progress at the middle of the 19th century that Botany could not escape its influence. A great unification was effected by a vast network of roads; the electric telegraph came (1851). From 1850 forwards railways were under construction. Parochialism receded. The interests of the majority were widened. As to the botanists, with whom we are concerned, he among them with a little leave to take could use it for enlarging his experience, and was not long in doing so. I will begin the chapter by recalling the names of the botanists who worked in India at the middle of the century.

The East India Company never engaged in Britain any officer expressly for what he knew of Botany; when they wanted a botanist they sought him among their officers already in India. It was otherwise in the manner of appointments for service in Ceylon, as Ceylon had no deep well to dip into, and in consequence only such men as the *ad interim* holders of the post of superintending the Peradeniya Garden on the death of Moon and the death of Gardner were found locally. Frazer, acting in Ceylon when Gardner died, seems to have collected a little. The Company's procedure, unlike that of Ceylon, left room for the chosen to have had time to grow a little rusty. And in 1854, as if in anticipation of the coming administrative changes and in step with the passing out of British politics of a conviction that *laissez faire* led to progress, the Court of Directors accepted the planning of education as a duty. But the acceptance of the duty did not press on the Directors, for their authority was swept away too soon. Nothing came; but there was an increase in the number of those who botanized which must be

attributed to diffusion of interest in botany in Britain in the stratum of the population whence came those who served in India.

Our science had been, as it were, an unexplored country into which a route is first made and names are given to landmarks; successive explorers perpetuate them. The route is marked on the maps along with the places on it suitable for rest and refreshment. Branch routes take off at these; their rate of establishment, like elongation of the main road itself, depending on the terrain penetrated. Into the kingdom of scientific Botany the main route is that of taxonomy; the landmarks are genera and species; the places of rest and refreshment are Botanic Gardens, Museums, Learned Societies, and the like; the branch roads are the several divisions into which the science has fallen, and the development of some may have been hindered for tools such as the microscope to be improved, adjuncts such as laboratories to be built, and data to be accumulated.

The resemblances are so close to reality that the facts recorded in the next three sections are arranged on the analogy.

THE BOTANISTS WHOSE ACTIVITIES CONNECT THE SECOND CHAPTER WITH THIS CHAPTER

Wight left India in 1855. For the last few years he had been occupied in winding up his affairs. The Coimbatore Experimental Farm had to be left so shaped that his successor could use it. He seems to have ceased to collect and dry plants; at any rate he left no collections from the Anaimalai Hills (*teste* C. E. C. Fischer in *Rec. Bot. Survey Ind.* 9 : 5) from which Coimbatore is only 26 miles distant. Apparently his collections were already in packing cases when the call came to close down; they had filled 10 bullock carts at the last move and would be larger than in 1850. Of his serial publications he closed these two: *ILLUSTRATIONS OF INDIAN BOTANY* in 1850 and *SPICILEGIUM NEELGHERRENSE* in 1851. He did not close down his *ICONES PLANTARUM INDIAE ORIENTALIS*; and a part was added after he had reached London, where also a report on cotton was finished and published.

Wight, who had learned the art of lithography in the house of Sir William Hooker when on leave in Britain, was now back in Britain and in contact with Sir William Hooker, whose resources for naming plants he could use; and Kew was ready to distribute his duplicate botanical specimens. Wight had dominated botanical work in India so greatly that his departure was a major event by which

the period changed. In some measure the leadership on his going passed to H. F. C. Cleghorn.

Hugh Francis Clarke Cleghorn (1820-1895) was a grandson of Hugh Francis Cleghorn who, as recorded in the second chapter (*Journal* 54 : 49), engaged Rottler to accompany him as interpreter on an inspection tour in Ceylon. He had been born in Madras and had taken a doctorate in medicine in Edinburgh. Having returned to India he was sent to Shimoga in Mysore as Civil Surgeon (1842). The teak forests of the district interested him; and in 1847 he called attention to the waste of timber caused by the way in which the land was exploited. In 1850, being on leave, he laid his case before the British Association which was meeting in Edinburgh and the Association appointed a Committee, of which he was secretary, to report back in 1851. In 1852, having returned to India, he found himself no longer a district surgeon, but a professor of Botany and Materia Medica in the College at Madras. There, from a position, which entitled him to a hearing, he addressed the Government (1856) and in 1857 he was taken from his teaching to occupy a new post, the post of Conservator of Forests. The reader notes the implication of caring for more than teak in the title of his post; there was in view wood-fuel, of all sorts; but teak-timber was most in view. From 1857 to his retirement in 1870 Cleghorn was occupied in Forest Service, and even afterwards as an adviser of the India Office. More about Cleghorn will be found later.

The reader doubtless appreciates the fact that Cleghorn came to his forest service as a botanist. He had previously collected dried plants which were given to the Calcutta Garden and he had written ecological papers. Contemporaries there were who were connected with conserving teak, but they were not botanists; they were practical men; and the association of these with botanists was merely provisional. One of these practical men was **H. A. Conolly**, Collector of the district of Malabar, where the teak forests had received the most damaging exploitation. He had asked to be allowed to buy up and replant ruined teak forest, and had great success in restocking, particularly in the Nilambur forest which is ideal for teak. Nilambur is half-way between Calicut and Ootacamund. Of course restocking, with cropping about 100 years ahead, does not allow Conolly's financial questions a place here; but Conolly showed himself a pioneer.

While he was doing what he had undertaken, Captain **Frederic Cotton**, an engineer, was making a road along the border of the State

of Cochin; and he called attention to the teak that he saw in the Anaimalai Hills—teak which Wight might have seen by going into the Hills from Coimbatore. Cotton's teak was put (1850) into the charge of another army officer, **James Michael**, then a lieutenant, ultimately a general. He held his charge until 1856, and did a little collecting of plants; but very little. In 1856 he was succeeded by one who was already a botanist, **R. H. Beddome**. It is to be noted that the year of Beddome's appointment is the year of the appointment of Cleghorn as Conservator of Forests; and that 1857 seems to have been a year of thinking ahead—a Forest Service was coming in Madras. In its foreshadowing is the third of the marks of our new period.

Michael in due time took leave and did not re-enter the Forest Administration, though he kept his interest in forestry through life. In the Anaimalai Hills he had tried to minimize the injury that fire did to his seedlings of teak by causing the coating of dying leaves that fell on them to be swept aside.

Richard Henry Beddome (1830-1911) had reached Jabalpur in 1848 and had commenced collecting there. The Government of Madras, when in 1856 it took him into the initial Forest Service, employed him in the Palni Hills, where he picked up Wight's mantle in one respect, namely the illustrating of the plants of southern India by the use of lithography. He threw himself with great energy into collecting and made a considerable herbarium. He learned his forestry by experience, but was all through his life predominantly a botanist.

I have classified Cleghorn as an ecologist, calling him the second ecologist that India had, the first having been Edgeworth. Both were Edinburgh students, but it is not clear that their interest had a common origin, though it is apparent that ecology was, so to speak, in the air at Edinburgh. **John Hutton Balfour** (1808-1884) introduced a little of it into his professorial teaching; and, though he had not become professor until 1845, he had given extra-mural lectures in Edinburgh some ten years earlier. I suggest that this vigorous teacher, whose classes were described as 'thronged' and as 'the largest ever brought together', forced the contemplation of the life of the plant into the teaching of his time; whereas Robert Graham, his predecessor, by making his students carry pocket lenses on their expeditions with him into the country, forced observation of the details of the flower into the teaching.

Wight, Michael, Cleghorn, and Beddome are not the only botanical names of the Madras collections of about the fifties: these also served: **Heber Drury** (1819-1872), a colonel in the Madras Army was in Travancore; **Sir Walter Elliot** (1813-1887), an administrator of wide interests, was at Vizagapatam; **Thomas Caverhill Jerdon** (1811-1872), who made his reputation as a zoologist but also collected plants, was in the southern part of the Presidency until 1868; **Gideon Thomson** (see Chapter 2, *Journal* 54 : 83) was collecting there until 1855; a missionary, **E. Johnston**, was a rather discriminating collector of the south-western coasts; where also was another, **Samuel Mateer** (1835-1893), who paid attention in particular to the vernacular plant-names that he encountered. There were two horticulturists in the Presidency who did excellent work in their own line, **Andrew T. Jaffray** and **William Graham Melvor**, the first at Madras, the second in the Nilgiri Hills at Ootacamund. The zoologist Jerdon made excursions into Botany and the botanist Beddome made excursions into Zoology.

As Ceylon at this date hung on to Madras by accepting the guidance that Wight gave, it is convenient at this point to look southward to it. General Warren Walker had protested that the Peradeniya Garden was in the charge of 'an ignoramus who could not read the language of Botany'. This was James George Watson (for whom see page 50 of the second chapter), and the General's protest had borne fruit at Watson's death, when Sir William Hooker had been able to get his former pupil, the surgeon **George Gardner**, accepted. **Sir James Emerson Tennent** was the Colonial Secretary; and between him and Gardner a friendship arose which led to companionship; one may say that the Botany in Tennent's account of Ceylon had been talked over with Gardner in joint rambles. It was during the years of this friendship that the German surgeon Warner Hoffmeister reached Ceylon (see the second chapter, *Journal* 54 : 50). Neither he nor Prince Waldemar of Prussia, with whom he was travelling, saw Gardner who was away from Peradeniya at the time. Hoffmeister wrote that Gardner was the only botanist in Ceylon; but this overlooks amateurs who were there; and the meaning of Hoffmeister's words must have been that Gardner was officially the only botanist. Another officer of the General's name, Colonel **James Thomas Walker**, collected plants in Ceylon between 1830 and 1840.

William Ferguson (1820-1887), by profession a surveyor, was in Colombo. It is not quite sure when his interest in ferns developed; but he assuredly was already interested in economic plants from his arrival in 1839. He was a man of great ability and activity.

Harmanis De Alwis, the splendid artist of the Peradeniya Garden, has a large claim for attention. He came on to Moon's staff as a clerk and Moon, discovering his talent, paid for his training as a flower-painter. He served from 1823 to 1861 and a son succeeded him.

Gardner on assuming charge, commenced work exactly as General Walker would have wished, i.e. by collecting vigorously. He had his artist to draw for him, and it is to be noted that perishable fungi received his attention but to be regretted that from want of direction these drawings, in Petch's opinion, are impressions rather than portraits.

Unfortunately Gardner's death came suddenly in 1849, when the Colonial Office appointed an equally efficient man G. H. K. Thwaites to succeed him and we find this new man in the last days of that year climbing the road from Colombo to Kandy to assume charge.

George Henry Kendrick Thwaites (1811-1882) was probably the most liberal-minded botanist then in the East. As a young man, earning his living by accountancy, he employed his leisure to very good effect in studying the lowest plants; then he became a teacher himself in the School of Pharmacy at Bristol and in succession to this in the Medical School. From Bristol he applied for a teaching post in Ireland; but he did not get it, though his sponsors were among the most prominent botanists in Britain and France. The reader, noting this, is made sure of the competence to which Thwaites had brought himself. Instead of the post in Ireland he was appointed to succeed Gardner in Ceylon. Thwaites in detail did so; as he climbed the road to Kandy he moved exactly into the work of Gardner, the work that General Walker had wanted; he became a student of the Flowering Plants of the island. The study of the Lower Plants was for those whom he could induce to work on what he would collect. **William Mitten** worked up his mosses, **W. A. Leighton** his lichens, and **Miles Berkeley** his fungi. Berkeley took **Christopher Edmund Broome** for a fellow worker and between them they carried the knowledge of the fungus flora of Ceylon a vast way beyond that of India. Thwaites could not have done better.

Let it be stressed here that Gardner had set the example of collecting the fungi.

Gardner seems to have brought a large personal herbarium to Ceylon and to have amalgamated it with the collection started by Moon. The amalgamation had to be undone so that Gardner's property could be sold for the benefit of his family. With that done

the growth of the herbarium became the work of Thwaites. Neither Berkeley nor Broome visited Ceylon, and the species which they named were those collected by Thwaites. A biographer credits Thwaites with being 'a naturalist, pure and simple, a keen and accurate observer of great industry, quietly enthusiastic and with great reasoning capabilities'. Broome had known him when resident in Bristol. Berkeley and Broome co-operated with equally great and equally quiet enthusiasm; in fact they isolated themselves.

William Ferguson (1820-1887), by training a surveyor, in Ceylon from 1839 until his death, developed, as already said, an interest in economic plants and in ferns; and he took an interest also in the seaweeds.

Thwaites used Wallich's way of getting help from Europe, the way of liberality, of distributing specimens in the hope of obtaining determinations; he made up sets of dried plants which were given where a return was expected, and were on sale also. His greatest help came from Kew, where Sir Joseph Hooker would compare the Ceylon with Indian plants. Thwaites's *ENUMERATIO PLANTARUM ZEYLANIAE CATALOGUS* (1858) was made on the materials that went into his sets.

The Colonial Government had been caused to transfer their botanical work from the coast to the hills by the rush into the coffee districts of would-be planters, many of them agriculturally ignorant and all in need of guidance, which they came to expect but did not particularly go to seek. Thwaites seems to have been left in his first years to find his feet. In 1854 came what Sir Emerson Tennent, the Colonial Secretary, described in his *CEYLON* (2: 211) as 'a murmur of ill-informed utilitarianism against the expenditure bestowed on the Botanic Garden and a proposal that the Garden be abandoned'. Tennent shows that official opinion supported Thwaites; and Ferguson took a leading part in upholding him; but Thwaites as a consequence had more economic work thrown on him, while the preparation of the *ENUMERATIO* was still in progress for yet another few years.

The following also botanized in Ceylon at this time: a chaplain, **John Gibson MacVicar**, just before 1850, and apparently the judge, **Sir William Norris**, in the period before he was transferred to Penang (1836). That these two were actual collectors of Ceylon plants is not certain; both may have developed collecting as a pastime after leaving Ceylon. **Edward Frederick Kelaart** (1818-1850) was born in Ceylon, but most of his botanical work was done elsewhere; and he was more interested in zoology than botany.

Neitner, a German biologist, made a stay in the island (1854-1855) and took a collection to Berlin.

It is time to turn northwards to the Bombay Presidency. **John Graham** had died in 1839. **Charles Lush** and **Joseph Nimmo** had died in 1854. A fourth botanist of Bombay of those years was lost to Bombay—Captain **Henry Geburne**, an Artillery officer, who left by retirement (1846). **John Sutherland Law** remained as the doyen, but not for long. He knew the plants of the districts in which he had served; but he published little. Four years after the year in which this chapter begins he also retired, taking with him a herbarium of about 1500 species, part of which went to Oxford and the rest to Kew.

When Law left India, the leadership in Bombay passed to **Alexander Gibson** who had been in charge of the Dapuri Garden in Poona from 1836 to 1847 and had published thence several not unimportant papers on economic plants including one on the Teak tree (1840). In 1847 he was appointed Conservator of Forests for the Presidency, a post he was still holding when Cleghorn came forward in Madras. **N. A. Dalzell** was under Gibson. It was not until 1861 that their joint BOMBAY FLORA appeared: two years later Gibson published his HANDBOOK TO THE FORESTS OF THE BOMBAY PRESIDENCY, and inserted into it an enumeration of the valuable forest trees of India as a whole. In the year after this he retired, giving to the Calcutta Garden, as he left, his collection of dried plants. Dalzell did not immediately succeed Gibson; but by way of economy the Bombay Government united the posts of Conservator of Forests with the charge of the Dapuri Garden in the person of **Eyre Champion de Crespigny** whose collection of dried plants is now the property of the University of Manchester. de Crespigny retired in 1862: Dalzell remained in India for a few more years in charge of the forests.

The forties had brought the first opportunity of making acquaintance with the interesting flora of Sind. Military operations led to it; they caused **Nathaniel Vicary** to be sent thither with his regiment. Vicary had been in India from before 1832, but it was not until more than ten years later that he found himself in Sind. He was a diligent collector who, perhaps because of his repeated transfers of station, let his collections suffer damage. It was probably the inconvenient size of his possessions which in 1832 or 1833 led to the gift of them to the Calcutta Garden. After that he began a new collection and when he left India for Australia there was a second gift. He published on the plants of Sind in 1854 and 1857.

The next to study the plants of Sind was J. E. Stocks.

John Ellerton Stocks (1822-1854) had been one of Lindley's pupils in London; and having qualified in Medicine he went to India in 1847 where he was sent out to vaccinate. At the end of a period of service of normal length he took his collections to Kew for determination; but he died prematurely. Hyderabad (Sind) was within his area and from Hyderabad he made his two expeditions into Baluchistan.

A contemporary surgeon of Bombay with an interest in ferns was **Andrew H. Leith**. His time of activity also spanned the year 1850. His collection is now the property of the University of Manchester. Another contemporary surgeon was H. J. Giraud. The Bombay Government brought him out from Britain to teach in the Grant Medical College and he was not of the Service which in general provided the Company's botanists. **Herbert John Giraud** (1817-1888) arrived in 1841 or 1842 with the title of Professor of Chemistry. Not at first, but after 1845 his teaching extended to Botany, and during his years he held various civic positions in addition to his teaching and is said to have been a popular lecturer. He returned to Britain in 1867.

John Forbes Watson (1827-1892) arrived in India in 1850 and taught Physiology in the Grant Medical College, then returned to Britain in 1858 to take the place that Royle had had in the service of India House as Reporter on Economic Products and Keeper of the Museum at India House. This post he held until 1879. The brothers **George Christopher Molesworth Birdwood** (1832-1917, knighted in 1877) and **Herbert Mills Birdwood** (1837-1907) arrived in India respectively in the years 1854 and 1858. The elder did much for Bombay. He had been born in the Presidency. He qualified in medicine at Edinburgh with Hutton Balfour as his teacher in Botany and was one of the keen men who helped in getting class-material together. After reaching Bombay he taught various subjects in the Grant Medical College; and a great interest in Materia Medica induced him to pay a collector on the coasts near Aden to seek for the trees yielding myrrh and frankincense. It led also, though less directly, to a catalogue of the economic products of Bombay. He served the city in many ways; among them he was Secretary of the Agri-Horticultural Society, and he took the leading part in raising money for a museum in the Victoria Park. When in 1868 ill-health drove him out of India, he carried his interests to Britain and gave his service to India through the India Office. The younger became a judge who wrote in his leisure a *FLORA OF MATHERAN AND MAHABLESHWAR* and an account of Indian timbers.

It may be mentioned here that the French botanist, **Charles Gaudichaud-Beaupré**, serving under Freycinet paid brief visits to Pondicherry and Calcutta in 1837; and that in 1845 the Danish exploring ship *Galathea* touched at Tranquebar, Pondicherry, Madras, and Calcutta on her way to the Andaman and Nicobar Islands, **Dietrich Ferdinand Didrichsen** collecting.

In 1850 Sir **Joseph Hooker** and **Thomas Thomson** were collecting plants with great thoroughness in the Khasia Hills. They had collected separately in the Sikkim Himalayas and the remotest parts of Kashmir; and were working for a joint account of the flowering plants of India. They would have called their publication '*Flora indica*', taking into it as much as they could, making it an account of the largest area that their knowledge could justify, just as Roxburgh had done with his *FLORA INDICA* and as Griffith would have done had he got so far as writing. '*Flora indica*' did not mean 'the Flora' but 'a Flora'. From the Khasia Hills they moved southwards as signs of autumn came over the uplands and, collecting through Sylhet, Chittagong, and the Sunderbans, reached Calcutta to leave for Britain early in February 1851.

Falconer was now in his second spell of work in India (1847-1855). He had been to Moulmein to report on the teak forests and was occupied, when Hooker left, in replanting the Calcutta Garden in the wake of McClelland's destructiveness. As for **McClelland**, after a short time in Birbhum he had been sent to Pegu to collect through the teak forests. Falconer had been of great service to Hooker by receiving his collections and preparing them for sending forward to London. He sent collectors of his own to the Khasia Hills to supplement Hooker's collections. **Francis Jenkins** was still the Governor-General's Agent in Assam and stimulating collecting from Gauhati. His subordinate **J. W. Masters** collected up the Brahmaputra to Sadiya. **Vicary** was making his last collections in India; he had collected in several parts of the lower Ganges valley and Hazaribagh. The strength of the army in the upper parts of the Ganges valley was so great that there was nearly continuous study of its flora. Lady (**Elizabeth**) **Gomme** wife of the Commander-in-Chief collected a little (1856). **William Jameson** (1815-1882) was in charge of the Garden at Saharanpur. He had been sent to Saharanpur in 1842 and when he understood that Hooker and Thomas Thomson would write a flora, he supplied them with plants in the hope of helping them . . . **M. P. Edgeworth**, now in Banda, was helpful from thence; and in the year 1850 he was transferred to Multan where he made a list of the

flora. Lieutenant **William Hawtayne Parish** sent Himalayan plants from Kulu and Mandi. Brigadier **J. B. Hearsey** was sending to Kew plants from the Punjab. **Thomas Lobb** was at the time, collecting plants worth culture for the firm of Veitch of Exeter; but of course a bird of passage as to India. The following three botanists reached India during the fifties—**John Lindsay Stewart** (1853), **Charles Murchison** (1853), and **James Edward Tierney Aitchison** (1858). The work of the first and the last will be indicated later; that of Murchison was little; during his two years in the Bengal Medical Service he made small collections of dried plants which he gave to Kew.

A missionary, **Francis Mason** (1799-1874), as avid of acquiring knowledge as William Carey, had arrived at Tavoy in Tenasserim and had moved to Moulmein in 1850 where he embarked on a book, small in its first edition, on Burmese plants etc., entitled *NATURAL PRODUCTIONS OF BURMAH OR NOTES ON THE FAUNA, FLORA, ETC. OF THE TENASSERIM PROVINCES AND THE BURMESE EMPIRE*. There was a second edition from the author in 1860 and remotely (1882) a greatly enlarged edition by another hand (W. Theobald's edition).

At the beginning of our period (1852) **Charles Samuel Pollock Parish** (1822-1897) went to Moulmein as Chaplain and threw himself with energy into a search for interesting plants. One expedition took him to the Andaman Islands.

BOTANIC GARDENS—THE BOTANIST'S FIRST CARAVANSERAI

After the men, their memorials! And as an opening question, by what is a botanic garden to be distinguished?

A garden becomes a botanic garden when its purpose is the bringing of plants into some kind of philosophic study. It must be a garden first. The missionaries of Tranquebar doubtless were provided with a garden of vegetables as a supplement to which, from 1768 when **Johann Gerhard Koenig** came among them, they accepted what interested him in his quest for knowledge and associated it with the vegetables, as that was convenient. Then their garden became a Botanic Garden, as they indeed called it. Equally the garden of the magistrate **M. R. Smith**, at Sylhet, when he began to use it as an entrepôt between the Khasia Hills and Roxburgh in the Calcutta Garden, became a Botanic Garden; and so he and his friends named it. But the Calcutta Botanic Garden did not get the adjective 'botanic' into its name in the same way. Kyd in the letter that carried his proposals to the Government of Bengal expressly excluded

from its operations the study of plants, i.e. the addition to the garden of the operation that entitled Koenig's and M. R. Smith's to be called botanic.

I have reached the conclusion that when Colonel **Kyd** set out to address the Government of Bengal on his proposal for the establishment of a Calcutta Botanic Garden, he had no clear mind as to the name to give it. He described what he was asking for in terms indicating a horticultural nursery. We have such nurseries today and there were such in Britain in Kyd's time: for instance, the first nursery held by the Veitch family was for raising trees for planting in Devon. Kyd would have the like close to Calcutta. He wanted something that was more than just a garden; as something better than a garden he called it a botanic garden. He proposed no pure botany for it and in fact explicitly wrote that there would be none.

He pointed to 310 acres along the river just below Calcutta and he estimated 200 rupees a month as the cost of maintaining. The Government approved, and began operations without waiting for sanction to come from the Directors in London. They used Kyd's name—Botanic Garden, and Botanic Garden it was to the man in the street. His expectation determined that it should develop in that direction, and so it did. Kyd lived on adjoining land and accepted charge. When the approval of the Directors came there was a comment with it that they would not have objected to a higher estimate of cost; Kyd lived for a further 9 years and, when he died, the Government called **Roxburgh** from Samalcottah to take his place. We see from the time of Roxburgh's arrival pure botany in place in the Garden mixed into the increasing stock of the nursery. The conduct of affairs now under Roxburgh diverged so much from the proposals of Kyd's first letter as to suggest that the adjective 'botanical' in Kyd's name had driven botany into the administration, actually during Kyd's years of control, so that at the date of Kyd's death it was a natural thing to call in a botanist.

Who was the founder of the Garden? Kyd for horticulture, Roxburgh in great measure for Botany.

To Banks and those in London who were taking part in the advancement of Botany through Kew, Roxburgh's greatest contribution to the Science was through his descriptions and drawings and it was customary for Banks to see the drawings.

Calcutta was in a great wave of prosperity and with consequent liberal impulses, the Government was prepared to retain all the 310 acres as garden, but later took some away. Little is the information

preserved on the Garden's early appearance. Its area was from a ditch bordering the property towards Howrah, on which Kyd lived, to the Great Banyan tree at the west end. This tree was young enough not to have completely suffocated the Indian date-palm tree on which its seed had germinated as an epiphyte. In depth the Garden extended from the river bank to an untidy undefined area to which Hooker thought the noisy picnickers from the city, amusing themselves by folk-dancing, might profitably be confined; and it is doubtful if at Hooker's visit the scenic possibilities of the river-front were attractively developed. But when Maria Graham visited the Garden as Roxburgh had it in 1810, she commented on its orderliness. Orderliness need not imply finish, and the scattered tanks and nurseries, remarked on by Griffith, indicate irregular and improvised extending of cultivation. Landscape gardening was not aimed at; and most certainly the Garden passed through a period when its greatest beauty was not in it but in the youth of its trees—natural, therefore, and not by art.

The founding of a garden in Calcutta led to a wish for other gardens, the promoters seeing possibilities much as Kyd saw them, but not as Roxburgh did.

Tipu Sultan of Mysore had converted a fruit-garden that his father had made in Bangalore into a garden of ease. On his downfall in 1800 the fate of this garden had to be decided and, pending a decision, it was put into the charge of **Benjamin Heyne**, he being the Madras botanist at the time, and a proposal having been made that it should become 'a botanic garden'. After Heyne it was entrusted to an agri-horticultural society; then relinquished but remaining an open space. **Cleghorn** contrived to get the status of garden restored. He made his recommendation in 1856; and it was to apply to 50 acres. A horticulturist named **New**, to whom there is a *Strobilanthes* dedicated, was put in charge; then followed **Allan Black**, sent out from Kew in 1863, but he lived for two years only. Black (1832-1865) had had a horticultural training at Kew and had held the post of Curator of the Herbarium. After him the Bangalore Garden had for its Superintendent from 1873 to 1907 **John Cameron**, to whose planting it has owed much of its beauty.

Another Cameron—**William Cameron**—had left Kew about 16 years earlier for the similar service of horticulturist at Peradeniya. It is said that when in 1857 he went to Ceylon he was entrusted with the conveying of a consignment of cinchona plants. He left Government

service in 1860 for coffee planting, was hit by the coffee-leaf disease, and piloted his estate back using cinchona.

One year before the death of Tipu, Ceylon had obtained a small acclimatization garden in Colombo entrusted to a gardener named Jonville, brought from Europe by a new Governor. This garden, to give it a better position, was removed for a short distance in 1810; then to increase the field of interest Banks caused **William Kerr**, a Kew gardener, to be sent out in 1812. Kerr had travelled to collect desirable plants and could be relied on to bring together such as he could get and grow. The Colombo site however was still condemned, as it was liable to be flooded; but there was available an abandoned sugar plantation at Kalutara, which though 26 miles from Colombo, was accepted; and the garden was moved. Kerr died in 1814, and another who had had the same training in travelling and collecting, **Alexander Moon**, was sent to Ceylon to replace him (1817). In that year the Government completed its military road from Colombo to Kandy. It was decided on this that Kandy should be the hot weather station of the Government with a residence for the Governor, and, following that, to use Nuwara Eliya as a sanatorium, for which purpose the road was continued right to the very middle of the hills. It opened a wide area for planting, and there was a rush into it of would-be planters, many of them very ignorant of planting possibilities. To meet the situation, the Government set aside about 150 acres at four miles from Kandy for a garden that could illustrate possibilities as well as acclimatise and become a Botanic Garden. They closed Kalutara and sent Moon uphill after the planters.

The Dutch when they held the coasts of Ceylon had tried to introduce coffee-growing as an industry. They got no further than to familiarise the bush in the coastal villages. The excellence of the hill climate for growing it did not remain unknown; but the cultivation in the hills came only with the entry of planters from 1817 forward. One of Moon's first acts when in possession of Peradeniya was to lay out with coffee an area conspicuously where the new high road passed the Garden and to lay out another with the traditional crop, cinnamon. These, the reader realises, were demonstrations. Moon added as he could, in order to attract the interest of the passers-by, a few acres near the gate of miscellaneous cultivation; the balance behind remained in natural forest.

This founding was in many ways unlike that of the Calcutta Garden; it was a lone job for Moon, whereas the founders of the Calcutta Garden had abundant well-wishers and potential supporters.

The two were alike in the liberal provision of land. Moon had the London idea of what a Botanic Garden should be; he backed it up by determining his plants, catalogued them and found an artist who pictured them. What he got into the cultivated acres can be gathered from his CATALOGUE OF CEYLON PLANTS, published in 1824. He died in the next year, a great loss. There is evidence that **Jonville** collected and dried plants.

Two years passed before Moon's successor arrived. This was **James Macrea** whose training for his work had equally been by travelling as a collector of useful and ornamental plants. Macrea died in 1830 and again it took two years to secure a successor. He was **James George Watson**, accepted on Wallich's recommendation, but not a success in the post. General Warren Walker's scathing condemnation of him has been quoted. At the time of Watson's death in 1838, the Government was allowing the produce of the Garden to be sold in Kandy; and it found locally successive caretakers, (i) in **J. G. Lear**, a professional horticultural collector who had been sent to Ceylon and (ii) and (iii) in two of the island's surgeons, **H. T. Normansell** and **W. C. Ondaatje**. They were naturalists and no doubt did faithful curating. Normansell died. A little later we discover Ondaatje on a visit to London where he joined the Linnaean Society. Exhibits which he brought to meetings indicate that he had an interest in medicinal plants. But in 1844, at last the post of superintendent was filled, as General Walker urged, by one able to study the botany of the island. This was **George Gardner**, with a qualification in Medicine, a pupil of Sir William Hooker and with a reputation as a botanist got from extensive plant-collecting in Brazil. At Peradeniya a close friendship sprang up between Gardner and Sir **Emerson Tennent**, who was at the time Colonial Secretary, so close that the botany in Tennent's CEYLON must have been talked over by the two in their rambles together. Tennent praises the Garden for horticultural efficiency. There were flower borders but not yet any of the art of landscape gardening.

Gardner died in 1849, and the custom established, of employing a botanist, led to the appointment of **Thwaites**. When Gardner was put in charge, 40 acres out of its 140 were in cultivation and, taking into consideration the way in which the Garden had been officered, it is hard to see how the planting community had had a real lead.

In 1821 the Governor-General of India, Lord Hastings, visited the North West Province¹. The reconstructed canal carrying water to Delhi

¹ Later the united Provinces of Agra and Oudh, and now Uttar Pradesh.

was one of his interests and he visited Saharanpur near to its head. In that pleasant station his attention was drawn to a neglected fruit-garden supported originally by the revenue of seven villages on the foundation of a public-spirited administrator and dedicated to the improvement of local horticulture. In its neglected state, self-sown inferior mango trees standing in coarse grass filled it. Lord Hastings decided that it should be preserved and replanted under the care of the Civil Surgeon, who at the time was the fully competent **George Govan**. Under him its small area of only a few acres was extended; canal water was brought in; roading was done; lawns made and it was dedicated anew to its original purposes. Govan, to extend its work, opened a nursery at Nahan on one of the routes of trade from the plains into the Himalayas. Retiring in 1823, he was succeeded by the energetic **J. F. Royle**, who intensified the work and investigated the flora on the near-by hills by sending collectors for plants and seeds, creating a herbarium, employing agents to bring fruit trees from Kashmir and, when Wallich went on leave, obtaining the services of the Calcutta artists. He closed the Nahan nursery, when he was able to open a larger and more elevated one at Mussoorie. Saharanpur with Mussoorie in support had resembled Kalutara with Peradeniya in support, if Kalutara had been retained; the years were the same.

Royle gave to Saharanpur all required to make it a Botanic Garden, of the Kew type, the display, the botanical nomenclature, the study of plants, and a recording in print and by illustration. Assuredly he knew Kew. The distance of Saharanpur from Calcutta and the entirely dissimilar climates kept the two Gardens from any competition. But in the eyes of the Administrators, the elder was always the elder brother, staffed therefore by the experienced, for instance Hugh Falconer, Thomas Thomson, and Sir George King; each in his time was entrusted with the care of Saharanpur before promotion to the care of the Calcutta Garden.

The north of India under Persian influence obtained a number of gardens of ease. Tipu's at Bangalore was the Persian influence carried to the south of India. All that Tipu's garden did towards the promotion of Botany was to provide land used botanically after a long interval. The Saharanpur Garden was not of the same kind of origin; but again what it did was to provide land after a break just as Tipu's garden did.

Three of the north-western gardens of ease may be mentioned in passing: (i) that at Fatehpur Sikri because it is so instructive in construction, (ii) that at Shalimar, a little to the west of Lahore, because

though never serving in pure Botany it played a part in fruit selection, and (iii) the better known Shalimar Garden in Kashmir for we have descriptions of it as it was. This garden, set on a superb site, exposed too much art.

I have need to revert to the Calcutta Garden. In the year 1830, Wallich being on leave in Britain, a Retrenchment Committee cut the financial support for the Garden so severely as to arrest progress. Wallich on his return to Calcutta in 1832 found he had to retrench; he could not withdraw from raising large quantities of stock for giving away and also for supplying to small experimental patches up and down Bengal which were in his charge. He did not send out collecting parties and, as I have said elsewhere, showed an unwillingness to maintain a collection of dried plants. His accumulation of drawings suggests economy, for a record exists to the effect that during his second period of service his artists gave him 552 drawings against the 2350 done for Roxburgh. I take it fair to say that this retrenchment fell on the development towards a mature Botanic Garden; and that the ideas of the Government retrogressed towards Kyd's nursery establishment.

Griffith, who criticised Wallich for abandoning Botany, took a very curious and unjust position when, along with the attribution to Wallich of what he saw amiss, he promised the Government in asking sanction for undoing so much of Wallich's work that he would do it on his budget allowance; for this he implied that the allotment was adequate. Of course the Government wished it to be so, and went on wishing until the Crown displaced the Company.

GARDENS ADDED FROM 1830

The first of these gardens was that of Bombay; it was originated by an agri-horticultural Society in 1830. Two years earlier John Graham had reached Bombay; and he was involved in the Society's welfare from its foundation. He had reached Bombay without employment, but must have had reasons to expect it. It seems that he was known in advance to the Governor, Sir John Malcolm, and the Governor took him into his own household on arrival. The Society formed an acclimatization garden at the suburb of Sewree and Graham could examine Bombay plants cultivated in it.

When Graham had ready for the press his *CATALOGUE OF PLANTS GROWING IN BOMBAY AND ITS VICINITY*, the Society undertook to see it printed. As we discover two grants of money from the Government

to the Society, one just before printing and one after, the inference that the Government was helping to finance its publication seems correct, although the Society had another cause for needing money, namely their expenditure on the laying out of their grounds by an expert named **MacCulloch**. Graham died when the type-setting had reached its 200th page.

The Society had willing support from some of the best of the citizens of Bombay. These may be named, **George Buisk** the Editor of *The Bombay Times*, **H. J. Giraud** who was called to Bombay to teach in the Grant Medical College and served the city in various capacities, and Dr. George Birdwood who also taught.

George Christopher Molesworth Birdwood (1832-1917, knighted in 1877) was born in India, then graduated in Medicine in Edinburgh and returned to India in 1854. In Edinburgh he had been a pupil of John Hutton Balfour a great teacher. When he had returned to Bombay, it fell to him to teach *Materia Medica* in the College. Out of his great energy, the Victoria Museum came into existence in the Agri-Horticultural Society's park. In 1862 he catalogued the economic products of Bombay; and he returned to Britain in 1868 on account of illness, but to continue economic work at the India Office.

The city of Madras obtained a botanic garden in the same way as the city of Bombay, namely through an agri-horticultural Society, the date being 1838. The reader notes that it was within eight years of the Bombay garden, and it is to be added that the Society grew on the willing service of the citizens in a like measure. It has been recorded that **Wight** in 1838 was taken from military service and instructed to look into the state of Agriculture in southern India. The year was that of the foundation of the Society's garden and **Wight** who had been called to Madras city looked after it. The records call him Superintendent. **H. C. F. Cleghorn** similarly looked after the garden when he was a professor in the Medical College (1852 forward). An Army officer, **Francis Alexander Reid** was Superintendent for a while. The Society for a considerable period had the services of the horticulturist, **Andrew T. Jaffray**. Another horticulturist, **Robert N. Browne**, trained in Edinburgh, succeeded from 1857 to 1865, and wrote a guide book which went to a second edition, edited by the surgeon, **John Joseph Wood** (1828-1867). He at the time was on the staff of the Medical College. When Wood left India the Garden was again superintended by one of the fighting forces, an officer of the Army, **Robson Benson** (1822-1894, ultimately a general) who had done the same service for the Agri-Horticultural

Society in Rangoon at the time (1865-1869) when he was with his regiment in Lower Burma.

Sir Joseph Hooker spent a day ashore in Madras at the very beginning of 1848 and passed his time in the Garden. Catalogues of other dates than those named above were issued. Certainly the Garden was very active.

A catalogue of the plants grown, prepared by **James Matthew Gleeson**, Superintendent of the garden, who left Kew for India in 1870, in the first instance to superintend experimental cotton cultivation in 1899, runs to 95 pages. It was issued in 1884.

The Nilgiri Hills, as we have seen, were coming forward and Ootacamund becoming a sanatorium in the days of Schmid, Metz, von Hugel, and Baikie. This development led to the establishment of a Garden of ease. A resourceful gardener from Kew laid it out in 1848. This was **William Graham MacIvor**. He had more land than he could immediately use, but it was not long before it was required for the experimental raising of Cinchona, whereby the garden may be said to have become a Botanic Garden. MacIvor died at his post in 1876.

To accommodate cinchona in Ceylon on its arrival the high level plantation of Hakgala was laid out as a branch from Peradeniya. The second horticulturist to be in charge of it, **William Nock**, whose service in Ceylon lasted from 1881 to 1904, was sent to Hakgala in 1882, and he embellished the area by extending the range of the plants cultivated. What he found the garden would grow may be read in a contribution which he made to Lemesurier's *MANUAL OF THE NUWARA ELIYA DISTRICT*. For the sanatoria of the Himalayas to get gardens may be regarded as natural; for a garden is a part of the road to health. The Garden at Naini Tal and the Lloyd Botanic Garden in Darjeeling were created on land donated for the purpose.

After the fighting in Lucknow in 1857, those who sought to remove the disfigurements set aside an area for a garden. At first it was but a garden of ease, indistinguishable in purpose from a half-dozen other gardens in the northern plains of India, but the second officer to be in charge of it, the surgeon **Emmanuel Bonavia**, added experimental studies of fruit trees (1876) and from that time it has had a claim to the name of Botanic Garden.

Emmanuel Bonavia (1826-1908) had entered the Bengal Medical Service in 1857 and was in charge of the Garden at Lucknow in 1876. It was then that he began to write about citrus fruits, their classification, and their history in cultivation, and about the date palms and other botanical subjects.

HORTICULTURE IN ALLIANCE

Horticulture is one of Botany's technologies. At any rate the two are mutually helpful; and botanists have been not a little indebted to the horticulturists for bringing the plant world under their eyes. The whole of the credit of conveying tropical plants alive and keeping them alive in temperate lands belongs to the horticulturists, for they worked out ways of transporting over the sea between India and the lands where Botany had a stronghold and they devised plant-houses with an artificial climate for their reception. There had been a century of experimentation from the time when the first plant-house was built for Clusius to the time when Europe had stoves hot enough to encourage a flow of plants from India to the curious in horticulture in western Europe. This section of my paper is devoted to the gains of Botany by reason of the aspirations of horticulturists, and the Calcutta Garden was called in to aid, if not already in Kyd's time, at least as soon as Roxburgh had been called to Calcutta. In the year after that (i.e. in 1794) the Company appointed **Christopher Smith** their 'Botanist at Calcutta'. His business was the stocking of the Company's possessions in the East with economic plants and he caused thousands of plants to be transported by sea within the tropics. The transport to Europe, which of course was round the Cape, was a somewhat more exacting task.

At that time a very generous friend of the Calcutta Garden was **M. R. Smith**, the magistrate stationed at Sylhet. His position enabled him to tap the riches of the Khasia Hills; and I would attribute to him the beginning of horticultural exploitation. At the same time **Francis Pierard** was sending to the Garden plants from the direction of Chittagong. **Francis Buchanan** had been to Ava with the Symes Mission and later was able to visit Chittagong where a flora of Burmese type is met with; and he too enriched the Garden. **Roxburgh** is known to have contrived to get orchids in good state to London where they were established in stove cultivation and to flowering (1813). **Wallich**, with the way shown to him, posted a collector at Pundua to work from a boat where **M. R. Smith** had gardened up to his death in 1819. **Duty** had sent **Wallich** to Lower Burma and to Northern Tenasserim, where he personally touched a flora rich in beautiful plants and after his return he had a collector there. He sent plants into cultivation freely.

Let the reader suggest, if he can, why so many beautiful flowers seem to have had their evolution there.

In 1818 the Royal Horticultural Society of Britain, being 14 years old and having created for itself a garden with greenhouses, set to work to furnish these by sending gardeners to various destinations to seek and bring back desirable, chiefly ornamental, plants. One of the gardeners was **John Potts**, who went by ship of the East India Company to Calcutta and to Canton. From Calcutta in spite of being based on the Botanic Garden his success seems to have been small—Wallich would be in Nepal at the time. But it was otherwise from Canton where **John Reeves** was living; and Reeves put him into the way of getting the showy plants of the Chinese flower market. Doubtless Potts travelled back along with what he had obtained in Canton and cared for it (1821), but was compelled to entrust to others his earlier consignment from Bengal. The lesser success from Bengal may not have been by his fault; but most certainly the Chinese had gone further than Bengal in flower selecting.

Many botanists must have asked exactly where Pundua is: it was 16 miles north-west of Sylhet, and owed its importance to shallowing water arresting trade and making it a terminus on the river; and it would be an excellent base for collecting. As Wallich's collecting trips would be somewhat expensive, the cessation of such after the Retrenchment Committee's sittings in 1830 is understandable; but a trip such as de Sylva's would have brought much living material into the Garden.

When Wallich went on leave in 1828, he took living plants with him as well as his accumulation of dried plants. Five years after Wallich's return the then Duke of Devonshire, who had adopted orchid-growing with enthusiasm, sent a gardener by name **John Gibson** to collect in the Khasia Hills. Gibson, aided by Wallich's direction and support, brought back large and possibly rather indiscriminate supplies but a number of novelties to cultivation (1837). Only a little more than a year earlier Wallich and Griffith had crossed the Hills seeking the tea bush; and **Griffith** was at the time of Gibson's visit at the head of the Brahmaputra valley. He had not seen *Vanda caerulea*, the gem of the Hills on that, his first crossing (1835), but did so where he varied his route in 1837. But Griffith did not take it alive; he dried specimens of it.

John Gibson (1815-1875), after some years at Chatsworth, moved to London, and in a busy life laid out or controlled nearly all of the large parks in London.

It is very evident, and indeed natural, that greenhouse plants sold in Britain more readily than stove plants; and therefore China was

the country to search but, if stoves were to be favoured, then the Khasia Hills were to be visited. The firm of **Loddiges and Sons** employed a collector in India; but it is not recorded who he was nor whither he went. It was to the Khasia Hills that the Duke of Devonshire sent his collector John Gibson.

Gibson's cases of living plants would need to be carried round the Cape and therefore be long at sea, and though the Wardian Case had been invented (1836) it is not certain that he was able to use it.

In 1843 the firm of **James Veitch and Sons** of Exeter sent their employee **Thomas Lobb** to Singapore as a collector. At Singapore he was to determine if the disturbed state of China would allow him to work there; if it would not, he was to go to Java: he went to Java and some other parts of Malaysia. In 1848 he signed on for another expedition and sailed for Calcutta. Among the many places he now visited were the Khasia Hills. Later he went to Tenasserim and he continued his travelling life over many years. He was away in 1853 when his employers moved that part of their business which was with stove plants to London, splitting the firm; and Lobb's services were thenceforward concentrated on the London half which became the predominant half. Hooker's record of Lobb's 'circus' passing him in the Khasia Hills has been recalled.

Contemporaneously **Simons**, the Government's apothecary at Gauhati, was sending local plants into cultivation and so also was a collector named **Freeman**, and a Captain **Williamson** who sent orchids to his uncle **John Day** (1821-1888), whose enthusiasm as a cultivator led him to make a trip to India, both to the north-east and the south, to inform himself on their cultural requirements.

In the fifties the lure of the orchid began to move south-eastwards. **Charles Samuel Pollock Parish** had become chaplain at Moulmein (1852) and he probably brought more eastern orchids into cultivation than anyone else, keeping the stream up at least until 1871. While Parish was active from Moulmein, so equally was an officer of the army, **Robson Benson**, ultimately a General (1822-1894), in Rangoon where he looked after the Garden of the local agri-horticultural Society. His most generous area was a transect of the country from the Arakan Yoma at the Toungup pass through Prome and through Toungou to the Shan plateau; the transect connects the best teak forests of Burma with orchids, but he obtained plants from other parts of Burma.

Following General Benson came Major-General **Emeric S. Berkeley** who sent orchids into cultivation from various parts of India but

chiefly from Burma. Of the professional plant collectors, Thomas Lobb's activities were along the trail made by M. R. Smith, Wallich, Gibson, and Simons and secondly in Tenasserim followed one of Wallich's trails which Parish had reopened. After these came **William Boxall**, first penetrating the area of the Lower Burma teak forests whence Robson Benson had drawn many orchids, then going into the Shan States because the exploring of Sir Henry Collett had exposed some of its riches.

There is a great interest but little explored in delimiting the area of the evolution of the magnificent orchids. The evolution has required long ages of continual tropical humidity fixing the plant and fixing its pollinating agents. Both are involved. **Henry James Murton** (1855-1881), the first horticulturist to be put in charge of the Singapore Botanic Garden, was seeking in the year after he had left Singapore to start in business as an orchid collector; his area Siam. Another collector of the same time was **J. C. Prazer**, who took employment under Sir George King when it would seem he was in Manipur. Thence he moved to the lower valley of the Salween.

THE LARGER MUSEUMS IN INDIA AND THEIR GROWTH IN EDUCATIONAL VALUE

Long ago, about the year 280 B.C., a Greek in power in ancient Egypt set apart a building, called the Museion, for the promotion of learning—whence the word museum. This building seems to have had attached to it land for the cultivation of plants and for the exhibition of captive animals. It is nice to recollect how long the word 'museum' has indicated a building where one stores to study and displays to instruct; and then the historian enquires into the line of culture intended by the dedication.

I propose to bring into one view the dates when India dedicated in its turn buildings as museums and the different sciences which benefited. The dates are somewhat clustered in the fifties of the last century.

1817: the Asiatic Society in Calcutta, at that date 30 years old and the possessor of a house holding their library and objects, mainly archaeological, which had been donated to the Society, planned to display these objects, and make the building function as an Archaeological Museum (let us call this collection No. 1), and further they would have it extended to Zoology (2), Geology (3), and Botany (4). But Botany soon fell out of the planning.

1819: it seems that Madras put by a little museum material (see Markham & Hargreaves, *THE MUSEUMS OF INDIA*: 176; 1936).

1840: the Government, directly interested and very desirous of increasing the public interest in India's mineral wealth, planned a 'Museum of Economic Geology' within 3, and

1841: brought into India from Britain a large collection of minerals (5) which was placed beside item 3.

1841: the Government at the same time agreed to give sufficient financial aid to pay a salaried whole-time Curator, and **Edward Blyth** was brought from Britain. Under him the zoological material (2) grew into a large collection.

1846: we read of a collection being formed in Madras (7) perhaps based on that of 1819; and we read later of a collection which would seem to have been the same or a part of it, being in the entrance hall of the Madras Medical School.

1850: the Government of India created the Geological Survey; and the Survey began to make a collection (8) in its own possession. In 1856 it was able to withdraw 5 from its position alongside 3 to its own premises.

1853: the Government of Madras planned an Exhibition and started energetic collecting for it (9), and absorbed 7. The London 1851 Exhibition doubtless suggested the Madras exhibition of 1855 to its promoters. When the Madras Exhibition came to closing, the Government desired to retain a part and having a building available converted that building into the Madras Museum (1857).

1855: the founding of a museum in Bombay had been under discussion for a few years; in 1855 a museum (10) of Economic Products of Bombay and processes of their manufacture took origin and was opened in 1857, then disordered by a hasty removal. Sir George Birdwood's *CATALOGUE OF THE ECONOMIC PRODUCTS OF BOMBAY* (1862) suggests what material was in it—at least in its earlier years. It became a mixed local museum, after reorganization.

1856: though the removal of the economic minerals (5) from the Asiatic Society's building gave a little relief, the museum remained overcrowded and the zoological collections (6) in particular were in need of much more room, moreover the geographic range covered had widened. Then the Asiatic Society memorialized the Government of India for the establishment in Calcutta of an Imperial Museum, and expressed their readiness to transfer all their extensive collections, except their library.

1866: the Indian Museum Act was passed, whereon collections 1 and 6 became possessions of Trustees created under the Act, while 3 was transferred to the Geological Survey.

1872: the Lieutenant-Governor of Bengal, Sir **George Campbell**, moved to get the economic products of his Presidency collected. A committee was set up in every district which collected samples of the grains, seeds, oils, fibres, timbers, and minerals. This collection (11) doubtless was very comprehensive by 1879 and had a considerable value; but the cart was before the horse, as the essential building—the Museum proper—to hold the collection was wanting. Disorganization then set in with vagabondage.

1875: the new Imperial Indian Museum building was ready for occupation by 1 and 6.

1882: an enquiry was raised if the Museum building could be made to hold an economic line; to this the reply was 'not without enlargement'. This was followed by a request for the temporary use of a part of the building to assist the holding of an exhibition; and an agreement was made that in return for temporary use an economic wing should be added.

1883-1884: the Calcutta Exhibition. By most energetic collecting exhibits (12) were brought together into which 11 had been absorbed.

1891: the wing of the Indian Museum for the display of Bengal economic products having been completed, stocking it began; but a considerable amount of replacement had become necessary, and this collecting (12) was set about. It required time. That which was good in the material was used for the Exhibition, and the new collections were gradually brought together, and the gallery receiving them was opened to the public at the commencement of 1901.

Until then Botany had had no place in the Museum; and, as my reader understands, it was only economic botany that now obtained a place.

Museums are of many kinds; the best have grown with declared purposes; some have been or have become no more than depositories.

After the founding of the Madras Museum several small museums were set up by decree in the Presidency. One is said not to have functioned; the others did in a way, but it is evident that they were too small to maintain interest, though even the smallest may have done good by intercepting historic stones and the like which were exposed to loss; in this doing as the beginnings of the Asiatic Society's collection did.

There is a particular interest to be found in the earliest years of that collection.

To the year 1817 the Society's house would have been a depository, though the establishment of a museum must have been adumbrated. The first official suggestion came in that year from Wallich, who had been 7 years in the East, had practised medicine in Serampur, and now was residing in Calcutta seeking a new medical practice and had not yet so succeeded as to be without leisure. He offered his services. The Council took up the idea, discussed the scope, and accepting Wallich's offer drew up a list of classes of gifts that they would receive, at the same time naming Wallich 'Superintendent of their Oriental Museum'. Difficulties for him were only just round the corner. He was almost immediately accepted as an Assistant Surgeon in the Medical Service, and ordered to join the column marching on Kathmandu. Where now was his availability? Though he did not join the forces he did not become fully available for the museum, as he was sent to the Calcutta Botanic Garden to take Roxburgh's place and the Garden needed the whole of his time. Wallich, however, kept the title of Superintendent.

The archaeological exhibits as they came in went into the care of the Librarian; it would be a simple matter for Wallich to separate the geological and zoological and to take the botanical to the Botanical Garden; but one does not know if there were many of the last. The Society on second thoughts had decided that botanical objects belonged to the Garden. After a few years so much travelling fell to Wallich that he could have had nothing to do with this receiving and putting away and a clerk looked after it; visitors were asked to help if they could.

The list of desiderata prepared by the Council when asking for specimens shows that the Society thought to educate their own members, not the public. The next move was an attempt to educate whoever it could reach in geological products, by the side of the most praiseworthy steadfastness of the Society in taxonomic zoology. Botany was kept apart, one may say, by the difference due to the way of handling its specimens.

Before Wallich's day, Roxburgh from the Calcutta Botanic Garden had collected and dried plants. He valued them less as evidence than he did his artists' drawings; he had no museum building and he dispersed the specimens to those who had the means of storing them. Wallich at 1828 likewise dispersed all that he had at that date. He too had no museum building, but kept part of the specimens in the

basement of his own house and another part in a seedhouse for the convenience of his more advanced horticultural staff.

The missionaries in Madras made an effort at continuous use of dried plants for identification, and Rottler showed himself so convinced that the Calcutta Botanic Garden should do as they did that he forced on Wallich the recommencement of maintaining a collection. Seeing him as he was on his way back to Calcutta in 1832, he gave him a bundle of dried plants.

Wallich took the lesson and proceeded to rebuild the set for the garden shed. Vicary seems to have followed by unloading his baggage on to Wallich; and Wallich in this way seems to have found himself not exactly with a herbarium but with a collection of collections. I do not know which of his successors did most of the work of unification; perhaps it was **Thomas Thomson**. Under **King** the material increased very rapidly, and King was successful in persuading the Government of Bengal to supply a fire-proof building for it (1883).

Common usage, because it associates display with museums, tends to dissociate herbaria and museums.

Exhibitions are temporary museums; but that statement does not carry a complete parting line. Exhibitions do not provide for research, which is what museums do. However exhibitions display very generally material suitable for museums and become part parent in consequence.

The first exhibition staged in India, that of Madras, gave hope to those concerned with education that the illiterate, to whom a label conveyed nothing, gathered knowledge by the sight of classified objects. Certainly they do.

The organizing of the exhibition was put into the hands of Surgeon **Edward Green Balfour** (1813-1889), who had been in India from 1838 and was to be Surgeon-General of Madras before he retired. His organizing work in this connection led to the publication of two books: his *CYCLOPAEDIA OF INDIA*, 1857, and his *TIMBER TREES OF INDIA*, 1858. The Exhibition led to two other publications: Sir **Walter Elliot's** so-called *FLORA ANDRICA*, 1859, and Colonel **Heber Drury's** *USEFUL PLANTS OF INDIA*, 1858.

Walter Elliot (1803-1887, knighted in 1866) had had rather long service in the southern Maratha country, where he had studied the local fauna rather closely; in 1837 he became Private Secretary to Lord Elphinstone, the Governor of Madras. Next he was transferred to the Telugu-speaking part of the Presidency and was there at the date of the exhibition. His so-called *FLORA ANDRICA* is a compilation of plant names, got together by his contact with the people and through

pundits; and shows that he must have known the flora. He was a man of many interests and a well-proved administrator.

Heber Drury (1810-1878) was a Colonel in the Madras army who studied with not a little care the flora of the southern parts.

The following officers were connected with the exhibition in different ways; General William Cullen, Resident in Travancore with the same interest as Colonel Drury, and the horticulturist Andrew T. Jaffray, then serving the Madras Agri-Horticultural Society. He did great service in assembling the exhibits. Later the name will be found in these pages in connection with the introduction of Cinchona.

Surgeon Balfour controlled the Madras Museum which, as said, was the outcome of the exhibition; and the study that he caused to be made of visitors is interesting. He kept statistics of their ability to read, and of course found a very large amount of illiteracy which frustrated in their case all values in the labels. Nevertheless it seemed that the illiterate did profit. The Government proceeded to arrange small museums for their larger towns. These must be called on the whole failures.

Few know that colonial Botanic Gardens throughout the Empire had received at one time instructions to keep small collections of plant products in the round and in a small number of cases the experiment succeeded.

The collection of miscellanea in Bombay did not come into their Museum in a manner quite like those of Madras: they were brought out of a store room in the Custom House as soon as there was a Museum building in the Victoria Park into which to put them (1857). The erection of this building has been mentioned earlier; the year was 1871.

Why Calcutta got its museum buildings later was mainly because it was a very much larger proposition to build the Indian Museum than it had been to build the Museum in Bombay. The year was 1875, twenty years after the institution of the Geological Survey of India, and 15 after the Asiatic Society in memorial to the Government of India had asked for the building, not of a Presidency Museum, but of an Imperial Museum, wherein to what they had stored could be taken. The reader notes that the date of this coincides with the creation of the Madras Museum and not unrelated to the planning of the Bombay Museum.

All three museums of the presidency cities had attained functioning when in 1882 the Government of Bengal sought to get the range of the display extended on the economic side and received the reply that

this could only be by adding to the building. Then followed an enquiry if the Museum could be made the focus of an exhibition and the discussion ended in an agreement that in return for this temporary accommodation the Government of Bengal would add a wing and so it did in due time: the Economic Section. Meanwhile the Calcutta Exhibition of 1883-1884 ran its course. The Government of Bengal naturally passed over to it what there was in its 'Economic Museum' though the specimens were in a sorry state. These—grains, fibres, oil-seeds, drugs, timbers, and minerals that had been commandeered from all parts of Bengal—had very soon after the institution of the collection outgrown the space allotted to them and more than one move had thrown them into disorder, into some neglect and disrepute. The collection was advantageously broken up with the retention of no more than was worth keeping and this now made part of a new collection gathered from all parts of India. Now the native of other parts of India who visited the exhibition could see what came from beyond his own knowledge, and surely this was a gain on the showing to the native of Bengal what might be familiar to him. The new wing which the Government of Bengal had promised was ready in 1891 and the Exhibition's collection, screened afresh and added to, was arranged in it over the years 1891 to 1901. The reader can if he desires get all the details for which he is likely to wish in the volume issued by the Trustees in 1914 for the Museum's Centenary.

The Imperial Museum in Calcutta and the Presidency Museums in Madras and Bombay have been immensely popular and undoubtedly have passed forward a great deal of elemental knowledge. The Superintendent of the Madras Museum, Dr. E. G. Balfour, kept a register of the proportions of literate and illiterate among the visitors and the percentage of the latter was high enough to suggest that the least promising gained something.

It is interesting to note that the earlier geologists of the Geological Survey lent themselves to promoting the collecting of plants almost as if they thought it incumbent in them. Thomas Oldham, Valentine Ball, William Blandford, and Ferdinand Stoliczka were of the Survey and remitted dried plants to the Calcutta Garden. Still more the zoologists did this—the surgeon John Scully, the ornithologists T. C. Jerdon, Allan O. Hume, and Eugene W. Oates; the entomologist W. S. Atkinson; the malacologist Lt.-Col. Henry H. Godwin-Austen, and others who will be named later.

(To be continued)

A Natural Sanctuary in the Himalaya:

Nanda Devi and the Rishiganga Basin

BY

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(With a map and two plates)

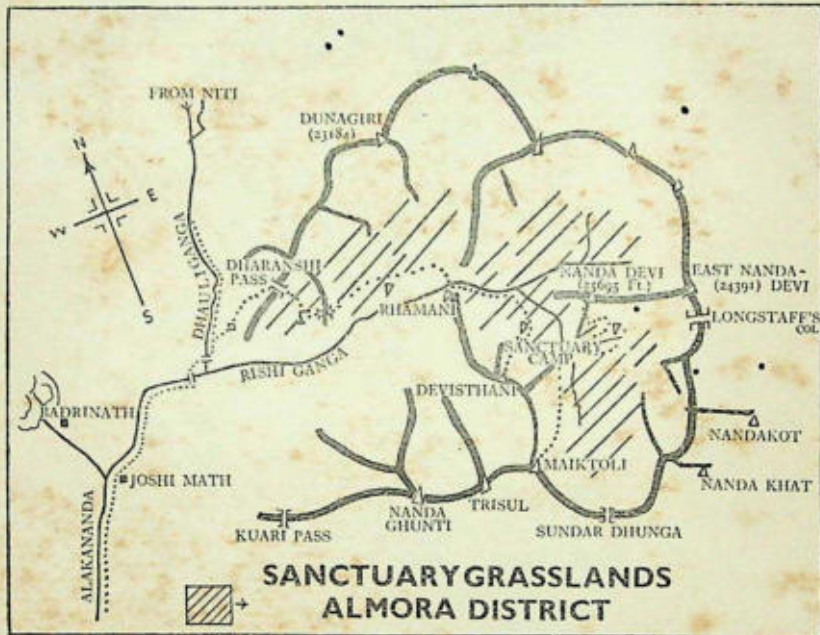
INTRODUCTION

Though I had heard of the natural sanctuary formed by a ring of high mountains around Nanda Devi in 1942, it was only in 1960, and again in 1961, that it was possible to actually visit the area, primarily with the object of mountaineering and photography. The second of these two trips eventually came to be sponsored by the Indian Mountaineering Foundation, the Mount Everest Foundation, London, and *The Statesman* newspaper, and the following report is based on information gathered during these two trips.

Nanda Devi is not only the highest mountain in the central Himalaya, but dominates 250 inaccessible square miles of the most beautiful mountain scenery in the world. The area around Nanda Devi is ringed by a continuous high ridge which descends below eighteen thousand feet only where Rishiganga River, draining the numerous glaciers of the region, has cut a deep and difficult gorge through the western side. Nineteen known summits of over 21,000 ft. stand on this ridge, which is located between the Dhauliganga and Goriganga rivers of the Kumaun-Garhwal Himalaya.

Much of this 250 square miles of mountainous terrain is alpine forest and pastureland, some accessible alps used by village flocks of sheep and goats, the greatest part the haunt of a wide variety of animals and birds characteristic of the higher Himalaya of the Indian region. The floral abundance alone is astonishing, not only putting the famed Bhyundar Valley (Frank Smythe's Valley of Flowers) into the shade in comparison, but also offering a potential hunting-ground for the

plant-hunter because of its insular virginity. If detailed and expert surveys were carried out in the region, many instructive and useful relationships, ecological and biological, might emerge about environmental adaptation in the complete absence of human influences such as are not possible elsewhere in the higher Himalaya.



It is the purpose of this article to consider a far-sighted plan for preserving this whole self-contained watershed as something more than a Game Sanctuary, which is its present status according to the Forest Department. This may, it will be suggested, be profitably made the first Wilderness Preserve in India, after the pattern adopted in the United States.

HISTORICAL

The Survey of India had always looked upon the gap in their knowledge of this area as more or less inevitable, because of its extreme inaccessibility. Light was first thrown on it by men working under the incentive of mountain-climbing and exploration.

W. W. Graham, accompanied by two Swiss guides, Ulrich Kauffman and Emil Boss, was the first enthusiast to try to force the gorge of the Rishi where it meets the Dhauliganga, some fifteen miles above Joshimath on the route to the border pass of Niti. A lone explorer and some hardy sportsmen, who have left no records, were his only predecessors, and he failed entirely in his attempt to traverse the almost overhanging lower section of the gorge, reaching the relatively easier middle-section of the Rishi over the 13,000 ft. high Dharanshi Pass situated on the outer ridge to the north, where it descends from the 23,184-ft.-high Dunagiri Peak. Graham claimed to have climbed Changabang, an extremely difficult mountain above the foot of the toughest portion of the Rishi gorge, from where the Nanda Devi massif is only five miles away.

It was left to Dr. Longstaff in 1907 to make another attempt, and this he did with the Swiss guides, the Brochorel brothers, and General Bruce, of the Gorkhas. He also entered only the easier middle-section of the Rishi, known as the Outer Sanctuary, over the Bagin^t pass to the north, and though successful in climbing Trisul (23,360 ft.) he too failed to find a feasible route over the last few miles of the Rishi gorge, despite gallant attempts from both banks of the thundering, constricted river.

In 1926, 1927, and 1932, Hugh Ruttledge, I.C.S., then Deputy Commissioner of Almora in Kumaun and a mountain-enthusiast, tried three other approaches to the Inner Sanctuary; from the south and south-west, he was brought up short by the hanging-glaciers of Sunderdhunga Col and the glaciers below Trisul overlooking Nandakini River. From the north-east, up the Timphu glacier, the prospect was no easier and the party abandoned the attempt, Ruttledge remaining convinced of the uniqueness and attraction of the Sanctuary, and equally certain that the Blessed Goddess, Nanda Devi, was then beyond human capacity or endurance to approach because of the obstacles it imposed on its votaries.

It was Eric Shipton and H. W. Tilman in 1934 who had the privilege of pioneering a memorable route to the Inner Sanctuary by forcing a passage up the upper Rishi gorge after weeks of effort. They rounded off the trip by descending the treacherous and insecure ice-fall over Sunderdhunga Col to the south which had so frightened Ruttledge. One of their two sherpas, Angtarkey, still recalls that trip with righteous horror not unmingled with pride.

Since that first crossing, a survey party guided by Eric Shipton, and four expeditions to climb Nanda Devi have followed their route;

the French, who lost two climbers, in 1951, Major Jayal, who did not make the summit either, in 1955, and Mr. Gurdial Singh and the writer, accompanied by Major John Dias and others this year, in 1960 and 1961.

GEOGRAPHICAL AND ECOLOGICAL

The central Himalaya can roughly be described as that section lying between the river Sutlej in the west and the river Kali (Mahakali), the Sharda of the plains, in the east. The Goriganga is a right bank tributary of the latter and drains a very large glaciated area. The Alaknanda, of which the Dhauli is a left bank tributary, joins the Bhagirathi at Devprayag to form the Ganges of the plains. The Rishiganga is the major left-bank tributary of the Dhauli and runs roughly east to west, draining the vast system of glaciers within the Nanda Devi area which, including in the term both the Outer and the Inner Sanctuaries, coincides with the Rishi's watershed.

Nanda Devi stands like a reigning deity at the end of the ridge which may be said to represent the shorter central arm of an reversed letter E, the two outer arms representing the high ridges which enclose the inner arm. Two other arms enclose the two outer arms, and Dunagiri and Nanda Ghunti are the western terminations of the northern and the southern arm respectively.

Nanda Devi Khal (19,390 ft.), known popularly as Longstaff's Col because that doyen of Himalayan exploration first climbed it from the east, and Sunderdhunga Col (c. 18,000 ft.) are the only two passes ever crossed into the Inner Sanctuary, but both are out of question for all but expert climbers. The only route feasible is up the Rishi, and this is now fairly beaten up to the foot of the really impassable gorge, known as Rhamani because a torrent of that name joins the Rishi from the right bank there. Beyond this inner gorge lies the Inner Sanctuary, an area of nearly a hundred square miles of mountain and meadowland, gentle grassland, and rugged cliff faces, which is unique even in Himalayan experience, bearing as it does the indications of Divine handiwork. This was *terra incognita* even to the local shepherds and poachers, who would sacrifice the excellent musk-deer and Burrhel prospects inside rather than face either the difficulties and dangers of the gorge or the wrath of the Blessed Goddess who, they felt, would surely punish any such desecration of 'Dev-bhūṅi' (holy ground) by mortals.

Ecologically, the Nanda Devi Sanctuary, including the Outer Sanctuary, may be divided conveniently into the following types:



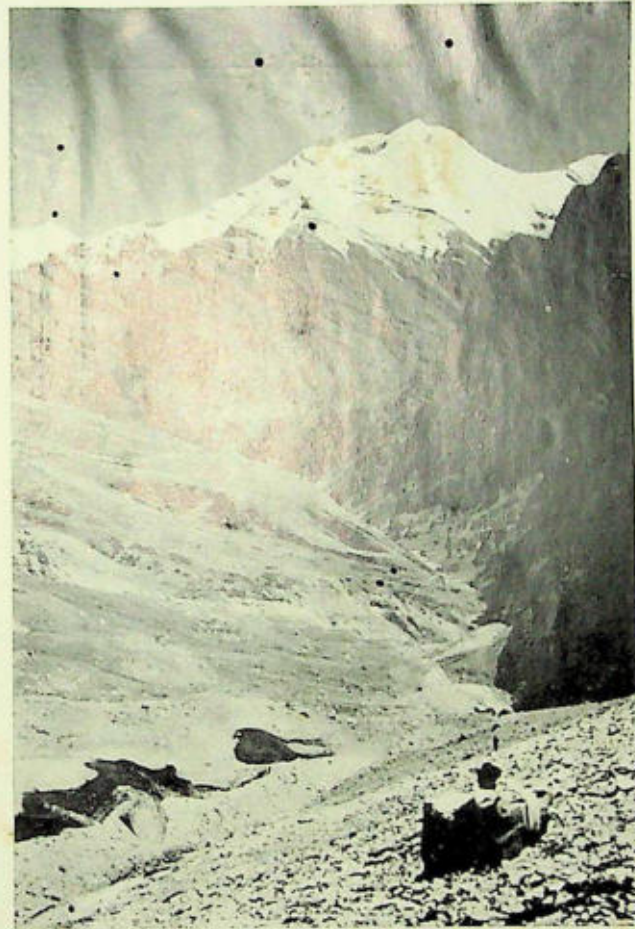
The Dibrugheba alp, amid temperate forests of Silver Birch, *Rhododendron campanulatum*, Spruce, and Cypress. One of the most beautiful spots in the Himalaya.



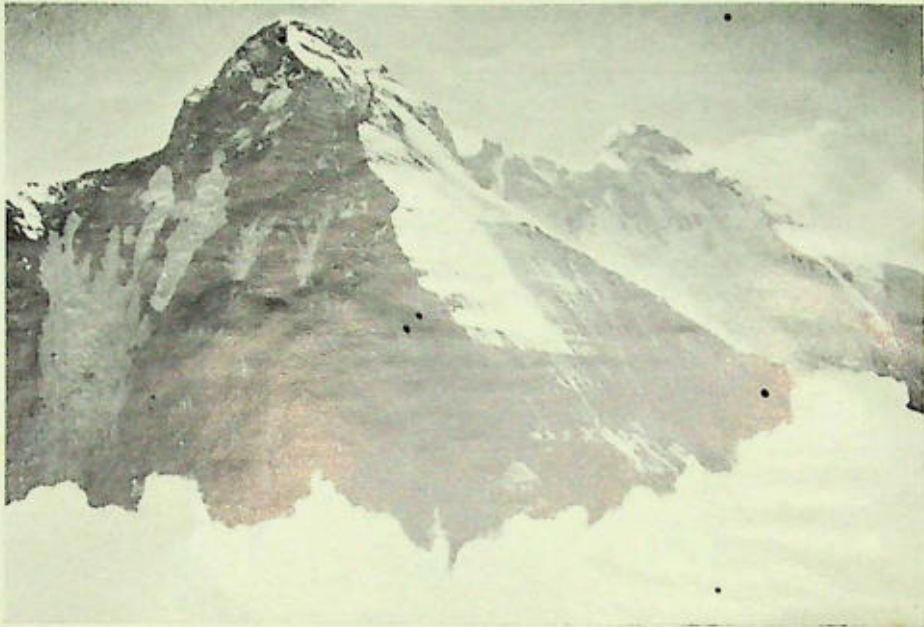
The Inner Sanctuary's grasslands, coming down to the southern Rishi at the base cliffs of Nanda Devi



The Dibrugheba alp, amid temperate forests of Silver Birch, *Rhododendron campanulatum*, Spruce, and Cypress. One of the most beautiful spots in the Himalaya.



The Inner Sanctuary's grasslands, coming down to the southern Rishi at the base cliffs of Nanda Devi



The main and east peaks of Nanda Devi. The climbing route used by expeditions lies up the ridge to the right of the main summit, merging into it tangentially.



Some more of the grasslands and mountain-scenery of the Inner Sanctuary

(Photos : Hari Dang)

1. Mixed-Temperate and Temperate forest, growing along hillsides and in sheltered re-entrants and warmer valleys to heights of 12,000 ft. Blue Pine, Deodar, Maple, and Horse Chestnut near the confluence of the Rishi with the Dhauli give way to Spruce, Cypress, Fir, Rhododendron (*R. campanulatum*), and Silver Birch higher up.

2. Temperate scrub continues above the tree-line, occasionally to as high as 15,000 ft., near the snow-line. Dwarf Rhododendron (*R. anthopogon* and *R. lepidotum*) and *Berberis*, *Cotoneaster*, and Juniper are the chief representatives of this class.

3. Alpine pastureland, varying in luxuriance from the lush and succulent, flower-rich alps of the lower areas to the scrawny, thin-soiled growth higher up. This kind of vegetation extends as high up as 18,000 ft., some mosses and pads extending a thousand feet higher in favoured locations, depending upon season and insolation.

In the Inner Sanctuary, especially where Silver Birch stands are few, there are extensive grasslands and excellent soil; villagers working for us have often expressed wistful longing to get their flocks up for the rich grazing, and been treated to cold looks from conservation-minded mountain-lovers. In addition there are miles of snowfields, rock faces, and ice-cliffs, of apparent uselessness yet invaluable as hallowed ground for the ardent mountaineer or nature-lover. Here, too, are lakes that no one has ever seen, hundreds of high and not-so-high mountains no one has ever climbed, passes that have yet to be crossed, and cliffs and valleys that are still sacred to their pristine inhabitants, the Burrel and the Thar, the Snow Leopard and the Musk Deer, and other slippery, lonely-hearted, eagle-haunted crags and pastures, beyond the leap of goat, beyond the gaze of man, that still echo only to the shrill calls of the Monal and the melancholy whistle of the Snow Cock. No village or human habitation mars this pristine wilderness.

FLORA

Lacking expert scientific knowledge, I have not made any wide and detailed observations or checklists, but I have personally seen or photographed, or seen companions photograph over three hundred different flowers, and this in the short period between climbing and travelling.

ANIMAL LIFE

According to the Uttar Pradesh Forest Authorities, the entire area lying between the mountains Nanda Devi, Dunagiri, and Trisul is a

Game Sanctuary, in the sense that no one is permitted to shoot there and shooting-permits are not issued. In fact, this is a 'paper' Sanctuary, like its coeval the Govind Ballabh Pant Sanctuary in the Tons Basin in Garhwal. Both have never been visited or explored personally by the contemporary 'paper' forest officers, nor are likely to be visited in the near future. Poaching on a grand scale is normal in the Tons Basin, and not uncommon in the Rishi Basin. Musk Deer are the chief quarry, hunted ruthlessly and bravely by the poor villagers for the valuable musk-pod, which sells at lucrative rates in the Kumaun and Garhwal fairs. For, strange to relate, the Government has given complete protection to the Musk Deer and yet permits the export of large quantities of musk to dollar areas—at any rate, this was the situation till last year.¹

Burrhel (*Ovis nahura*) abound all over the less rugged areas of the Rishi Basin, and often even over difficult terrain. Their numbers have dwindled greatly since Tilman and Shipton first saw large herds. This is largely the result of poaching by villagers in the Outer Sanctuary. Still, they are even now excessive for the limited feeding which the pastures offer. Sheep and goats from villages as far away as Wan give Burrhel keen competition, and may be spreading epidemics that might be decimating their numbers unknown to us. The tenet that the wilder the animal the less its resistance to infection from outside is only too true in this case. The Himalayan Thar (*Hemitragus jemlahicus*) is a very plentiful game animal in the basin, frequenting the most difficult terrain in the gorge of the Rishi, coming out into the grasslands only in the post-monsoon months for a spell before retreating to overhangs and precipices for the winter. This animal, too, is suffering decimation by meat-hungry villagers armed with new gun-licences. Even without guns, both Thar and Burrhel, more so the former, are vulnerable through their habit of coming to lower rock-faces when the snow lies deep on their summer haunts. Here they are cornered and chased by villagers and actually murdered with staves and spears. The means adopted to exhaust them before administering the coup, are many and ingenious, including lassoing them at night.

Musk Deer are still very plentiful, but are constantly molested, both by shikaris with guns and by shepherds with dogs, the latter being remorseless trackers of this highly odorous creature. Each time we went up the gorge, we met at least one large party of shikaris, who had had consistently successful hunting. One possible cause of the

¹ The export of musk is still unrestricted.—Eos.

Musk Deer's abundance may be its greater propensity to take refuge in heights where even the shikaris dare not follow.

The Snow Leopard is another glorious animal which remains extraordinarily common, when a comparison is made with other mountain areas. This is not only the result of indifference from villagers, who are either too scared or too poor as marksmen to hunt him, but also of the abundance of Thar, Musk Deer, and Burrhel, its natural prey.

Though a few Black Bear have occasionally been seen, they are not common in the Rishi Valley, and this is only natural when the difficulty of terrain is considered.

Serow are not uncommon in the lower and less steep mixed-forests of the Dudh-ganga, Ronti-nala, and Sat-pula-nala. Streams like these, originating in the glaciers on either side of the Rishi abound, there being no fewer than twenty major and easily one hundred minor glaciers which feed the Rishi. All these subsidiary valleys have their own pastures and forests.

Snow-foxes, Marmots, musk-rats, and tailless rats abound.

Of bird life, Monal Pheasants, Snow Partridge, and Snow Cock are very common in their habitat. The Himalayan Rubythroat, seen at between 13,000 ft. and 16,000 ft., was a constant companion of base-camp off-days, serenading the occupants from the early hours of the morning.

The Blue Rock Thrush was encountered in pairs and parties of up to four couple, flying around above alpine grassland. The Himalayan Greenfinch, Hedge Sparrow, Redflanked Bush-Robin, Whitecapped and Plumbeous Redstart, the Stonechat, the Kashmir Whitethroated Dipper were some of the more interesting birds seen and clearly identified, while notes were compiled of birds seen but not clearly identified. Detailed observations were not made as time was short, and mountain-climbing the main objective.

The Lämmergeier or Bearded Vulture and the Golden Eagle were also seen. A large eagle (?) was seen in the act of swooping down and carrying off a Thar ewe.

PROSPECTS FOR THE FUTURE

Though hitherto known to only a few enthusiasts, it is not unlikely that the area will arouse—has in fact, already aroused—great curiosity and covetousness, the former among prospective tourists, the latter among villagers desirous of pasturage.

Having observed with deep and helpless regret what the 'paper' Forest Department has done to the Valley of Flowers further west (I refer to a four-foot high boundary wall which has been built to fence off a horticultural scheme for some vague medicinal plants, right across the valley), it is my intention that a similar programme be frustrated by forestalling the authorities by making a wiser suggestion to them which they cannot afford to ignore.

Poaching, rampant now, is bound to increase as the number of guns increases. Already the Milam and some other valleys of Kumaun and Garhwal have been shot clear of Musk Deer, Burrhel, and Thar, and skins of Burrhel and their young ones murdered in winter can be purchased for a few rupees in any hill fair or market-centre from Garbyang and Almora to Pipalkoti and Chamoli. In other mountain areas of India mountain game has been wiped out *en masse* by the army and the Border Police, and a likely increase in military activity in Garhwal would deal a like blow to mountain game here; hence the need for at least one region where not only the shooting of game but also the construction of monstrosities like the Bhyundar boundary wall can never occur. This requires something more than a Game Sanctuary status for the area and, in the current official mood of 'paper' sympathy for conservationist ideals, it would not be difficult to muster sufficient strength and momentum for the idea of a Rishi Wilderness Preserve to push through the necessary measure through Parliament, by which act alone can such a status be obtained.

SUMMING UP

Perhaps I am carried away by my enthusiasm for the Nanda Devi area, which has for long represented to me an unattainable ideal, an intensely personal wilderness reservoir. This need not detract from the value of this wilderness in its unspoilt and untampered condition. If we can retain the Rishi's Sanctuary without a motorable or even a bridle track, without boundary walls and Rest Houses, without official interference or tourist-huts—and I do not think of the next decade only, but of the next century, granted that we survive this decade—then perhaps those who do not migrate from the earth will find some consolation in its tranquil snows and mist-wreathed pastures, its stupendous scree and gentle swards. This is the true aim of this article, though an inadequate attempt has been made to cast it in a formal mould.

The Genus *Oedogonium* in Mysore State

BY

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(With twelve figures)

References to the occurrence in western India of genera and species which belong to the Oedogoniales have been few, as has been shown by the authors in a previous paper (*Gonzalves & Sonnad, 1957). In this paper, species of *Oedogonium* from various places in the Dharwar, Belgaum, and Karwar districts of Mysore State are recorded.

OEDOGONIACEAE

Genus *Oedogonium* Link

1. *Oedogonium succicum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 82, pl. 2, f. 15, 1900. Attached to aquatic plants in a small pool at Nagargali, September 1952.
2. *O. varians* Wittr. & Lund. ex Hirn, *ibid.* 27 : 89, pl. 4, f. 23, 24, 1900. In a small pool at Londa, September 1952.
3. *O. cardiacum* (Hass.) Wittr. ex Hirn var. *carbonicum* Wittr. ex Hirn, *ibid.* 27 : 87, pl. 4, f. 22, 1900. Attached to the leaves of rice plants in fields at Kyarkop, August 1951.
4. *O. franklinianum* Wittr. ex Hirn, *ibid.* 27 : 88, pl. 2, f. 18, 1900. In a pool at Naglavi, September 1951.
5. *O. glabrum* Hallas, Bot. Tidsskr. 26 : 408, f. 18, 1905. In a pool at Naglavi, September 1951.
6. *O. intermedium* Wittr. ex Hirn var. *szechwanense* Jao, Pap. Mich. Acad. Sci. 19 : 89, pl. 6, f. 15-17, 1933/34. In a small pool at Londa, September 1952.
7. *O. fennicum* Tiff., Ohio J. Sci. 34 : 324, 1934. Attached to the leaves of rice plants in a field at Mugad, September 1951.
8. *O. hirnii* Gut. ex Hirn, Acta Soc. Sci. fenn. 27 : 93, pl. 5, f. 29, 1900. In a tank at Masur, April 1952.
9. *O. patulum* Tiff., Ohio J. Sci. 34 : 324, 1934. In a small pool at Gunji, January 1953.
10. *O. globosum* Nordst. ex Hirn, Acta Soc. Sci. fenn. 27 : 94, pl. 5, f. 30, 1900. In a tank near Gadag, January 1953.

* Gonzalves, Ella A. & Sonnad, G. R. (1957). The Genus *Bulbochaete* in Western India. *J. Univ. Bom.* 25 (5) : 1-15.

11. *O. fragile* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 96, pl. 5, f. 33 ; pl. 6, f. 34, 1900. In a small pool at Anmode, August 1952.

12. *O. fragile* var. *abyssinicum* Hirn, ibid. 27 : 97, pl. 6, f. 35, 1900. In a pool at Alnavar, September 1952.

13. *O. vaucherii* (Le Cl.) Al. Br. ; Wittr. ex Hirn, ibid. 27 : 97, pl. 6, f. 36-38, 1900. In a pond at Tavargatti, September 1952.

14. *O. vaucherii* var. *parvum* var. nov. (f. 1, a, b)

Monoica. Ut plurimum plantae paucis cellulis constantes. Cellulae vegetativae cylindricae ; cellulae basales elongatae, terminales vero apicaliter acuminatae. Oogonia solitaria, globoso-ovoidea vel ovoidea ; poro superiore. Oosporae globosae vel subglobosae, oogonium haud implentes vel fere implentes ; parietes crassi et leves. Antheridia 1-5, subepigyna vel subhypogyna. Antherozoida 2 ; divisio horizontalis.

Cellulae vegetativae 18-32 μ diam., 38-130 μ long. ; oogonia 40-56 μ diam., 47-72 μ long. ; oosporae 34-50 μ diam., 36-50 μ long. ; antheridia 17-30 μ diam., 6-10 μ long.

Typus lectus in palude in loco Ranebennur, mense februario 1952, et positus in herbario auctoris senioris sub numero O.24.

The few-celled plants and the usually acuminate end cell differentiate this variety from the type.

15. *O. richterianum* Lemm. ex Hirn, Acta Soc. Sci. fenn. 27 : 117, pl. 12, f. 63, 64, 1900. Attached to aquatic plants in a pond at Bistenhatti, September 1952.

16. *O. pseudo-boscii* Hirn, ibid. 27 : 291, pl. 13, f. 67, 1900. In a pool at Khanapur, October 1952.

17. *O. oviforme* (Lew.) Hirn, ibid. 27 : 116, pl. 12, f. 62, 1900. In a pond at Tavargatti, September 1952. In a pool at Alnavar, September 1952.

18. *O. brevingulatum* Jao var. *robustum* var. nov. (f. 2)

Monoica. Cellulae vegetativae robustae, cylindricae. Oogonia solitaria, ovoidea vel obovoidea ; poro superiore. Oosporae globosae vel subglobosae, haud penitus complentes oogonium ; parietes sporae leves. Antheridia 1-3. Antherozoida 2 ; divisio horizontalis.

Cellulae vegetativae 30-33 (-37) μ diam., 57-86 μ long. ; oogonia 49-57 μ diam., 60-72 μ long. ; oosporae 43-50 μ diam., 47-54 μ long. ; antheridia 30-32 μ diam., 8-13 μ long.

Typus lectus natans in palude Nuggikeri, in loco Dharwar, mense februario 1952 et positus in herbario auctoris senioris sub numero O.27.

The oogonia, oospores and antheridia of this variety are longer than those of the type.

19. *O. martinicense* Hirn, Acta Soc. Sci. fenn. 27 : 134, pl. 16, f. 92, 1900. In a pond at Bistenhatti, September 1952.

20. *O. kurzii* Zell. ex Hirn, ibid. 27 : 135, pl. 16, f. 93, 1900. In a pond at Devarayi, October 1952.

21. *O. lageniforme* Hirn, ibid. 27 : 291, pl. 13, f. 68, 1900. Wittr., Brittonia, N. Y. 2 : 168, pl. 1, f. 16, 17, 1936. In a pond at Tinaighat, January 1953.

22. *O. ellipsoideum* Jao, Sinensia 8 : 305, pl. 3, f. 17-21, 1937. In slow-flowing water at Castle Rock, August 1951.

23. *O. plagiostomum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 100, pl. 6, f. 39, 1900. In a pond at Nagargali, October 1951.

24. *O. diversum* (Hirn) Tiff., Ohio J. Sci. 34 : 324, 1934. In a pond at Londa, October 1952.

25. *O. majus* (Hansg.) Tiff., ibid. 34 : 324, 1934. In a pond at Devarayi, October 1952.

26. *O. oboviforme* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 141, pl. 20, f. 103, 1900. Attached to aquatic plants in a pool at Bistenhatti, September 1952.

27. *O. subrectum* Hirn, ibid. 27 : 141, pl. 20, f. 102, 1900. Attached to the leaves of rice plants in fields at Mugad, September 1952.

28. *O. landsboroughi* (Hass.) Wittr. ex Hirn, ibid. 27 : 135, pl. 16, 17, f. 94-96, 1900. In a small pool at Tavargatti, September 1952.

29. *O. crassum* (Hass.) Wittr. ex Hirn, ibid. 27 : 139, pl. 18, f. 99, 1900. In a pool at Tavargatti, September 1952.

30. *O. amplum* (Mag. & Wille) Tiff., Ohio J. Sci. 34 : 324, 1934. In a pond near Bistenhatti, January 1952.

31. *O. paludosum* (Hass.) Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 120, pl. 13, f. 69, 1900. Attached to aquatic plants in a pond near Nagargali, September 1952.

32. *O. carolianum* Tiff., Ohio J. Sci. 34 : 324, 1934. In a small pool at Kamarganvi, September 1952.

33. *O. leiopleurum* Nordst. & Hirn in Hirn, Acta Soc. Sci. fenn. 27 : 126, pl. 14, f. 79, 1900. Attached to the leaves of rice plants in fields at Mugad, September 1952.

34. *O. arcyosporum* Nordst. & Hirn in Hirn, ibid. 27 : 104, pl. 7, f. 44, 1900. In a pool at Londa, September 1952. In a pond at Gunji, September 1952.

35. *O. areolatum* Lag. ex Hirn var. *elongatum* var. nov. (f. 3 a, b)

Dioica, macrandra. Cellulae vegetativae cylindricae; cellulae femineae masculis largiores. Oogonia 1-2, obovoidea vel ovoidea; poro superiore. Oosporae globoso-ovoideae vel ovoideae, haud complentes oogonium longitudinaliter, series media parietum sporarum areolata; interior et exterior series leves. Antheridia 3-8. Antherozoidea 2; divisio horizontalis.

Cellulae vegetativae femineae 18-21 μ diam., 130-220 μ long.; cellulae vegetativae masculae 14-19 μ diam., 100-201 μ long.; oogonia 50-56 μ diam., 70-90 (-108) μ long.; oosporae 49-51 μ diam., 60-70 μ long.; antheridia 13-17 μ diam., 8-11 μ long.

Typus lectus in uligine ad Khanapur, mense octobri 1952 et positus in herbario auctoris senioris sub numero O.52.

The vegetative cells, oogonia and oospores of the above variety are longer than those of the type.

36. *O. dictyosporum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 103, pl. 7, f. 43, 1900. In a pool at Mugad, August 1951.

37. *O. subareolatum* Tiff., Brittonia, N. Y. 2 : 168, pl. 1, f. 13-15, 1936. In a pool at Alnavar, September 1951.

38. *O. siveolatum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 106, pl. 7, f. 46, 1900. In a pool at Yellapur, September 1949.

39. *O. excavatum* Jao var. *minus* var. nov. (f. 4)

Monoica. Cellulae vegetativae cylindricae. Oogonia solitaria, globosa vel ovoideo-globosa; poro superiore. Oosporae globosae, oogonium complentes, series media parietum scrobiculata, interior atque exterior series leves. Antheridia 2-3, subepigyna. Antherozoidea 2; divisio horizontalis.

Cellulae vegetativae 9-13 μ diam., 40-93 μ long.; oogonia 38-41 μ diam., 40-50 μ long.; oosporae 34-40 μ diam., 33-40 μ long.; antheridia 7-11 μ diam., 7-9 μ long.

Typus lectus in orysetis ad Kogilgeri, mense septembri 1952 et positus in herbario auctoris senioris sub numero O.56.

The variety described above is smaller than the type.

40. *O. wyliei* Tiff., Trans. Amer. micros. Soc. 45 : 90, pl. 1, f. 1-4, 1926. In rice fields at Chendie, near Karwar, December 1951. In a pond at Bistenhatti, February 1952.

41. *O. santurcense* Tiff., Brittonia, N.Y. 2 : 168, pl. 1, f. 20-22, 1936. In a rice field at Bistenhatti, September 1952.

42. *O. spinosum* sp. nov. (f. 5 a-c)

Dioica, macrandra. Cellulae vegetativae cylindricae, masculae et femineae cellulae eiusdem diametri; cellulae basales elongatae, terminales vero apicaliter obtusae. Oogonia solitaria, obovoideo-globosa vel ovoidea; poro superiore. Oosporae globosae, haud implentes oogonium; exterior series parietum spinulis magnis ornata, interior vero levis. Antheridia 1-3. Antherozoidea 2; divisio horizontalis.

Cellulae vegetativae 14-22 μ diam., 70-115 μ long.; oogonia 46-47 μ diam., 52-56 μ long.; oosporae 38-43 μ diam., 38-44 μ long.; antheridia 14-19 μ diam., 6-9 μ long.

Typus lectus in orysetis ad Naglavi, mense octobri 1951 et positus in herbario auctoris senioris sub numero O.60.

The only other dioecious macrandrous species with oogonia opening by a superior pore and with the wall of the oospores spiny is *O. santurcense*. The latter differs from the species described above in dimensions. Moreover, the spines on the wall of the oospores of this species are large and rather sparse, while they are fine and closely arranged in *O. santurcense*.

43. *O. pseudacrosporum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 193, pl. 32, f. 196, 1900. In a pond at Kogilgeri, September 1951.

44. *O. paucostriatum* Tiff., Ohio J. Sci. 34 : 325, 1934. Attached to aquatic plants in a pond at Bistenhatti, September 1952.

45. *O. costatosporum* Jao, Rhodora 36 : 88, pl. 6, f. 8-10, 1934. In a rice field at Mugad, September 1951. In a pond at Mundgod, September 1950.

46. *O. costatosporum* var. *longisporum* var. nov. (f. 6 a-c)

Dioica, macrandra. Cellulae vegetativae cylindricae, eae quidem prope apicem longissimae et angustae, basales vero breves et robustae. Oogonia solitaria, subellipsoidea vel ellipsoidea, operculata; divisio superior. Oosporae ellipsoideae, fere implentes oogonium; series media parietis costis 25-30 ornata, series vero externa atque interna leves. Antheridia non visa.

Cellulae vegetativae 7-19 μ diam., 72-190 μ long.; cellulae basales 21-27 μ diam., 79 μ long.; oogonia 38-44 μ diam., 68-96 (-105) μ long.; oosporae 32-43 μ diam., 57-74 μ long.

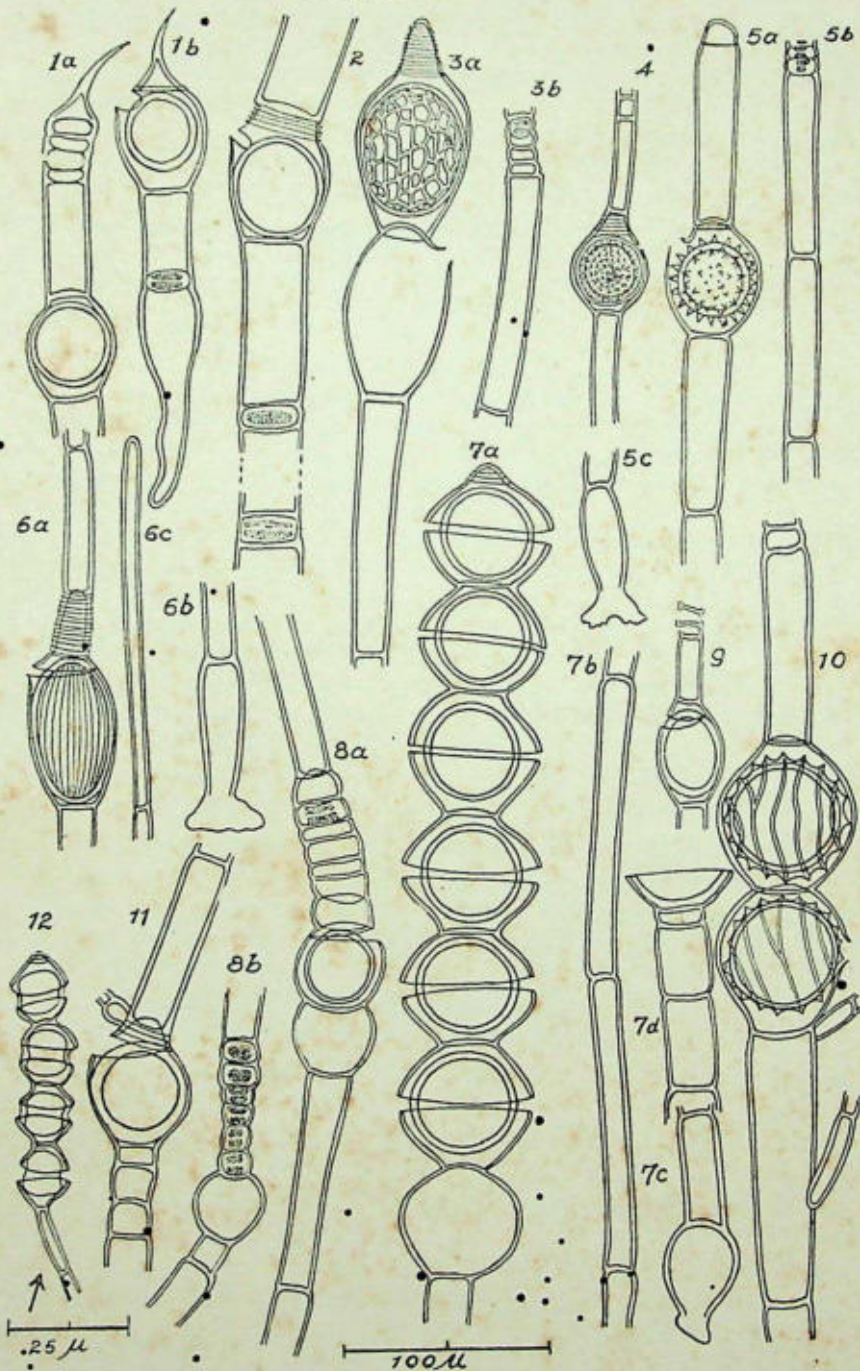


Fig. 1. *a, b*. *Oedogonium vaucherii* var. *parvum* var. nov.; Fig. 2. *O. brevicin-gulatum* var. *robustum* var. nov.; Fig. 3. *O. areolatum* var. *elongatum* var. nov.: *a*. Part of a female plant; *b*. Part of a male plant; Fig. 4. *O. excavatum* var. *minus* var. nov.; Fig. 5. *O. spinosum* sp. nov.: *a*. Part of a female plant; *b*. Part of a male plant; *c*. Basal cell; Fig. 6. *O. costatasporum* var. *longisporum* var. nov.: *a*. Part of a female plant; *b*. Basal cell; *c*. Terminal cell; Fig. 7. *O. bharatense* sp. nov.: *a*. Series of oogonia; *b*. Cells near the apex of the filament; *c*. Basal cell; *d*. An antheridium; Fig. 8. *a, b*. *O. variabile* sp. nov. Filaments with antheridia of varying sizes; Fig. 9. *O. kirchneri* var. *majus* var. nov.; Fig. 10. *O. illinoisense* var. *indicum* var. nov.; Fig. 11. *O. laetevirens* var. *amplum* var. nov.; Fig. 12. *O. pusillum* var. *minus* var. nov.

vel subglobosae, haud implentes oogonium; parietes leves. Antheridia 1-7, epigyna vel hypogyna, latitudinis variabilis. Antherozoidea 2; divisio horizontalis.

Cellulae vegetativae 16-20 μ diam., 28-101 μ long.; oogonia 34-39 (-44) μ diam., 34-45 μ long.; oosporae 29-37 μ diam., 29-39 μ long.; antheridia 13-20 μ diam., 9-15 μ long.; et 24-29 μ diam., 11-20 μ long.

Typus lectus in palude ad Desur, mense octobri 1952 et positus in herbario auctoris senioris sub numero O.78.

This species resembles *O. autumnale* Wittr. ex Hirn, but can be distinguished from it by the smaller oogonia and the varying sizes of the antheridia.

60. *O. obesum* (Wittr.) Hirn, Acta Soc. Sci. fenn. 27: 166, pl. 26, f. 148, 1900. In a pond at Bistenhatti, January 1952.

61. *O. crispum* (Hass.) Wittr. ex Hirn, ibid. 27: 159, pl. 25, f. 138, 139, 141, 1900. In a pond at Yellapur, September 1952.

62. *O. crispum* var. *gracilescens* Wittr. ex Hirn, ibid. 27: 162, pl. 25, f. 143, 144; pl. 26, f. 144, 1900. In a tank near Nagargali, September 1952.

63. *O. crispum* var. *uruguayense* Mag. & Wille ex Hirn, ibid. 27: 164, pl. 26, f. 145, 146, 1900. In a pond at Tavargatti, September 1952. Attached to aquatic plants in a pond at Nagargali, September 1952.

64. *O. crispum* var. *hawaiiense* Nordst. ex Hirn, ibid. 27: 165, pl. 26, f. 147, 1900. In a puddle in the jungle near Londa, September 1952.

65. *O. rupestre* Hirn, ibid. 27: 168, pl. 26, f. 152, 1900. In a small pool at Nagargali, September 1952.

66. *O. rupestre* f. *pseudautumnale* Hirn, ibid. 27: 169, pl. 27, f. 153, 1900. In a puddle near the railway lines between Londa and Devarayi, September 1951.

67. *O. kirchneri* Wittr. ex Hirn var. *majus* var. nov. (f. 9)

Monoica. Cellulae vegetativae cylindricae. Oogonia solitaria, ovoidea vel ovoideo-ellipsoidea, operculata; divisio superior. Oosporae globoso-ellipsoideae vel ovoideo-ellipsoidea, fere implentes oogonium; parietes leves. Antheridia 1-3, hypogyna vel subepigyna. Antherozoidea 2; divisio horizontalis.

Cellulae vegetativae 13-16 μ diam., 28-56 μ long.; oogonia 28-36 μ diam., 43-52 μ long.; oosporae 24-34 μ diam., 40-47 μ long.; antheridia 11-14 μ diam., 6-10 μ long.

Typus lectus in vado ad Gunji, septembri 1952 et positus in herbario auctoris senioris sub numero O.104.

The larger oogonia and oospores and the occasional subepigynous antheridia, in addition to hypogynous ones, differentiate this variety from the type.

68. *O. gracillimum* Wittr. & Lund. ex Hirn, Acta Soc. Sci. fenn. 27: 184, pl. 29, f. 180, 1900. In a pond near Nagargali, September 1952.

69. *O. oblongellum* Kirch. ex Hirn, ibid. 27: 182, pl. 29, f. 177, 1900. Attached to aquatic plants in a pond at Naglavi, September 1952.

70. *O. hallasiae* Tiff., Ohio J. Sci. 34: 325, 1934. In a pond at Khanapur, September 1950.

71. *O. undulatum* (Breb.) Al. Br.; Wittr. ex Hirn, Acta Soc. Sci. fenn. 27: 257, pl. 45, f. 273-275, 1900. In a pool at Londa, September 1951.

72. *O. undulatum* f. *senegalense* (Nordst.) Hirn, ibid. 27: 261, pl. 45, f. 276, 277, 1900. In a tank at Godgeri, January 1952.

73. *O. aster* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 198, pl. 32, f. 202, 1900. In a pond at Tavargatti, August 1951.

74. *O. exspirale* Tiff., Ohio J. Sci. 24 : 184, pl. 2, f. 1-3, 1924. In a pond at Nagargali, August 1951.

75. *O. illinoense* Trans. var. *indicum* var. nov. (f. 10)

Dioica, nannandra, gynandrospora. Cellulae vegetativae cylindricae, cellulae suffulcientes paulum dilatatae. Oogonia 1-2, subglobosa vel obovoideo-globosa; poro medio. Oosporae globosae vel subglobosae, fere implentes oogonium; externa series muralis spora spiraliter costata, costis 5-8 in aspectu optico. Androsporangia 2-4, ut plurimum subepigyna. Mares nani cellulis suffulcipientibus insidentes. Apheridia externa.

Cellulae vegetativae 17-22 μ diam., 70-130 μ long.; cellulae suffulcientes 23-33 μ diam., 100-133 μ long., oogonia 65-68 μ diam., 69-72 μ long.; oosporae 60-66 μ diam., 60-67 μ long.; androsporangia 17-19 μ diam., 17-19 μ long.; marium nanorum stipites 7-12 μ diam., 20-27 μ long.

Typus lectus in vado ad Londa, mense septembri 1953 et positus in herbario auctoris senioris sub numero O.114.

The diameters of the vegetative cells, oogonia, oospores and androsporangia are greater than those of the type, while the suffultory cells are less in diameter, but longer.

76. *O. spirale* Hirn, Acta Soc. Sci. fenn. 27 : 201, pl. 33, f. 206, 1900. In a puddle at Alnavar, September 1952.

77. *O. spirale* var. *majus* Singh, Proc. Indian Acad. Sci. 8 : 38, f. 4 A-C, 1938. In a pond near Bistenhatti, October 1952.

78. *O. latviense* Tiff., Ohio J. Sci. 34 : 325, 1934. In a small pool at Mundgod, September 1952.

79. *O. subsexangulare* Tiff., ibid. 34 : 325, 1934. In a pool along the railway lines near the Devarayi railway station, September 1952.

80. *O. stellatum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 205, pl. 34, f. 210, 1900. In a pool near Castle Rock, August 1952.

81. *O. alternans* Wittr. & Lund. ex Hirn, ibid. 27 : 251, pl. 42, f. 263, 1900. In a tank at Godgeri, September 1952.

82. *O. armigerum* Hirn, ibid. 27 : 203, pl. 33, f. 208, 1900. In a pond at Devarayi, August 1952.

83. *O. cyathigerum* Wittr. ex Hirn, ibid. 27 : 252, pl. 43, f. 265, 266, 1900. Attached to the decaying leaves of rice plants in a field at Mugad, September 1952.

84. *O. wolleanum* Wittr. ex Hirn, ibid. 27 : 220, pl. 37, f. 226, 1900. In a tank at Yellapur, September 1951. In a pond at Devarayi, September 1952.

85. *O. concatenatum* (Hass.) Wittr. ex Hirn, ibid. 27 : 223, pl. 38, f. 230, 1900. In a pond near Nagargali, September 1952.

86. *O. hispidum* Nordst. ex Hirn, ibid. 27 : 210, pl. 35, f. 215, 1900. In a pond at Khanapur, September 1952.

87. *O. elegans* West & West, Trans. Linn. Soc. Lond. (Bot.) 6 : 128, pl. 17, f. 6, 7, 1902. In stretches of shallow water at Alnavar, November 1951.

88. *O. elegans* var. *americanum* Jao, *Rhodora* 36 : 204, pl. 288, f. 28-30, 1934. In a pond near Londa, September 1952.

89. *O. indicum* Hirn, *Acta Soc. Sci. fenn.* 27 : 269, pl. 46, f. 288, 1900. Attached to the leaves of rice plants in fields at Tavargatti, September 1952.

90. *O. confertum* Hirn, *ibid.* 27 : 272, pl. 46, f. 291, 1900. In a pond at Tavargatti, December 1951.

91. *O. perspicuum* Hirn, *ibid.* 27 : 273, pl. 46, f. 293, 1900. In Nuggikeri Tank, Dharwar, January 1952.

The specimens were definitely idioandrosporous. The androsporangia were 1 to 8-seriate.

92. *O. oelandicum* Wittr. ; Hirn, *ibid.* 27 : 273, pl. 47, f. 297, 1900. Attached to the leaves of rice plants in a field near Kambarganvi, August 1951.

93. *O. platygynum* Wittr. ex Hirn var. *ambiceps* Jao, *Rhodora* 36 : 208, pl. 287, f. 26, 27, 1934. In a pond at Alnavar, January 1952.

94. *O. senegalense* (Nordst.) Tiff., *Ohio J. Sci.* 34 : 326, 1934. In a rice field at Naglavi, October 1951.

95. *O. decipiens* Wittr. ex Hirn, *Acta Soc. Sci. fenn.* 27 : 266, pl. 46, f. 283, 284, 1900. In a pool at Belgaum, October 1952. In rice fields at Kyarkop, September 1952.

96. *O. decipiens* var. *dissimile* (Hirn) Tiff., *N. Amer. Flora* 11 : 68, pl. 24, f. 384, 385, 1937. In a pool at Dandeli, October 1953.

97. *O. decipiens* var. *bernardense* (Bates) Hirn, *Acta Soc. Sci. fenn.* 27 : 268, pl. 46, f. 286, 1900. In a pool at Khanapur, September 1952.

98. *O. rugulosum* Nordst. ex Hirn, *ibid.* 27 : 241, pl. 40, f. 249, 250, 1900. In a ditch at Belgaum, October 1952.

99. *O. laetevirens* Wittr. ex Hirn var. *amplum* var. nov. (f. 11)

Dioica, nannandra, gynandrospora. Cellulae vegetativae cylindricae, Oogonia solitaria, globosa vel obovoideo-globosa; operculata, divisio superior. Oosporae globosae, oogonium implentes; parietes leves. Androsporangia 2-3, subepigyna vel hypogyna. Mares nani oogoniis insidentes. Antheridia externa.

Cellulae vegetativae 14-23 μ diam., 50-80 μ long.; cellulae basales 23 μ diam., 65 μ long.; oogonia 43-50 μ diam., 44-56 μ long.; oosporae 39-48 μ diam., 39-48 μ long.; androsporangia 14-23 μ diam., 10-21 μ long.; marium nanorum stipites 10-12 μ diam., 19-22 μ long.

Typus lectus in palude ad Gunji, mense octobri 1952 et positus in herbario auctoris senioris sub numero O.151.

The above variety is much larger than the type.

100. *O. implexum* Hirn, *Acta Soc. Sci. fenn.* 27 : 283, pl. 49, f. 316, 1900. In stretches of shallow water at Alnavar, January 1952.

101. *O. monile* Berk. & Harv. ex Hirn, *ibid.* 27 : 229, pl. 38, 39, f. 235, 236, 1900. In a pool at Desur, August 1952.

102. *O. eminens* (Hirn) Tiff., *Ohio J. Sci.* 34 : 326, 1934. In a strip of shallow water at Khanapur, October 1952.

103. *O. exomonile* Tiff., *ibid.* 34 : 326, 1934. In a pool at Londa, August 1951.

104. *O. obtruncatum* Wittr. ex Hirn, Acta Soc. Sci. fenn. 27 : 284, pl. 49, f. 318, 1900. Attached to aquatic plants in a pool at Alnavar, September 1952.

105. *O. tapeinosporum* Wittr. ex Hirn, ibid. 27 : 297, pl. 23, f. 117, 1900. In rice fields at Karwar, December 1951.

106. *O. inconspicuum* Hirn, ibid. 27 : 296, pl. 23, f. 116, 1900. In a small pool at Devarayi, September 1952.

107. *O. pusillum* Kirch. ex Hirn, ibid. 27 : 299, pl. 24, f. 125, 1900. In a strip of shallow water at Alnavar, September 1952.

108. *O. pusillum* var. *minus* var. nov. (f. 12)

Cellulae vegetativae cylindricae. Oogonia solitaria, subconico-ellipsoidea vel subconico-globosa; operculata, divisio media, lata. Oosporae subglobosae atque tenuiter constrictae ad medium, haud penitus implentes oogonium; parietes leves.

Cellulae vegetativae 2.5-4.5 μ diam., 10-21 μ long.; oogonia 10-14 μ diam., 11-16 μ long.; oosporae 9-11 μ diam., 10-12.5 μ long.

Typus lectus in palude ad Alnavar, mense januario 1953 et positus in herbario auctoris senioris sub numero O.170.

This variety is smaller than the type, while the oogonia are not solitary or in twos, but are up to 4-seriate.

109. *O. inclusum* Hirn, Acta Soc. Sci. fenn. 27 : 318, pl. 50, f. 324, 1900. Attached to aquatic plants in a pond at Haliyal, September 1952.

110. *O. selandiae* Hallas, Bot. Tidsskr. 26 : 496, f. 14, 1905. Attached to aquatic plants in a pond at Naglavi, September 1952.

111. *O. flexuosum* Hirn, Acta Soc. Sci. fenn. 27 : 313, pl. 48, f. 310, 1900. Attached to aquatic plants in Kempkeri Tank, near Dharwar, August 1952.

112. *O. virceburgense* Hirn, ibid. 27 : 301, pl. 24, f. 128, 1900. In a pond near Khanapur, February 1952.

Occasionally oogonia up to 14-seriate were found.

113. *O. calvum* Wittr. ex Hirn, ibid. 27 : 316, pl. 50, f. 323, 1900. In a rice field near Kambarganvi, September 1952.

114. *O. pseudospirale* Nyg., Trans. roy. Soc. S. Afr. 20 : 136, f. 32, 1932. In a tank near Tavargatti, September 1952.

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Entomological Survey of Himalaya

Part XXVI. A Contribution to our Knowledge of the Geography of the High Altitude Insects of the Nival Zones from the North-West Himalaya

PART 2

BY

M. S. MANI, D.SC., F.L.S. AND SANTOKH SINGH, Ph.D., F.R.E.S.

(With nine text-figures)

[Continued from Vol. 58 (2) : 406]

COLEOPTERA

We have given some account of the distribution of Coleoptera from the NW. Himalaya in an earlier paper (99). The order represents about 49% of the total nival insect fauna (Table I; Fig. 3). About 190 species belonging to 18 families are so far known (Table II; Fig. 12).

Species endemism is 59%. Nearly 96% of the species are Palaearctic (Tables III and X); of these about 3% represent the Mediterranean elements. About 5% of the species extend to the Nearctic realm. Nearly half the species occur north of the crest line of the Great Himalaya.

Carabidae, Staphylinidae, Tenebrionidae and Curculionidae are the dominant families. Analysis of the faunal component elements is summarized in Table III and the percentage composition of the four dominant families in Table IV (Fig. 13).

The family Carabidae, with 84 species belonging to 27 genera, represents about 45.3% of the total nival Coleoptera above the timber line. Of these, 33 species (under 10 genera) occur above an elevation of 4000 m. above m.s.l. Nearly half the species are endemites. Of the endemic species, 4 fall under the genus *Amara*, 15 under *Bembidion*, 4 each under *Carabus* and *Cymindis*, and 2 under *Nebria*.

TABLE II

Analysis of the abundance of species in different families of nival Coleoptera

Serial No.	Family	No. of Species	Percentage in total nival Coleoptera
1.	Cicindelidae	..	0.52
2.	Carabidae	84	45.30
3.	Dytiscidae	7	4.16
4.	Hydrophilidae	7	4.16
5.	Histeridae	2	1.04
6.	Staphylinidae	32	16.60
7.	Cantharidae	1	0.52
8.	Meloidae	1	0.52
9.	Elateridae	1	0.52
10.	Coccinellidae	2	1.04
11.	Tenebrionidae	17	8.80
12.	Scarabaeidae	3	2.08
13.	Geotrupidae	1	0.52
14.	Aphodidae	1	0.52
15.	Rutelidae	2	1.04
16.	Cerambycidae	4	2.08
17.	Chrysomelidae	4	2.08
18.	Curculionidae	16	8.30
Total nival species		186	

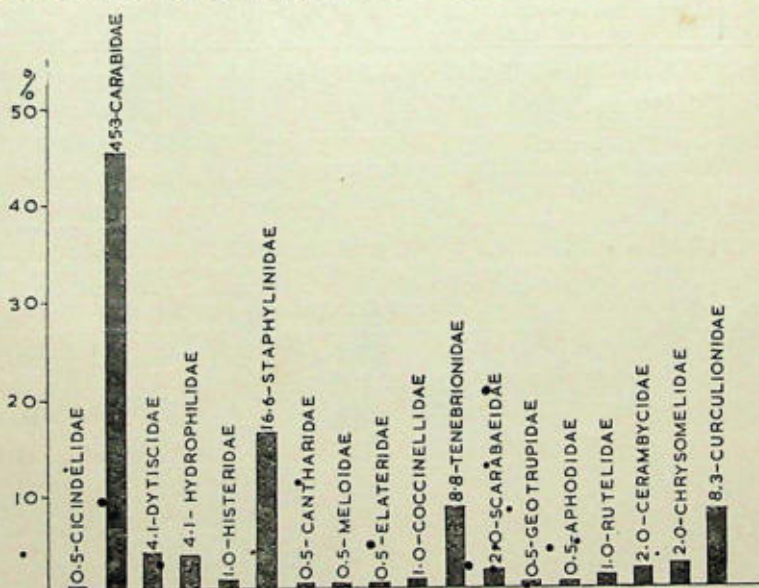


Fig. 12. The nival Coleoptera from the north-west Himalaya.

The endemites *Bembidion pictum* (Fald.), *Bembidion hutchinsoni* Andr., *Bembidion irregulare* Net., *Bembidion ixion* Andr., *Bembidion*

TABLE III
Faunal elements of the nival Coleoptera

Serial No.	Family	Total Species	Endemites	Palaeartic		Oriental (Indo-Malayan)	Remarks
				Total	Medit.		
1.	Cicindelidae ..	1	—	1	1	—	2 spp. extend to Nearctic; 1 sp. wide-spread.
2.	Carabidae ..	84	44	81	3	4	
3.	Dytiscidae ..	7	4	7	—	—	
4.	Hydrophilidae ..	7	1	7	—	—	
5.	Histeridae ..	2	1	2	—	—	
6.	Staphylinidae ..	32	26	32	1	—	
7.	Cantharidae ..	1	—	1	—	—	
8.	Meloidae ..	1	—	—	—	1	
9.	Elateridae ..	1	—	1	—	—	
10.	Coccinellidae ..	2	—	2	—	—	
11.	Tenebrionidae ..	17	16	17	—	—	
12.	Scarabaeidae ..	3	—	3	—	—	
13.	Geotrupidae ..	1	1	1	—	—	
14.	Aphodidae ..	1	1	1	—	—	
15.	Rutelidae ..	2	1	2	—	—	
16.	Cerambycidae ..	4	1	4	—	—	
17.	Chrysomelidae ..	4	1	4	—	—	
18.	Curculionidae ..	16	12	14	—	—	
Total ..		186	109	180	5	5	
Percentage out of total 186 species ..			58.8%	95.3%	—	4.1%	
Percentage of the Mediterranean elements in the total Palaeartic					3.0%		

TABLE IV

Percentage of the faunal component elements in the four dominant families of nival Coleoptera

Serial No.	Family	Total species	Endemites	Palaeartic		Indo-Malayan
				Total	Medit.	
1.	Carabidae ..	84	52.0	98.0	4.8	2.0
2.	Staphylinidae ..	32	81.2	100.0	3.1	—
3.	Tenebrionidae ..	17	94.0	100.0	—	—
4.	Curculionidae ..	16	75.0	87.5	—	12.5

ladas Andr., *Bembidion leve* Andr., and *Bembidion livens* Andr. are strictly localized in the area drained by R. Indus north of the

crest line of the Great Himalaya, and also mostly occur at elevations above 4000 m. *B. pictum* (Fald.), *B. hutchinsoni* Andr., *B. ladas* Andr., and *B. leve* Andr. are never found below an elevation of 4000 m. *B. hutchinsoni* Andr., found at 4734 m., represents at present the maximum altitude record in the genus *Bembidion* in the NW. Himalaya. Three species *B. algidum* Andr., *B. caporoaccoi* Net., and *B. irregulare* Net. often descend below 3000 m. to within the fringe of the taiga.

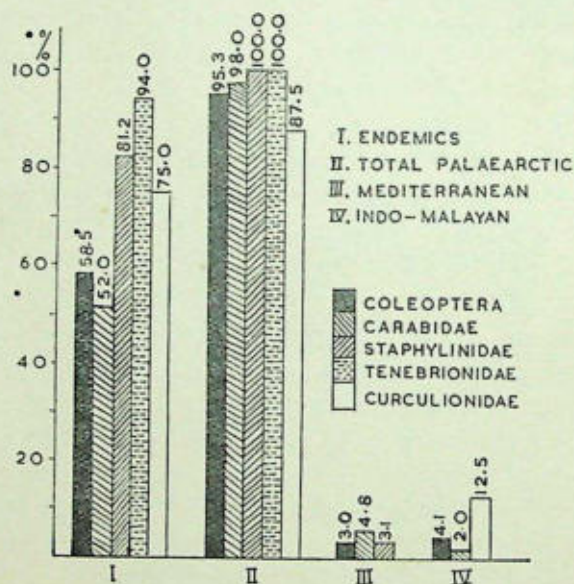


Fig. 13. The faunal elements of the nival Coleoptera from the north-west Himalaya.

Of the four endemic *Amara*, two species *ambigene* Bates (4267 m.) and *lamia* Andr. (3400-4664 m.) are also localized in the Indus drainage area. *Carabus (Imaibus) barosomus* (Bates), *Carabus (Imaibus) dardiellus granuliparus* Bates, *Carabus (Imaibus) epipleuralis* Sem., and *Carabus (Imaibus) rostianus* Sem. are localized near the timber line in the area drained by R. Jhelum on the Pir Panjal Range and south of the main crest line of the Great Himalaya. *Cymindis alticola* Gebl., *Cymindis babaulti* Andr., and *Cymindis glabrella* Bates, found near an elevation of 3200 m., and *Cymindis rubriceps* Andr. found at an elevation of 5151 m., are localized in the Indus drainage area. Also localized in the same area is *Nebria limbigera babaulti* Andr., occurring at an elevation of 4420 m. The typical form *Nebria limbigera* Solsky, found at elevations ranging

from 4267 m. to 4541 m. in the Indus drainage area, is also known from Kumaon Himalaya, Pamir, Alai, Kokand, and China (Fig. 14). Outside the NW. Himalaya, we have the interesting record of the occurrence of the three subspecies *Nebria limbigera alaiensis* Glas. from Alai and Pamir, *Nebria limbigera picta* Sem., and *Nebria limbigera kandspstisa* Glas. from Pamir. Among the other endemic Carabidae, the monotypic *Chaetobrosicus anomalus* (Chaud.), found between 3000 m. and 3657 m., is localized in the drainage area of R. Jhelum, south of the main crest line of the Great Himalaya. Also localized in the same area are *Phaeropsophus stenoderus* Chaud. (Indo-Malayan) and *Pristonychus kashmirensis babaulti* Andr. The typical form *Pristonychus kashmirensis* Bates, found between 3300 m. and 4267 m., is localized in the Indus drainage area.

Bembidion has a total of 27 species and is also characterized by maximum species endemism. It is essentially a Holarctic genus, with only one or two species found in the lowlands of India, but several species are known from Finno-scandinavia, Alaska, and the far North. The Holarctic *Trechus*, of which several species are known from Turkestan mountains, is represented by three species in the NW. Himalaya. *Trechus cameroni bistratus* Jeann., an endemite, is localized in the Chenab-Beas drainage area, south of the main crest line of the Great Himalaya. The typical form is known from the Simla Hills of the Garhwal Himalaya. The distribution of the non-endemic species of *Trechus* is shown in Fig. 14. It is interesting to observe that the Palaearctic *Harpalus*, which with one exception is restricted to the Himalaya in India, is strictly localized in the drainage areas of Jhelum and Chenab-Beas and is mostly found below an elevation of 4300 m. The subgenus *Nebria* (*Patronebria*), with one species *himalayica* (Bates), is also known from Garhwal, Kumaon, Bhutan, Tibet, and Siberia. Among the non-endemites, *Cymindis mannerhemi* Gebl., occurring between 4267 m. and 4520 m. and localized in the Indus drainage area, is also known from Pamir and central Asia. *Amara brucei* Andr., found at an elevation of 5300 m. in the Indus drainage area, is also reported to occur at an elevation 5030 m. near the Mt. Everest area in E. Himalaya. *Amara darjilingensis* Putz., found at about an elevation of 3200 m., is also known from Kumaon, Sikkim, Darjeeling, and Khasi Hills. *Amara himalaica* Bates, which occurs above an elevation of 3300 m., is reported at lower elevations from Simla Hills and Kumaon Himalaya (Fig. 15). Of the non-endemic *Bembidion* (Fig. 15), five species viz. *braculatum* Bates, *gagates* Andr., *hasurda* Andr., *nivicola* Andr.,

and *pluto* Andr., occur in other parts of the Himalaya, E. of the R. Sutlej. *Bembidion bucephalum* Net. and *Bembidion dardum* Bates are known from Turkestan mountains, *Bembidion himalayana* Andr. and *Bembidion pamiricola* Lut. from Pamir, and *Bembidion satanus* Andr. from Hindukush. *Bembidion fuscicrus* Motsch. is widely distributed in Pamir, central Asia, Siberia, and western parts of N. America (Fig. 16).

The Palaearctic element is high and amounts to nearly 95.0% of the nival species known at present. *Calosoma* represents the Mediterranean element. The subspecies *Calosoma maderae auro-punctatum* (Herb.) is endemic but *Calosoma maderae indicum* Hope is also reported from the lowlands of India and Peshawar in Pakistan. *Calosoma maderae kashmirensis* Breun. occurs in Tibet also. *Phaeropsophus catoirei* (Dej.), *Phaeropsophus cosularis* (Schm. & Boeb.), *Phaeropsophus stenoderus* Chaud., and *Scarites predator* Chaud. comprise the Indo-Malayan forms, which are found mostly near the timber line and do not seem to occur above an elevation of 3500 m. *Bradytus apricarius* (Payk.), found in the Indus drainage area, is also known to occur in Pamir, Canada, and the President Range in the Nearctic Realm. The distribution of the genus *Bradytus* is shown in Fig. 17.

Of the 7 species of Dytiscidae so far known in the nival zones of the NW. Himalaya, 4 species are endemites. Six of the species are localized in the Indus drainage area and often occur at elevations ranging from 4267 m. to 4527 m. *Potamonectes (Potamonectes) griseostriatus* Deg. (Fig. 18), found in many localities in the NW. Himalaya, is also known from Europe, Siberia, and N. America.

In the Hydrophilidae, the only endemite is *Helophorus (Meghelophorus) aquaticus* Linn., occurring between 4175 and 4300 m. *Atracthelophorus frater* d'Orch., occurring at an elevation of 4724 m., represents at present the highest altitude record in the family. The wide distribution of the remaining non-endemic forms in the Tibetan Palaearctic is shown in Fig. 19. d'Orchymont (29) has briefly discussed the peculiarities of the distribution of the high altitude Hydrophilidae of Tibet and Himalaya.

The family Staphylinidae, with 32 species, representing about 16% of the total nival Coleoptera, stands next to Carabidae in abundance. All the species are Palaearctic and the species endemism is about 81%. Of the 26 endemites, 19 belong to the genus *Atheta*, of which there are also 3 other non-endemic forms. The five species *Atheta (Acrotona) fitigi kashmirensis* (Gr.), *Atheta (Aloconota) iguensis*

Cam., *Atheta* (*Bessobia*) *submetallica* Cam., *Atheta* (*Dimetrota*) *hutchinsoni* Cam., and *Atheta* (*Microdota*) *ladakiana* Cam. are mostly localized in the Indus drainage area and the remaining endemic species are localized in the Jhelum drainage area. The rest of the endemic species belong to the genera *Geodromicus*, *Lesteva*, *Ocyusa*, *Oxypoda*, *Philonthus*, *Pseudocyusa*, and *Tachinus*.

Among the non-endemic Staphylinidae, the distribution of the following species is interesting. *Aleochara* (*Coprochara*) *bilineata* Gyll., occurring at an elevation of 4870 m., is also known from Garhwal Himalaya, Caucasus, and Europe. *Atheta triangulum* (Kr.), a Mediterranean element, seems to be confined to elevations immediately above the timber line. Five species are found above an elevation of 4000 m. *Atheta* (*Dimetrota*) *hutchinsoni* Cam., found at an elevation of 5600 m., represents the highest altitude at which any Coleoptera is known at present from the world.

The family Tenebrionidae is remarkable for the highest degree of species endemism in Coleoptera, viz. 100%. There are also two endemic genera, viz. *Bioramix* and *Chianalus*. All the species are Palaearctic forms. Outside the NW. Himalaya, the genus *Ascelosodis* is known from Pamir only. *Syachis* is represented by one species from Turkestan mountains and one species from Afghanistan. *Cyphogenia* is widely distributed in the steppes of Asia from Mongolia and China to Caspian Sea and has about eight species in Iran and Afghanistan. *Prosodes* is also found in Iran, Afghanistan, Baluchistan, and SE. Europe. *Blaps* is known from Palaearctic and south Palaearctic of Asia, African Mediterranean, E. and central Europe. It is also interesting to note that all the species are localized in the Indus drainage area. Two species of *Blaps*, *Cyphogenia plana* Bates and *Myatis quadraticollis* Bates, occur above an elevation of 4000 m.

Species endemism in Curculionidae is 75% and the Palaearctic elements amount to nearly 87%. The genus *Catapionus* (Fig. 20) is known from Japan, Semirjetschensk, Siberia, Altai, Thian Shan, Kasghar, Karakorum, Turkestan mountains, Sikkim, Tibet, Kurlien Islands, and Amur. The genus *Scepticus* is distributed (Fig. 20) in Kasghar, Turkestan Mountains, Altai, Japan, Okinawa, Formosa, and does not extend west of Turkestan. In the NW. Himalaya it is widely distributed in the areas drained by R. Indus, R. Jhelum, and Chenab-Beas system, both N. and S. of the main crest line of the Great Himalaya. *Blosyodes* represents the Indo-Malayan element. Among the non-endemic species, *Otiorrhynchus ruscicus* Stier. is known from Russia, and *Sitones calossus* Gyll. is known from central and S. Europe and

central and W. Asia. Most of the species occur immediately above the timber line but four species, which are all endemic, occur at elevations above 4000 m.

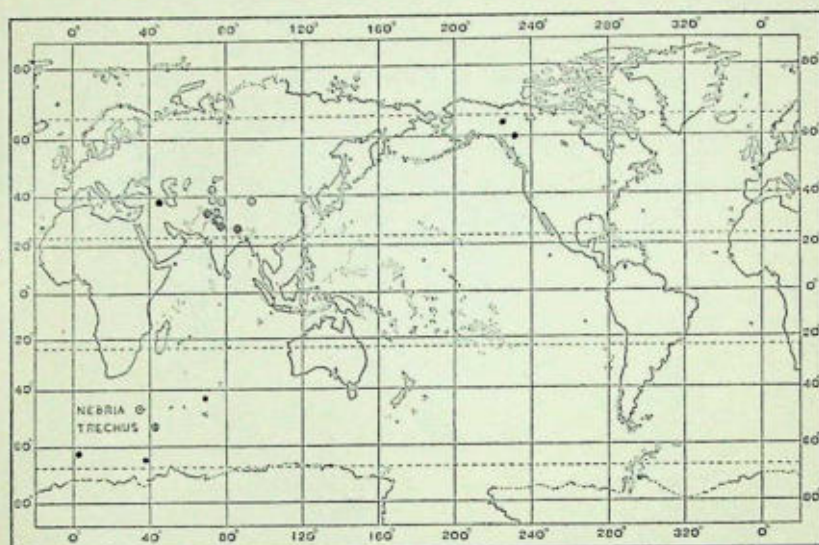


Fig. 14. The world distribution of the non-endemic nival species of *Nebria* and *Trechus* from the north-west Himalaya.

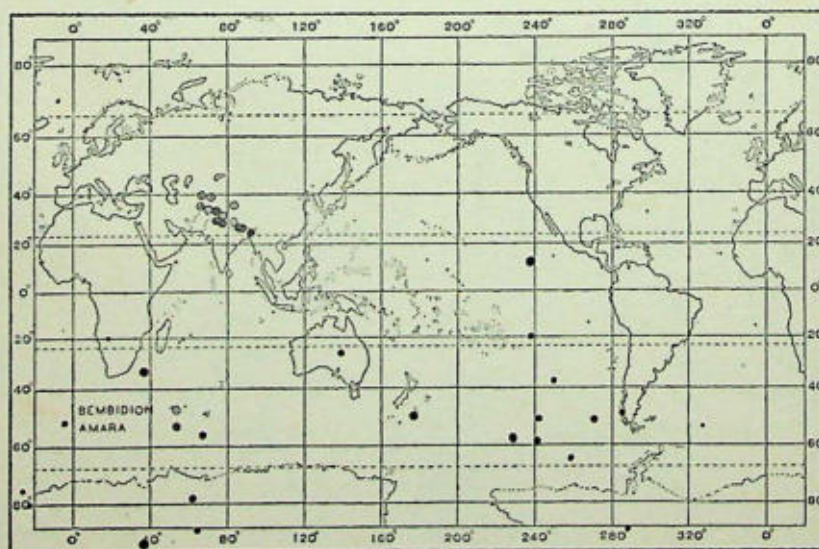


Fig. 15. The world distribution of the non-endemic species of *Amara* and *Bembidion* from the north-west Himalaya. The area of their endemism is confined to the Pamir-Tibet-north-west Himalaya region.

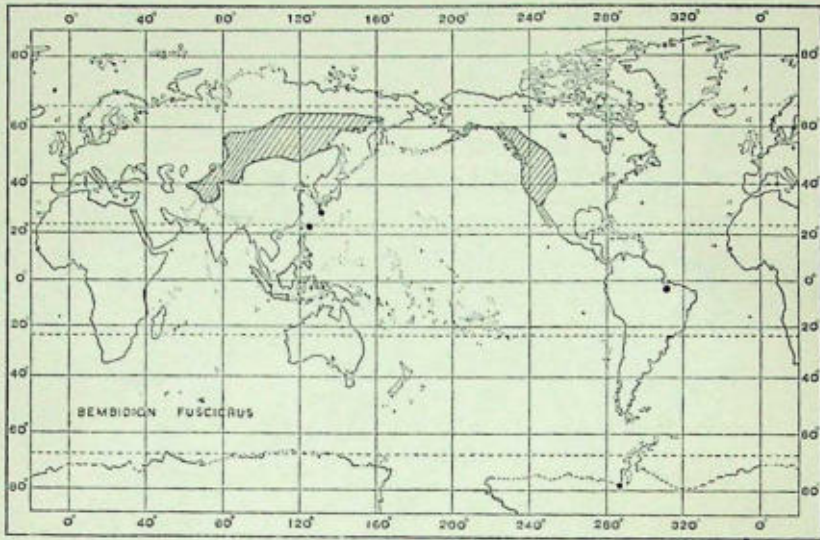


Fig. 16. The area (striped) of the world distribution of the interesting Holarctic species *Bembidion fuscicrus* (Motschulsky).

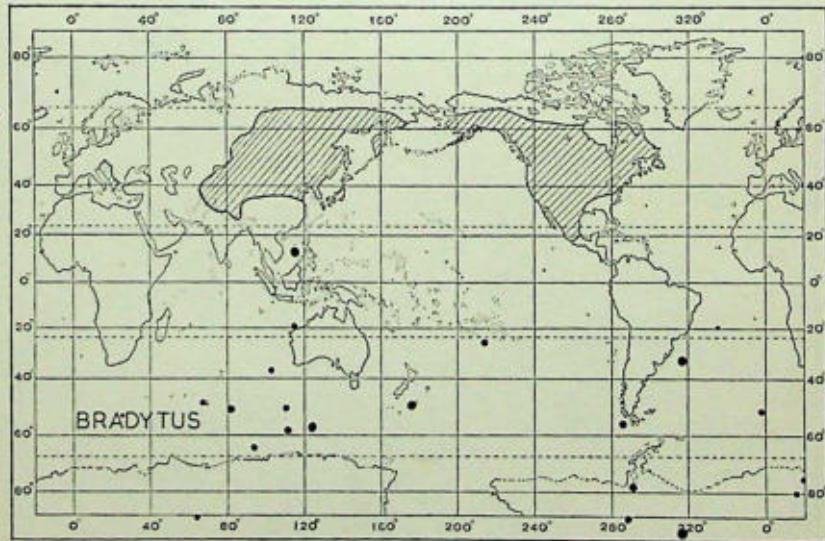


Fig. 17. The area (striped) of the world distribution of the genus *Bradytus*.

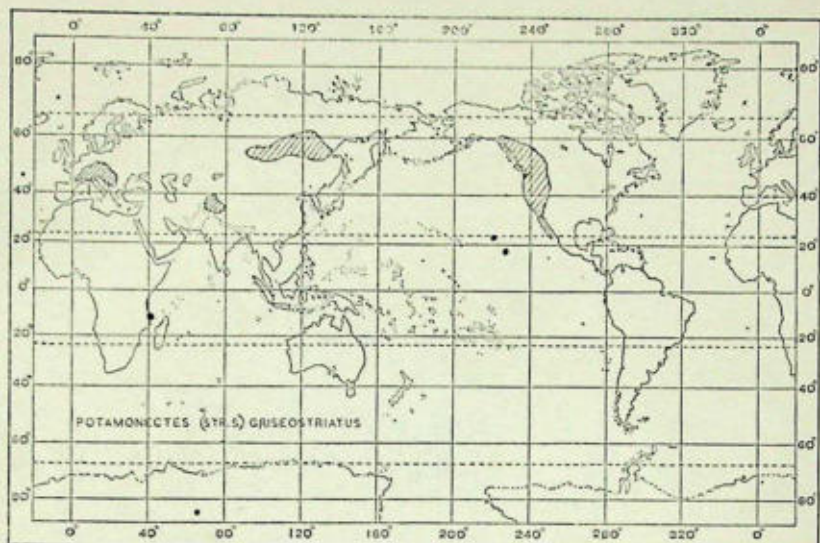


Fig. 18. The area (striped) of the world distribution of *Potamonectes* (*Potamonectes*) *griseostriatus* Deg.

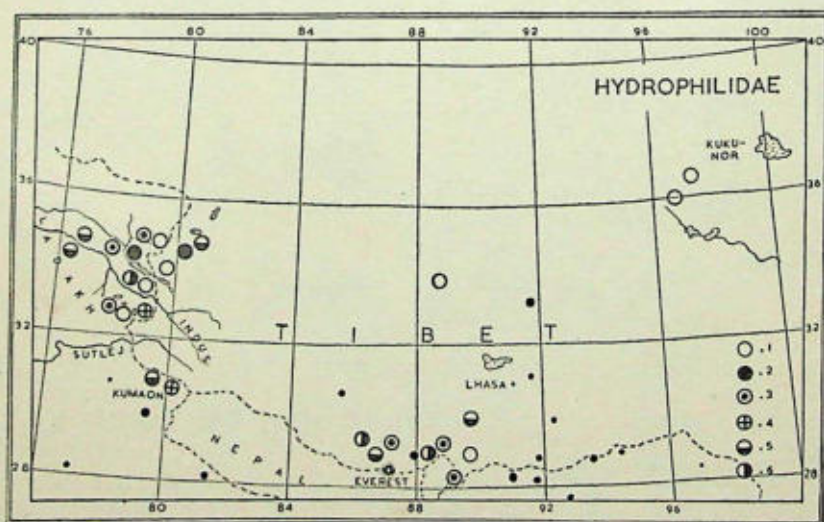


Fig. 19. The world distribution of the nival Hydrophilidae from the northwest Himalaya, modified from d'Orchymont (29). 1. *Helophorus* (*Lihelophorus*) *ser* Zait. 2. *Helophorus* (*Meghelophorus*) *aquaticus* Linn. 3. *Helophorus* (*Helophorus*) *splendidus immaensis* d'Orchymont. 4. *Helophorus* (*Atractelophorus*) *frater* d'Orchymont. 5. *Helophorus* (*Atractelophorus*) *montanus* d'Orchymont. 6. *Laccobius* (*Laccobius*) *hingstoni* d'Orchymont.

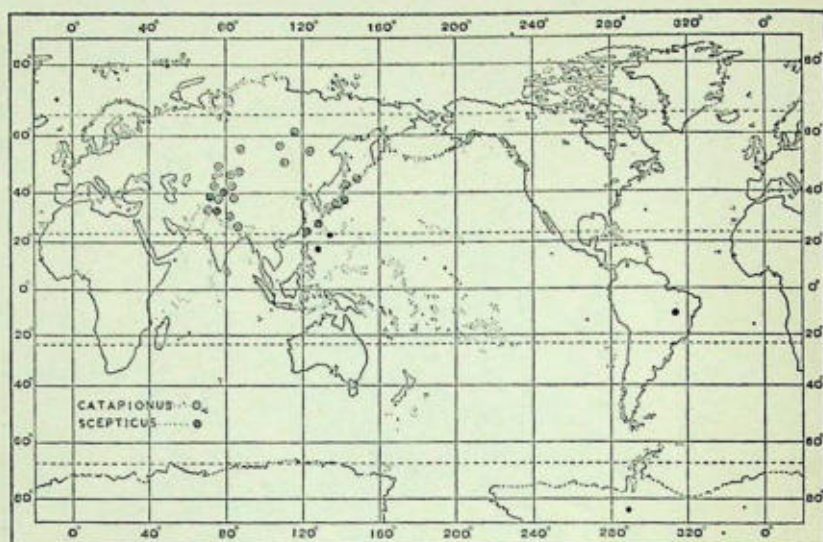


Fig. 20. The world distribution of the non-endemic nival species of *Catapionus* and *Scepticus* from the north-west Himalaya.

Cicindelidae

1. *Cicindela sublacerata* balucha Bates

Localities : Skardu 3000 m.

Other Distribution : Baluchistan.

Carabidae

2. *Agonum ladakense* Bates

Localities : Kashmir about 3000 m.

Other Distribution : Pamir ; Jalalabad ; Tibet 3960 m.

*3. *Amara ambigene* Bates

Localities : Pangong Valley between Tanktze and Chagra, 4267 m.

4. *Amara brucei* Andr.

Localities : Ororotse Tso 5300 m., Anem La 5181 m., Tso-Nyak region 4350 m.

Other Localities : Second Mt. Everest Expedition Base Camp 5030 m.

5. *Amara darjilingensis* Putz.

Localities : Jalore Pass 3290 m., Dharmsala, Naggur, Parbati Valley.

Other Distribution : Kumaon, Sundardhunga Valley, Sukha Tal, Gori Valley, Bhurphu, Chuli Khad (Chakrata), Sikkim, Darjeeling, Lachang, Khasi Hills.

*6. *Amara depilatus* (Bates)

Localities : Goorais Valley, Skardu about 3000 m.

7. *Amara himalaica* Bates
Localities : Dras 3100 m., Kargil 2740 m., Leh 3437 m., Sumdeo 3300 m.,
Bashahr (Poo) 2800 m.
Other Distribution : Simla Hills, Kotgarh, Matiana, Almora, Ranikhet.
- *8. *Amara lamia* Andr.
Localities : Leh 3440 m., Tso-Morari 4664 m.
9. *Amara nila* Andr.
Localities : Manikaran, Pulga, Tchary-Djoni, Tsho-ti 3200 m., Kulu, Kandy,
Kote, Bajaura, Chamba.
Other Distribution : Mussoorie, Pindar Valley, Sundardhunga Valley,
Konain, Chitri Khud.
- *10. *Amara tiruka* Andr.
Localities : Sonemarg 3000 m., Leh 3440 m.
- *11. *Amolops piliferus* (Bates)
Localities : Goorais Valley, Skardu 3000 m., Murree.
- *12. *Anchomenus bernardi* Andr.
Localities : Gondhla 3200 m., Keylang 3300 m., Sisu 3300 m., Pulga,
Tchary-Djoni, 3200 m., Manikaran, Kulu, Kote, Parbati Valley.
13. *Anchomenus ladakensis* Bates
Localities : Leh 3440 m., Kargil 2740 m., Pangong Valley between Tanktze
and Chagra 4267 m.
Other Distribution : Tibet (Gyangtse) 3600 m.
14. *Anchomenus caesitius* Andr.
Localities : Sisu 3300 m., Sumdeo 3300 m., Kulu, Kandy, Kote.
Other Distribution : Almora.
- *15. *Bembidion ajmonis* Net.
Localities : Razdhainangan 3500 m.
- *16. *Bembidion algidum* Andr.
Localities : Gulmarg 2438-2743 m., Khilanmarg 3350 m.
- *17. *Bembidion aquilum* Andr.
Localities : Patseo 3500 m., Gond, Baltal 3000 m., Leh 3440, Mulbek 4520
m., Skardu, Gulmarg 2800 m.
- *18. *Bembidion atlanta* Andr.
Localities : Lianmarg 3050 m.
- *19. *Bembidion beasoni* Andr.
Localities : Khilanmarg 3350 m., Razhainangan 3657 m.
20. *Bembidion braculatum* Bates
Localities : Skardu 3000 m., Matayan 3050 m.
Other Distribution : Kumaon, Gori River gorge, Laptel 4572 m., Milam in
Gori Valley 3500 m.

21. *Bembidion bucephalum* Net.
Localities : Chhota Deosi 3962 m., Boorgi Nullah 3657 m., Braldo Valley, Kro Brok 3700 m., Thla Brok 4267 m., Punmah Valley, Dumiltar 4267 m., Baltora, Urdukas 4080 m., Mundu 3960-5000 m., Lopsang Bransa 4578 m. All Kashmir.
Other Distribution : Turkestan, Bukhara, Transcaspia.
- *22. *Bembidion caporoacoi* Net.
Localities : Sind Valley, Kangan 2000 m., Olthingthang 2618 m., Shigar Valley, Alchori, Kushumul all above 3000 m., Braldo Valley, Askole and Biaho 3050 m.
23. *Bembidion dardum* Bates
Localities : Goorais Valley, Skardu 3000 m.
Other Distribution : Bukhara.
24. *Bembidion fuscicrus* Motsch.
Localities : Baltal 3000 m., Leh 3440 m., Mulbek 4420 m., Nurla, Salt Lake 3627, Tso-Morari 4541, Nima Mud 4267 m., Pangur Tso 4437 m., Tso-Nyak 4470 m.
Other Distribution : Central Asia, Siberia, Western States of North America.
25. *Bembidion gagates* Andr.
Localities : Gond 3050 m., Manikaran, Pulga, Keylang 3220 m., Patseo 3300 m., Sumdeo 3300 m., Kulu, Kote, Kangra.
Other Distribution : Upto eastern Kumaon.
26. *Bembidion hasurada* Andr.
Localities : Gulmarg 2800 m., Apharwat 4260, Kangan, Mulbek 4420 m., Pulga, Batote, Raman, Kulu.
Other Distribution : Simla Hills, West Almora, Chakrata.
27. *Bembidion himalayanum* Andr.
Localities : Patseo 3300 m., Kangra, Baijnath, Dharmasala, Triund, Jalori Pass 3280 m.
Other Distribution : Kurram Valley, Tibet.
- *28. *Bembidion hutchinsoni* Andr.
Localities : Kyam 4734 m. (Edge of hot spring).
- *29. *Bembidion irregularae* Net.
Localities : Gond 2440 m., Shaksgan Valley 3962 m., Tarim Basin 4572 m.
- *30. *Bembidion ixion* Andr.
Localities : Matafan 3050 m.
- *31. *Bembidion ladakense* Andr.
Localities : Mulbek 4420 m., Gond 3000 m., Baltal 3000 m., Sumdeo 3300 m., Khalatse 4572 m., Biaho Valley, Bardumul 3362 m.
- *32. *Bembidion ladae* Andr.
Localities : Nima Mud 4267 m., Tso-Morari 4541 m., Salt Lake 3627 m., Leh 3440 m., Mulbek 4420 m., Rango.

- *33. *Bembidion leve* Andr.
Localities : Mulbek 4420 m.
- *34. *Bembidion livens* Andr.
Localities : Khalatse 3048-3657 m.
- *35. *Bembidion luntaka* Andr.
Localities : Suru Basin 3050 m., Shimtsa 3200 m., Karboo, Parkutta, Tolti, Golskardu, Leh 3440 m., Mulbek 4520 m., Nurla, Baltal 3000 m., Sonemarg 3000 m., Nima Mud 4267 m., Keylang 3300 m., Sisu 3300 m., Zingzingbar 4267 m., Olthingtlang 3140 m., Shigar Valley, Juno, Alchori, Kushumul 2440 m.
36. *Bembidion nivicola* Andr.
Localities : Daulad Begaldi near Karakoram Pass 4730 m.
Other Distribution : Mt. Everest Base Camp 4730 m.
37. *Bembidion paniricola* Lutchnik.
Localities : Biaho Valley, Bardumul 3352 m.
Other Distribution : Pamir.
38. *Bembidion petrimagni* Net.
Localities : Deosi, Lal Pani 3962 m., Baltoro 4000-4800 m., Widukas 4327 m.
Other Distribution : Pamir.
- *39. *Bembidion pictum* (Fald.).
Localities : Leh 3440 m., Mulbek 4420 m., Nurla, Baltal 3000 m., Lac Sale 3627 m., Tso-Morari 4541 m., Nima Mud 4267 m.
40. *Bembidion pluto* Andr.
Localities : Nima Mud 4267 m., Tso-Morari 4541 m., Salt Lake 3627 m., Leh 3440 m., Tangyar 4430 m., Lukung 4267 m., Igu 3637 m.
Other Distribution : Kumaon.
41. *Bembidion satanas* Andr.
Localities : Goorais Valley 2133 m., Gulmarg 2590 m., Liddar Valley 2743 m., Gond, Kolahoi 3360 m.
Other Distribution : Chitral.
42. *Bradytus apricarius* (Payk.)
Localities : Sind Valley, Sonemarg 3000 m., Dras 3100 m., Kargil 2740 m., Leh 3440 m.
Other Distribution : Between Sirikol and Panga, Canada, President Range (America).
- *43. *Calathus kollari* Putz.
Localities : Sumdeo 3400 m., Pulga, Manikaran, Tchary-Djoni 3200 m., Bajaura, Kulu, Kote, Kandy, Baltal 3000 m.
- *44. *Calosoma maderae europunctatum* (Herb.)
Localities : Kulu, Sumdeo 3400 m., Patseo 3300 m., Keylang 3200 m., Cimuc 3300 m., Rohtang Valley 3900 m., Chamba, Sonemarg, Kogyar, Sind Valley, Dras 3100 m., Kargil 2740 m., Leh 3440 m.

45. *Calosoma maderae indicum* Hope
 Localities : Pulga, Tho-ti 3200 m., Manikaran, Gond, Srinagar.
 Other Distribution : Peshawar, Taru, Kohat, Calcutta, Pusa (Bihar),
 Chapra, Dehra Dun.
46. *Calosoma maderae kashmirensis* Breun.
 Localities : Kashmir, Kulu, Rohtang Valley 3900 m., Sumdeo 3300 m.
 Other Distribution : Tibet 4000 m.
47. *Clivina tenuelimbatus* Ball.
 Localities : Goorais Valley, Leh 3440 m.
 Other Distribution : Turkestan.
- *48. *Carabus (Imaibius) barysonus* (Bates)
 Localities : Goorais Valley, Pir Panjal, Batote 2440-3050 m., Hazara,
 Lower Kagan Valley, Shran.
49. *Carabus (Imaibius) boysi* Tatum.
 Localities : Sonemarg 3000 m., Kulu, Kani, Chamba, Pulga, Tchary-Djoni
 3200 m., Tsho-ti 3200 m.
 Other Distribution : Simla, Garhwal, Mundali, Dgoban, Bodyar, West
 Almora, Dhudatoli and Sundardhunga Valley.
- *50. *Carabus (Imaibius) dardiellus granulisparsus* Bates.
 Localities : Goorais Valley, Pir Panjal south of Srinagar 2440-3050 m.,
 Jhelum Valley, Gulmarg 2750 m.
- *51. *Carabus (Imaibius) epipleuralis* Sem.
 Localities : Mountains west of Pir Panjal and north of Poonch 3000-
 3500 m.
- *52. *Carabus (Imaibius) rostianus* Sem.
 Localities : North-east of Islamabad 1828 m., Songam Dusu, south-east
 of Islamabad 1828-3050 m., Liddar Valley, Tanin 2750 m.
53. *Carabus (Imaibius) stoliczkanus* Bates
 Localities : Mountains west of Pir Panjal 1820-3050 m., Murree.
 Other Distribution : Campbellpore.
- *54. *Chaetobrosicus anomalus* (Chaud.)
 Localities : Sisu 3200 m., Rohtang Valley 3900 m., Shishramnag 3657 m.,
 Khilanmarg 3050 m., Lidarwat 2750 m., Jalori Pass 3300 m., Tragbal Pass
 3300 m., Chamba, Dalhousie.
55. *Chlaenius caeruleus* (Stey.)
 Localities : Mulbek 4420 m., Goorais Valley, Srinagar, Sergj.
 Other Distribution* : Baluchistan, Armenia, S. Russia.
- *56. *Chlaenius tenuelimbatus* Ball.
 Localities : Leh 3440 m.
- *57. *Cymindis altica* Gebl.
 Localities : Between Dras and Leh 3100-3440 m.
- *58. *Cymindis babaulti* Andr.
 Localities : Leh 3440 m.

59. *Cymindis championi* Andr.
Localities : Tso-Nyak 4357 m.
Other Distribution : Northern Kumaon, Tibet.
- *60. *Cymindis glabrella* Bates
Localities : Baltal 3000 m., Ladakh 3200 m.
- 61. *Cymindis mannerheimi* Gebl.
Localities : Baltal 3000 m., Mulbek 4520 m., Pangong Valley 4267 m.,
Tangyar 4470 m.
Other Distribution : Pamir, Tarabagtai Mountains, Issyk-kul, all central
Asia.
- *62. *Cymindis rubriceps* Andr.
• Localities : Anem La 5181 m.
- *63. *Dyschirius ladakensis* Andr.
Localities : Ladakh 3500 m.
- *64. *Harpalus amarellus* Bates
Localities : *Kangra, Bajaura, Mandi, Naggar, Cimur 3300 m., Keylang
3200 m., Sumdeo 3300 m., Sisu 3200 m.
65. *Harpalus melaneus* Bates
Localities : Baltal 3000 m., Sonemarg, Rohtang Valley 3900 m., Kote,
Pulga, Sumdeo 3300 m., Zingzingbar 4267 m., Patseo 3770, Sisu 3200 m.,
Keylang 3300 m. Gondhla 3200 m., Cimur 3300 m., Chamba, Murree,
Dalhousie.
Other Distribution : Mundali, Dehra Dun, Almora.
66. *Harpalus quadricollis* (Redt.)
Localities : Sisu 3200 m., Zingzingbar 4267 m., Patseo 3770 m., Sumdeo
3300 m., Keylang 3300 m., Pulga, Baltal.
Other Distribution : Rawalpindi, Kumaon.
67. *Hypsinephus ellipticus* Bates
Localities : Baltal 3000 m., Pangong Valley 4267 m.
Other Distribution : Supi River (Tibet).
- *68. *Leistus nivium* Andr.
Localities : Dusu, Sintan Pass 3000 m.
69. *Liocnemis himalaica* Bates
Localities : Sumdeo 3200 m., Sonemarg 3000 m.
Other Distribution : W. Almora.
- *70. *Metabletus tartarus* Bates
Localities : Patseo 3770 m., Sind Valley.
71. *Nebria limbigeræ* Solsky
Localities : *Tso-Morari 4541 m., Nima Mud 4267 m., Zingzingbar 4267 m.,
Mulbek 4420 m., Kargil 2740 m.
Other Distribution : Kumaon, Turkestan, Kokand, Alai Mountains, Pamir,
China : Monpin.

- *72. *Nebria limbigera babaulti* Andr.
Localities: Baltal 3000 m., Mulbek 4420 m.
73. *Nebria (Patronebria) himalayica* (Bates)
Localities: Goorais Valley, Skardu 3000 m., Parbati Valley, Bashahr (Poo).
Other Distribution: Almora, Milam in Gori Valley, 3500 m., Khedar Khud (Chakrata Division).
- *74. *Pardileus indicus* (Bates)
Localities: Pulga, Tsho-ti, Tehary-Djoni 3200 m., Bajaura, Kulu, Kandi, Kangra.
75. *Phaeropsophus catoirei* (Dej.)
Localities: Bajaura, Kulu, Naggur, Mandi, Gharry, Baltal 3000 m.
Other Distribution: Ceylon, Burma, Andaman Island.
76. *Phaeropsophus consularis* (Schm. & Boeb.)
Localities: Gharry 3000 m., Kangra.
Other Distribution: Dehra Dun, Ranikhet, Chhota Nagpur, Konbir, Chapra, Sardah, Dacca, Assam, Silonibari, Sibsagar, Siliguri, Surada, Karen Hills, Bhamo.
- *77. *Phaeropsophus stenoderus* Chaud.
Localities: Gharry 3000 m., Bajaura.
78. *Pristonychus kashmirensis* Bates
Localities: Goorais Valley, Liddar Valley, Khilanmarg 4000 m., Gulmarg 2750 m., Sintan, Pir Panjal, Upper Mundag, Kulu.
Other Distribution: Simla.
- *79. *Pristonychus kashmirensis babaulti* Andr.
Localities: Tsho-ti, Tehary-Djoni 3200 m., Pulga, Sisu 3200 m., Gondhla 3200 m., Keylang 3300 m., Sumdeo 3300 m. Rohtang Valley 3900 m., Kote, Kandy, Sonemarg 3000 m.
80. *Scarites praedator* Chaud.
Localities: Gharry, Baltal 3000 m., Sonemarg 3000 m.
Other Distribution: Sikkim, Assam, Bangla, Bihar, Orissa, Punjab, Bombay, Kodaikanal, Nilumbur, Burma, Rangoon.
81. *Tachys octostriatus* Net.
Localities: Sind Valley, Kangan, Suru Basin 3000 m., Kargil 2740 m.
Other Distribution: Sangla 2440 m., (east of Sutlej Valley in Bashahr).
82. *Trechus cameroni* Jeann.
Localities: Rohtang Pass 4150 m., Jalori Pass 3280 m.
Other Distribution: Simla Hills, Narkanda 2800 m., Throch 3050 m.
- *83. *Trechus cameroni bistriatus* Jeann.
Localities: Kareri Lake 3050 m.
84. *Trechus indicus championi* Jeann.
Localities: Pulga, Cimur 3300 m., Baltal 3000 m., Sonemarg 3000 m., Dharamsala, Mandi.

Other Distribution : Simla, Darjeeling, Gopalda, Ranikhet, Nainital, Almora, Sikkim, Gumti Valley.

*85. *Trichocellus roborowskii* Tchitch.

Localities : Baltal 3000 m., Leh 3440 m., Lac Sale, Nima Mud 4267 m.

Dytiscidae

86. *Dytiscus nitidus* Fab.

Localities : Dras 3100 m., Kargil 2740 m., Leh 3440 m.

Other Distribution : Central Europe.

*87. *Coelambus flaviventris* Motsch.

Localities : Thongmon Tso above 4000 m.

88. *Potamonectes (Potamonectes) griseostriatus* Deg.

Localities : Kashmir, Ladakh, Digar Polu 3960 m., Kangral, Spring below Fotu La, Chushul 4340 m., Tso Kar 4527 m., Ghulam Bagh, Pangong Valley.

Other Distribution : East Europe, Siberia, N. America.

*89. *Agabus (Anagabus) jucundus* Guignot

Localities : Kargil about 3000 m.

*90. *Agabus (Dichonectes) nitidus* F.

Localities : Sonemarg 3000 m., Dras 3100 m., Kargil 2740 m., Nima 4267 m., Digar Polu 3960 m., Bao-Shaple 4570 m.

*91. *Agabus (Gaurodytes) adustus* Guignot

Localities : Chushul 4336 m.

92. *Rahntus pulverosus* Steph.

Localities : Ladakh, Sonemarg 3000 m., Kangan, Ghulam Bagh, Srinagar.

Other Distribution : Europe, North Africa, Asia, Australia, Sunda Isles.

Hydrophilidae

93. *Helophorus (Atractelophorus) frater* d'Orch.

Localities : Kashmir, Tso-Morari 4541 m.

Other Distribution : Laptel, 4572 m., border of Tibet and Kumaon, Sangehar 4724 m.

94. *Helophorus (Helophorus) splendidus immaensis* d'Orch.

Localities : Bai 4616 m., Kyam (Valley of R. Chang Chenmo) 4725 m., Sta-Ask-puk-Tso (Tso Bar) 4538 m.

Other Distribution : Central Tibet : Phar, Kampe, Dshong 4420 m., Lingka 4420 m., Tingri 4572 m.

95. *Helophorus (Atractelophorus) montanus* d'Orch.

Localities : Fotu La 3720 m.

Other Distribution : Western Tibet : Sulphur spring of Lake Mangzka 5400 m., central Tibet : Tingri 4572 m., Lingka and Shekka 4420 m., Gyangse 3962 m., Tibet-Kumaon-Border Laptel 4572 m., outside Tibet also from Aulie Ata on Syr-Daya.

96. *Helophorus* (*Lihelophorus*) *ser* Zaitzera
 Localities : Kyam in Chang Chenmo Valley 4725 m., Chushul south of Pongong Tso 4300 m.
 Other Distribution : Western Tibet : 50 kilometres east of Pongong Tso. Central Tibet : 4863 m., Eastern Tibet : The region of Kuku-Nor, Mang Tso 4429 m.
- *97. *Helophorus* (*Meghelophorus*) *aquaticus* Linn.
 Localities : East of Mugleb and between Mugleb and Tanktze 4175 m., north of Pongong Tso.
98. *Hydrous pallidipalpus* M'Leay
 Localities : Kashmir 3000 m.
 Other Distribution : Tibet 3900 m., Burma, China, Japan, Formosa, Sumatra and Java.
99. *Laccobius* (*Laccobius*) *hingstoni* d'Orch.
 Localities : Chushul south of Pongong Tso 4336 m.
 Other Distribution : C. Tibet : Kampa, Dshong 3200 m., Tingri 4572 m.

Histeridae

- *100. *Hister indicola* Desb.
 Localities : Pulga, Kulu, Kandi, Keylang 3300 m., Sumdeo 3300 m., Sisu 3200 m.
101. *Hister pullatus* Erich.
 Localities : Manikaran, Gharry about 3000 m.
 Other Distribution : Badia, Bilaspur, Dahora.

Staphylinidae

102. *Aleochara* (*Coprochara*) *bilineata* Gyll.
 Localities : Tsak Shang above Tso-Morari 4870 m.
 Other Distribution : Chakrata, Dehra Dun, Simla Hills, Europe, Caucasus.
103. *Aleochara* (*Mesochara*) *inornata* Cam.
 Localities : Jalori Pass 3300 m.
 Other Distribution : Chakrata, Deoban, Dehra Dun, Kumaon, Nainital, West Bhalkot.
- *104. *Atheta* (*Acrotona*) *fungi kashmirensis* (Gr).
 Localities : Askole (Braldo Valley) 3100 m., Shimtsa (Punmah) 3200 m.
- *105. *Atheta* (*Acrotona*) *inequalata* Cam.
 Localities : Gulmarg 3050 m.
- *106. *Atheta* (*Aloconota*) *iguensis* Cam.
 Localities : Igu 3380 m.
- *107. *Atheta* (*Aloconota*) *morosa* Cam.
 Localities : Gulmarg 3050 m.

- *108. *Atheta (Bessobia) submetallica* Cam.
Localities : Tsak-Shang 4870 m.
- *109. *Atheta (Datomicra) sordiduloides* Cam.
Localities : Gulmarg 3050 m.
- *110. *Atheta (Datomicra) subarenicola* Cam.
Localities : Gulmarg 3050 m.
111. *Atheta (Dimetrota) adjacens* Cam.
Localities : Gulmarg 3050 m.
Other Distribution : Kotgarh, Narkanda.
- *112. *Atheta (Dimetrota) associata* Cam.
Localities : Gulmarg 3050 m.
- *113. *Atheta (Dimetrota) hutchinsoni* Cam.
Localities : Marsimik La 5600 m., Ororotse 5300 m.
- *114. *Atheta (Dimetrota) nigrans* Cam.
Localities : Gulmarg 3050 m.
- *115. *Atheta (Dimetrota) suballocera* Cam.
Localities : Gulmarg 3050 m.
116. *Atheta (Liogluta) subumbonata* Cam.
Localities : Gulmarg 3050 m.
Other Distribution : Chakrata, Deoban 2800 m.
- *117. *Atheta (Microdota) amiculoides* Cam.
Localities : Gulmarg 3050 m.
- *118. *Atheta (Microdota) gracillima* Cam.
Localities : Gulmarg 3050 m.
- *119. *Atheta (Microdota) ladakiana* Cam.
Localities : Tsak-Shang, above Tso-Morari 4870 m.
- *120. *Atheta (Microdota) subluctuosa* Cam.
Localities : Gulmarg 3050 m.
- *121. *Atheta (Oreostibia) nimbicola* Cam.
Localities : Apharwat 3960 m., Gulmarg 2743 m.
- *122. *Atheta nigrolucens* Cam.
Localities : Gulmarg 3050 m.
- *123. *Atheta (Paraloconota) jaloriensis* Cam.
Localities : Jalori Pass 3280 m., Bhabu Pass 2743 m.
- *124. *Atheta (Paraloconota) musicola* Cam.
Localities : Gulmarg 2433 m., Khilanmarg 3050 m., Kulu, Naggar.
125. *Atheta triangulum* (Kr.)
Localities : Gulmarg 2433-3050 m.
Other Distribution : Simla Hills, Gahan, Europe, Asia Minor.

- *126. *Geodromicus affinis* Cam.
Localities : Kargil about 3000 m.
- *127. *Lesteva karglensis* Cam.
Localities : Kargil about 3000 m.
- *128. *Ocyusa (Cousya) quadrisulcata* Bernh.
Localities : Baltora, Mondu 4300 m., Urdukas 4000 m., Lopsang Bransa 4500 m., Liligo 3800 m., Biaho-tal, Paju 3400 m.
129. *Oxypoda (Podoxya) nigrita* Cam.
Localities : Jalori Pass 3280 m., Jibhi, Seraj 1828 m., Gulmarg.
Other Distribution : Kumaon, Chakrata, Simla Hills.
- *130. *Philonthus diversus* Schub.
Localities : Sintan, Shishram Nag, Liddar Valley 3657 m.
- *131. *Philonthus himalayicus* Bernh.
Localities : Kulu 3050 m.
- *132. *Pseudoocyusa kashmirica* Cam.
Localities : Gulmarg, Khilanmarg 3050 m.
- *133. *Tachinus beesoni* Cam.
Localities : Khilanmarg 3352 m.

Cantharidae

134. *Cantharis biocellata* Fair.
Localities : Karakoram 4000 m.
Other Distribution : Tibet 3900 m., North India, Hindukush.

Meloidae

135. *Mylabris phalerata* (Pall.)
Localities : Lakka Pass 3657 m., Dharmsala, Dalhousie, Kulti Nal 3657 m.
Other Distribution : Throughout India.

Elateridae

136. *Comsolacon aequalis* Cand.
Localities : Kashmir 3352 m.
Other Distribution : Wama (Afghanistan).

Coccinellidae

137. *Coccinella septempunctata* Linn.
Localities : Throughout Himalaya up to 4270 m.
Other Distribution : India, Europe.

138. *Thea bisoetonata* Muls.

Localities : Dhaula Dhar 4270 m.

Other Distribution : Indian plains, Egypt, Eritrea, Arabia, Palestine, Cape Verde Isles.

Tenebrionidae

*139. *Ascelosodis assimilis* Bates

Localities : Dras 3100 m., Kargil 2740 m., Leh 3440 m.

*140. *Ascelosodis ciliatus* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*141. *Ascelosodis grandis* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*142. *Ascelosodis intermedius* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*143. *Bioramix ovalis* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*144. *Bioramix puncticeps* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*145. *Blaps ladakensis* Bates

Localities : Tangtze to Chagra, Pangong Valley 4267 m.

*146. *Blaps perlonga* Bates

Localities : Tangtze to Chagra, Pangong Valley 4267 m.

*147. *Chianalus costipennis* Bates

Localities : Dras, Kargil, Leh, 3000-3450 m.

*148. *Cyphogenia plana* Bates

Localities : Dras, Kargil, Leh 3000-3450 m., Pangong Valley 4267 m.

149. *Myatis quadraticollis* Bates

Localities : Between Leh and Yarkand.

Other Distribution : Yarkand.

*150. *Opatrum ochthebiodes* Fauvel

Localities : Dras, Kargil, Leh, 3000-3450 m.

*151. *Prosodes trisulcata* Bates

Localities : Dras, Kargil, Leh 3000-3450 m.

*152. *Syachis ajmonis* Bates

Localities : High valleys of Kashmir, Dras, Kargil, Leh, 3000-3450 m.

*153. *Syachis cygiae* Gridelli

Localities : High valleys of Kashmir, 3000-3450 m.



- *154. *Syachis himalaicus* Bates
Localities : Dras, Kargil, Leh 3000-3450 m.
- *155. *Syachis picicornis* Bates
Localities : Dras, Kargil, Leh 3000-3450 m.

Scarabaeidae

156. *Onthophagus gibbosus* (Scriba)
Localities : River Sutlej, Tibet-Indian frontier, 3050 m.
Other Distribution : Turkestan, Persia, Asia Minor, Europe.
157. *Onthophagus sutlejensis* Splich.
Localities : Rajpur, Rampur, River Sutlej, Indian-Tibet frontier 3050 m.,
Bashahr.
Other Distribution : Wama, Nuristan (Afghanistan).
158. *Onthophagus tibetanus* Arrow
Localities : Khilanmarg 3050 m.
Other Distribution : Chaksam (Tibet) 3657 m., Brāhmaputra Valley,
Gyangtse 3962 m., U.P. : Dhauliganga Valley, Almora 3220 m.

Geotrupidae

- *159. *Geotrupes kashmirensis* Sharp
Localities : Dras, Kargil, Leh 3000-3450 m.

Aphodidae

- *160. *Aphodius kashmirensis* Sharp
Localities : Dras, Kargil, Leh 3000-3450 m.

Rutelidae

- *161. *Adoretus ladakensis* Ohaus.
Localities : Ladakh 3450 m., Murree.
162. *Callistopopillia iris* (Cand.)
Localities : Ladakh 3450 m.
Other Distribution : Tibet, Yatong 3200 m., Sikkim, Kurseong, Mungphu.

Cerambycidae

163. *Apatophysis kashmiriana* Sem.
Localities : Kashmir about 3000 m.
Other Distribution : Punjab, W. Tibet 3900 m.
164. *Clytus monticola* Gahan
Localities : Kashmir about 3000 m.
Other Distribution : W. Tibet 3900 m.

- *165. *Leptura rubriola* Bates
Localities : Murree, Gulberg, Liddar 3350 m.
166. *Purpuricenus montanus* White
Localities : West Kashmir about 3000 m.
Other Distribution : Campbellpore, W. Tibet 3900 m., outer Himalaya.

Chrysomelidae

167. *Galeruca sexcostata* Jacoby
Localities : Liddar 3350 m., Srinagar, Burzil Chauki 3350 m.
Other Distribution : Lahore.
- *168. *Leptosonyx octocostatus* Weise
Localities : Khalatse 4572 m.
169. *Longitarsus cyanipennis* Bryant
Localities : Lahaul 3200 m.
Other Distribution : Kumaon, Surju Valley, Almora 2743 m., Nainital, Darjeeling, Gopaldhara.
170. *Merista quadrifasciata* (Hope)
Localities : Ladakh 3450 m., Kashmir, Kangra Valley 1370 m., Abbottabad, Murree.
Other Distribution : Bhimtal 4500 m., Almora 1670 m., Nainital, Simla, Ranikhet, Muktesar, Jeolikot, Mussoorie, Dehra Dun, Nepal : Gowchar, Gopaldhara, Pharping, Mungphu, Rungbong Valley.

Curculionidae

- *171. *Achlaenomus babaulti* Hustache
Localities : Leh 3450 m., frontier of Tibet, Lac Sale 3657 m., Tso-Morari 4541 m.
- *172. *Achlaenomus squamulosus* Hustache
Localities : Patseo 3400 m., Zingzingbar 4267 m., Sisu 3200 m., Rohtang Valley 3900 m., Kote, Kashmir.
173. *Blosyroides pubescens* Marshall
Localities : Sisu 3200 m., Rohtang Valley 3900 m., Kashmir : Jarji 3410 m., towards Gilgit.
Other Distribution : Baluchistan.
174. *Blosyroides variegatus* (Redt.)
Localities : Kashmir, Kangra, Bajaura, Tchary-Djoni 3200 m., Pulga, Gond.
Other Distribution : Mussoorie.
- *175. *Calmycterus distans* (Faust.)
Localities : Tchary-Djoni 3200 m., Pulga.
- *176. *Catapionus basilicus* Schnoh.
Localities : Kōty, Gilgit, Tchary-Djoni, 3200 m.

- *177. *Heteronyx ferus* Faust.
Localities : Tchary-Djoni, Tsho-Ti 3200 m., Pulga.
- *178. *Heteronyx ferus loevior* Hustache
Localities : Sisu 3200 m., Rohtang Valley 3900 m.
- *179. *Legenolobus lineolatus* Hustache
Localities : Leh 3450 m., Nima Mud 4267 m., Tso-Morari 4541 m.,
Lac Sale 3627 m., Tibet Frontier.
- *180. *Leptomias marshalli* Hustache
Localities : Gondhla 3200 m., Keylang 3300 m., Sumdeo 3300 m.
- *181. *Leptomias scribeollis* Marshall
Localities : Kashmir, Tchary-Djoni 3200 m., Pulga.
- *182. *Otiorrhynchus ruscicus* Stierill.
Localities : Kashmir about 3000 m.
Other Distribution : Sirikol, Russia : Tchaar-Tasch.
- *183. *Rhyncoius himalayensis* Stebb.
Localities : Tchary-Djoni 3200 m., Manikaran, Bajaura.
- *184. *Scepticus nubifer* Faust.
Localities : Kargil 2740 m., Dras 3100 m., Leh 3450 m., Sisu 3200 m.,
Keylang 3300 m., Pateseo 3400 m., Sumdeo 3300 m., Zingzingbar
4267 m., Baltal 3000 m., Sonemarg, Gond, Rupshu, Tso-Morari 4541 m.
- *185. *Sitones vergicolor* Faust.
Localities : Keylang 3300 m., Sumdeo 3300 m.
- *186. *Sitones callosus* Gyll.
Localities : Gondhla 3200 m.
Other Distribution : Central, South-West Europe, Mediterranean Region,
West and central Asia.

(To be continued)

Flora of District Muzaffarnagar in the Doab of the Rivers Ganga and Yumna

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(With a map)

PHYSICAL FEATURES AND TOPOGRAPHY OF THE AREA

Muzaffarnagar district, situated in the Indo-Gangetic plain in Uttar Pradesh, is bounded by the districts of Saharanpur in the north and Meerut in the south. On the west the River Yumna separates it from Panipat and Thaneshar tehsils of Karnal district (in East Punjab), while on the east the River Ganga separates it from Bijnor district. The main stream of the Ganga flows about 18 miles from the town, touching the boundary of the district at Sukhartal. The doab between these two rivers is served by a network of tributaries of the Ganga, namely the Kalinadi, the Budhiganga, the Solani, and the east Ganga canal.

The area is a plain consisting of recent alluvial deposits with kankar intercalations underneath, and at most places the topmost 'kankar pan' is within 6 ft. (2 m.) of the ground level. The top soil is variable, from sandy to sandy loam and clay.

Erosion along the banks of the Ganga and the Yumna is common. During the monsoons, water collecting and running scores out small gullies. As the ravines unite the intensity of soil erosion increases and, with the increase in the volume of running water, the ravines are dug deeper and wider.

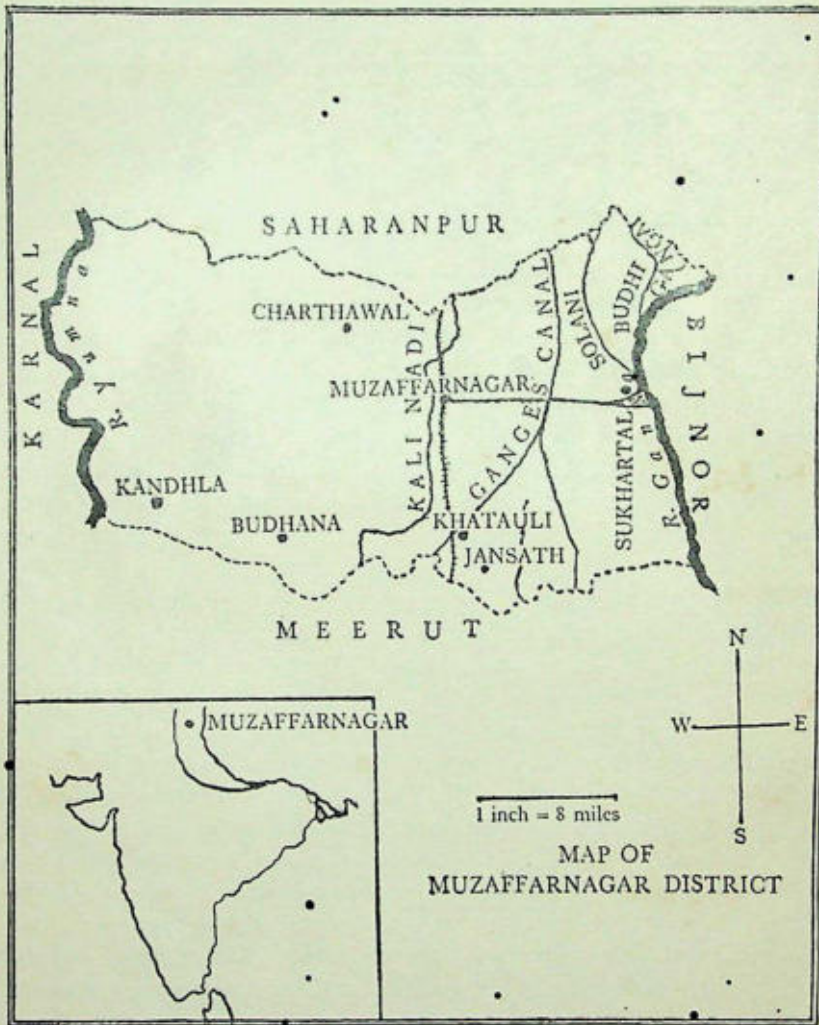
Excessive grazing, heavy human population, and the local agricultural practices, all contribute to the erosion. Low-lying areas, either arising naturally as depressions, eroded gullies, stream beds, and oxbows, or artificially dug pools, puddles, and tanks form a conspicuous aspect of the landscape.

CLIMATE

The climate is dry monsoonic; 760-1015 mm. of the precipitation falls during July to September. The mean annual temperature is about

¹ Present address: French Institute, Pondicherry.

24° C.; the maximum during the summer may rise to 46° C., the minimum may touch freezing point. *Loo* (hot wind) is prevalent during summer, in the greater part of May and June, till the break of the rains. Occasional frosts occur during winter.



• • VEGETATION

With the increase of population and consequent increase of cultivation, only a few areas exist where natural vegetation can be seen; these are the Ganga 'Khadars' and 'Kholas', and the ravines of the Yumna and Ganga.

The 'Khadars' are the low-lying water-logged areas along the banks of the Ganga. The natural vegetation comprises *Tamarix* sp., with occasional patches of *Butea monosperma* (Lamk.) Taub. mixed with *Phoenix* sp. The 'Kholas' run adjacent to the 'Khadars' with occasional trees of *Salmalia malabarica* Schott. & Endl. and undergrowth of *Adhatoda vasica* Nees, *Carissa spinarum* A. DC., and *Capparis decidua* (Forsk.) Pax; the ravines along the rivers Yumna and Ganga in moist localities have *Acacia arabica* Willd., *Prosopis spicigera* L., with shrubs of *Capparis decidua* (Forsk.) Pax, *Capparis zeylanica* L., *Adhatoda vasica* Nees, and *Carissa spinarum* A. DC. On the low 'usar' land, shrubs of *Calotropis procera* R.Br. with scattered trees of *Acacia arabica* Willd., *Butea monosperma* and *Azadirachta indica* A. Juss. can be seen. At some places trees are entirely absent and only few stunted grasses exist. On sandy and badly-drained soils one may find stunted trees of *Butea monosperma*. Where soil conditions are better *Acacia arabica* Willd. and *Dalbergia sissoo* Roxb. are present along the banks of the east Ganga canal.

Along the banks of the Ganga *Phoenix sylvestris*-*Butea monosperma* association is frequent and, if unhampered by biotic and edaphic factors, may pass to *Dalbergia sissoo*-*Acacia arabica* association. On the ravines in barren lands the first species to occur are the grasses, and as the soil and moisture conditions improve other plants, such as *Carissa spinarum* A. DC., *Adhatoda vasica* Nees, *Prosopis spicigera* L., and *Acacia arabica* Willd. occur.

Dudgeon (1920), while discussing the ecology of the Upper Gangetic Plain, distinguished four types of topographic succession, showing a developmental tendency to the climatic types. Since the distribution of rainfall and temperature during the year produce distinct climatic seasons, the physiological responses of the plants to the climate are well marked and have been described for the Gangetic Valley by Misra (1946), Verma (1936), Puri (1957), and others.

During the rainy season (July-September) the vegetation is luxuriant everywhere, and a closed community of *Boerhavia diffusa* L., *Indigofera enneaphylla* L., *Cynodon dactylon* Pers., *Evolvulus alsinoides* L., *Convolvulus pluricaulis* Chois., and *Justicia simplex* L. are commonly seen on the low-lying lands and cultivated fields. After the rains *Cassia tora* L., *Rungia pectinata* L., *Euphorbia thymifolia* Burm., *Convolvulus arvensis* L., *Vernonia cinerea* Less., *Sida rhombifolia* L., *Heliotropium indicum* L., *Croton bonplandianum* Baill. are most common. On the sides of the pools and puddles, where during the monsoons rain water gets stored, plants like *Cynodon dactylon* (L.) Pers., *Rumex dentatus* L., *Scirpus maritimus* L., *Polygonum plebejum* R.Br. are seen. November to February is the season for the growth of many annual and perennial grasses, but as the temperature decreases the process slows down and,

when a few sporadic showers fall, they stimulate the growth of many winter annuals like *Spergula arvensis* L., *Fumaria indica* Pugsley, *Stellaria media* L., *Capsella bursa-pastoris* Medic., *Senebiera pinnatifida* DC., *Sisymbrium irio* L., *Artemisia scoparia* Waldst. & Kit., *Artemisia parviflora* Roxb., and *Vicoa indica* (Willd.) DC., etc. During March most of the woody plants flower. June is the worst season for the vegetation; annuals die and the flora assumes typical desert aspect, with only a few species consolidating the soil against erosion. Common plants are *Capparis decidua* (Forsk.) Pax, *Capparis zeylanica* L., *Carissa carandas* L., *Prosopis spicigera* L., *Acacia arabica* Willd., *Zizyphus mauritiana* Lamk., *Randia spinosa* Thunb., *Calotropis procera* R.Br., and *Phoenix* sp. Thorny species predominate, affording protection against grazing to the vegetation growing near them.

Vegetation in the monsoon pools shows definite succession from submerged, floating leaf forms to amphibious forms. Common free-floating forms are *Ceratophyllum demersum* L., *Trapa bispinosa* Roxb., *Eichhornia crassipes* Solms., and *Azolla pinnata*. Submerged plants are *Hydrilla verticillata* Royle, *Potamogeton pectinatus* L., *Vallisneria spiralis* L., and *Chara* sp. Common fixed aquatic plants include *Typha elephantina* Roxb., *Ranunculus sceleratus* L., *Scirpus maritimus* L., *Polygonum glabrum* Willd., etc. During summer months the water dries up and mud communities develop in the centre of these pools.

LIST OF PLANTS COLLECTED

The following is a list of the plants collected from the area, arranged according to Bentham & Hooker's system of classification. Where nomenclatural changes have been made, the correct name is given first, then the name given in Duthie's FLORA OF THE UPPER GANGETIC PLAIN AND OF THE ADJACENT SIWALIK AND SUB-HIMALAYAN TRACTS (1903-1920). The numbers given after the plants refer to collections made by the author. Plants marked with an asterisk have not been mentioned by Duthie in his FLORA. Some of these plants have been recently reported by Sri M. B. Raizada (1931-1958); they are really exotics but have now become completely naturalised in the area.

Ranunculaceae

Ranunculus sceleratus Linn.

Erect annual with pale yellow flowers, near water streams and moist places. (Gupta 116, 148D, 357, 358)

Menispermaceae

Cissampelos pareira Linn.

Lofty climber, flowers green. May-August. (Gupta 554)

Nymphaeaceae

Nymphaea stellata Willd.

Aquatic herb with white flowers. August-October. In ponds throughout the district. (Gupta 641)

Nelumbo nucifera Gaertn.

Aquatic herb with rosy-red flowers. Cultivated in tanks near the temples.

Papaveraceae

Argemone mexicana Linn.

Prickly annual with yellow flowers. March-May; in waste places and roadsides. (Gupta 170, 342)

Fumariaceae

Fumaria indica Pugsley. (*F. parviflora* Lamk.)

Pale green diffuse herb with rose coloured flowers. January-March; in fields and moist shady places. (Gupta 50, 344, 345)

Cruciferae

Capsella bursa-pastoris Medic.

Annual with white flowers. July-August; in fields and moist places. (Gupta 353)

Senebiera pinnatifida DC. (*S. didyma* Pers.)

Annual, leaves pinnatifid with strong smell when bruised. Flowers white, petals dissimilar. January-March; on moist places. (Gupta 350)

Sisymbrium irio Linn.

Annual; flowers yellow. January-March. (Gupta 355)

Sisymbrium thalianum Gay & Monn.

Annual, flowers white. January-March; it is reported to occur between 5000 and 10,000 ft. (1525 to 3050 m.) by Hooker but seems to have come down recently.

Capparidaceae

Capparis decidua (Forsk.) Pax. (*Capparis aphylla* Rgh)

Much-branched shrub. Flowers red-brown. April-July; in waste places and ravines of the Yumna and Ganga. (Gupta 346, 347)

Capparis zeylanica Linn. non Hk. f. & Th. (*C. horrida* Linn. f.)

A shrub with stout recurved thorns. Flowers white. Common on roadsides and fallow fields.

Cleome viscosa Linn.

Annual; flowers yellow. July-September; in waste places. (Gupta 522)

Gynandropsis gynandra (L.) Briq. (*G. pentaphylla* DC.)

Glandular pubescent herb, flowers purplish yellow. July-September; in waste places. Leaves have peculiar smell. (Gupta 154, 349, 426)

Caryophyllaceae

Stellaria media Linn.

Annual, flowers white, star-like; in cymes. February-April; in moist places. (Gupta 315)

Silene conoidea Linn.

Glandular pubescent annual, flowers pink. February-March. (Gupta 180)

Dianthus chinensis Linn.

Perennial herb, flowers solitary, terminal. February-March. (Gupta 553)

Saponaria vaccaria Linn.

Annual decumbent herb, flowers white. February-April; in fields. (Gupta 318)

Arenaria serpyllifolia Linn.

Annual decumbent herb, flowers white. February-April. (Gupta 317)

Spergula arvensis Linn.

Annual with linear subulate leaves in whorls, looking like that in *Chara* sp., flowers white. January-March; in moist places. (Gupta 321)

Polycarpaea corymbosa Lamk.

Annual or perennial herb with white flowers. August-November, in cultivated fields. (Gupta 642)

Portulacaceae

Portulaca quadrifida Linn.

Annual, flowers yellow, solitary terminal. (Gupta 554)

Tamaricaceae

Tamarix dioica Roxb.

Small tree with pink flowers. Near the east Ganga Canal and elsewhere near water.

Malvaceae

Sida acuta Burm.

Undershrub with yellow flowers. September-October; on roadsides and waste places. (Gupta 335)

Sida cordifolia Linn.

Erect undershrub, flowers yellow. August-September; on roadsides. (Gupta 333)

Sida rhombifolia Linn.

Erect undershrub, leaves rhomboid, flowers yellow. September-October. (Gupta 324)

Malvastrum coromandelianum (L.) Garcke. (*M. tricuspidatum* A. Gray)

Erect herb, flowers yellow. September. (Gupta 473)

Urena lobata Linn.

Erect undershrub, flowers pink. August-September. (Gupta 337, 340 432A)

Malva parviflora Linn.

Spreading annual, flowers pale pink. May-June. (Gupta 330, 331)

Abutilon indicum G. Don.

Annual, flowers yellow, opening in the evening only. March-September. (Gupta 338, 462A)

Abutilon polyandrum W. & A.

Densely pubescent annual, flowers orange-yellow. September-December. (Gupta 329)

Hibiscus vitifolius Linn.

Annual, leaves 3-5 lobed, flowers yellow, with purple spot. Cultivated. (Gupta 341)

Bombacaceae

Salmalia malabarica Schott. & Endl. (*Bombax malabaricum* DC.)

Large tree with spreading branches and red crimson flowers. January-March.

Sterculiaceae

Firmiana fulgens (Wall. ex Mast.) Corner. (*Sterculia fulgens* Wall. ex Mast.)

Small tree, flowers covered with yellowish down. Cultivated. (Gupta 61)

Sterculia villosa Roxb.

Tree with velvety leaves, cultivated. (Gupta 463)

Tiliaceae

Grewia subinaequalis Wall. (*G. tiliaefolia* Vahl.)

Tree with purplish branches and feather-veined leaves. Drupe small. Flowers March-May. (Gupta 480)

Corchorus aestuans Linn. non Forsk. (*C. acutangulus* Lamk.)

Annual herb, flowers yellow. August-September; in waste places. (Gupta 421, 454A)

Corchorus olitorius Linn.

Annual, flowers yellow. August-September. (Gupta 555)

Triumfetta bartramia Linn. (*T. rhomboidea* Jacq.)

Suffruticose annual, flowers yellow. August-September. (Gupta 336)

Zygophyllaceae

Tribulus terrestris Linn.

Annual prostrate herb, flowers yellow. May-July. Cocco with two long and two short spines. In waste places and along railway lines. (Gupta 446)

Geraniaceae

Oxalis repens Thunb. (*O. corniculata* Linn.)

Perennial herb, flowers yellow. March-April. (Gupta 556)

**Oxalis latifolia* H.B.K.

Erect herb, flowers pink. May-July. (Gupta 440D)

Impatiens balsamina Linn.

Herb, flowers pink. August-September. (Gupta 557)

Rutaceae

Murraya paniculata Jacq. (*M. exotica* Linn.)

Shrub, flowers white. August-September. (Gupta 466)

Murraya koenigii Spreng.

Strongly scented shrub, flowers white. April-May. (Gupta 558)

Aegle marmelos Corr.

Small tree with greenish-white, sweet scented flowers. Wild and also cultivated for the fruits and leaves.

Meliaceae

Azadirachta indica Juss. (*Melia azadirachta* Linn.)

A large tree commonly seen on the roadside. Flowers white.

Rhamnaceae

Zizyphus mauritiana Lamk. (*Z. jujuba* Lamk. non Mill.)

Trees or shrubs, flowers greenish yellow. September; on ravines. (Gupta 167, 185)

Zizyphus xylopyra Willd.

Straggling shrub, flowers greenish yellow. April-May. (Gupta 559)

Sapindaceae

Dodonaea viscosa Linn.

Evergreen shrub. Cultivated as hedge plant. (Gupta 208)

Anacardiaceae

Mangifera indica Linn.

A large tree with yellow, odorous flowers. Common on roadsides and in gardens. (Gupta 508)

Leguminosae

Crotalaria medicaginea Lamk.

Diffuse perennial herb, flowers yellow. April-September. (Gupta 284, 328)

Crotalaria mysorensis Roth.

Densely silky perennial herb, flowers yellow. July-September. (Gupta 290, 313)

Crotalaria juncea Linn.

Shrub, flowers bright yellow. Cultivated for the fibre, sometimes wild also. (Gupta 264)

Melilotus indica All. (*M. parviflora* Desf.)

Annual, flowers pale yellow. March-April. (Gupta 273, 296, 308)

Melilotus alba Lamk.

Annual, flowers white. October-December; in shady places. (Gupta 178, 272)

Medicago lupulina Linn.

* Herb, flowers yellow. January-February.

**Medicago sativa* Linn.

Herb, branched copiously, flowers yellow. June-July. (Gupta 281)

Desmodium gangeticum DC.

Undershrub, flowers whitish. June-July; in moist places. (Gupta 280, 434A)

**Desmodium floribundum* G. Don.

* Undershrub, flowers lilac. July-August. (Gupta 294)

Dalbergia sissoo Roxb.

Erect tree with roundish 3-5 leaflets, flowers yellowish. March-May. (Gupta 266)

Dolichos lablab Linn.

Annual twiner, flowers reddish. Cultivated for the pod. (Gupta 301)

Alysicarpus rugosus DC.

Annual, flowers flesh-coloured. August-September. (Gupta 428)

Alysicarpus hupleurifolius DC.

Annual, flowers pink. August-September. (Gupta 265)

Lathyrus aphaca Linn.

Annual herb with abortive leaflets, flowers yellow. March-April. (Gupta 177, 304)

Lathyrus sativus Linn.

Annual, flowers reddish purple. January. (Gupta 168, 302)

Abrus precatorius Linn.

Climber with reddish flowers in racemes. August-September. (Gupta 560)

Sesbania bispinosa (Jacq.) W.F. Wight. (*S. aculeata* Pers.)

Annual shrub with pale yellow flowers, standard dotted with red. December-February. (Gupta 173A)

**Sesbania sesban* (L.) Merr. (*S. aegyptiaca* Poir.)

Perennial soft-wooded shrub, flowers pale yellow, tinged with red. December-February. (Gupta 28, 285, 311A)

Ternstroemia labialis Spreng.

* Climber with reddish flower. (Gupta 262)

Cajanus cajan (L.) Mill. (*C. indicus* Spreng.)

Erect shrub with yellow flowers. Cultivated for the pulse obtained from the seeds. (Gupta 288, 295, 310, 312)

Phaseolus mungo Linn.

Sub-erect annual, clothed densely with loose deflexed hairs, flowers yellow. Cultivated. (Gupta 301)

Clitoria ternatea Linn.

Climber, flowers bright blue, with orange centre. September-October. (Gupta 271)

Tephrosia purpurea Pers.

Sub-erect perennial shrub, flowers red-purple. July-September (Gupta 404)

Vicia tenera Grah.

Climber, flowers pale yellow. March-April. (Gupta 156)

Vicia sativa Linn.

Annual sub-erect herb, flowers red-blue. Cultivated. (Gupta 286, 300)

Atylosia scarabaeoides Benth.

Twiner, flowers yellow. August-September. (Gupta 267)

Trifolium repens Linn.

Trailing herb, flowers white in globose heads. March-July. (Gupta 269, 282)

Butea monosperma (Lamk.) Taub. (*Butea frondosa* Koen. ex Roxb.)

An erect tree, commonly seen as scrub on sandy and badly drained soils throughout the district. Flowers yellow; February-May.

Indigofera enneaphylla Linn.

An annual, much-branched, spreading herb with small red flowers. July-October. Common on grassy areas.

Trigonella foenum-graecum Linn.

An annual herb with yellow flowers. Cultivated for the leaves, used as pot herb; sometimes found as escape.

Cassia occidentalis Linn.

Diffuse undershrub, flowers yellow, petals with reddish veins. July-September. (Gupta 268, 305, 407, 464)

Cassia sophera Linn.

Diffuse shrub, flowers orange-yellow. July-September. (Gupta 274, 277, 287)

Cassia tora Linn. (*C. obtusifolia* Linn.)

Gregarious annual with orange-yellow flowers. July-August. (Gupta 561)

Cassia mimosoides Linn.

Diffuse perennial, flowers yellow. July-August. (Gupta 260, 297)

Cassia javanica Linn.

Shrub, flowers yellow. Cultivated. (Gupta 212, 311B)

Bauhinia purpurea Linn.

Erect tree, flowers reddish, in terminal corymbs. September-November. (Gupta 261)

Caesalpinia bonducella (L.) Fleming

Prickly shrub, flowers yellow. April-September. (Gupta 270)

Caesalpinia pulcherrima Swartz

Shrub with few prickles, flowers reddish yellow. Cultivated. (Gupta 259)

Prosopis spicigera Linn.

Low prickly tree, flower heads in axillary spikes. July-September. (Gupta 363)

Acacia arabica Willd.

Common spiny tree, flowers yellow. July-September. Common on the ravines and 'usar' lands conserving soil against erosion.

Pithecellobium dulce Benth.

Spiny shrub, flowers yellow. Commonly grown as hedge plant.

Rosaceae

Fragaria indica Andr.

Perennial herb, flowers yellow. June-July. (Gupta 562)

Eriobotrya japonica Lindl.

Large tree with white fragrant flowers; November-January. Cultivated for the fruits.

Combretaceae

Terminalia belerica Roxb.

Tree with flowers in solitary axillary spikes. Cultivated on the roadsides and in avenues.

Terminalia chebula Retz.

Tree with flowers in terminal spikes. Cultivated on roadsides and in avenues.

Quisqualis indica Linn.

A sub-scandent shrub with flowers in short axillary and terminal spikes. The flowers are white when they open, soon becoming red. Monkeys are very fond of the leaves. Cultivated in gardens.

Myrtaceae

Psidium guajava Linn.

Small tree with white flowers. Commonly cultivated in gardens for the fruit.

Syzygium cumini (Linn.) Skeels. (*Eugenia jambolana* Lamk.)

Large tree with a thick and crooked trunk. Cultivated on the roadsides and in avenues for shade and for the fruits.

Lythraceae

Ammannia multiflora Roxb.

Annual herb, flowers in compound peduncled cymes. (Gupta 56)

Lawsonia alba Lamk.

Spinous shrub, flowers white. Cultivated as hedge.

Onagraceae

Trapa bispinosa Roxb.

A floating herb commonly cultivated in tanks for the fruit.

Cucurbitaceae

Melothria maderaspatana Cogn.

Annual herb, flowers yellow. July-August. (Gupta 256)

Coccinia indica Wt. & Arn.

Climber, flowers white. September-December. (Gupta 258)

Trichosanthes bracteata (Lamk.) Voigt. (*T. palmata* Roxb.)

Climber, flowers white. July-August. (Gupta 257)

Brynnopsis laciniosa Naud.

Slender twiner, flowers greenish yellow. September-October. (Gupta 255)

Momordica dioica Roxb.

Climber with yellow flowers. July-August. (Gupta 563)

Ficoideae

Trianthema monogyna Linn.

Prostrate herb. Flower solitary. July-September. (Gupta 307)

Umbelliferae

Centella asiatica (L.) Urb. (*Hydrocotyle asiatica* Linn.)

Prostrate herb, rooting at the nodes, flowers July-August. (Gupta 564)

Rubiaceae

Wendlandia exserta DC.

Small tree with white fragrant flowers. March-April. (Gupta 468)

Borreria stricta (Linn. f.) Schum. (*Spermacoce stricta* Linn. f.)

Annual erect herb with white flowers. August-September. (Gupta 565)

Borreria hispida (L.) Schum. (*Spermacoce hispida* Linn.)

Annual procumbent herb with white flowers. July-August. (Gupta 209)

Rubia cordifolia Linn. var. *munjista* Miquel.

Perennial climber. Flowers dark red. July-August. (Gupta 566)

**Leptodermis lanceolata* Wall.

Erect shrub with white flowers; cultivated. (Gupta 532)

Oldenlandia diffusa Roxb.

Annual herb with white flowers. July-August. (Gupta 567)

Oldenlandia corymbosa Linn.

Annual herb with white flowers. August-September. (Gupta 568)

Randia spinosa (Thunb.) Poir. (*R. dumetorum* Lamk.)
Large spiny shrub with white flowers. May-June. (Gupta 569)

Hamelia patens Jacq.
Evergreen shrub with reddish flowers. Cultivated in gardens.

Compositae

- *Vernonia cinerea* Less.
Erect herb with pink flowers. March-April. (Gupta 230, 241, 249, 414, 447A)
- Ageratum conyzoides* Linn.
Softly hairy annual with pale blue flowers. March-April. (Gupta 159)
- Erigeron canadensis* Linn.
- Erect annual with flowers having pale rose ligules. August. (Gupta 234)
- **Erigeron linifolius* Willd.
Hairy annual with flower heads having purple ray florets. August. (Gupta 570)
- Blumea membranacea* DC.
Glandular pubescent annual with yellow florets. April-May. (Gupta 235)
- Blumea aromatica* DC.
Aromatic, glandular shrub-like herb with yellow flowers and red pappus. April-May. (Gupta 232, 242, 253, 409)
- Gnaphalium indicum* Linn.
Slender woolly herb with small flower heads in spikes. February-March. (Gupta 245, 247)
- Caesulia axillaris* Roxb.
A semi-aquatic herb with white flowers in compound heads. September-October (Gupta 192, 233, 246, 410)
- Pulicaria crispa* Schultz.
Shrubby perennial with yellow flowers. February-March. (Gupta 221)
- Xanthium strumarium* Linn.
Coarse herb with fruits covered with hooked bristles. August-September. (Gupta 182, 441)
- Siegesbeckia orientalis* Linn.
Pubescent annual with yellow flowers. September-October. (Gupta 572)
- Eclipta prostrata* Linn. (*E. erecta* Linn.)
Strigose slender herb with white flowers. August-September. (Gupta 53, 406)
- *Bidens biternata* (Lour.) Merr. & Sherff.
Erect annual with yellow flowers. August-September. (Gupta 236, 250, 472)
- Tridax procumbens* Linn.
Perennial straggling herb with yellow flowers. April-May. (Gupta 411A)
- **Artemisia scoparia* Waldst. & Kitt.
Herb with yellow flowers. September-October. (Gupta 243)

**Artemisia parviflora* Roxb.

Tall herb with wedge-shaped leaves. Flowers : August-September. Recently come down. (Gupta 573)

Emilia sonchifolia DC.

Slender herb with pinkish-violet flowers. February-March. (Gupta 219, 251)

Launaea nudicaulis Hook. f.

Glabrous perennial with yellow flowers in cold months.

Launaea asplenifolia Hook. f.

Glabrous herb with yellow flowers in cold months.

Adenostemma lavenia (Linn.) O. Kuntze. (*A. viscosum* Forst.)

Annual herb with white flowers. August-September. (Gupta 574)

Sonchus oleraceus Linn.

Annual herb with yellow flowers. March-April. (Gupta 201)

Sonchus arvensis Linn.

Perennial with yellow flowers. March-April. (Gupta 89D)

Vicoa indica DC. (*V. auriculata* Cass., *Inula indica* Linn.)

Viscidly pubescent herb with orange-yellow flowers. (Gupta 198, 224, 225, 440A)

Vicoa vestita Benth. (*Inula vestita* Wall.)

Softly hairy herb with bright yellow heads. (Gupta 222)

Centaurea cyanus Linn.

Erect cottony herb with large blue ray florets. Cultivated but naturalised in the area. (Gupta 226)

**Tanacetum vulgare* Linn.

Robust perennial with yellow heads. Recently naturalised in the area. (Gupta 244)

**Gamolepis annua* Less.

Glabrous wiry annual with bright yellow heads. Naturalised recently in the area. (Gupta 228)

**Carthamus oxyacantha* Bieb.

Thistle-like herb with orange-yellow flowers. (Gupta 408)

Taraxacum officinale Wigg.

Herb with yellow flowers. (Gupta 575)

Centipeda orbicularis Lour.

Prostrate woolly annual with yellow flowers; November-February. In fields and waste places. (Gupta 644)

Solidago virga-aurea Linn.

Perennial herb with yellow flowers. (Gupta 645)

Siegesbeckia orientalis Linn.

A pubescent annual with yellow flowers. On the edges of the rice fields and in shady places. (Gupta 646)

Spilanthes acmella Linn.

Annual herb with yellow-white flowers. In waste places. (Gupta 647)

Plumbaginaceae

Plumbago zeylanica Linn.

Sub-scandent perennial herb with white flowers in spike-like racemes. August-September. (Gupta 576)

Primulaceae

Anagallis arvensis Linn.

Annual herb with blue flowers. February-March. (Gupta 173, 319, 69D)

Oleaceae

Jasminum pubescens Willd.

Scandent shrub with white fragrant flowers. December-April. (Gupta 445)

Olea cuspidata Wall.

Tree with flowers in April-May. Cultivated. (Gupta 467)

Apocynaceae

Carissa carandas Linn.

Evergreen shrub with white faintly scented flowers. April-June. (Gupta 188)

Lochnera pusilla K. Sch.

Erect annual with white or pink flowers. (Gupta 439)

Ichnocarpus frutescens R.Br.

Evergreen climbing shrub with greenish-white flowers. August-December. (Gupta 186, 210, 534)

Carissa spinarum Linn.

An evergreen shrub with scented, white flowers April-June. In dry situations. (Gupta 188)

Nerium odorum Soland.

An evergreen shrub with milky juice. Flowers fragrant, rose-red; April-June. Cultivated near temples, often found as escape.

Thevetia peruviana (Pers.) K. Schum. (*T. nerifolia* Juss.)

Evergreen shrub with milky juice. Flowers bright yellow; throughout the year. Often grown as fences in gardens and near temples.

Plumeria acutifolia Poir.

Small tree with white, fragrant flowers. Planted near temples and in gardens.

Asclepiadaceae

**Asclepias curassavica* Linn.

Undershrub with bright orange flowers. August-September. (Gupta 578)

Calotropis procera R.Br.

Large shrub with pink flowers having purple spots. March-May. (Gupta 577)

Cryptolepis buchanani R. & S.

Twining shrub with pale greenish-yellow flowers. March-April. (Gupta 589)

Leptadenia reticulata W. & A.

Twiner with pale brown flowers. May-July. (Gupta 590)

Leptadenia pyrotechnica Decne. (*L. spartium* Wight)

Erect leafless shrub with yellow flowers. December-January. (Gupta 62)

Marsdenia volubilis (Linn. f.) Cooke. [*Wattakaka volubilis* (Linn. f.) Stapf]

Twining shrub with yellowish-green flowers in drooping axillary cymes. April-June. (Gupta 507)

Pergularia daemia (Forsk.) Chiov. (*Daemia extensa* R. Br.)

A foetid climber with flowers pale yellowish-green and red. (Gupta 62)

Loganiaceae

Buddleia asiatica Lour.

An evergreen shrub with white scented flowers. March-April. (Gupta 15)

Boraginaceae

Ehretia laevis Roxb.

Small tree with white flowers. February-April. (Gupta 187)

Cordia myxa Linn.

Tree with white flowers. March-April. Often planted.

Trichodesma indicum R.Br.

Bulbous based hairy, annual herb with pale blue flowers changing to white. December-February. (Gupta 206, 436)

Heliotropium indicum Linn.

Hairy diffuse annual with white flowers. October. (Gupta 214)

Cynoglossum zeylanicum Thunb. (*C. denticulatum* var. *zeylanica* Clke.)

Annual herb with dark blue flowers. October-November. (Gupta 592)

Convolvulaceae

Cuscuta reflexa Roxb.

Parasitic twining herb with white flowers. September-February. (Gupta 38D)

Evolvulus alsinoides Linn.

Diffuse perennial with white or blue flowers. July-November. (Gupta 593)

Convolvulus arvensis Linn.

Pubescent annual with pink flowers having a pale yellow centre. December-February. (Gupta 594)

Convolvulus pluricaulis Chois.

Diffuse perennial with pale rosy flowers. December-February. (Gupta 595)

Ipomoea pilosa Sweet

An annual twiner with purple flowers (Gupta 648)

Ipomoea nil (Linn.) Roth. (*I. hederacea* Jacq.)

An annual twining herb with blue flowers, tinged with pink. In the villages flowering in the morning in winters. (Gupta 649)

Ipomoea palmata Forsk.

A perennial twiner with purple flowers. Often on trees in gardens. (Gupta 650)

Solanaceae

Solanum xanthocarpum Schrad. & Wendl.

Prickly perennial with bluish-purple flowers. March-April. (Gupta 529)

Solanum nigrum Linn.

Annual with small white flowers. June-July. (Gupta 445A)

Physalis minima Linn.

Annual with yellow flowers. May-August. (Gupta 527)

Datura stramonium Linn.

Coarse annual with large white flowers. (Gupta 526)

**Nicotiana plumbaginifolia* Viv.

Annual herb with white flowers. August-September. (Gupta 596)

**Cestrum nocturnum* Linn.

Sub-scandent evergreen shrub with pale yellowish-green flowers fragrant at night. (Gupta 536)

Scrophulariaceae

Lindenbergia indica (Lehm.) O. Kze. (*L. urticaefolia* Link & Otto)

Glandular hairy annual with yellow flowers. August-September. (Gupta 600)

Lindernia nummularifolia (Roxb.) Wett. (*Vandellia nummularifolia* Don)

Herb with reddish-purple flowers. August-September. (Gupta 602)

Lindernia crustacea (L.) F. V. Muejl. (*Vandellia crustacea* Benth.)

Annual with purplish-white flowers. August-September. (Gupta 605)

Lindernia ciliata (Colsmann) Pennell. (*Bonnaya brachytha* Link & Otto)

Herb with pink or white flowers. August-September. (Gupta 604)

Lindernia anagallis (Burm.) Pennell. (*Bonnaya veronicifolia* Spr.)

Herb with violet flowers. October-November. (Gupta 608)

Verbascum coromandelianum (Vahl.) O.Kze. (*Celsia coromandeliana* Vahl.)

Annual herb with yellow flowers. December-February. (Gupta 610)

Verbascum thapsus Linn.

Stellate tomentose herb with pale yellow flowers on the banks of Kali River. April.

Antirrhinum orontium Linn.

Herb with pale pink flowers. December-February. (Gupta 615)

Mazus japonicus (Thunb.) O.Kze. (*M. rugosus* Lour.)

Annual with pale blue flowers. August-September. (Gupta 443)

Stemodia viscosa Roxb.

Viscidly pubescent aromatic herb with violet flowers. December-February, in moist localities. (Gupta 619)

Torenia cordifolia Roxb.

Annual with bluish-purple flowers. August-September. (Gupta 621)

**Torenia fournieri* Linden.

Much-branched herb with pale violet flowers, yellow on back. Naturalised in the area. (Gupta 440, 449A)

Scoparia dulcis Linn.

Undershrub with white flowers. August-September. Weed of cultivated land. (Gupta 444A)

Veronica agrestis Linn.

Annual with blue flowers. December-February. (Gupta 205)

Veronica anagallis Linn.

Herb with pale purple flowers. December-February. (Gupta 83D)

Striga euphrasioides Benth.

Annual with white flowers; in sugarcane fields. (Gupta 612)

**Bacopa monnieri* (L.) Pennell

Creeping herb, rooting at the nodes with purplish-pink flowers. The plant resembles *Centella asiatica* and prefers swampy localities.

Kickxia ramosissima (Wall.) Janchen. (*Linaria ramosissima* Wall.)

Perennial herb with yellow flowers in ravines and dry localities. (Gupta 434, 438)

Orobanchaceae

Aeginetia indica Linn.

Parasitic leafless herb tinged with purple having solitary purple flower. (Gupta 627D)

Orobanche aegyptiaca Pers.

A leafless parasitic herb, branching from the base of the stem; flowers blue. Common in mustard fields. (Gupta 651)

Bignoniaceae

Kigelia pinnata DC.

Ornamental tree with maroon-coloured flowers on long pendant racemes; on roadsides. (Gupta 450)

Pedaliaceae

Martynia annua Linn. (*M. diandra* Glox.)

Tall herb with rose-coloured flowers. Fruit beaked by two strong curved spines. (Gupta 511, 427A)

Acanthaceae

Hygrophila polysperma T. Anders.

Procumbent branched herb with pale blue flowers. July-September. (Gupta 174)

Eranthemum nervosum (Vahl.) R.Br. (*Daedalacanthus nervosus* T. Anders.)

Herb with deep blue flowers often cultivated. (Gupta 528)

Phlogacanthus thyrsoiflorus Nees

Evergreen shrub with orange-coloured flowers. March-April. (Gupta 469)

Barleria dichotoma Roxb.

Small undershrub with blue-purple flowers. August-September. (Gupta 175)

Justicia simplex Linn.

Small herb with pale purple flowers. August-September.

Adhatoda vasica Nees. (*Justicia adhatoda* Linn.)

Evergreen shrub with white flowers, corolla with pink or purple thread. February-May. (Gupta 162)

Peristrophe bicalyculata Nees

Herb with pink flowers. August-September. (Gupta 457 D)

Rungia pectinata (L.) Nees. (*R. parviflora* Nees var. *pectinata* Clke.)

Annual herb with bluish white flowers. July-September. (Gupta 469 A & B)

Dicliptera bupleuroides Nees. (*D. roxburghiana* Nees var. *bupleuroides*)

Herb with pink flowers. (Gupta 625)

Verbenaceae

Lantana camara Linn.

Prickly shrub with orange flowers. March-April. (Gupta 626)

Lantana indica Roxb.

Shrub with white, pale and yellow flowers. August-September. (Gupta 422 A)

Callicarpa macrophylla Vahl.

Erect shrub with rosy flowers. July-September. (Gupta 424)

Vitex negundo Linn.

Shrub with bluish flowers. July-August. (Gupta 638)

Clerodendrum serratum Spreng.

Shrub with blue-purple flowers. April-August. (Gupta 627)

Clerodendrum infortunatum Linn.

Shrub with white flowers tinged with pink. December-April. (Gupta 476)

**Clerodendrum fragrans* R.Br.

Undershrub with white-pink flowers. Cultivated. (Gupta 216)

Clerodendrum phlomidis Linn. f.

A large shrub with white or pink flowers. In hedges. (Gupta 652)

Duranta plumieri Jacq.

Erect spiny shrub with blue flowers. Cultivated as hedge. (Gupta 293, 294, 450 D)

**Caryopteris incana* Miq. (*Caryopteris mestacanthus* Schauer)

Small shrub with violet-blue flowers. Cultivated. (Gupta 499, 509)

Labiatae

Ocimum sanctum Linn.

Herb with purplish-pink flowers. Sacred and cultivated in houses. (Gupta 520)

Ocimum basilicum Linn.

Herb with white-pink flowers. (Gupta 204, 419 D)

Ocimum gratissimum Linn.

Shrub with greenish yellow flowers. (Gupta 531)

Ocimum americanum Linn. (*O. canum* Sims.)

Herb with white flowers. (Gupta 514)

Anisomeles indica (Linn.) O. Kuntze. (*A. ovata* R.Br.)

Herb with pale purple and bluish flowers. September-October. (Gupta 176, 523)

Leucas aspera Spreng.

Annual with white flowers. August-September. (Gupta 515)

Leucas cephalotes Spreng.

Annual with white flowers in dense globose heads. July-September. (Gupta 435A, 517)

Leucas urticaefolia R. Br.

A hairy annual with white flowers in dense globose whorls. (Gupta 77 D)

Leonotis nepetaefolia R.Br.

Tall annual with orange-scarlet flowers in globose whorls. October. (Gupta 497)

Salvia pseudo-coccinea Jacq. (*S. coccinea* Juss.)

Slender herb with scarlet flowers. March-April; escape. (Gupta 500, 502)

**Salvia farinacea* Benth.

Perennial herb with many clustered stems and violet-blue flowers, becoming naturalised in the area. (Gupta 503)

Ajuga bracteosa Wall.

Perennial with pale blue flowers. August-September. (Gupta 620)

Ajuga macrosperma Wall. ex Benth.

Decumbent annual with blue flowers. March-April. (Gupta 524)

Mentha piperita Linn.

Aromatic herb with blue flowers along the water course. July-August. (Gupta 629)

Nepeta hindoostana (Roth.) Haines. (*N. ruderalis* Buch.-Ham.)

Pubescent annual with bluish-purple flowers. March-April. (Gupta 183, 416, 519, 521)

Plantaginaceae

Plantago major Linn.

Perennial with small flowers. June-July. (Gupta 213, 460)

Nyctaginaceae

Boerhavia repens Linn. var. *diffusa* (*B. diffusa* Linn.)

Diffusely branched herb with small pink flowers. March-April (Gupta 54A, 405, 525)

Amaranthaceae

Deeringia amaranthoides (Lamk.) Merrill (*D. celosioides* R.Br.)

Climbing shrub with pale yellowish-green flowers. August-September. (Gupta 422)

Celosia argentea Linn.

Annual with pink flowers when young. September-October. (Gupta 447, 425)

Digera muricata (L.) Mart. (*D. arvensis* Forsk.)

Slender annual with pink flowers. September-October. (Gupta 439A, 452A, 454, 455)

Amaranthus spinosus Linn.

Spinous shrub with greenish-white flowers. March-April. (Gupta 200)

Amaranthus gracilis Desf.

Annual with green flowers. March-April. (Gupta 446A, 453)

Aerva sanguinolenta Blume. (*A. scandens* Wall.)

Climbing undershrub with silvery flowers. March-April. (Gupta 172, 446, 448)

Nothosaerva brachiata Wight

Slender annual with glistening white flowers. July-August. (Gupta 449)

Achyranthes aspera Linn.

Weed with greenish-white flowers in terminal spike. July-August. (Gupta 412D)

Pupalia lappacea Juss.

Straggling undershrub with pink flowers in terminal spike. September-October. (Gupta 423, 468A, B)

Alternanthera echinata Smith

A biennial herb with small flowers, in dense axillary spike-like clusters. On roadsides and backyards of houses. (Gupta 518)

Chenopodiaceae

Chenopodium album Linn.

Herb with greenish flowers in clusters forming paniced spikes. August-September. (Gupta 630)

Chenopodium murale Linn.

Foetid herb with flowers in dense cymes in axillary raceme. August-September. (Gupta 452)

Polygonaceae

Polygonum plebejum R.Br.

Prostrate herb with pink flowers. July-August. (Gupta 197, 459)

Polygonum alatum Buch.-Ham.

Procumbent annual with flowers in heads. July-September. (Gupta 457)

Polygonum glabrum Willd.

Erect annual with pink flowers. August-September. (Gupta 458)

**Polygonum chinense* Linn.

Herb about 5 ft. with flowers in heads. October-November. (Gupta 479)

Polygonum serrulatum Lagasc.

Annual with white flowers. August-September. (Gupta 467)

Rumex dentatus Linn.

Erect annual with green flowers changing to red. September-October. (Gupta 631)

Loranthaceae

Dendrophloe falcata (Linn. f.) Etting. (*Loranthus longiflorus* Desr. var. *falcata*)

Parasitic shrub with orange-red flowers on mango and guava. (Gupta 198)

Euphorbiaceae

Euphorbia microphylla Heyne ex Roth.

An annual herb with small leaves. In waste places. (Gupta 471D)

Euphorbia tirucalli Linn.

A small tree with spreading terete rush-like leafless branches. Often seen as hedge plant in villages. (Gupta 653)

Euphorbia pulcherrima Willd.

A shrub, much cultivated in the gardens throughout the district.

Euphorbia dracunculoides Lamk.

Much-branched annual. April-June. (Gupta 485, 490)

Euphorbia hypericifolia Linn.

Decumbent annual, flowering throughout year. (Gupta 495)

Euphorbia thymifolia Linn.

Small annual herb flowering greater part of the year. (Gupta 471 A & B)

Euphorbia hirta Linn. (*E. pilulifera* Jacq.)

Annual herb, with flowers. April-September. (Gupta 443a, 494)

Euphorbia prostrata Ait.

Herb with many slender prostrate stems resembling *E. microphylla* Heyne ex Roth. in habit. (Gupta 486)

Euphorbia geniculata Orteg.

Annual herb with flowers August-September. (Gupta 460 A)

Emblia officinalis Gaertn. (*Phyllanthus emblica* Linn.)

A moderate-sized tree, often planted near the villages for its fruit and near temples, since it is held sacred.

**Croton bonplandianum* Baill. (*C. sparsiflorus* Morung.)

Annual weed with white flowers in waste places. (Gupta 489)

Ricinus communis Linn.

Tall tree-like shrub with large flowers in racemes. February-March.

**Jatropha pandurifolia* Andr.

Shrub with rose-pink flowers. Cultivated. (Gupta 487)

Phyllanthus niruri Linn.

An annual herb with minute axillary flowers; July-August. In cultivated fields and as garden weed. (Gupta 654)

Acalypha indica Linn.

An annual herb with flowers in lax axillary elongate spikes. Common garden weed in the area. (Gupta 655)

**Acalypha godsefiana* Mast.

Shrub with green leaves, margin with cream colour. (Gupta 444, 488)

Urticaceae

Cannabis sativa Linn.

Undershrub with greenish-white flowers. May-June. (Gupta 632)

Pouzolzia pentandra Benn.

Perennial herb with cream-coloured flowers in clusters. August-September. (Gupta 493)

Morus alba Linn.

Small tree with flowers on short ovoid spikes. February. (Gupta 451)

Ceratophyllaceae

Ceratophyllum demersum Linn.

A submerged aquatic herb. Common in the tanks and in still water.

Hydrocharitaceae

Hydrilla verticillata Royle

Slender aquatic herb with small flowers in running or still water. (Gupta 363)

Vallisneria spiralis Linn.

Submerged stemless herb, common. (Gupta 40D)

Amaryllidaceae

Agave sp.

A perennial, commonly planted on the borders of the gardens and fields throughout the district. The species could not be identified due to the absence of flowers. It seems that there is more than one species cultivated in the area and which now have naturalised completely.

Furcraea gigantea Vent.

A perennial, often grown as a hedge plant in the area and sometimes occurs on the sides of the railway lines.

Liliaceae

Asparagus racemosus Willd.

Scandent spinous undershrub with fragrant flowers. September-October. (Gupta 190, 314, 422)

Gloriosa superba Linn.

Herbaceous climber with scarlet flower. June-October. (Gupta 634)

Asphodelus tenuifolius Cav.

Annual herb with white flowers. December-February. (Gupta 161)

Pontederiaceae

Eichhornia crassipes Solms.

Aquatic herb. Flowers blue. March-July. Common in pools and puddles. (Gupta 431)

Commelinaceae

Commelina nudiflora Linn.

Diffuse annual with dark blue flowers. August-September. (Gupta 415)

Commelina benghalensis Linn.

Dichotomously branched annual with blue flowers. August-September. (Gupta 418)

Palmae

Phoenix sylvestris Roxb.

Tall palm. Flowering in December-January.

Phoenix humilis Royle

Shrub with scattered leaves. Flowering during December-January.

Typhaceae

Typha elephantina Roxb.

Tall bulrush with broad 3-gonous leaves above sheath. Common in pools and puddles. (Gupta 635)

Typha angustifolia Sibth. & Sm.

A tall marshy herb. Flowers in cylindric spikes, male and female often much separated. (Gupta 656)

Aroideae

Colocasia antiquorum Schott.

Herb with a thick corm and ovate leaves, having broad triangular basal sinus. Often cultivated for the leaves and for the corms that are edible.

Lemnaceae

Spirodela polyrrhiza Schleid.

A minute aquatic herb with several roots. Fronds dark green above usually purple beneath. Commonly growing with *Azolla pinnata* R. Br. in the tanks. (Gupta 657)

Wolffia arrhiza Wimm.

A minute aquatic herb, smallest of the flowering plants. Commonly covering the water of the ponds like a green scum.

Alismaceae

Sagittaria sagittifolia Linn.

An aquatic perennial with sagittate leaves. Flowers white. Commonly seen near the field channels. (Gupta 659)

Naiadaceae

Potamogeton pectinatus Linn.

Aquatic herb. Flowers: October-March. (Gupta 636)

Zannichella palustris Linn.

Aquatic slender herb with minute flowers. (Gupta 637)

Cyperaceae

Cyperus rotundus Linn. (Gupta 401)*Kyllinga triceps* Rottb. (Gupta 639)*Scirpus maritimus* Linn. (Gupta 640)*Scirpus lacustris* Linn. (Gupta 91D)*Fimbristylis polytrichoides* Vahl. (Gupta 44D)*Eleocharis spiralis* R. Br. (Gupta 165)

Gramineae

Sporobolus diander Beauv. (Gupta 409)*Sporobolus commutatus* Kunth. (Gupta 369)*Setaria verticillata* Beauv. (Gupta 388, 396, 399, 463 C)

- Setaria glauca* Beauv. (Gupta 394, 397, 418, 430D)
Themeda triandra Forsk. (Gupta 391, 400)
Sorghum halepense Pers. (Gupta 448)
Arundo donax Linn. (Gupta 404, 442B)
Eragrostis tenella Beauv. ex R. & S. (Gupta 456A)
Eragrostis pilosa Beauv. (Gupta 390, 393, 395, 398, 411)
Eragrostis major Host. (Gupta 373)
Eragrostis willdenoviana Nees. (Gupta 193)
Oplismenus burmannii Beauv. (Gupta 403A, 467A & B)
Chloris incompleta Roth. (Gupta 441A)
Vetiveria zizanioides (Linn.) Nash. (Gupta 384, 420)
Amphilophis pertusa Willd. (Gupta 412)
Apluda mutica Linn. (*Apluda mutica* var. *aristata* (L.) (Pilger) Hack. (Gupta 27, 374)
Apluda varia Hack. (Gupta 392, 402)
Polyopogon monospeliensis (L.) Desf. (Gupta 375, 381)
Panicum flavidum Retz. (*Paspalidium flavidum* A. Camus). (Gupta 383)
Thysanolaema maxima Kuntze. (Gupta 161, 385, 389)
Arundinella leptochloa (Nees ex Steud.) Hk.f. (*A. lawsonii* Hk.f.). (Gupta 386)
Cenchrus ciliaris Linn. (Gupta 387)
Desmostachya bipinnata (Linn.) Stapf. (Gupta 371)
Perotis indica (L.) O.Ktze. (*P. latifolia*). (Gupta 55D, 376, 377, 378)
Echinochloa colonum (L.) Link. (Gupta 379)
Tragus biflorus (Roxb.) Schult.
Sporobolus tremulus (Willd.) Kunth. (Gupta 78D)
Phalaris minor Retz. (Gupta 62)
Cynodon dactylon Pers.

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Obituary

SIR REGINALD SPENCE

We sorrowfully record the breaking of another link with the past by the death in England last September of Sir Reginald Spence.

Born in 1880, the son of Robert Spence of Bickley, Kent, young Spence came out to Bombay in 1901 as an assistant in the firm of Phipson & Co. From the very beginning of the Society, Phipsons have been closely associated with it. Following this tradition Spence took an active interest in the Society's welfare and served as its Honorary Secretary from 1920 to 1933, during which period the Society extended its activities in several fields. Spence's genial personality won him many friends and the esteem in which he was held by the public and the Government was of immense value to the Society. The negotiations begun by his predecessors for the transfer to the Government of Bombay of the financial responsibility for the housing and proper care of the Society's collections were completed by him, and the detailed plans for the beautiful new Natural History wing of the Prince of Wales Museum, Bombay, were drawn up before he left India, though he was not here to see them actually carried out.

• From 1907 to 1933 Spence was one of the editors of the *Journal*. Towards the end, owing to the increasing demands made on his time by business and social work, he had to leave much of the actual editing to his colleagues, but he took an unremitting interest in the *Journal* and guided its general policy throughout the period. Outstanding contributions to the *Journal*, both written jointly with S. H. Prater, were 'The Fish Supply of the West Coast of India' (34: 973-991, 35: 77-88) and 'Game Fishes of Bombay, the Deccan and the Neighbouring Districts of the Bombay Presidency' (36: 29-66).

• Spence was as public-spirited as he was sociable and, among his many activities outside business and the Society, he found time to represent the non-official Europeans of Bombay for several years at first in the General Legislative Assembly, then in the Central Council of State, and finally in the Bombay Legislature. His public services were fittingly rewarded in 1926 by the conferment of a knighthood.

Retiring in 1934, Sir Reginald settled in Blackboys, Sussex, where for many years he continued to take part in public affairs.

With his death the Society loses one of its oldest members—one who was actively associated with the promotion of its welfare and development in the 'twenties.

EDITORS

Reviews

1. BIRDS OF CEYLON. BOOK 4. By W. W. A. Phillips. Pp. 50 (18.5×12.5 cm.). With 20 coloured plates, 6 photographs, and a coloured map. Colombó, 1961. The Associated Newspapers of Ceylon Ltd. Price Rs. 8.50.

This is the fourth of a series of books written by the author on the birds of Ceylon. The first dealt with the familiar birds of the garden, the second with the birds of the swamps and tanks, the third with the birds of the highlands, and this deals with the birds of the Ruhuna National Park. With the completion of this book the author has covered the 409 different species and subspecies of birds known to exist in Ceylon either as residents or migrants.

The Ruhuna National Park on the south-eastern coastal region of Ceylon contains about 200 species of birds. All these have been listed by the author at the end of the book, and they are sensibly arranged in different groups, e.g. Small Waders and Plovers; Falcons, Eagles, Hawks, Kites; Large Wading-Birds, etc. From this list one gets a very good idea of the types of bird that can be found in this area. In this volume the author has described 25 of the more prominent birds that are seen in this park. There are six good black-and-white photographs by the author and 20 coloured plates by Mrs. G. L. Lushington. Though Mrs. Lushington is apparently an experienced and competent painter, the drawings and printing of the plates in this volume are far from satisfactory. The one illustrating the Brahminy Kite and the Whitebellied Sea-Eagle is so bad that it should not have found a place in this book.

Any book dealing with the birds of Ceylon has a special interest for the birdlover in India. W. W. A. Phillips seems to have modelled his work on that of Sálim Áli, for this book has the same general scheme as THE BOOK OF INDIAN BIRDS. There is a coloured illustration for every bird described, and in 300 words you find an account of a species and information about nesting habits, distribution, song, food, and general behaviour. The author writes from his own personal observations and whatever he has to say holds our interest.

The majority of the birds of Ceylon are just minor variations of the kinds we have here, and when going through this book one has

to remind oneself often that the book is not dealing with the birds of our country.

It is curious, that some of the birds described, though belonging to the same species and subspecies as those of India, appear to have a different type of call, and sing a different tune. For instance, the Whitespotted Fantail Flycatcher in India has a song consisting of 12 to 13 notes. The author says that in the Ruhuna Park in Ceylon these birds have a song of only 7-8 notes. Again the Indian Stone Curlew's call is a distinct *pick pick pika*. We heard this bird nightly in Saurashtra during September. But the call of the same bird in Ceylon has been rendered by Mr. Phillips as *whew whew whew whew whew whew whew whew*. In the case of the Blackbellied Finch-Lark, however, whose call is so well described as *jingly jingly jingly Ecee*, there is close correspondence between the birds here and those in Ceylon. This is a useful little book to have in one's bird library.

ZAFAR FUTEHALLY

2. UNDER THE BANYAN TREE. By Kála Teetur. Pp. 69 (25×18.5 cm.). Numerous line illustrations. Cape Town, Union of South Africa, 1961. Cape Times Limited.

This is a slim volume of reminiscences of small game shooting in the plains of northern India.

The actual identity of the author is covered by the pen name 'Kála Teetur', but the text reveals him to be a keen and experienced shikari, a good naturalist, and obviously British. He has an eye that sees very little go unobserved, and here lies much of the book's charm. Fortunately it does not fall into the class of shikar books which concern themselves exclusively with killing and attempts thereat. The good shikari sees a lot more than what he shoots at. In a shikar outing 'Kála Teetur' observes and comments on the plants and the soil, the people and their ways, the villages and the structure of the houses. Then there are amusing accounts of the elaborate staff work necessary for arranging the commissariat, and gathering suitable personnel, factors which are so necessary for a well-planned and enjoyable shoot.

The book is given its title UNDER THE BANYAN TREE in token of gratitude to and appreciation of that remarkable tree, which so often must have afforded the solace of coolth and shade to the shikari parched and weary after a hard morning's shoot in the open plains.

The initial chapter 'Introducing the Tree' draws a brief character sketch of the common trees of the plains and dwells at length on the banyan, and the amazing variety of creatures that gather under it for shade and sustenance. The subsequent chapters describe typical outings throughout the shooting season, starting from the opening shoot immediately after the rains and ending with the warm and dusty excursion well on in March. The narrative obviously does not recount events as they actually occurred, but each chapter is put together from long and varied experience to make a composite picture so typical that one feels that one has had just such a shoot somewhere sometime.

I think I have made it clear that this is not a book of instructions on good shooting. It attempts and succeeds in bringing back the sights and scenes and the events which the author and presumably his readers have enjoyed so intensely. To the middle-aged whose capacity for strenuous shooting is on the wane, these reminiscences of days when both vigour and game seemed inexhaustible are particularly enjoyable. Strangely, in memory, the inevitable fatigue and discomfort of a shoot seem vague and unreal, but a difficult right and left brought off long ago and good companionship enjoyed are still vividly exhilarating. The four middle chapters of the book are devoted to accounts of 'The Christmas Shoot'—that extremely improbable ritual with which the Nativity came to be celebrated in Anglo-India. Strangely the institution of the Christmas Shoot appears to have taken firm root in our native soil, and has been adopted reverently by the keen Indian sportsman. He annually hears that strange clinking staccato that intrudes on the pre-dawn stillness of a reedy jheel in the early hours of Christmas morning. It is the chattering of his teeth as he stands thigh deep in mud and icy water waiting for first light. Not even mad dogs! . . . but never mind that. As I have just remarked the memory of that numbing chill brings no extra twinge to the stiff rheumatic knees, but the old heart beats faster as one reads: 'A single shot rings out at the farthest end, sounding flat and very distant . . . Immediately there is a muffled roar' like the approach of an express train. In a black cloud a vast swarm of duck and teal rise from the distant horizon . . .'

'There are two more distant shots and then two more in rapid fire. The shooting at the far end settles down to a steady barrage. The birds begin to break up into small parties flying to and fro. For the keen duck-shooting man this is his finest hour.'

3. A BIOLOGY OF CRUSTACEA. By J. Green. Pp. xv+180. With four plates and 58 text-figures. London, 1961. H.F. & G. Witherby Ltd. Price 30s.

Compared to the voluminous literature on insects, that on another important group among the arthropods, viz. the Crustacea, is sparse. Carcinologists will, therefore, welcome this recent addition to our knowledge of Crustacea, where, in a concise form, the author has given a general account of various important aspects of their study.

In the opening chapter, he has given the terminology and a brief morphological account of different animals and their position in evolution. He then goes on to a more elaborate description of the mechanism of, and adaptations to, filter feeding.

A good deal of space in the chapter on blood and circulation is devoted to that in *Daphnia*. The nature of pigments, and the mechanism of colour change and its nervous control are well treated. In the fifth chapter, an account of the interesting phenomenon of ecdysis and the inter-relationship of the moult-inducing and moult-inhibiting hormones is combined with descriptions of the various larval stages.

The reactions to environmental changes with reference to light, sound, smell, gravity, humidity, etc., which together constitute behaviour are discussed. The latter part of the book deals with parasitic forms, distribution in space, and the impact of these animals on man.

In a work of this size, it is to be expected that several important topics have had to be excluded. The author has restricted his studies to the exterior of the animal. Even then, some topics such as osmotic regulation, terrestrial adaptations, autotomy and regeneration, etc. are left out. However, the author has clearly explained his choice of material for inclusion in the preface.

This book, written in simple language, will serve to stimulate the interest of those who desire to have general information on Crustacea available in one place. Lists of references at the end of each chapter provide information to those who wish to make a further study.

4. ORCHIDS: THEIR BOTANY AND CULTURE. By Alex. D. Hawkes. Pp. xii+297 (23×15 cm.). Coloured frontispiece and several black-and-white photographs and line-drawings. London, 1961. Peter Owen Limited. Price 45s.

The author of this comprehensive little handbook on Orchids is well qualified for the task, being the editor among other horticultural journals of *The Orchid Journal* and *The Orchid Weekly*, and having a working acquaintance with orchids extending over more than twenty years.

The book is written in four parts. The first gives the reader general information on orchids: what are orchids?; where are they found? (how many of us know that they come from such diverse places as the 'frigid dales of Alaska' and the 'parched sandy deserts of Australia and Africa?'); their colours, sizes, and forms (sizes may vary from an overall height of less than a quarter of an inch to more than 20 ft.); how they grow; their economic importance (*Vanilla planifolia* was the original source of commercial vanilla extract, and various orchids have supplied vegetables, a beverage made after the fashion of tea, medicines, love philtres, glue, and material for weaving and basketry work, and the pseudobulbs have been fashioned into bracelets and even into horns or trumpets for use in special religious ceremonies); the history of early orchid cultivation (it is encouraging to the beginner to realise that the stronger orchids are able to live through considerable mishandling). The second part deals with the culture of orchids, and gives detailed instructions which the beginner as well as the expert will find useful. An interesting section is that dealing with orchids as plants to grow in the house—flowering orchids will be a welcome change from the Money Plant, which is so popular with Bombay residents. Part III begins with a list for beginners of easily grown orchids. A list of the principal cultivated orchids follows—about 200 species arranged in their respective genera. The list is alphabetical, so that the orchid you are searching for is readily found. General descriptions of the genera and species are given, along with notes as to where they come from and instructions about their culture. Several of the species come from the Himalayas, Assam, Burma, Ceylon, Malaya, or some other place in SE. Asia, and should be available to the orchid enthusiast in India. One longs for a similar book dealing with Indian orchids generally. However, the culture notes, even if they relate to different species, will suggest various lines of treatment, one or more or a combination of which may be found suitable. Part IV is for the more advanced orchid

grower, and deals with hybrids and hybridization.

The correct pronunciation of all the generic and specific names is indicated, and a glossary explains the meanings of the technical terms used. The book is profusely illustrated with one colour plate and several black-and-white photographs and line drawings. A comprehensive index finishes this very welcome handbook.

D.E.R.

5. GNETUM. By P. Maheshwari and Vimla Vasil. Pp. xii+142 (24×16 cm.). 2 photographs in black-and-white and 85 maps and diagrams. New Delhi, 1961. Council of Scientific and Industrial Research. Price Rs. 20 or 40s.

This is the first in a series of about thirty Botanical monographs to be published by the Council of Scientific and Industrial Research, India, with the object, as stated by Prof. M. S. Thacker in the foreword, of bringing together all the information, at present scattered in numerous scientific periodicals, with a view to stimulate further research and to provide much helpful material for teachers and students of Botany in India. There is no doubt that this very well-illustrated treatise prepared by an outstanding botanist ably assisted by very careful research workers will fulfil a long-felt need of many a teacher in India and abroad.

In this monograph the authors present the distribution of various species very clearly with the help of maps taken, with due acknowledgement, from previous workers. The morphology, anatomy, and embryology—particularly of *Gnetum gnemon* and *G. ula*—are presented in full detail, and supported with very good illustrations. Previous work on these and other species from S. America and W. Africa is compared and discussed.

It might appear odd that the Delhi studies could not verify the chromosome number in the two species on which extensive and careful work was carried out. As often happens in such studies, suitable material may not have been available to the authors for this purpose. It is also rather intriguing why the taxonomy of *Gnetum* should have missed inclusion in the text. Photographs or figures of the Indian species would have enhanced the value of this monograph considerably as they are not available in Bharadwaja's work. An inquisitive mind will however find the extensive list of literature appended at the end very helpful.

The chapter on relationships gives a scholarly and frank appraisal of the situation as it obtains at present and ends with the statement that *Gnetum* remains largely a phylogenetic puzzle. This interesting genus is Gymnospermous but possesses some strong Angiospermic features. It is to be hoped that further work will be carried out on other species of *Gnetum* and on allied genera of this interesting group of plants by this active school of phytomorphology to solve this puzzle.

The quality of this monograph will encourage other workers to carry out critical work on many other facets of Indian botany. The best feature of this monograph is the excellence of its production, and the clarity of the photographs, diagrams, and other figures. It is hoped that the monographs that follow will maintain the same standard of scholarship and production.

P. V. BOLE

6. ATLAS OF AVIAN HEMATOLOGY. BY Alfred M. Lucas and Casimir Jamroz. Pp. vi+271 (26×20 cm.). 413 figures in colour or monochrome. Washington, 1961. United States Department of Agriculture. *Agriculture Monograph* 25. Price \$4.

The ATLAS is the first of a series of publications designed to provide the basic histology and anatomy of the fowl.

The descriptive material, profusely illustrated, is presented in seven chapters. The first chapter outlines the methods of study followed by different workers, and makes appropriate reference to the necessity of employing standard criteria for the diagnosis of the cell type. The second and most extensive chapter gives an exhaustive account of the cells in the circulating blood of the hatched chicken, and is illustrated throughout with an able delineation of cell lineage and morphogenesis. The variations in morphological features due to artefacts in technique are given due emphasis. The comments on haemokonia and serum granules are unexceptionable. The third chapter deals with the cells in the circulating blood of the embryo. Blood cells from various haematopoietic organs of the embryo are described in the fourth chapter. Blood cells from the bone marrow of the hatched chicken are detailed in the fifth chapter. Blood cells of other avian species with particular reference to their difference from the blood cells of the chicken are reviewed in the sixth chapter. Standard techniques for the collection of blood, for staining blood

cells, and cytometric methods are clearly described in the seventh chapter. Lastly a useful list of bibliography has been appended.

The illustrations are remarkable for their originality, precision, and clarity. As an up-to-date account of avian haematology, the book is indispensable to the research worker. As providing a ready reference to the veterinarian for the appearance of the normal cell types and their developmental stages, it will help in the fight against disease. It is therefore very good value for the money.

J. B. CHATTERJEA

ADDITIONS TO THE SOCIETY'S LIBRARY UP TO
30TH SEPTEMBER 1961

The following books have been added to the Society's library since August 1959:

- Abercrombie, M., Hickman, C. J., and Johnson, M. L.: *A DICTIONARY OF BIOLOGY*. Penguin Books Ltd., Harmondsworth, 1951. (Presented by Col. R. W. Burton)
- Ali, Sálím: *THE BIRDS OF GUJARAT*. Gujarat Research Society, Bombay, 1956. (Presented by Gujarat Research Society)
- Ali, Sálím: *THE BIRDS OF TRAVANCORE AND COCHIN*. Oxford University Press, Bombay, 1953.
- Allen, Hugh: *THE LONELY TIGER*. Faber & Faber Ltd., London, 1960. (Review copy)
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Miscellaneous Notes

1. MUTUAL ASSISTANCE BETWEEN MOTHER LANGURS

[*PRESBYTIS ENTELLUS* (DUFRESNE)]

On 10 February 1960 at Jaipur I was watching a small troop of Langurs, *Presbytis entellus* (Dufresne), consisting of one full-grown male, five full-grown females, and five babies. I was surprised to see that one of the females (No. 1) was carrying two babies. The troop settled on the roof of a near-by house and one of the two babies was passed on to another female (No. 2), who immediately suckled it. The langurs were disturbed by the occupants of the house, whereupon female No. 1 took the baby from female No. 2 and scampered away with both the babies clinging to her breast. I noticed that female No. 2 ran on three legs; the left forelimb was pressed against her breast and appeared to be badly injured. The troop again came to rest and the young one immediately came to its real mother and started sucking. This 'handing over' and 'taking over' was observed several times in the course of two and a half hours. The other three females took no part in looking after the baby.

DEPARTMENT OF ZOOLOGY,

MAHARAJA'S COLLEGE,

JAIPUR,

August 10, 1960.

ISHWAR PRAKASH

2. THE PRESENT STATUS OF THE CARACAL (*FELIS CARACAL* SCHREBER)

Sen (*J. Bombay nat. Hist. Soc.* 56 : 317) and Srivastava (*ibid.* 57 : 214) have reported observing the caracal at Hazaribag (Bihar), Sariska (Rajasthan), and Saharanpur (Uttar Pradesh). While surveying the Rajasthan desert for mammal studies in 1954, I saw a caracal skin with a *Sansi* (local tribesman) who refused to sell it at any price. He said that he had captured and killed it at Bikaner but, during our study, we did not collect any specimen of caracal from the Bikaner region. Adams (1899, WESTERN RAJPUTANA STATES: 170, Taylor & Francis) states 'The red lynx (*Felis caracal*) . . . are fairly numerous in

these 'states'. Pocock (1939, FAUNA OF BRITISH INDIA, MAMMALIA 1 : 309) speaks of its rarity and suggests that in all probability it will follow the fate of the Cheetah, *Acinonyx jubatus*, unless strict measures can be enforced for its protection. One of my shikari friends tells me that caracal are still found in fair numbers in the Bundi region of Rajasthan.

DEPARTMENT OF ZOOLOGY,
MAHARAJA'S COLLEGE,
JAIPUR,
August 10, 1960.

ISHWAR PRAKASH

3. THE SENSES OF THE TIGER

On a former occasion (1951, *J. Bombay nat. Hist. Soc.* 49 : 732) the present writer reported an instance of a tiger winding the presence of a man at 50 yards. Here is a personal experience which affords evidence of the tiger using his nose, and of his remarkable keenness of vision.

On the morning of 22 March 1928 in the Central Provinces it was found that a large tiger had killed my tethered buffalo calf, broken the wire rope, and taken the kill about 200 yards, the latter part through lantana. The only available tree was leafless. By 2.30 p.m. a chair-machan was fixed on it, and screened all round and below with leafy branches. Towards dusk the tiger uttered a 'woof' to scare any intruder. Then came the shrill alarm call of a cock junglefowl. Next I heard him using his nose—loud sniffs. He came to my left and below me. More sniffs. Then he went away and began a 'grumbling' approach along the drag of the kill, through the lantana. He was hungry. Now arrived the last glimmer of daylight.

I had tethered the kill fore and aft so as to afford a sideways shot. The electric-light box was suitably placed. My loophole was screened by a khaki handkerchief tied at three corners with the lower right hand corner secured by a large pin readily removable. The arms of the chair, the shooting-bar, and the footrest were all padded with khaki woollen putties. The seat of the chair had a leather cushion. No movement of mine could make any sound. There was no breath of air. Wanting to watch the tiger, I lifted a very small corner of the pinned handkerchief. He must have had his eyes lifted upwards as he crept along, for he instantly uttered a frightened 'woof' and

crashed away on his back tracks like a scalded cat. And that was the last of him.

He must have had some previous sharp experience, and perhaps been fired at and, maybe, slightly wounded.

c/o LLOYDS BANK LTD.,
39, PICCADILLY,
LONDON W. 1,
October 31, 1961.

R. W. BURTON,
LT.-COL., I.A. (RETD.)

4. NOTE ON A REPUTED SKULL OF *NEMORHAEDUS CRANBROOKI*

(With two text-figures)

It is only recently (Hayman, 1961) that the existence of a bright red goral from the north-east frontier region of Assam and from extreme north Burma has been recognised and the name *Nemorhaedus cranbrooki* proposed for it. The material described consisted of a complete skin (the type) from the Adung Valley of Upper Burma, collected in 1931 by Lord Cranbrook, and a rug made of pieces of skin from animals collected in the Mishmi Hills of Assam in 1922 by Mr. H. L. Cooper. This material is in the collection of the British Museum (Natural History). Reports were also quoted from the literature as far back as 1912 indicating that the goral of this region was very distinct in colour. A still earlier reference (Blyth, 1863) indicates that a red goral from Assam was known nearly a hundred years ago.

Unfortunately, at the time of description of *Nemorhaedus cranbrooki* (1961, *Proc. zool. Soc. Lond.* **136** : 319) no skull was available for description. The type was originally complete with skull, but only the mandible could be traced. Although this gave a valuable indication of the age of the animal and the probable proportions of the missing skull to which it belonged, an obvious gap in the description remained to be filled.

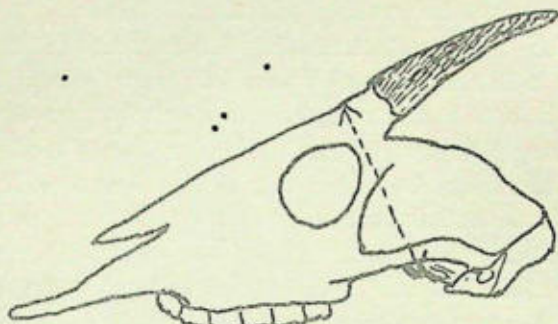
The skins forming the rug presented to the British Museum (Natural History) by Mr. H. L. Cooper in 1960 were without skulls, but I was informed by Mr. Cooper that at the time of collection a more or less complete skin and skull of this animal was sent to the Bombay Natural History Society. As a result of enquiries I have

made recently, it appears that this skin can no longer be traced, but that the Society has in its collection the skull of a goral from the Mishmi Hills entered in its records as having been received in 1925 from Mr. Cooper. I am greatly indebted to the Honorary Secretary, Mr. Humayun Abdulali, for making this skull immediately available to me in London for examination. Detailed comparison of this skull, B.N.H.S. No. 5091, with all other goral skulls available has disclosed that in certain details of structure it can be separated at once from all other known forms. The skull is unfortunately incomplete: the nasal and premaxillary bones are missing, the horns are missing, the back of the cranium has been cut away, and the first two premolars on each side have been lost. The remaining teeth show that the animal was adult but not aged. Its general condition and colour suggest that it may have been acquired originally from a Mishmi hunter or picked up in a Mishmi village, since it appears to have been smoke-dried, and the cutting away of the back of the cranium may well have been done to extract the brain for food.

In its general features the skull is undoubtedly that of a moderate-sized goral. It is in the conformation of the anterior part of the brain case that it differs from all other goral skulls seen. The plane of the horn cores is only very slightly elevated above the plane of the frontal bones forming the forehead; in most other goral skulls there is a distinct angle. The brain case shows a comparative shallowness best demonstrated by the following measurement. The total depth of the post-orbital part of the cranium measured from the surface of the frontal bone at the upper base of the horn core to the surface of the glenoid fossa is 54.5 mm. In a *Nemorhaedus goral hodgsoni* skull, B.M. No. 21.5.1.45, of the same approximate age, of almost identical overall dimensions, and with an identical maxillary tooth row length, the corresponding figure is 60. The reduction in depth of the cranium in the Mishmi skull is quite obvious, and in all larger or older goral skulls examined the difference in this part of the skull is still more obvious, as is also the generally greater elevation of the plane of the horns. (Text-fig. 1)

The distinctions outlined above leave me in little doubt that the skull from the Mishmi Hills represents *Nemorhaedus cranbrookii*. Its posterior reduction in overall depth is paralleled by the comparatively shallow depth of the mandible of the type. The following skull measurements of skull No. 5091 may be recorded here with, in parentheses, the corresponding figures for the *N. g. hodgsoni* skull, B.M. No. 21.5.1.45. Maxillary tooth row at alveoli 67 (67); palatal

breadth outside $m^1 - m^1$ 55 (56.5); zygomatic breadth 83.8 (83.5); anterior edge of orbit to anterior point of maxilla 92 (92); length of horn core from lower base 62 (50).

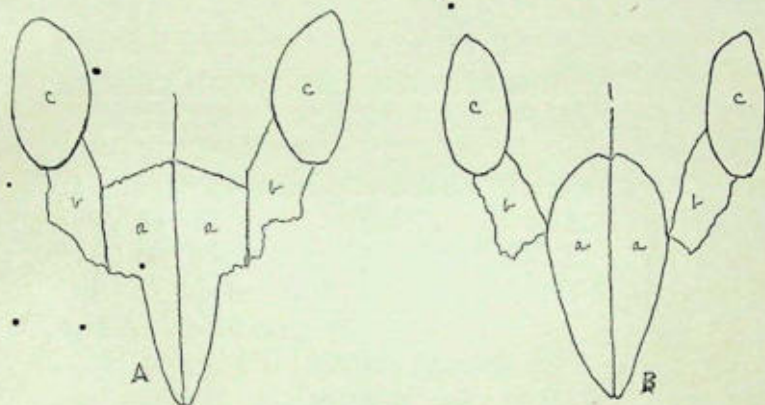


Text-fig. 1. Lateral view of goral skull to show measurement (dotted line) used in comparison. $\times \frac{3}{4}$.

While making these comparisons, a hitherto undescribed feature of the skull of the type and only known specimen of *Nemorhaedus baileyi* Pocock from south-east Tibet was noted. Pocock gave no details of the skull, and based his description of the animal as a distinct species entirely on external characters. These do not indicate any close relationship to *N. cranbrooki* although the latter is geographically not distant. The distinctive feature of the skull of *N. baileyi*, separating it clearly from all other goral skulls seen, is the form of the nasal bones and their relationship to the adjoining lachrymal bones. In all skulls of other gorals examined the posterior part of the outer margin of the nasal bone curves sharply forward to make contact laterally with the upper edge of the lachrymal bone only at or about the anterior upper angle of that bone, close to its junction with the upper edge of the maxilla. From that point the outer edge of the nasal bone tapers forward evenly to its apex. Even though the nasal bones are missing from the Mishmi Hills skull here believed to represent *N. cranbrooki*, it is obvious from the position of the sutures in relation to the lachrymals that the same pattern occurs. (Text-fig. 2, B).

On the other hand, in the skull of *N. baileyi* the posterior part of the outer edge of each nasal, instead of curving forward to make limited contact only with the anterior edge of the lachrymal, extends laterally to meet the upper edge of the lachrymal about half way along its length, i.e. about half way between the anterior margin of the orbit and the anterior upper angle of the lachrymal. Thus the outer edge

of the posterior part of the nasal bone has a long contact, about 20 mm., with the upper edge of the lachrymal and the adjoining upper edge of the maxilla. The outer edge of the nasal, instead of then tapering forward evenly to the apex as in all other gorals, forms a sharp inward angle before narrowing abruptly and then tapering forward evenly to the apex (Text-fig. 2, A). In addition the



Text-fig. 2. Nasals and lachrymals of (A) *Nemorhaedus baileyi*, Type $\times \frac{1}{4}$ and (B) *N. goral* and *N. cranbrookii*, $\times \frac{1}{2}$. (a) Nasals; (b) Lachrymals; (c) Orbits.

greatest breadth of the combined nasals, 38 mm. measured across their lateral junction with the lachrymals, is greater than in any other skull seen and very much greater than in most.

This modification of the form of the nasals, taken together with the distinctive external characters of the animal, leads to the suggestion that *N. baileyi* may eventually have to be recognised as a distinct species, and not regarded as a local subspecies of *N. goral* as in current classification.

I may here put on record that although the skull of the type of *N. cranbrookii* has remained untraced, one of the horns, fully labelled, has come to light recently. It is similar in form to those of other small gorals, is rather slender, and measures $4\frac{3}{8}$ inches on the front curve, 4 inches in a straight line.

Finally, I would appeal through the pages of this journal for sportsmen, officials, or travellers who may have the opportunity of obtaining further specimens of the red goral from the Mishmi Hills or north Burma, or from any adjoining hill territories to send complete specimens, skins with skulls, with exact data of locality, to the

Bombay Natural History Society in order that the characters and true relationships of these little-known animals may be further studied.

BRITISH MUSEUM (NATURAL HISTORY),
CROMWELL ROAD,
LONDON, S.W. 7,
September 15, 1961.

R. W. HAYMAN

5. THE DUGONG, *DUGONG DUGON* (MÜLLER), AT BOMBAY; AN INCORRECT RECORD

Dr. C. V. Kulkarni, Director of Fisheries, Maharashtra State, has drawn our attention to the statement at page 137 of Volume I of THE GAZETTEER OF BOMBAY CITY AND ISLAND, published in 1909, that the dead body of a dugong or sea-cow drifted ashore just opposite Colaba Church, on Bombay Island, in the year 1849. A foot-note in the GAZETTEER indicates that this statement is based on *The Times of India* dated 13-5-1849 and 16-5-1849.

The Times of India in those days went under the appellation of *The Bombay Times and Journal of Commerce* and appeared twice a week. Through the courtesy of *The Times of India* we were permitted to examine the files of old issues. There was no issue dated 13-5-1849, but the issue of 16-5-1849 carries a report that, in the forenoon of the previous Sunday (13-5-1849), 'a tolerably large species of whale-bone whale' drifted ashore on the rocks opposite to Colaba Church. The report goes on to mention that 'recently' some people in Ceylon had seen 'a *burra-muchee*, which was later identified as a dugong'. From the coincidence of the dates and the resemblances between the two accounts it appears that a mistake has been made and that the statement in the GAZETTEER, so far overlooked and unquoted, has no basis in fact. This is an interesting example of the necessity for careful scrutiny of assertions of fact, even in official records.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6,
November 15, 1961.

EDITORS

6. ON THE INDIAN GREAT REED WARBLER,
ACROCEPHALUS STENTOREUS (HEMPRICH &
EHRENBERG) BREEDING IN KERALA

While collecting data on birds nesting in the reed beds of Vembanad Lake in Kuttanad area in Kerala State, I was puzzled by the identity of a pair of birds which I frequently heard calling out from the reeds but was unable to see. Careful search in a boat revealed three nests with eggs. The general characters and plumage coloration as noted in the field pointed to one of two possibilities, either the Thickbilled Warbler (*Phragamaticola aëdon*) or the Indian Great Reed Warbler (*Acrocephalus stentoreus*). By collecting a specimen I determined the identity as the latter, an identification which was kindly confirmed by Dr. Sâlim Ali, according to whom there is as yet no record of this bird nesting in Travancore (1953, THE BIRDS OF TRAVANCORE AND COCHIN).

The three nests with eggs were discovered on 17th August 1961. Two empty nests, similar in construction, appearance and location, were discovered the next day. The nests were neat, deep, massive cups, firmly slung between three to seven reed stems (*Ochlandra travancorica*) standing in 5½ to 6 ft. depth of water. They were made of dead reed stalks and leaves with the inside lined with soft tender reed leaves and were placed 2 to 3½ ft. above the surface of the water. The nests were within a circle about 100 ft. in diameter; the shortest distance between two nests (both with eggs) was about 10 ft. Within an area of about 100 acres searched, only these five nests were found and the birds were seen or heard only in the immediate vicinity.

Each of the three clutches consisted of three eggs, oval in shape, dirty bluish in colour, speckled with blackish brown, and without any gloss. The speckling was heavier at the broad end than at the thin end. The specimen collected had very worn plumage; the other birds seen (two more were handled) also had worn plumage and appeared to be in heavy moult.

VATTAPARAMBIL, KAINADY,

PALLOM, KERALA,

October 25, 1961.

P. V. GEORGE

[Though long believed to be only a winter visitor to peninsular India, in 1934 Sâlim Ali (*J. Bombay nat. Hist. Soc.* 35 : 450) recorded that though no nests were found their behaviour left no doubt that the species nested in mangrove swamps that fringed the tidal swamps

near Bombay. Subsequent observers have also seen and heard the birds in July and August. Mr. George's note records an interesting discovery. The single specimen available does not permit racial identification though *A. s. meridionalis* (Legge) is known to be resident in Ceylon.—Eds.]

7. 'THE MOULTING OF DUCK AFTER ARRIVAL IN INDIA'

On 9 November 1961 I was shooting at a large lake in Nasik District, Maharashtra, when I saw a duck swimming on the water apparently unable to fly. When I approached it by boat, it attempted to escape by diving repeatedly. Thinking it was injured, I shot it, and, upon examination, found it lacking the primaries of both wings; evidently this prevented flight. The bird in question was a female white-eyed Pochard [*Aythya nyroca* (Güldenstädt)]. There are earlier records of similarly moulting Common Teal, Shoveller, and Wigeon having been obtained in the same area and at Bharatpur, Rajasthan (*J. Bombay nat. Hist. Soc.* 42 : 443-5; 44 : 300-1).

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S. CHAUDHURI

8. NOTES ON THE BIRDS OF NEPAL

I have followed with much pleasure Dr. Biswas's interesting series of articles in the *Journal* on the Birds of Nepal. The following notes are written with particular reference to the first three parts and include some fresh records collected during 1960-61. On the Pharping road, SW. of Kathmandu, there is a small jheel called Taudah. It is covered with water lilies and weeds and surrounded by grass and reeds. As it is in a cultivated area and people are always present, washing, watering cattle, or tending domestic ducks, I had not thought there would be many wild birds on it and rather neglected this area in the past. This year I found many new birds on it, and probably many of Scully's birds, not recorded since from the Valley, may have come from this area.

Podiceps ruficollis capensis Salvadori. Indian Little Grebe.

Not recorded in the Valley since Scully's day. On 21 March 1961 I found two pairs on the Taudah jheel. They were constantly uttering the peculiar whinnying cry which I have always associated with breeding birds. I remember in England watching a pair building in late February in a flooded quarry. As they collected water weed and piled it on to the nest they uttered this cry continuously. I visited the jheel again on 24 April. Only one pair was present, very wary and diving whenever one approached them. In June they had left the jheel and up-to-date (Oct.) they have not been seen there again.

Nycticorax n. nycticorax (Linn.). Night Heron.

I was quite mistaken in recording this bird as a resident in the Kathmandu Valley (*J. Bombay nat. Hist. Soc.* 48 : 719). Dr. Fleming first pointed out to me that it was certainly not here in winter and this is quite correct. This year I kept careful records. It was seen for the first time on 22 April, about 15 birds flying over the Royal Hotel at dusk. Not noticed again until the end of May when odd birds seen, also in June. Common July and August. Not noticed in September, but a single bird flew over my garden on 3 October in twilight. They used to be common standing along the side of the Rani Pokhri in the monsoon, but this year very few birds seen there. 2 birds on 19 October.

Ixobrychus cinnamomeus (Gmelin). Chestnut Bittern.

Only recorded by Biswas in the Dun of central Nepal, but one or two pairs breed regularly in the Valley near Gowkarna. They live in the rice fields during the monsoon. This year we shot a breeding male on 17 June.

Anser indicus (Latham). Barheaded Goose.

There appear to be no records for the Valley, but Colonel Roberts of the British Embassy shot one in the spring of 1959. He also reported seeing a single bird in the same area, the Manora River, just before Christmas 1960. On 10 October 1961 I saw a single bird flying over my garden. It was quite low and could be clearly seen. All these birds were solitary, and I suppose odd stragglers get separated from flocks of migrating birds and wander by chance into the Valley.

Aythya nyroca (Güldenstädt). White-eyed Pochard.

Not recorded from the Valley since Scully's time. Colonel Roberts tells me they are quite common on the lakes at Pokhara in central

Nepal in winter. This year 2 females were seen on the Rani Pokhri a small lake in Kathmandu town. They were there in the second week in May and remained for several days.

Aythya fuligula (Linn.). Tufted Duck.

In early July I was told that there were 7 of these duck on the Rani Pokhri. I went down on 15 July and saw 3 drakes and 1 duck. They sat in a little knot in the middle of the lake. They were there till 30 July when only 1 drake and 1 duck remained. On 1 August 1 drake only; on 4 August all gone and none seen since. This seems a very odd record to me. Dr. Biswas has reported them on high elevation lakes in May, so perhaps these were birds which had finished breeding early, although one would think they had hardly had time for this.

Accipiter gentilis schvedowi (Menzbier). Goshawk.

Although not recorded from the Valley since Scully's day the Goshawk is in fact tolerably common on the forested hills round the Valley. We have seen it many times on all the main ridges about 7500-8500 ft. (2300-2600 m.), but it never leaves the forest. It frequently perches on some prominent tree overlooking a little glade and no doubt watches to pounce on partridges etc., although we have never seen it do this. It does not appear to move at all with the seasons. On May 18 on the Mamche Danda a Goshawk flew into an oak very close to us. It was furiously mobbed by a pair of Jungle Crows. It is a large bird and could not possibly be confused with any other species. When perched other birds take no notice of it, but when it flies a chorus of terrified squeaks and calls accompany its passage.

Spizaetus nipalensis nipalensis (Hodgson). Hodgson's Hawk-Eagle.

Quite a common bird, although each pair has a very large territory. One pair for the whole Sheopuri Ridge, where in spring they perform a very beautiful nuptial flight. It is then possible to approach them closely. Another pair is resident on Phulchowk, and I think a third on the Nangi Danda Ridge beyond, but this might be the Phulchowk pair. Odd single birds are often seen on Nagar Jung, perhaps young birds without territory.

Aquila chrysaetos (Linn.). Golden Eagle.

Not uncommon on the Gandak-Kosi watershed above 9000 ft. (2800 m.) in summer. I have seen 2 adults and 1 young bird soaring

over the ridge below Thare Pate. My husband watched one at 14,000 ft. (4270 m.) on the Gosainkund Lekh in May. It attacked a covey of large partridges, perhaps the Tibetan Partridge, but he was unable to identify them.

Circaetus gallicus (Gmelin). Short-toed Eagle.

During the weekend of 14-16 April we were on the Kakani Ridge at 7000 ft. (2130 m.) and each day we saw this eagle soaring and frequently hovering along the north side of this ridge. Several times we saw it dive steeply into the Valley [which here drops abruptly to about 2000 ft. (600 m.)] but we were never able to see the end of the dive nor what it caught. On many later visits to this ridge we have not seen it again.

Falco subbuteo Linn. The Hobby.

On 22 May 1961 on the Mamche Danda (the ridge north of the hills bounding the Kathmandu Valley) we watched 3 Hobbies wheeling round the oak-covered ridge on which we were camped. They were there all day, but never seemed to catch anything but butterflies, which they ate on the wing, holding them in their claws and tearing off the wings before eating them. A few days later Dr. Fleming said he saw 5 Hobbies behaving in exactly the same way on the ridge near Kakani. Both ridges between 7500-8500 ft. (2300-2600 m.). I have often seen them in winter, but then they are usually single. I have never seen them on the hills south of the Valley.

Alectoris graeca chukar (J. E. Gray). Chukor.

Although we had constantly heard tales of Chukor on the hills round Kathmandu, we had not come across them in 12 years of searching, and were inclined to think the birds extinct in this area. However, this year we saw a covey near Kakani [7000 ft. (2130 m.)] in January, and in April my husband saw a bird calling. Dr. Fleming has since shot a bird and said they were tolerably common well east of Kathmandu, so our birds are not stragglers on the extreme eastern limit of their range as we had supposed.

Francolinus francolinus asiae Bonaparte. Black Partridge.

I am sure this bird has increased very much in numbers during the last 5 years. It is now really common on the hills round Kakani at 5-7000 ft. (1520-2130 m.). Its call is heard on all sides during May, June, July, but we have never heard it call after the beginning of August.

Ithaginis cruentus cruentus (Hardwicke). Blood Pheasant.

Common on the Gandak-Kosi watershed at 11-12,000 ft. (3350-3660 m.) in bamboo forest. They are very tame.

Grus grus (Linn.). Common Crane.

Anthropoides virgo (Linn.). Demoiselle Crane.

Both these birds are common in the Rapti Dun in winter. On 22 October my husband saw a flock migrating over the ridges beyond Kakani. He estimated the flock at about 300 birds. They flew at least 1000 ft. (300 m.) above the ridges but, although this was not necessary, they always flew directly over the passes which form the lowest point in each ridge. They flew directly south, avoiding the Kathmandu Valley and were making in a direct line for the area where we have seen them in winter. They appeared to have flown down the Trisuli Valley which leads through the main Himalayan mountains into Tibet. My husband was unable to tell to which species they belonged.

Porzana pusilla pusilla (Pallas). Baillon's Crake.

Not recorded since Scully's day. I saw one on Taudah jheel on 21 March 1961. The reed cover was very thin and I had an excellent view as it walked nervously through the grass. I was able to get within 8 feet (c. 2 m.) of it. It must have been on migration as it has not been seen there again.

Amaurornis phoenicurus chinensis (Boddaert). Whitebreasted Waterhen.

Common in the Rapti Dun, but seen only once in the Valley. A single bird was in the rice near the Bagmatti River and when disturbed flew over the wall of the King's Reserve at Gowkarna. 17 June 1961.

Gallinula chloropus indica Blyth. Indian Moorhen.

Very common in suitable country in the Rapti Dun, but not previously recorded from the Valley. This autumn I saw two birds on Taudah jheel on 23 September. They were still there on the 25th. On 7 October there were 5 birds. Teal and Garganey use this jheel as a resting place when migrating and on 7 October there were 77 Garganey on the jheel. The Moorhen kept together in a little cluster. The Garganey got up as we approached the water. The Moorhen did not fly with them but moved off together to the far side of the jheel.

***Eupodotis bengalensis bengalensis* (Gmelin).** Bengal Florican.

Biswas says this bird has not been found in Nepal since Hodgson's day, but it is certainly not uncommon in the Rapti Dun in winter. It is found in the open grass country between the Rapti and Narayani rivers. I have seen them several times in December and last year had an excellent view of one quite close to us. We had seen it fly into a mustard field and failed to flush it out, when it suddenly walked out quite near us. When it crouches its camouflage is excellent and it appears to melt suddenly out of sight.

***Scolopax rusticola rusticola* Linn.** Woodcock.

Woodcock breeds quite commonly on the Gandak-Kosi watershed. Most birds seen about 10,500-11,000 ft. (3200-3350 m.). We have found it there in early and late May and often watched it roding in the evenings. In winter it is also much commoner than I had supposed on the hills north of the Valley, where there are many small damp valleys with berberis, camellia, etc. bushes. They are found in the same place year after year.

***Calidris subminutus* (Midden).** Longtoed Stint.

Dr. Fleming obtained this bird on the Bagmatti in May. This autumn I have examined carefully the flocks of Temminck's Stints which congregate on a small island in the Manora River from October to April. There are usually about 30 birds there, and two or three are darker than the others and spotted above. I had thought these were birds still in breeding plumage but think now that probably one or two Longtoed Stints are often present amongst the flocks of the commoner species.

***Rostratula benghalensis benghalensis* (Linn.).** Painted Snipe.

Not uncommon in the Rapti Dun in winter. We have seen odd ones in the Valley during the monsoon. My husband shot a male here in July and a female in November.

***Burhinus oedicnemus indicus* (Salvadori).** Indian Stone Plover.

On 24 August, 1961 we saw a pair of these birds near the Manora River. They are obviously rare stragglers to the Valley during the monsoon.

***Cuculus poliocephalus poliocephalus* Latham.** Small Cuckoo.

This year we trekked up to the Gosainkund Lekh in late May and found this bird absolutely abundant from 8000 ft. (2450 m.) to

nearly 12,000 ft. (3660 m.). A breeding male was shot at 10,500 ft. (3200 m.). They start to call much later in the year than the other cuckoos and continue calling until the end of July when most of the other cuckoos are silent. I have not heard them before the first week of May. The Cuckoo and the Himalayan Cuckoo start to call in late March and the Indian Cuckoo in the first week of April. The first two birds call till the 3rd week of June, the Indian Cuckoo till the 3rd week of July.

Coracias benghalensis benghalensis (Linn.). Indian Roller.

Although never seen in the Nepal Valley it is common in the Dun and lower hills below 3500 ft. (1060 m.). This year a bird remained for some time on Kakani Ridge [7000 ft. (2130 m.)]. This was in August during heavy monsoon weather. It spent all day quartering the ridge and roosted at night in a solitary pine tree in front of the bungalow.

Conostoma aemodium Hodgson. Great Parrotbill.

This bird is extremely local but very common in the limited area where it occurs. This is the mixed bamboo, maple, etc. forest at 11,000-12,000 ft. (3350-3660 m.) along the head of the Tādi Khola on the Gosainkund Lekh. Every naturalist who has visited that area reports seeing them. We watched them for some time this year in late May and shot one which proved to be a female near breeding. The birds were very noisy with much churring and chattering very like a *Turdoides*. They have also a characteristic note very harsh *krrarchah, krarch krachah*. I did not hear the mellow whistle described by Smythies. They keep very much to bamboo jungle, and though large clumsy birds are skilful at keeping out of sight.

Myzornis pyrrhoura Blyth. Firetailed Myzornis.

On the Gandak-Kosi watershed in late May we found a pair of these birds feeding young in the nest. This was in deep juniper forest at 12,000 ft. (3660 m.). The parents were very busy collecting insects on the trunks of junipers and they ran up the trees almost in the manner of a tree-creeper. Their bills were absolutely crammed with tiny black insects.

Callacanthis burtoni (Gould). Redbrowed Finch.

I can find no records of this bird in Nepal, and never saw it here myself till this year. On 25 March, 3 of these birds were feeding on the ground on Sheopuri at 8200 ft. (2500 m.). They were in an open glade

in deep forest. When disturbed they flew up into a bush but soon returned to the feeding ground. A male shot was not in breeding condition. They were quite silent. I have not seen them again.

Leucosticte nemoricola nemoricola (Hodgson). Hodgson's Mountain Finch.

Large flocks, at least 200 birds and probably many more, wander on to the hills north of the Valley during January to early March. They keep to the open grassy hillsides with berberis and pyrus bushes.

Propyrrhula subhimachala subhimachala (Hodgson). Redheaded Rosefinch.

We found these birds tolerably common in the high level mixed forest above Pokhara in November, but had never seen them in the Kathmandu Valley until this year. On 27 March on Sheopuri at 8400 ft. (2560 m.) I watched a pair of these birds feeding on the berries of *Mahonia nipalensis*. The male was gorging on the green berries, half hidden by them and obviously under the impression that he was completely hidden for, when a cooly passed by, he froze and allowed the man almost to brush against him. I managed to creep very close and he continued feeding, sometimes turning almost upside down to pick a berry and then reversing to normal position while he ate it. He was presently joined by the female who perched lower in the bush, and also ate the berries and was equally tame. A very beautiful sight.

Carpodacus thura thura Bonaparte & Schlegel. Whitebrowed Rosefinch.

During the last week of May we found these birds very common at Thare Pate on the Gandak-Kosi watershed. They were in pairs, but the pairs kept together in loose flocks. A female shot was not in breeding condition. They were always found in *Rhododendron campanulatum*, which was still in flower between 12,000 ft. (3660 m.) and 13,000 ft. (4000 m.). The birds were rather noisy. They had a ringing call but harsh and ill-tempered in sound *cha cha cha cha cha*.

BRITISH EMBASSY,
KATHMANDU,
NEPAL,

DESIRÉE PROUD

October 19, 1961.

9. CORRECTIONS TO 'SOME NOTES ON THE BIRDS OF THE NEPAL VALLEY'

I would like to make the following corrections to my paper 'Some Notes on the Birds of the Nepal Valley' (*J. Bombay nat. Hist. Soc.* 48 : 695-719) which was based on sight records:

p. 711. *Riparia riparia*: Small Sand Martin.

This should of course be *Riparia paludicola* (Vieillot); Plain Sand Martin. I have seen birds with a faint dark band across the breast, but all shot have been *paludicola*.

p. 712. *Anthus campestris*: Tawny Pipit.

A complete mistake. I have never found this pipit here. The pipits of the Valley are as follows:

Anthus hodgsoni hodgsoni Richmond: Hodgson's Tree Pipit. Breeds on the higher hills up to at least 13,000 ft. A few pairs breed as low as 8000 ft. On 22 May 1961 I found a pair feeding young in the nest at 8000 ft. on the Mamche Danda. They winter on the hills round the Valley from 6500 to 8500 ft., but I have never found one in the Valley itself.

Anthus hodgsoni yunnanensis Uchida & Kuroda: Yunnan Tree Pipit. Abundant wintering bird in the Valley and Duns. First date this year 22 September, a single bird in my garden. Most arrive first week October. All gone by 19 April.

Anthus novaeseelandiae richardi Vieillot: Richard's Paddyfield Pipit. Winter visitor and passage migrant.

Anthus novaeseelandiae rufulus Vieillot: Paddyfield Pipit. The common breeding pipit of the Valley and up to 7000 ft. in places.

Anthus pelopus J. E. Gray: Hodgson's Pipit. Breeds commonly on the higher hills, above 11,000 ft. Very abundant at 12,000 to 13,000 ft. I have not been higher than this, so do not know to what height it goes. Winters in the Valley and Duns.

Anthus cervinus (Pallas): Redthroated Pipit. I think a passage migrant. A few are seen in the marsh round the rice fields each year in September, but I have not yet obtained a specimen and this may not be a correct identification.

Anthus (Oreocorys) sylvanus (Hodgson): Upland Pipit. Common on all the hills from 5500 to 8000 ft., but rather local.

p. 713. *Aethopyga gouldiae*: Mrs. Gould's Sunbird.

This should be *Aethopyga nipalensis* (Hodgson): Nepal Yellow-backed Sunbird.

p. 719. *Nycticorax nycticorax*: Night Heron.

This is only a monsoon visitor to the Valley.

BRITISH EMBASSY,

KATHMANDU,

NEPAL,

September 26, 1961.

DESIRÉE PROUD

10. RECOVERIES OF RINGED MIGRATORY AND RESIDENTIAL BIRDS AT HINGOLGADH, JASDAN

An Orphean Warbler *Sylvia hortensis* ringed on 27th September 1960 at Hingolgadh, Jasdán, was recaptured at the same place on 21st September 1961. Similarly, a Wryneck *Jynx torquilla* ringed on 10th October 1960 at Panelia (barely 3 miles as the crow flies from Hingolgadh) was recaptured there on 13th October 1961. These birds must have travelled many thousands of miles during the year, but they were recaptured in the same places.

There were several recoveries in Sept./Oct. 1961 of residential birds ringed in Sept./Oct. 1960. In all these cases: 5 Redvented Bulbuls, 1 Indian Robin, 1 Rufous-backed Shrike, 1 Bay-backed Shrike, 1 Great Grey Shrike, no bird ringed at Panelia was recovered at Hingolgadh and *vice versa*. In fact in the case of the Great Grey Shrike, the bird was ringed on 10th October 1960 and recaptured on 13th October 1961 in the same babool tree as last year. This time it had brought along its mate too and so both now have rings.

A House Sparrow (*Passer domesticus*) was caught at Jasdán, and ringed (A. 3072) and released at Hingolgadh 12 miles from Jasdán on 27th September 1960. It was recaptured at Jasdán on 6th April 1961 where it was building a nest in the same room where it had been caught in 1960.

THE PALACE,

JASDAN,

October 15, 1961.

YUVRAJ SHIVRAJKUMAR

11. NOCTURNAL 'PREDATOR' OF FRUIT OF YELLOW OLEANDER (*THEVETIA NERIIFOLIA*)

On several days in October last I found in the early mornings under some mango trees in my garden the remains of the meal which some creature of the night seemed to have eaten in the trees. Usually it consisted of green guavas with the flesh partly eaten. On six separate occasions, however, it was the fruit of the Yellow Oleander (*Thevetia nerifolia*), which is said to be highly poisonous. On four occasions a small portion of the flesh was eaten, and in the flesh that remained there were pits dug by a beak-like mouth; in one case less than half the flesh of the fruit remained; in another there was a freshly denuded seed under the tree and I could not find any trace of the flesh. Looking about near the place where the partly eaten fruit has been dropping I found ten more seeds of Yellow Oleander. There is no Yellow Oleander plant near by from which the seeds could have come; so the night feeding has probably been going on for some time. Could this be the work of a fruit-eating bat? One night at about 9.30 my daughters saw a flying fox in flight near the mango trees but it did not settle.

There are records of Yellow Oleander fruit being eaten by the Koel (M. Krishnan, 1952, *J. Bombay nat. Hist. Soc.* 50 : 943-5) and by the Grey Hornbill (K. K. Neelakantan, 1952, *ibid.* 51 : 738). N. L. Bor & M. B. Raizada (1954, *SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS*: 195) say that 'all parts of the plant are poisonous' and A. P. Benthall (1946, *THE TREES OF CALCUTTA AND ITS NEIGHBOURHOOD*: 303) that 'all parts of the plant have to be used with great caution'. Both these authors expressly speak of the latex, the seeds, and the wood as poisonous, but make no special mention of the fruit. M. Krishnan (*loc. cit.*) says that the pulp of the fruit is 'known to be definitely poisonous to mammals', in which case it would be remarkable if it is a bat that has been eating the fruit. From the Editorial note to M. Krishnan's Miscellaneous Note it appears that Kirtikar & Basu (*INDIAN MEDICINAL PLANTS*) speak of the fruit as poisonous. Could it be that there is a stage in the development of the fruit at which the poison is innocuous to certain animals, a fact that helps the plant to spread its seeds?

49 PALI HILL,
BANDRA,
BOMBAY 50,
November 4, 1961.

D. E. REUBEN

12. JUMPING SNAKES

I have only recently seen Mr. A. E. Butler's account of how the Russell's Viper, *Vipera russelli*, will jump to attack [*J. Bombay nat. Hist. Soc.* 55 (1) : 173].

I can state categorically that no known species of snake *deliberately* jumps off the ground to attack. But just as directly it can be stated that certain species of vipers in the act of striking do in fact *involuntarily* jump off the ground, but the jump is unintentional.

The vipers (or adders) are poisonous snakes with movable or hinged fangs which when not in use are folded back against the roof of the mouth. To get the fangs into striking position the snake has to depress the lower jaw, but this cannot be effected while the creature is flat on the ground. In consequence, the strike is made with an initial backward movement of the head, faster than the eye can see, to enable the fangs to move into the striking position, and at the same time the head comes forward in a flash to effect the bite. This forward thrust can be so vigorous that sometimes the snake, and particularly smaller ones, throws its body right off the ground.

The nature of this movement is well-illustrated by a vernacular name of the African Puff Adder, *Bitis arietans*, which refers to the snake 'which has to turn on to its back before it can bite'.

But the best exponent of 'jumping' in Africa is the Night Adder, *Causus rhombeatus*, a fairly slender species which rarely exceeds a length of two feet. I have frequently seen examples of the Night Adder lift themselves off the ground the equivalent of their own length, but by no means all will do this, in fact the majority do not. In order to reinforce the vigour of its strike this species sometimes inflates the anterior third or half of its body, and as it strikes it deflates with such force that the strike becomes a definite 'jump'.

I hope these remarks afford a satisfactory and convincing explanation of a snake's 'jump'.

FLAT 9,
17 CHELSEA EMBANKMENT,
LONDON, S.W. 3,
June 16, 1961.

C. R. S. PITMAN

13. UP-STREAM MIGRATION OF ELVERS OF *ANGUILLA NEBULOSA* (= *BENGALENSIS*) OVER FIRST ANICUT OF THE RIVER GODAVARI¹

(With one plate)

During investigations on the freshwater prawn fishery in the river Godavari the author came across the interesting phenomenon of the up-stream run of young elvers of *Anguilla nebulosa* (= *bengalensis*) over the first anicut at Dowleishwaram, situated 80 km. from the sea.

On 26 August 1960, shortly after dusk, small elvers of *A. nebulosa* were noticed negotiating the anicut by slowly moving up-stream along portions of the sloping cement pavement over which the current was sluggish; the movement extended to adjoining areas which were kept moist by spray from the stream. Subsequent regular observation showed that this run of elvers continued throughout the period of overflow of the water over the anicut. It ceased with the stoppage of the overflow towards the end of February 1961. The up-stream migration of the elvers started again in June 1961, when the water once more began to overflow. During the non-flood period, when the shutters of the anicut were raised, the elvers were observed to move vertically up the iron shutters, particularly between two shutters where there was slight leakage.

The anicut at Dowleishwaram covers the entire breadth of the river, 6.4 km., and consists of four sections with islands in between. The shutters, about one metre in height, fall automatically during heavy flood and allow a continuous flow of water, often submerging the entire anicut and maintaining the same water-level on both sides. The run of the elvers was recorded on all edges of the anicut adjoining land.

In all, 452 elvers were collected and measured. The sizes ranged from 48 to 58 mm., the size frequency distribution showing a unimodal curve with a well-defined mode at 53 mm. Nearly 90% of the elvers were between 51 and 55 mm. in length. Microscopic examination of the skin and its scrapings showed no trace of scales on any part of the body.

Rahimullah *et al.* (1944) recorded 152 mm. long elver of *A. nebulosa* from Nizamsagar Dam, higher up the Godavari River, about 725 km. from the sea. Presuming it to be impossible that

¹ Communicated by the Director, Central Inland Fisheries Research, Institute Barrackpore, W. Bengal.



Elvers of *Anguilla nebulosa* (= *bengalensis*) moving up-stream over sloping cement pavement of R. Godavari at Dowleishwaram.

elvers of this size could have overcome the intervening obstacles of two anicuts and some precipitous falls, they opined that *A. nebulosa* probably breeds in fresh water. Pantulu (1956), relying on his study of *A. nebulosa* from Hooghly River, felt that there was not sufficient reason to accept the assumption of Rahimullah *et al.* The present record of successful negotiation of the Dowleishwaram Dam by 49-58 mm. long elvers shows how migration can take place to the upper reaches of the river. Pantulu (1956) recorded a monthly growth rate in *A. nebulosa* from the Hooghly of 9 to 12 mm. for specimens ranging from 47 to 150 mm. Considering the different size groups recorded at Dowleishwaram and at Nizamsagar, we might estimate that the elvers recorded at Dowleishwaram will reach Nizamsagar in about a year.

In the third week of July 1961 in Godavari River elvers were recorded in good number in the fry collection nets operated at Yanam (20 km. from the sea), Kotipally (32 km.), and Kapileshwaram (48 km.). At the first two places 62 elvers were taken in 15 hours of fry collection, and the size frequency showed a well-marked mode at 48 mm. (range of size 45-56 mm., 82% of collection ranging from 47-51 mm.). This along with the facts recorded above is evidence supporting a migration of elvers from the sea to the upper reaches of the river at Nizamsagar.

My conclusions are supported by the observation of Sundara Raj (1916) that every year by about November a number of elvers measuring 2 to 3 in. (50 to 75 mm.) ascend the rivers Cooum and Adyar. I may mention also the observation of Frost (1954) that elvers of *A. nebulosa labiata* ascend Tana River in Kenya, overcoming many waterfalls including a vertical fall of 75 ft. (23 m.).

ACKNOWLEDGEMENT

I am gratefully indebted to Dr. M. P. Motwani for his kind encouragement and critical perusal of the manuscript, and Sri [redacted] of this Institute for supplying me with the elvers collected from [redacted] and Kotipally.

CENTRAL INLAND FISHERIES
RESEARCH INSTITUTE,
RAJAHMUNDRY,
October 7, 1961.

K. H. IBRAHIM

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14. THE CALANOID COPEPOD *PSEUDODIAPTOMUS*
ARDJUNA BREHM—A NEW DESCRIPTION¹

(With one plate)

Pseudodiaptomus ardjuna was first created by Brehm (1953) for two specimens collected by him from Thana creek, near Bombay, but his description and illustrations are incomplete. Hence, an attempt is made here to illustrate and describe this species in detail from the specimens collected from the plankton samples from Mahim backwater in March 1959.

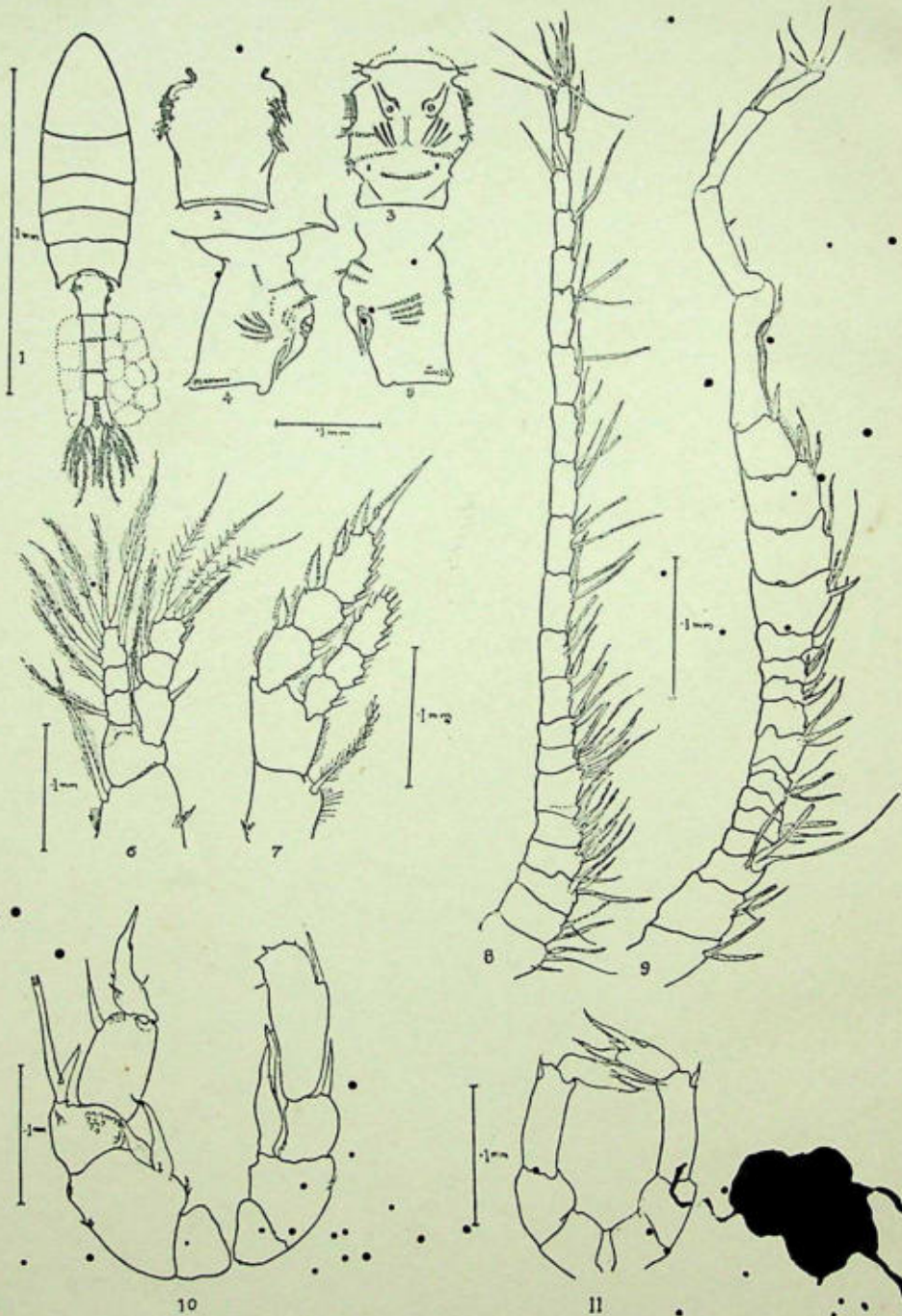
***Pseudodiaptomus ardjuna* Brehm**

Female. Total length, 1.2 mm. (Plate, fig. 1).

The proportional lengths of the cephalothorax and the abdomen are 63:37=100.

There are five cephalothoracic segments and the head is fused with the first thoracic segment. Forehead rounded in dorsal view and prominent and arched in side view; posterior thoracic margins produced into small spines directed backwards and outwards; rostral spines small, delicate, and curved downwards and backward.

¹ While this paper was still in the proof stages our attention was drawn to a paper entitled 'Studies on Indian Copepods 4. Description of the Female and a Redescription of the Male of *Pseudodiaptomus ardjuna* Brehm (Copepoda, Calanoida) with Notes on the Distribution and Affinities of the Species', by A. N. P. Ummerkutty [*J. Mar. Biol. Ass. India*, December 1960 (published on 11-11-1961) 2 (2): 179-185] in which specimens obtained in the Gulf of Mannar and the Palk Bay are described. We have, therefore, in consultation with the authors deleted the descriptions of the swimming legs, and are retaining the rest as there appear to be some differences in the two accounts.—EDS.



The Calanoid Copepod *Pseudodiaptomus ardjuna* Brehm

1. ♀ entire, dorsal; 2. ♀ genital segment, dorsal; 3. ♀ genital segment ventral; 4. ♀ genital segment, right side; 5. ♀ genital segment, left side; 6. ♀ 1st swimming leg; 7. ♀ 2nd swimming leg; 8. ♀ 1st antenna; 9. ♂ 1st right antenna; 10. ♂ 5th pair of legs. 11. ♀ 5th pair of legs.

The abdomen consists of four segments, the proportional lengths of which are as follows:

Abdominal segments				Furca	
1	2	3	4		
26	19.5	21	14	19.5	= 100

The genital segment is asymmetrical in shape and is the largest of the abdominal segments. Its surface is ornamented with an elaborate system of spinules distributed in different groups (Figs. 2, 3, 4, 5). On the ventral side the genital orifice is guarded by two backwardly projecting spines. Posterior margins of the abdominal segments 1, 2, and 3 are fringed with triangular teeth along their dorsal aspect only. They gradually decrease in size towards the lateral sides. Furcal rami are thrice as long as broad and are lined with coarse hair along their inner margins. There are six furcal setae; the second is the smallest and is situated somewhat dorsally.

Ovigerous female has a single ovisac with about 22 to 25 eggs.

First antenna (Fig. 8) reaches back to about the posterior margin of the genital segment and consists of 21 segments, the proportional lengths of which are as follows:

Segments:	1	2	3	4-5	6-7	8-9	10	11	12	13	14
	48	40	28	36	36	24	32	32	48	56	60
	15	16	17	18	19	20	21	22	23	24-25	
	64	68	68	64	60	40	44	48	48	56=1000	

Segment 19 has a modified strong seta with margin serrated along its inner side.

The remaining mouth parts are similar to those of the other members of the genus like *P. serricaudatus* and *P. hickmani*.

Male. Total length, 1 mm.

Proportional lengths of cephalothorax and abdomen are 68:32=100.

There are five abdominal segments, the proportional lengths of which are:

Segments					Furca	= 100
1	2	3	4	5		
9.5	23	22	9	11.5	15	

Posterior margins of the segments 2, 3, and 4 are fringed with teeth as in the female.

1st right antenna (Fig. 9) is modified to form a grasping organ. It has 21 segments and it resembles the grasping antenna of *P. hickmani*.

Fifth pair of legs (Fig. 10):

The structure of the fifth pair of legs is the main distinguishing character of this species. It resembles to some extent the structure of the same appendage of *P. hickmani* (Sydney variety) as figured by Dakin & Colefax (1940). The 2nd basal of the right side has double spinous processes (endopod), one with a small hairy projection on the tip and the other with a bifid tip. The latter is missing in the figure given by Dr. Brehm. It is observed that this structure is usually lost in handling of specimens. Exopodite is three-jointed. First segment has a Y-shaped spinous process with the inner short and the outer long arm with the bifid tip. There is a small spine at its base. Along its inner anterior face there are 15 to 18 strong blunt teeth arranged in U-shape. Second segment has a spine distally on outer margin and a few teeth in front of its base. Third segment is sickle-shaped. On the left side, the endopodite is sickle-shaped but it has a bifid tip. Exopodite is two-jointed. First segment has a spine distally on its outer margin. Second segment is a plate-like structure, twice as long as broad, with a spine on its outer margin distally. Its distal margin is serrated and produced into a beak-like structure on its inner extremity.

Discussion

Apparently the sketches given by Dakin & Colefax (1940) for *P. hickmani* resemble our specimens in many respects, but *P. ardjuna* can be easily distinguished from the former by the structure of the 5th pair of legs in the male.

The Thana creek from which Dr. Brehm collected his specimens, as well as the Mahim backwater from which the present specimens were collected were formerly confluent water masses. The reclamation programme of the Bombay Municipal Corporation has separated

these two bodies of water in recent years. No specimen of this species was, however collected from the offshore waters of Bombay, tending to show that it prefers low salinity.

We take this opportunity to thank Dr. S. Krishnaswamy, Reader in Zoology, Zoological Research Laboratory, University of Madras, Madras, for his valuable suggestions, and Mr. M. C. Joshi for supplying the material.

INSTITUTE OF SCIENCE,
BOMBAY,

July 10, 1961

H. V. DESAI

D. V. BAL,

Ph.D.

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15. MIGRATION OF BUTTERFLIES

This report is sent to place on record a migratory flight of butterflies witnessed by me on 4 August 1961. I first noticed it at about 9 a.m. at Sathuperi, about 7 miles south-west of Vellore, three Common Indian Crows (*Euploea core* Cramer) and one Blue Tiger (*Danaus limniace* Cramer) floating slowly in a NE. to SW. direction. At the time I was on my way to Kammavanpeth, 15 miles south of Vellore. All the way the flight continued, butterflies crossing the road singly or in twos or threes, flying from a few inches to a few feet above the ground except when clearing obstacles, all flying in the same direction NE. to SW. At Kammavanpeth the migration was still in progress but rather thin. As a rough test I counted the number of butterflies passing between two trees about 60 feet apart. The figures were:

1st 5 minutes: 4 *D. limniace*

2nd 5 minutes: 3 *D. limniace* and 1 *E. core*

3rd 5 minutes: 1 *D. limniace*

4th 5 minutes: nil

The migration was still in progress along the whole distance of 15 miles when I drove back to Vellore at 11 a.m. At places it appeared to be denser than at Kammavanpeth, but it was difficult to estimate with certainty when driving a car. Except at Kammavanpeth, the number of *E. core* exceeded that of *D. limniace*.

A few butterflies were seen in Vellore town, one crossing the main street.

VIRUS RESEARCH UNIT,
C.M.C. HOSPITAL,
VELLORE,
September 13, 1961.

R. REUBEN

16. OCCURRENCE OF THE BLUE MORMON (*PAPILIO POLYMNESTOR* CRAMER) IN BOMBAY

In my Miscellaneous Note dated 13 April 1960 [*J. Bombay nat. Hist. Soc.* 57 (1) : 231-3], I reported the occurrence of the Blue Mormon butterfly (*Papilio polymnestor* Cramer) on Pali Hill in Bandra and, having special regard to the uniformity of the direction of flight observed by Mr. Basil W. Wirth at Colaba, I suggested that this might be a case of local migration. Further observation on Pali Hill shows that *P. polymnestor* occurs in several months of the year, and that it does not fly in any one direction. My observations, made in the compound of No. 49 Pali Hill and its immediate neighbourhood, are as follows:

Month	1960		1961		Remarks
	No. of days on which seen	No. of times seen	No. of days on which seen	No. of times seen	
January	nil		1/1		
February	1/1		1/1		
March	1/1		7/10		
April	nil		5/7		
May	nil		No observations		
June	nil		nil		
July	5/7		nil		
August	nil				No observations after July 1961
September	6/6				
October	7/12				Seen 4 times on one day. Flitted about in the garden on two days.
November	11/20				Seen flitting about in the garden on three separate occasions.
December	3/3				

On every occasion only one butterfly was to be seen. The impression created was of one butterfly moving about in a restricted

area and being seen from time to time. For some days the butterfly had a portion of a wing damaged and so it was possible to identify it in several successive appearances.

In view of the facts noted it does not appear likely that Pali Hill is merely a point on a route of local migration. It is possible that there is a seasonal appearance of the butterfly on Pali Hill, a possibility that can only be tested by observations over an extended period.

49 PALI HILL,
BANDRA,
BOMBAY 50,
November 3, 1961.

D. E. REUBEN

17. MASS OCCURRENCE OF THE PREDATORY STINK
BUG, *CANTHECONIDIA (CANTHECONA) FURCELLATA*
(WOLFF.) ON *AMSACTA ALBISTRIGA* WALK.
IN SOUTH INDIA¹

The red hairy caterpillar, *Amsacta albistriga* Walk. (Arctiidae, Lepidoptera), is a very serious pest of the dry crops, especially groundnut, in most of the rain-fed tracts of Madras State. Apart from the record of the parasite *Apanteles creatonoti* Vier. (Ramakrishna Ayyar & Margabandu, 1934) in Mysore, there seems to be no record of any natural enemies on the pest under field conditions in India. Under laboratory conditions the eggs were found to be parasitised by *Trichogramma* sp. in Mysore (Kunhi Kannan, 1931), and the larvae attacked by the pentatomid bug *Cantheconidia furcellata* (Wolff.) in Coimbatore (Cherian & Brahmachari, 1941). Recently, however, during a study tour to the southern districts, the bug *C. furcellata* (Wolff.) was observed in the field to account for considerable mortality of the caterpillars of *Amsacta albistriga* Walk. in Alagarkoil area (Valayapatti village) of Melur taluk in Madurai district. Since this is the first time that it has been found to exercise some natural check on the pest in the field, a short account of the insect is given here.

While studying the recent outbreak of the hairy caterpillar pest on groundnut crop in Alagarkoil area it was observed that many dead

¹ Communicated by the Dean, Agricultural College & Research Institute, Coimbatore.

caterpillars were hanging, head downwards, from the under surface of the leaves of the redgram (*Cajanus cajan* Mill.) plants on which they were found resting after devastating the whole groundnut crop. On examination it was found that the mortality of the caterpillars was due to the attack of the bug *C. furcellata* (Wolff.). A very large number of the bugs were present on the redgram plants, and the last instar nymphs and the adults of the bug were attacking the caterpillars of advanced stage, i.e. from the third instar onwards. The mode of attack was to approach the caterpillar from behind, place the rostrum in between the two anal prolegs, and thrust the stylets into the posterior part of the larva. Most probably the young bugs breed on the redgram plants or weeds in the locality. This is in conformity with the observation of Cherian & Brahmachari (1941) that the bugs feed at first on the plant sap and only later turn their attention to the insect-food.

Cantheconidia furcellata (Wolff.) has a wide distribution. It occurs in Formosa, Malaya, Borneo, Philippines, India, Ceylon, Burma, Java, etc. and is well known as a predator of lepidopterous larvae. In India so far it has been noted from Bihar, Bengal, Calcutta, Ranchi, Bombay, Madras, Coimbatore, Saidapet, Musiri, and Aduthurai. Previous records in India show that it has been noted as predaceous on larvae of *Laphygma exigua* Hb. (Vassiliev, 1914), *Prodenia litura* Fb., *Athalia proxima* Kl. (Ballard, 1922), *Thosea cervina* Moore (Ananda Rau, 1936), *Utetheisa pulchella* Linn. in Central Provinces (Fletcher, 1917), *Hybloea puera* Cram., Tusser silkworms *Antherea* sp. (Distant, 1902), *Semiothisa pervolgata* Wlk., *Terias hecabe* Linn., *Catopsilia pyranthe* Linn. (Cherian & Brahmachari, 1941). Under laboratory conditions (*loc. cit.*) the bug was noted attacking the caterpillars of *Tarache nitidula* Fb., *Earias fabia* Stoll., *Orthaga* sp., *Spodoptera mauritia* Boisd., *Cirphis unipuncta* Haw., *Psalis securis* Hubn., *Euproctis fraternus* Moore, *Argina cribraria* Clerck., *Hypsa sericae* Moore, *Utetheisa pulchella* Linn., *Amsacta albistriga* Walk., *Eupterote mollifera* Wlk., *Stomopteryx nerteria* Meyr., *Sylepta derogata* Fabr., *Schoenobius incertellus* Wlk., *Scirpophaga* sp., *Papilio demoleus* Linn., *P. aristolochiae* Fab., *Acherontia styx* Westw., *Melanitis ismene* Cram., and *Parnassia matthias* Fabr. Fletcher (1914) has reported an instance wherein the bug was bred in large numbers and released in cotton and gram fields to check caterpillar attacks on these crops. In the Insect Collections at the Agricultural College & Research Institute, Coimbatore, a few bugs have been collected as predaceous on the larvae of *Athalia proxima* Kl. (Coll: T. V. R. Ayyar, 1912).

Chloridea sp. on cotton (Coll: M. S. Kylasam, 1929), and *Thiacidas postica* Walk. on *Zizyphus* (Coll: T. V. Subramanian, (1936).

Recent researches have indicated that the pest *A. albistriga* Walk. can be controlled by dusting BHC, 10% at its most vulnerable stage, i.e. when the caterpillars are a week old. Spraying 0.05% Parathion to control grown-up caterpillars is practicable only in places where there are water facilities available. Inasmuch as the bug has been previously utilised by breeding and liberating in cotton and gram fields for controlling caterpillar pests of the crops, it may possibly be used in the biological control of the red hairy caterpillar *A. albistriga* Walk.

POST-GRADUATE TRAINING
CENTRE,
COIMBATORE,
October 28, 1960.

B. VASANTHARAJ DAVID
M. BASHEER

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18. STRANGE BEHAVIOUR OF SOME DRAGONFLIES

Chandola is a large irrigation lake three miles south of Ahmedabad situated on the Ahmedabad-Bombay National Highway. Since I started taking an interest in nature study more than thirty years ago, Chandola Lake has been my field observatory for the study and collection of butterflies, dragonflies, and other insects, fishes, birds, and lately spiders. When full of weeds, it is populated by a large number of dragonflies.

I have noticed that, whenever I move on the bank of the Lake on my bicycle, a number of dragonflies fly parallel with my back wheel,

about 8"-12" off and keep company. A sudden burst of speed or slowing down does not inconvenience them, and they immediately accelerate or decrease their speed. If I brake and stop, they also stop without moving even a foot further and then disperse, some resting on ground, some on grass stems, and some flying away. The moment I start my bicycle again, several dragonflies collect from somewhere (I am not sure if they are the same insects) and fly parallel to the back wheel. They follow me for a distance of 50 to 100 yards according to where I stop. This is not an isolated experience. It has occurred time and again, more or less regularly, for a number of years in seasons when dragonflies were plentiful. Their number varies from 10 to 50. I have been too lazy to collect specimens and hence am unable to name the species, but they invariably belonged to that drab or dull (yellowish brown) coloured, short and thick-bodied kind of insects grouped under the sub-order Anisoptera of the order Odonata. None of the brilliantly coloured slender-bodied Zygoptera was ever found to indulge in this pastime.

What is the explanation of this peculiar behaviour on the part of the dragonflies? Apparently, they seem to be attracted by the spinning back wheel (why not the front wheel?) or is the whirring sound of the fast moving wheel the cause of this strange behaviour? That excellent book DRAGONFLIES by Corbet, Longfield, and Moore (New Naturalist, Collins, 1960) does not refer to any such habit.

In this connection, there is one side of the dragonfly character which should not be lost sight of. They are by nature fun-loving insects. They continuously chase each other without any apparent reason, and also fight with each other if they are near water. Perhaps this habit of continuous movement may be responsible for the peculiar behaviour referred to above, being attracted by the moving wheel. A dragonfly sitting or resting on a weed or branch of some bush will immediately leave its perch if another dragonfly flies over it and will fly after the other.

Or is the action similar to that of flies (?) collecting round or over the head of a human being in the form of a cloud, a thing we often see?

GUJARAT NATURAL HISTORY SOCIETY,

AHMEDABAD,

November 15, 1961.

HARINARAYAN G. ACHARYA

19. ASYMMETRICAL POSITION OF PALE ANTENNAL SEGMENTS OF *PARALABIS DOHRNI* (KIRBY)
(LABIDURIDAE, DERMAPTERA)

(With one text-figure)

In an attempt to identify the earwig *Paralabis (Psalis) dohrni* (Kirby), I was struck by the fact that the position of the pale antennal segments varies not only between different specimens of the species but also between the left and the right antennae of the same specimen (see text-figure). This was confirmed by the examination of more than fifty specimens, handpicked from gardens in Poona and found generally under earthen flower pots (*kundis*). Out of the total number examined two specimens had no pale segment and in four there was symmetry between the antennae. In the table below I give details of 11 of the specimens examined by me.

TABLE

Some asymmetrical positions of the pale antennal segments of
Paralabis dohrni (Kirby)

Sp. No.	Left Antenna		Right Antenna	
	Total No. of segments	Serial Nos. of pale segments	Total No. of segments	Serial Nos. of pale segments
1	13	12, 13	12	10, 11
2	17	14, 15, 16	13	11 (3/4), 12, 13
3	17	14 (3/4), 15, 16, 17	19	15, 16, 17
4	14	12, 13	12	12
5	18	14 (3/4), 15, 16, 17 (3/4)	17	15, 16, 17
6	15	13, 14, 15	17	13, 14, 15
7	14	14 (1/4)	14	12 (1/4), 13 (1/4), 14
8	18	14, 15, 16	12	10 (1/4), 11, 12
9	12	10 (1/4), 11, 12	13	13 (1/4)
10	16	13 (1/4), 14, 15	17	13 (1/4), 14, 15
11	17	nil	11	nil

The late Dr. W. D. Hincks (1960, personal communication), of the Manchester Museum, to whom I am grateful for confirming

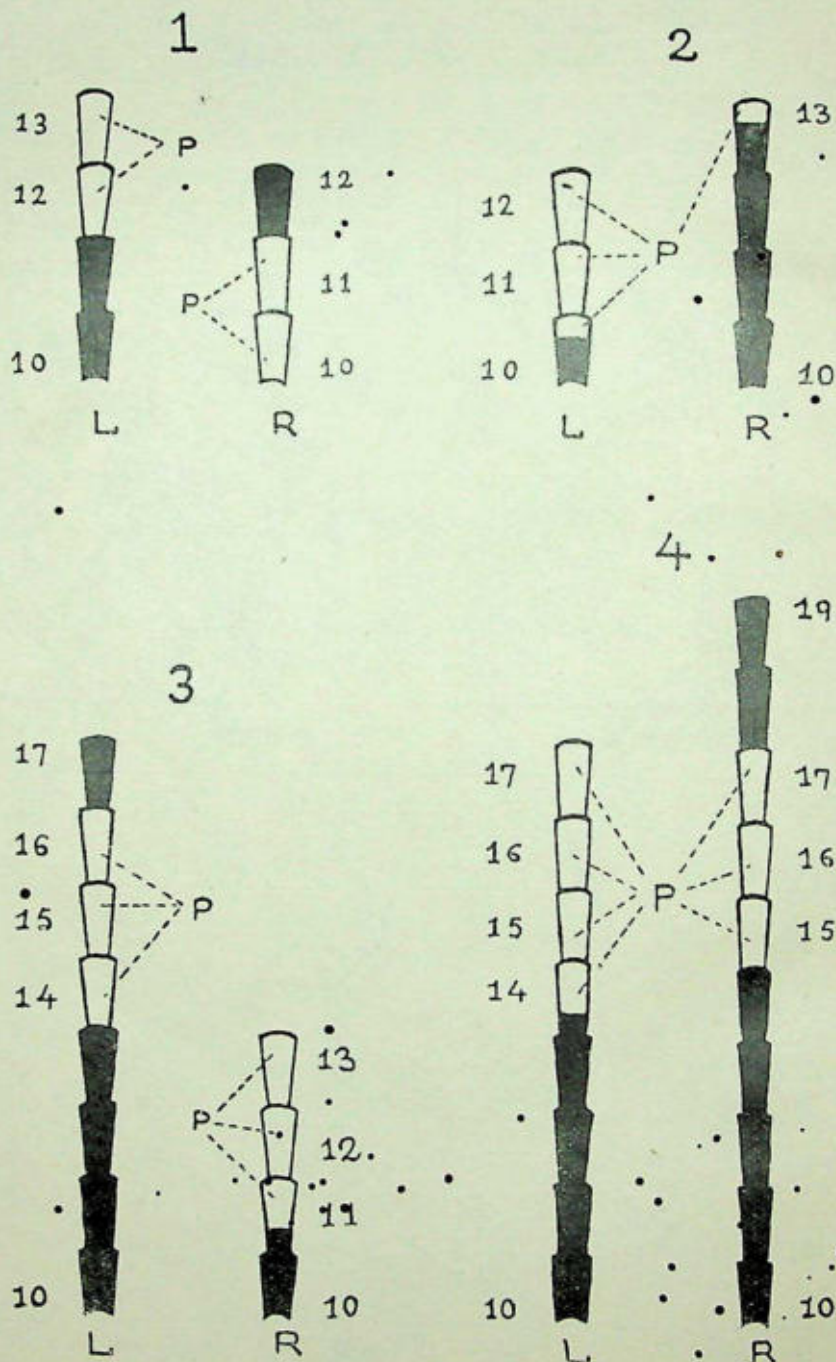


FIG. 1: Some of the asymmetrical positions of the pale antennal segments of *Paratabis dohrni* (Kirby). L: Left antenna. R: Right antenna. P: Pale segments. Nos. 10, 11, 12, etc.: Number of antennal segments.

my identification observed: 'It should be remembered that the significant segment in the development of the antennae is segment 3, which divides from instar to instar producing an increasing number of segments per instar. The increase exhibits a different pattern in different species but within a species the pattern is surprisingly constant. Occasionally something goes wrong with this process producing a slightly different pattern in a particular individual, which may thus be asymmetrical if only one side is affected or symmetrical if both sides are equally influenced.' If Dr. Hincks's suggestion is correct and the asymmetry is attributable to an accidental cause, it is remarkable that it should be found in such a large proportion of the cases examined.

Similar asymmetry in the distribution of the pale antennal segments was observed in *Euborellia annulipes* (Lucas), but I have not kept a detailed record of my observations.

RESEARCH LABORATORY,
ZOOLOGY DEPARTMENT,
N. WADIA COLLEGE,
POONA 1,
July 20, 1961.

P. V. JOSHI

20. OBSERVATIONS ON THE SPIDER *LATRODECTUS HASSELTII INDICUS* SIMON WITH A NOTE ON ARACHNIDISM

(With a text-figure)

On 17 June 1961 a female spider *Latrodectus hasseltii indicus* Simon, carrying a cocoon was collected by the junior author (PWS) under a stone in open scrub country on the tableland 2000 ft. at Suriamal in north Thana, Bombay. The spider was kept alive for observation some time. To the account in Pocock's FAUNA volume on Arachnida which is restricted to the size and colour of the female (?) it may be added from observation of this specimen that the two terminal segments of all the legs of the adult female are reddish brown in colour. The following further notes may be of interest.

On the 18th, in transport and transfer to its new home in a rectangular glass jar (20.5×10×24 cm.) the spider and the cocoon were separated, the latter lying on the bottom. However, during the night the spider spun a few strands in a corner of the jar c. 10 cm. off the bottom, recovered the cocoon, and attached it to the web. She showed no further interest in it though she usually spent the day on the web quite close to the cocoon. On 22 June a second cocoon,

similar in dimensions to the first, was spun quite close to the first on the same web. The cocoons were white in colour, coarse-textured, spherical in shape, with a diameter of 10 mm.

On 9 July, 23 days after collection, young emerged from the first cocoon, and on 13 July from the 2nd cocoon, 22 days after it was spun. The spiderlings emerged through a small circular hole on the cocoon. There are instances of the mother spider of other species aiding the young by perforating the cocoon; in the present case the young emerged at night and we were unable to make any observations. The young spiders remained mainly on the web strands and on the muslin cover of the jar. The spiderlings from the two cocoons totalled 304, but it was not possible to keep separate counts.



× 2

The spiderlings differ markedly from the adult in colour and body pattern. Unlike the jet black of the adult with the patches of scarlet on the upper side of the abdomen and at the tip of the lower side of the abdomen, the young are mainly white and brown. The thorax is pale brown above and below, with a black border to the edge of the sternum; abdomen white above with four black spots arranged distally in pairs and a large pale brown proximal spot, a middle brown patch, and a distal smaller brown spot, all situated along the mid abdomen; ventrally white, with a black line along the sides, which end above the spinneret; fangs black; legs translucent brown. Size less than 1 mm. in length.

The cocoon and the colour of the young are in many respects similar to those of the American species *Latrodectus mactans*.

The adult was fed on flies and black ants (*Crematogaster* sp.), but there are records of the species feeding on much larger insects. The young were to a certain extent cannibalistic. None survived.

The genus *Latrodectus* is widely distributed, and is regarded as particularly dangerous in widely separated parts of the world: *L. menavodi* in Madagascar, *L. katepo* in New Zealand, *L. geometricus* and *L. indistinctus* in Africa, the Black Widow (*L. mactans*) in West Indies and North America, and the Karakurt or Black Wolf (*L. tredecimguttatus*) in Southern Europe.

A comprehensive article on arachnidism entitled 'The health problem of Arachnidism' by Z. Marectic and M. Stanic, based on their observation and work, clinical and otherwise, in combating an outbreak of Arachnidism in the Istrian region of Yugoslavia in the late forties and early fifties, was published in the *World Health Organization Bulletin*, 1954, 11 : 1007-1022. The notes below are compiled from that article as very little information is available on the subject in India, where only one little-known species occurs.

In south Europe, where *L. tredecimguttatus* the type species of the genus is common, there appear to be periodic fluctuations in the number of specimens seen. In some years the spiders are found in enormous numbers and then disappear for years, even decades. In Austria and Yugoslavia, it is said to be extremely common and to be collected from almost every square yard. The spider is not aggressive, biting only in self-defence. During the period 1948-53 over 180 cases, mostly among agriculturists, were treated.

The effect though serious is not usually dangerous to life. The reactions follow a set pattern. The first symptom, which appears in 10 to 20 minutes or in some cases even an hour or more later, is a burning sensation at the site of the bite followed by pain in the lymphatic nodes (axillary or inguinal). This is followed by a feeling of pressure in the chest and pain in the belly, back, and extremities, particularly the legs. Intense agonising pain is in fact the main symptom. In serious cases the patient is unable to stand erect and becomes stiff. There is increased tendon reflex, profuse sweating, sometimes shedding of tears, excessive salivation or a dry mouth, convulsion, and in some cases tetanic spasms of the jaw muscles. There is also considerable restlessness, the patient having an urge to move and walk, is convulsed and writhes. These movements, also noticed in experimental animals, give a certain amount of relief from pain, and are believed to be the origin of hysterical tarantism, from which originated the name of the Tarantella dance.

The symptoms in untreated persons last for a week and convalescence takes a month or more. There is considerable loss of weight, one patient having lost 5 kg. in 3 days. In experimental animals there is an instance of a rat having lost 20% of its weight in 24 hours.

Curiously enough the effect of the venom on different animals varies and the relative size of the animal appears to be of no importance. The poison is deadly to camels and horses (a horse injected with the macerate of a single spider died within 24 hours) but has no effect on goats! Among the smaller animals mice are highly sensitive, death following a bite in 10 to 20 minutes. Rabbits and dogs are resistant. The venom has no effect on reptiles. It is especially effective on nerve cells, and is believed to have a toxic effect 15 times greater than that of the rattlesnake. The venom is of a clear lemon-yellow colour. The Ph changes with temperature, becoming alkaline above 25° C. and consequently more toxic. It is also established that the venom of different species is practically identical and anti-venom against the bite of one species gives equal protection against allied species. The method of treatment which gave the best results was simultaneous application of anti-venom and calcium; however, injection of calcium salts alone in the absence of anti-venom would be sufficient to give relief. An intravenous injection of calcium gluconate, chlorate, or bromate gives immediate and great relief from pain. The pain may recur but these relapses run a milder course. Several injections of calcium are recommended to complete the treatment.

The bite of most species of spiders causes no more harm than momentary discomfort.

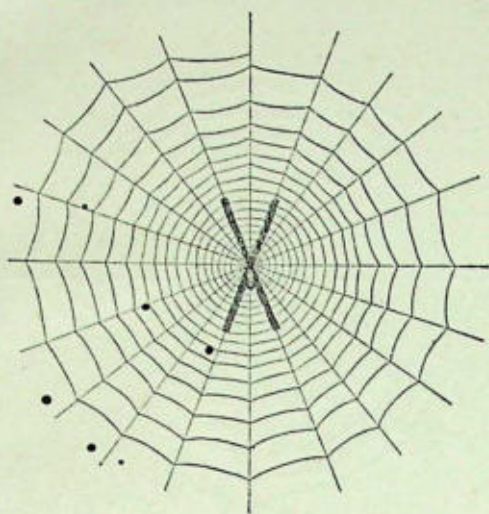
BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6,
November 22, 1961.

J. C. DANIEL
P. W. SOMAN

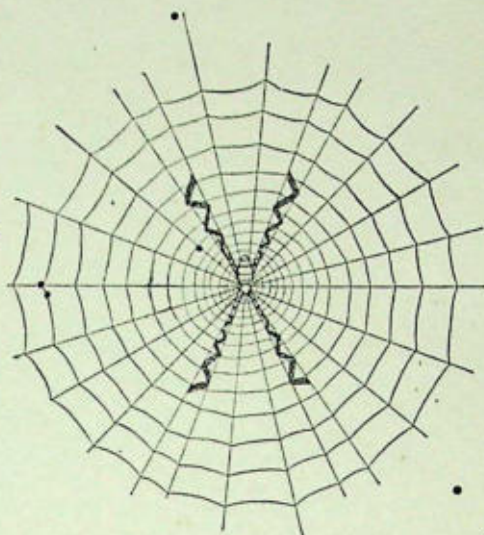
21. PROTECTIVE DEVICES OF SOME ORB-WEAVING SPIDERS FROM INDIA

(With nine text-figures)

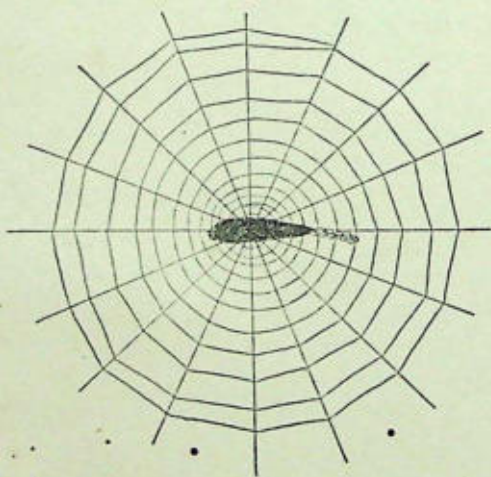
In the course of my field collections of spiders in India I have come across interesting examples of protective devices, mainly among the orb-weaving spiders. In this note I summarise some of my observations.



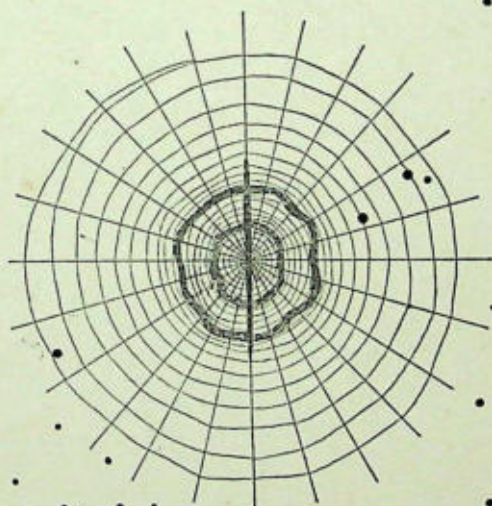
Text-fig. 1. Web of *Argiope arcuata*, with X-shaped protective band



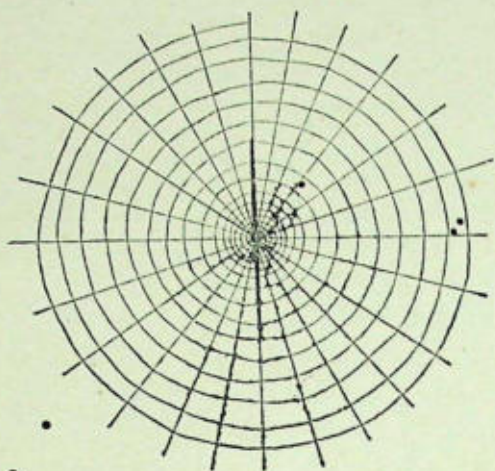
Text-fig. 2. Web of *Argiope pulchella*, with zigzag protective band



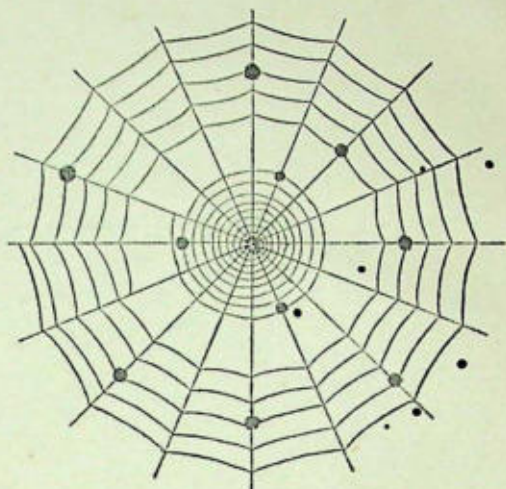
Text-fig. 3. Web of *Uloborus* sp. with broad protective band



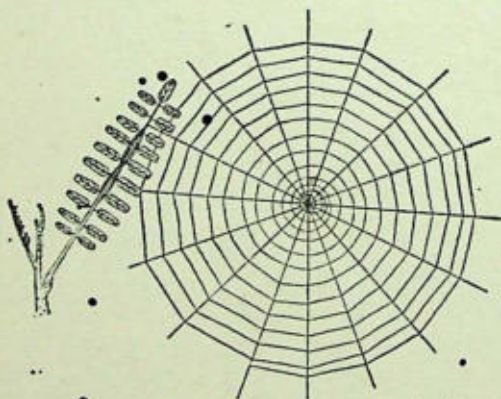
Text-fig. 4. Web of *Cyclosa* sp. with circular protective bands



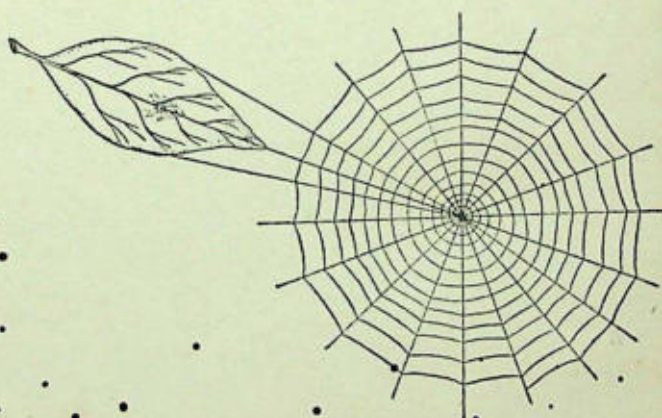
Text-fig. 5. Web of *Cyclosa* sp. with rod-like protective band



Text-fig. 6. Web of *Gasteracantha arcuata*, with protective masses of waste products



Text-fig. 7. Web of *Tetragnatha mandibulata*, with the spider sheltering in the leaf of a leguminous plant



Text-fig. 8. Web of *Araneus dehaanii*, with a leaf attached

At first sight it must seem rather strange that the customary position of a spider, in the middle of its web, is the one in which the creature is conspicuously exposed to every prey and enemy.

The spiders of the genus *Argiope* are true orb-weaving spiders and are very common all over India. All the known species are beautifully coloured on their abdomen. They construct a net web, often suspended between two adjoining branches of low-growing plants. It is a large orb-shaped construction with four characteristic white silken lines, making an 'X' in the centre. On these four white lines the spider places its four pairs of legs in such a manner that one is not able to see the spider from the other side. The spider hangs vertically, head downward. If anybody approaches the web from the front, the spider immediately goes to the other side and at the same time vibrates the entire web in such a way that one cannot see the spider. *Argiope arcuata* Simon makes the 'X' with wide ribbon-like bands (Text-fig. 1). *Argiope pulchella* Thorell does so with zigzag lines (Text-fig. 2).

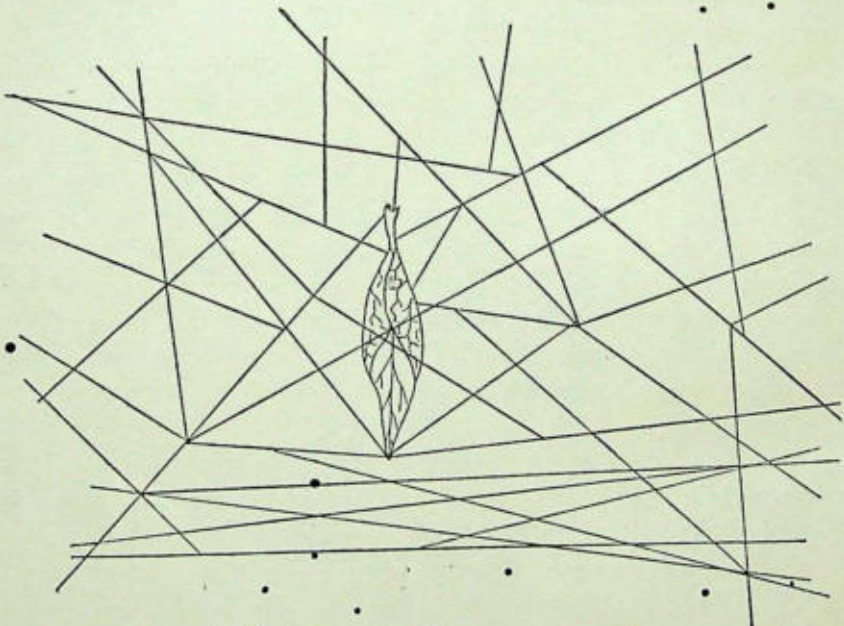
Some species of *Uloborus* from western Sikkim occur on rock. It is very difficult to spot these spiders on their webs. They prepare their webs a few centimetres from the rock and at the centre of the web is a spreading band. The spider and the band are of the same colour. The spider hangs downward just behind the central band, and sometimes the egg mass also hangs along the band (Text-fig. 3). A *Cyclosa* sp. from Shillong illustrates an extension of this mode of concealment. It spins the central shield and round it adds rough irregular circles of silk ribbon. These circular ribbons have a protective value and the spider sits just behind the central ribbon (Text-fig. 4).

I have collected other species of *Cyclosa* from Sikkim. They prepare their web in the normal way but in the centre of the web they place vertically a rod-like band, in the middle of which there is a small gap of dimensions depending on the size of the spider (Text-fig. 5). When the spider rests in the gap, the band seems like a continuous straight line. Different species of *Cyclosa* may be of different colours, e.g. one is silvery white and another ash-coloured. The colour of the protective band corresponds to the body colour.

The spiders of the genus *Gasteracantha* have large abdomens and are beautifully coloured, and move very slowly. I have collected some specimens of *G. arcuata* Fabr. from Kalimpong, West Bengal. At first I was unable to discover the spider in the web but on careful

observation I detected it at the centre of the web, among many rounded masses of waste products, woven by the spider itself and almost similar in colour and size to the spider, scattered about on the web (Text-fig. 6). I have collected *Tetragnatha mandibulata* Walcknear from the twigs of a leguminous plant overhanging a tank near Jodhpur, Rajasthan. The spider prepares its web so that some of the twigs or leaves are in the web, and during the day rests among them with its legs stretched out before and behind in line with its body (Text-fig. 7).

Araneus dehaanii Dol. is a large spider but in the day-time it is difficult to find it in the web. I saw many new webs, here and there, on the bank of Tista River near Nayabazar but not a single spider. After careful observation I saw at least one big leaf of an adjacent plant attached to each web and the spider resting during the day-time just below the mid-rib of the leaf (Text-fig. 8).



Text-fig. 9. Web of *Theridion* sp. enclosing dry leaf

Some species of *Theridion*, from Maharashtra and Mysore, prepare their web in a very irregular manner in the bushes. The spider places at least one dry leaf in the middle of the web in such a manner that the leaf is attached to the web. The spider rests inside the

cavity of the twisted dry leaf, and comes out only at the time of catching its prey (Text-fig. 9).

WESTERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
POONA,
September 6, 1961.

B. K. TIKADER

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22. OCCURRENCE OF THE ECHIUROID *OCHETOSTOMA ZANZIBARENSE* STEPHEN IN THE GULF OF KUTCH

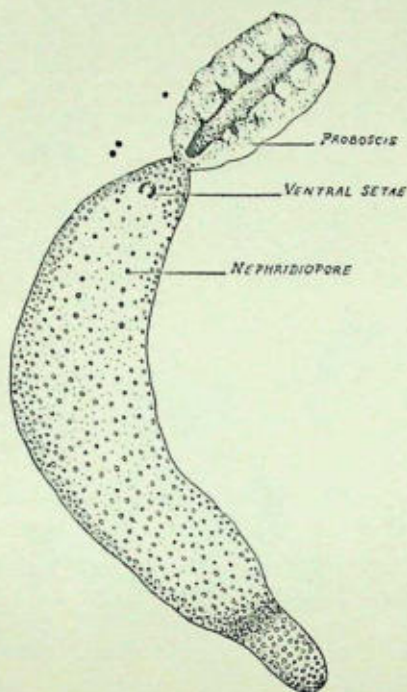
(With a text-figure)

We found the interesting Echiuroid *Ochetostoma zanzibarense* Stephen in the low tide belt of Pirotan Island in the Gulf of Kutch, 10 miles off Jamnagar, on 22 September 1960. The specimen was lying about 1 foot deep in the water on the coral reef in the beacon area south-west of the island. On lifting the specimen from the water we noticed the peristaltic movement of the animal, the waves of contraction passing from the anterior to the posterior end.

The live animal was a little over 7 inches in length including the proboscis and was greenish red in colour. The proboscis is a solid structure, about an inch in length and pale yellow in colour. The lateral margin of the proboscis is inflected. The region of attachment of the proboscis and the body is very delicate. The body is covered over by green papillae. There is a pair of ventral setae. The longitudinal muscles are divided into 12 bands. The nephridia are of characteristic shape with spirally coiled filaments. The anal vesicles are sac-like.

Dr. A. C. Stephen of the Royal Scottish Museum, whom we consulted about its identity, very kindly sent us all the available literature on Echiuroids. On comparing our observation with Stephen's

description (1952) we identify this specimen as *Ochetostoma zanzibarensis* Stephen. Since its discovery from Zanzibar in 1952 nobody reported the animal. This is the second report on the occurrence of



Ochetostoma zanzibarensis Stephen

echiuroids from the Gulf of Kutch, the first being that of Gideon *et al.* (1956).

We are grateful to Principal S. M. Mitra, D.Sc., for his interest and encouragement throughout the work.

DEPARTMENT OF ZOOLOGY,
BIRLA COLLEGE,
PILANI, RAJASTHAN,
August 21, 1961.

A. K. DATTA GUPTA
P. K. B. MENON

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- Stephen, A. C., & Robertson, J. D. (1952): A preliminary report on the Echiuridae and Sipunculidae of Zanzibar. *Proc. Roy. Soc. Edin. B* 64(4): 426-444.

23. A NOTE ON THE FLOWER COLOUR OF *POLYGALA ERIOPTERA* DC.¹

Polygala erioptera DC. is an annual herb, generally flowering and fruiting in August-October, sometimes up to March. The colour of the flowers has been variously described by several authors.

According to Dalzell & Gibson (*Bom. Fl.* 13, 1861 under *P. vahliana* DC.), Cooke (*Fl. Pres. Bom.* 60, 1901), Duthie (*Bot. Bih. & Oriss.* 1 : 62, 1903), Gamble (*Fl. Madr.* 1 : 41, 1957, reprinted edition) and Mukerjee (*Bull. Bot. Soc. Beng.* 12 : 47, 1959) the flowers are yellow. Saxton & Sedgwick (*Rec. Bot. Surv. Ind.* 6 (7) : 245, 1918) report this plant from north Gujarat and state: 'the flowers vary from yellowish-pink to reddish-purple but never yellow'. Blatter & Heilberg (*J. Bombay nat. Hist. Soc.* 26 : 223, 1918) describe the flowers as 'pale-rose coloured with the tip of the keel petal and the crest darker'. Phatak & Oza (*ibid.* 55 : 593, 1958) state that the flowers collected in August-September from Pavagadh in Gujarat State were of the usual yellow colour, whereas in October some plants had rose- or red-coloured flowers and that the colour remained even when the flowers began to fade. They consider the latter as a red- or rose-flowered variant of *Polygala erioptera* DC.

In Blatter Herbarium there are several sheets of this plant from Saurashtra, Baroda, and Broach, and a few from Nasik, Deolali, Poona, Ahmednagar, Kolhapur, and Andhra; most of the sheets are collected between August and November and bear the remark: 'flowers pink, red, or pale purple'; occasional sheets have 'white' flowers. One sheet, collected from Poona by Razi on 7-7-1951, bears the remark: 'flowers yellow'. Ezekiel (No. 30458), who collected this plant from Poona on 22-8-1917, describes: 'flowers yellow fading pink'. Plants from Andhra collected on 10-7-57 have 'white or pinkish flowers' (Wagh No. 5994).

On several occasions the author collected the present plant from Baroda and Broach in Gujarat State, where it is fairly common among grasses during August-October. The flowers were invariably found to be pink, red, or pale purple; in no case were yellow flowers seen.

It would appear from the above data that the flowers of *P. erioptera* DC. when fresh may be yellow but later on turn pink, red, or even white. Such a change in colour is also observed in several plants, e.g. *Abelmoschus manihot* Medik., *Hibiscus lampas* Cav. It is worth while to make careful field observations on this point at different

¹ Communicated by Professor P. V. Bole.

times during the flowering season in various localities to confirm if the change in colour is on account of the time of the year and the age of the plant or connected with some ecological factor.

ST. XAVIER'S COLLEGE,
BOMBAY,
November 17, 1961.

G. L. SHAH.
M.Sc., Ph.D.

24. OCCURRENCE OF *UTRICULARIA HIRTA* KLEIN IN SOUTH INDIA

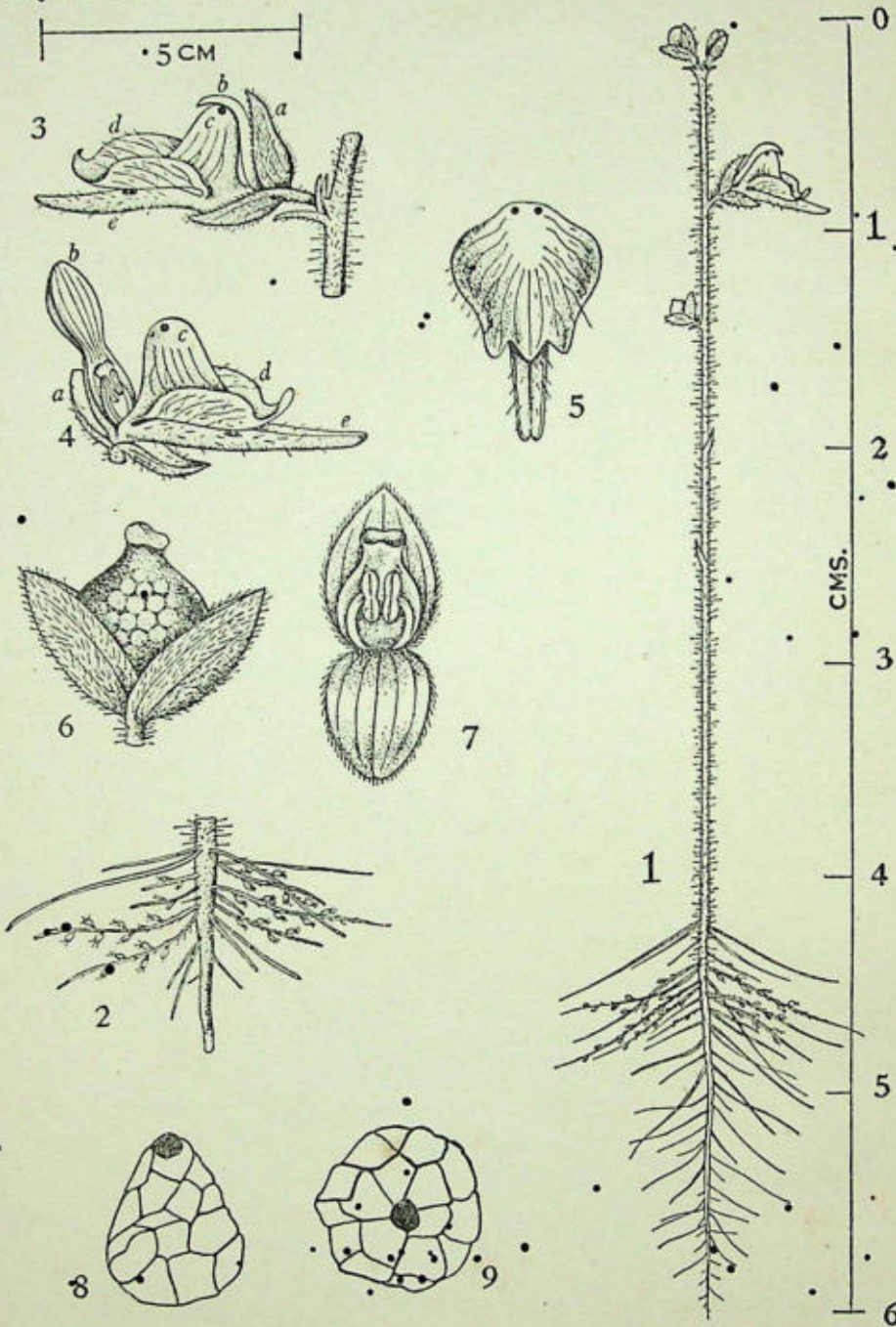
(With one plate)

Utricularia hirta Klein ex Link in Jahrb. 1 (3): 55, 1820; Oliver in J. Proc. Linnean Soc. 3 (12): 183, 1859; Hook. f. Fl. Brit. Ind. 4: 332, 1885.

This is a rare insectivorous plant collected by the junior author from Gingee Reserve Forests of Madras State at an altitude of c.115 m. during the botanical exploration tours of the Botanical Survey of India, Southern Circle. There is no authentic report of its occurrence in south India, nor has the taxon been described in any of the south Indian floras. In India, it is reported to have been collected previously at an altitude of c.650 m. from Giridih, Hazaribagh District, by Clarke and from Manbhum District by Campbell, both in Chota Nagpur, and at c.1000-1600 m. from Khasia mountains by Griffith (Hooker, 1885); Klein's collection of the species from Deccan Peninsula is not specific as to the exact locality. Because this interesting taxon has not been described in any flora of south India and the available description is incomplete in many respects, a detailed description is presented here.

The taxon has been found growing in abundance in two isolated spots only of the whole forest floor. It was in wet sandy soil near a rocky area but was not found on a rock surface or near a stream. The plants come up on wet, open, sandy soil, the pH of which varies from 6 to 5. They come up during the retreating monsoon from middle of September to December and complete their life cycle before the commencement of the next season. The leaves could not be collected, probably due to their ephemeral nature. A detailed description of the species is given below.

An ephemeral herb; leaves looked for but not found; bladders minute, pyriform, on the capillary structures (stolons) at the base of the scape, shortly stalked laterally; stolons minutely and sparsely hairy;



Utricularia hirta Klein

1. Entire plant; 2. Basal portion of scape with capillary structures bearing bladders; 3. Entire flower (side view); 4. Corolla showing position of essential organs at base of upper lip; 5. Lower lip of corolla with spur; 6. Fruit with persistent calyx; 7. Calyx lobes with gynoecium and androecium; 8 & 9. Seeds—side and dorsal views.

scapes slender, simple, 4 to 8 cm. high, rarely branched, densely hirsute all over; 3- to 4-flowered, erect raceme with one or two sterile basal bracts; *bracts* basifixed, minute, as long as or a little longer than the pedicels, hairy, bracteoles 2, both bracts and bracteoles linear, lanceolate, acute, and erect; *flowers* c. 5 mm. short-pedicelled, semi-erect; *calyx* 2-lobed, ovate, obtuse, hairy, persistent, spoon-shaped c. 2 mm. long and c. 2 mm. broad at the base, subequal; *corolla* white or bluish-purple, deciduous, bilobed, upper lip oblong obtuse, constricted at the middle, well appressed and bent over the hump of the lower lip; lower lip c. 3 mm. long and 4 mm. broad, sparsely hairy reflexed with a high hump, 3-lobed, mid-lobe smaller and tooth-like, side lobes auricular, acute, lobes slightly incurved, hump shows 2 yellow dots; *spur* conically cylindrical, horizontal with a slight upward bend near the apex, a little longer than the lower lip and protrudes beyond the lower lip, sparsely hairy, blunt end is cleft, with 2 conspicuous yellow spots on the side; *stamens* 2, in front of the ovary with short filaments; *ovary* globular, *stigma* sessile, *ovules* numerous, placentation basal; *fruit* 2 to 3 mm. globose, semi-erect with persistent calyx lobes; *seeds* minute, numerous, brownish, rhomboid, reticulate.

The following are a few of the variations noted in the specimens collected from south India and the description given for the species by Oliver (1859). The scape is smaller and measures only 4 to 8 cm. while Oliver records a wide variation from 2.5 cm. to 15 cm.; 3 or 4 flowers have always been found in south Indian species while the former record is 'often 1-2 flowered'. The upper lip of the corolla is oblong-obtuse, constricted at the middle, differing from the obovate or oblong-obovate or quadrately oblong characters described formerly. However, the species has been confirmed at the Royal Botanic Gardens, Kew, by Mr. Peter Taylor to whom we are grateful.

BOTANICAL SURVEY OF INDIA,
SOUTHERN CIRCLE,
COIMBATORE,
June 26, 1961.

J. JOSEPH,
K. RAMAMURTHY

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Hooker, J. D. (1885): The Flora of British India 4: 392.
Oliver, J. (1859): The Indian species of *Utricularia*. *J. Proc. Linnæan Soc.* 3 (12): 183.

25. A NEW SPECIES OF *JATROPHA* FROM SOUTH INDIA

(With a plate)

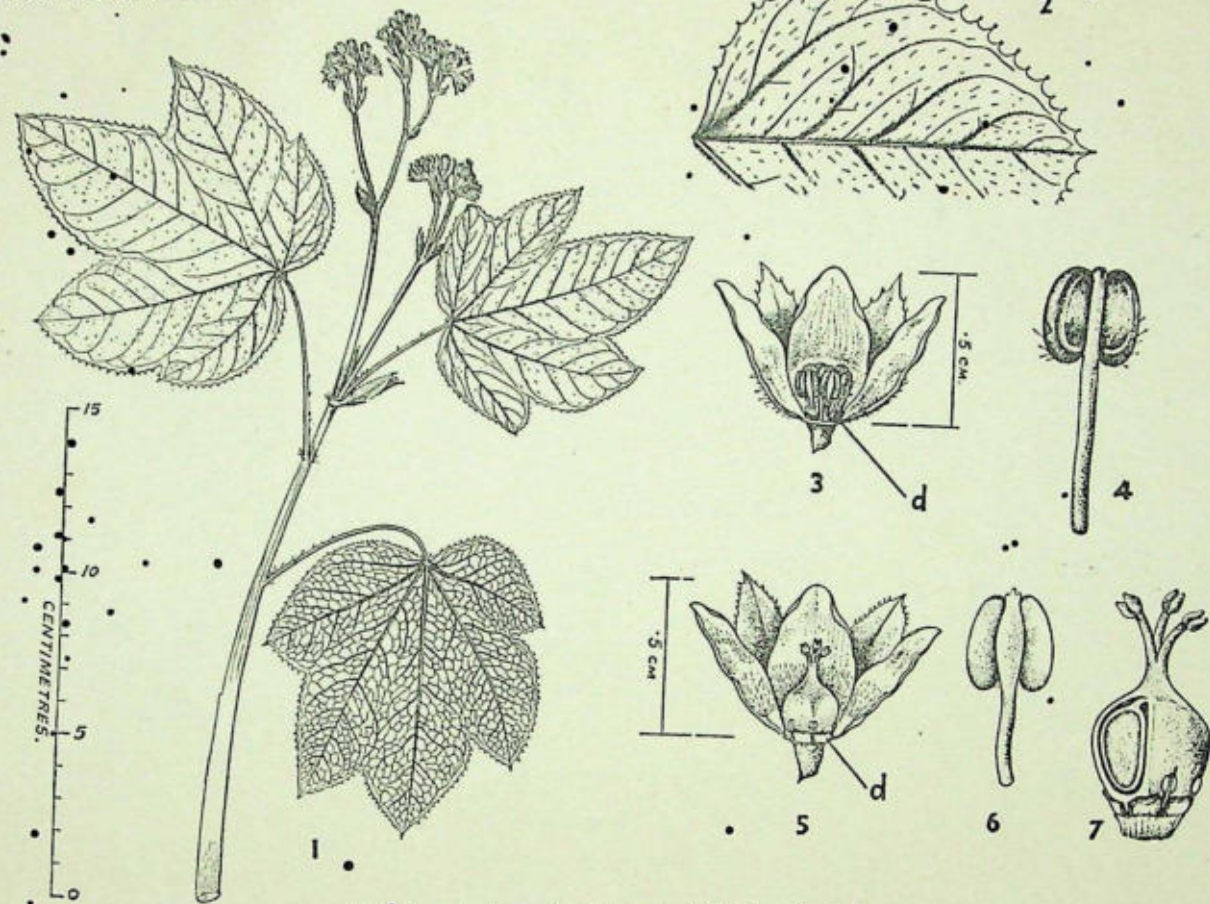
A new species of *Jatropha* collected at Kallimedu in Vedharanyam Forest, Tanjore District, Madras State, south India, is described.

***Jatropha tanjorensis* Ellis et Saroja, sp. nov.**

Pertinet ad Euphorbiaceas Crotonoideas Cluytieas, affinisque est *Jatrophae glanduliferae* Roxb., a qua tamen differt foliis supra medium lobatis, stipulis brevioribus in segmenta filiformia ad apices glandulifera incisis, floribus polygamis, florum vero bisexualium petalis ad tertiam partem ex basi connatis.

Frutex glaber, puberulus tamen in juvenili conditione; caulis longus, robustus, dichotome ramosus. *Folia* simplicia, alterna, 7.5-11.5 cm. longa, aequae lata ac longa, palmatim 3-5 lobata supra medium, lobis late ovatis, acuminatis, marginibus distanter serratis, serrationibus singulis desinentibus in setam glanduliferam, sparse pilosa in utraque pagina, velutina ad utrumque latus nervorum nervulorumque, tenuiter cordata ad basim sinu tenui; nervi principes 7-9, eminentes; petioli 4.5-7.5 cm. longi, nonnullis capillis glanduliferis prope basim supra ornati; stipulae breves, ciliatae, singulae desinentes in capitulum glandulare. *Flores* polygami, corymbose cymosi, virides colore pallide rosaceo tincti; bractea 6-20 mm. longae, 2-5 mm. latae, lanceolatae, acutae, capillis glanduliferis ad margines ornatae. *Flores* ♂ breviter pedicellati; calyx 5-lobus, quincuncialis, lobis liberis, ovatis, tenuiter serratis, ± 4 mm. longis, extus pilosis; corollae 5-lobae segmenta libera, contorta, obtusa, rotundata, ± 4 mm. longa; discus constans glandulis 5 minutis ad basim columnae staminalis situs; stamina 8, libera; antherae erectae, basifixae, 5-7 capillis ornatae, connectivo prominenti, cellulis polliniferis ad utrumque latus positis. *Flores* hermaphroditi breviter pedicellati; calycis 5-lobi segmenta libera, 5-8 mm. longa, quincuncialia, pilosa ad margines serratos glanduliferos; corollae 5-lobae segmenta connata ad tertiam partem ex basi, 5-8 mm. longa, obtusa contorta, nervosa, intus pilosa; discus circum ovarium constans glandulis 5, levis; stamina 6-8 libera, antherae erectae, complanatae, basifixae, connectivo prominenti; ovarium superius, glabrum, triloculare, syncarpum, uno ovulo pendulo in unoquoque loculo; styli 3; singuli in duo stigmata furcati. *Fructus* non visus.

Holotypus, *Ellis* 11809 A, et isotypi, *Ellis* 11809 B-F, lecti a J. L. Ellis ad Kallimedu, in silva Vedharanyam dicta, in regione Tanjorensi.



Jatropha tanjorensis Ellis et Saroja, sp. nov.

1. Portion of a branch ; 2. Portion of lamina enlarged—abaxial surface ; 3. Tangential section of a staminate flower ; 4. Stamen of staminate flower ; 5. Tangential section of a bisexual flower ; 6. Stamen of the bisexual flower ; 7. Ovary cut open to show nature of ovule. d : disk.

in Statu Madras, in India meridionali die 20 januarii anni 1961, et positi in Herbario Bot. Surv. Ind. ad Coimbatore.

Jatropha tanjorensis Ellis & Saroja, sp. nov.

(Euphorbiaceae—Crotonoideae—Cluytiaceae), allied to *Jatropha glandulifera* Roxb., but differs in having leaves lobed above the middle, stipules shorter with a few filiform glandular-tipped divisions, flowers polygamous, and petals connate to one-third their lengths at the base in bisexual flowers.

Shrub glabrous, puberulous in young condition; stem long, stout, dichotomously branched. *Leaf* simple, alternate; lamina 7.5-11.5 cm. long and as broad as long, palmately 3-5 lobed above the middle, lobes broadly ovate, acuminate, the margins distantly serrate, each serrature ending in a gland-tipped bristle, sparsely hairy on both the sides, velutinous on either side of the veins and veinlets, base slightly cordate with a shallow sinus; main nerves 7-9, prominent; petioles 4.5-7.5 cm. long with a few glandular hairs near the base adaxially; stipules short, ciliate, each ending in a glandular head. *Flowers* polygamous, in corymbose cymes, green with pale pink tinge; bracts 6-20 mm. long, 2-5 mm. broad, lanceolate, acute with gland-tipped hairs on the margins. *Staminate flower* shortly pedicellate; calyx free, 5-lobed, quincuncial, lobes ovate, slightly serrate, c. 4 mm. long, pilose outside; corolla 5-lobed, free; segments contorted, obtuse, rounded, c. 4 mm. long; disc of 5 small glands at the base of the staminal column; stamens 8, free; anthers erect, basally attached, 5-7 hairs on the anthers, connective prominent with pollen sacs on either side. *Bisexual flower* shortly pedicellate; calyx free, 5-lobed, 5-8 mm. long, quincuncial; segments ovate, pilose inside with gland-tipped serratures on the margins; corolla lobes connate to one-third their length at the base, 5-lobed, 5-8 mm. long, segments obtuse, contorted, veined, hairy inside; disc of 5 glands around the ovary, smooth; stamens 6-8, free; anther erect, flat, basally attached, connective prominent; ovary superior, glabrous, trilocular, syncarpous, with one pendulous ovule in each locale; styles 3, each bifurcating into two stigmata. *Fruit* not seen.

Holotype, Ellis 11809 A, and *Isotypes*, Ellis 11809 B-F, were collected by J. L. Ellis at Kallimedu in Vedharanyam Forest, Tanjore District, Madras State, south India, on 20 January 1961. They were incorporated in the Southern Circle Herbarium, Botanical Survey of India, Coimbatore, south India.

ACKNOWLEDGEMENTS

The authors wish to express their thanks to the Director, Royal Botanic Gardens, Kew, England, for his help in comparing this species with the rest of *Jatropha* represented in Kew, and to Dr. K. M. Sebastine, Systematic Botanist in charge, Botanical Survey of India, Coimbatore, for his keen interest and kind encouragement throughout the present study. Thanks are also due to Rev. Fr. H. Santapau, S.J., Chief Botanist, Botanical Survey of India, Calcutta, for his constructive suggestions and rendering the diagnosis into Latin.

BOTANICAL SURVEY OF INDIA,
SOUTHERN CIRCLE,
COIMBATORE,
August 5, 1961.

J. L. ELLIS
T. L. SAROJA

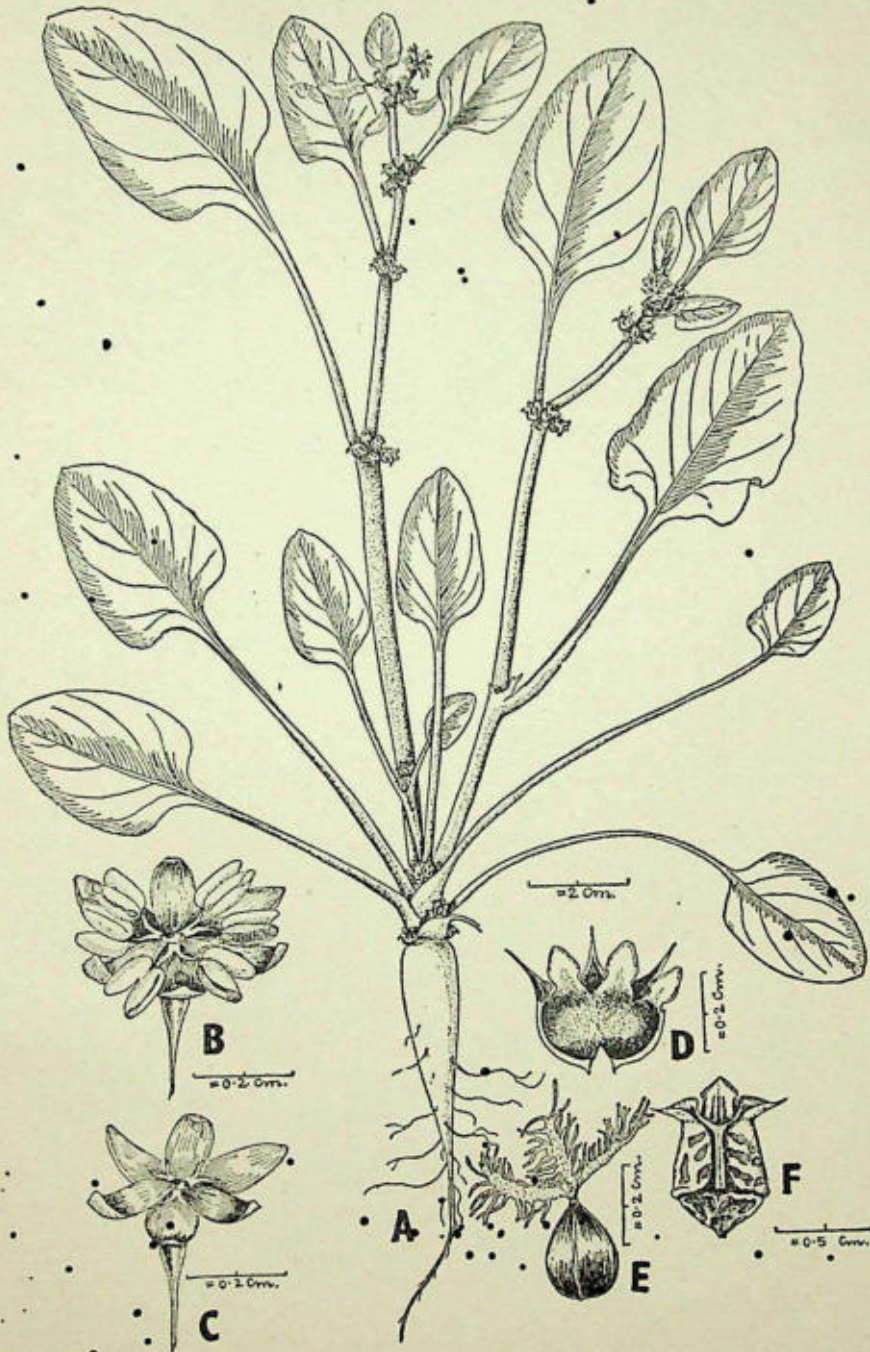
26. *EMEX SPINOSA* (LINN.) CAMPD. (POLYGONACEAE):
A NEW RECORD FOR INDIA

(With one plate)

The genus *Emex* Neck. (Polygonaceae) has only two known species. One is *E. australis* Steinh., a native of South Africa, where it grows as a common weed by river banks and on damp ground. This species is known to have spread in several parts of the world, e.g. Australia, where it has naturalised itself as a common roadside weed of certain regions. The second species, *E. spinosa* (Linn.) Campd. is said to be native of the Mediterranean region and is seen to grow as a very common weed, particularly in sandy waste places in Algeria, Egypt, Palestine, Crete, Greece, and Arabia, and is also known from Spain, Portugal, Sicily, Canaries, S. Africa, Australia, and Florida. This species is now being recorded for the first time in India, where it seems to have been a recent migrant from the Middle East countries.

Emex spinosa (Linn.) Campd.

Description. An annual, 20-80 cm. high, ascending or decumbent glabrous herb. Tap root 5-15 cm. long, more or less fusiform. Stems 1- many, 5-15 mm. thick, cylindrical, with longitudinal whitish streaks when green, sulcate and light brown when dry, sub-dichotomously branched — generally near base; nodes somewhat swollen, internodes up to 15 cm. long, rarely more; older stems fistular. Leaves 10-30 cm. long, radical and basal, cauline with much longer petioles — about



Emex spinosa Campd.

A. Whole plant (a small specimen); B. Male flower; C. Male flowers after shedding anthers; D. Dissected female flower showing inside of perianth-tube and position of inner perianth lobes; E. Pistil; F. Fruit (cauline) in face view.

two-third of the entire length; the petioles adaxially flat, much dilated at base, the bases persisting; lamina 4-10 by 3-6 cm., apex round, margins entire — sometimes undulate towards base, glabrous on both surfaces, veins prominent beneath. Ochrea silvery, membranous, tubular, soon becoming torn and jagged — ultimately lost at age. Flowers monoecious. Females usually forming axillary whorl-like clusters of (6-) 8-10 (-12) flowers, subsessile, those in axils of pseudoverticillate radical leaves ('radical flowers') usually solitary, larger, and sessile; perianth green — a triquetrous tube with deep pitted obconic base and faces almost equal with a stout median ridge and similar pittings (the radical flowers have nearly truncate base and the outer faces broader and roundish with usually more than one ridge and excessive pittings — the outer two faces being proportionately reduced), 6-lobed, the lobes in two alternating series, outer three divergent with spinescent apices extending along angles of the tube; inner having lower halves erect with three prominent ribs, upper halves deltoid and converging to form an almost closed trigonous top. Ovary pink, trigonous, enclosed tightly by the perianth tube; stigmas large, extruding through the angles of the inner perianth. Male flowers in axillary clusters among the females — excepting radical clusters, or on short (up to 4 cm. long) axillary or leaf-opposed shoots — often with few female flowers at lower nodes, pedicellate — the pedicels 1-3 mm. long, slender; perianth segments (4-) 5-6 (more commonly 5) in two alternating series, 1.5-2.5 by .5-1.5 mm., elliptic-ovate, acute, sepeloid, outer three broader than inner. Stamens (6-) 5 (rarely 4) — when 6, a pair opposite each outer perianth segment but usually one or at times two reduced to solitary; anthers slightly extruding; filaments persistent. Fruit trigonous, brown, 5-7 by 4-5 mm., including the persistent perianth (now enlarged and much hardened); the radical fruits with perianth up to 9 by 6 mm. with the spines nearly blunt. Seeds trigonous with a pointed tip, brown, 3-4 by 2-3 mm., those of radical fruits proportionately larger.

Flowers and fruit: February-May.

V. S. Sharma 890 (Mall Rd., 2 March 1959): 1460 (Pushkar, 3 March 1960); 1676 (Adarshnagar, 8 March 1961). These are the numbers of the specimens collected by the author during his studies on the Flora of Ajmer (Rajasthan).

During the examination of a large number of locally collected fresh as well as dried specimens it was noticed that occasionally one or more, especially, outer perianth segments in male flowers, are on

the way to become quite thick and spinescent like those in the female flowers. Some abnormalities like cohesion of two radical flowers are also seen.

The species by now has naturalised itself well in the cultivated fields, especially of the sandy regions. Besides its occurrence in mostly wheat and barley fields, I have frequently seen the weed in beds of *Spinacia oleracea* Linn., where it generally remains stunted (probably due to regular plucking), resulting in the development of only radical leaves which make the plant similar in appearance to the vegetable crop. It appears that in the very near future, this species may spread to other parts of the country and become one of the most troublesome weeds, a possibility that is quite conceivable with its abundant fruits and owing to its adhesive perianth which provides an efficient means of dispersal. In my opinion, the probability cannot be ruled out that the present species may have already established itself in other sandy regions of the State and in regions of west and south Rajasthan during its migration.

I am greatly indebted to Dr. B. Tiagi, Reader, University Department of Botany, Jodhpur, for guidance and to Shri Bhim Sen, Principal, Government College, Ajmer, for providing all research facilities. I also express my sincere thanks to Shri M. B. Raizada, Officer-in-charge, Botany, Forest Research Institute, Dehra Dun, for Herbarium and library facilities.

DEPARTMENT OF BOTANY,

GOVERNMENT COLLEGE,

AJMER (RAJASTHAN),

October 30, 1961.

V. S. SHARMA

27. *CONVOLVULUS PLURICAULIS* CHOISY, A SYNONYM OF
CONVOLVULUS MICROPHYLLUS SIEB.

While attempting to establish the botanical identity of Shankha-pushpi, an important drug of indigenous medical practice, it was found that *C. microphyllus* and *C. pluricaulis* formed two of the five different sources of this drug. On further scrutiny of the literature, herbarium specimens, and authentic drug samples, we found it practically impossible to distinguish them from each other, and, therefore, suggested [1961, *Ind. Jour. Pharm.* 23 (8) : 223-224] that the two species should be merged into one. The fusion could not be accomplished then as the type material could not be examined, and so we sought

the help of the Director, Royal Botanic Gardens, Kew, for examining the type material in their herbarium. The opinion of the Kew authorities based on the type duplicates of both the species has confirmed our earlier findings. They say: 'The distinctions suggested by Clarke (Hooker's, 1885, FL. BR. IND. 4 : 218) between the widespread *C. microphyllus*, extending from Egypt to India, and *O. pluricaulis*, which has only been identified as occurring in India and Pakistan, do not appear to be tenable. It would seem that all the material should be referred to a single variable species for which the correct name would be *C. microphyllus*. Detailed study would be required to establish whether varieties should be recognised, but in the Indian material none are readily distinguishable.'

The nomenclature of the Indian plant described under these two names is given below:

Convolvulus microphyllus Sieb. ex Spreng. Syst. 1: 611, 1824.
Syn. *C. pluricaulis* Choisy, Convol. Or. 95, 1834.

The authors are grateful to the Director, Royal Botanic Gardens, Kew, Richmond, Surrey, for his kind help.

BOTANY DEPARTMENT,
ST. XAVIER'S COLLEGE,
BOMBAY,
November 28, 1961.

P. V. BOLE
VIRBALA SHAH

Notes and News

Toxic Chemicals

The increasing use of toxic chemicals for the protection of agricultural crops in India requires attention to be drawn to an aspect that may be overlooked or noticed too late—the destruction of wild animals and birds caused by these chemicals. Lovers of nature have long been seriously concerned about this menace to wild life. Indisputable evidence, in the shape of post-mortem analyses of dead birds and animals collected from different parts of England, has recently been furnished by a Joint Committee of the British Trust for Ornithology and the Royal Society for the Protection of Birds. As a result of the activities of this Committee and criticism, both in Parliament and in the press, a complete ban has been placed on the use for spring sown grain of seed dressings containing dieldrin, aldrin, heptachlor, and in the other seasons their use is permitted only for autumn and winter wheat 'where there is real danger of attack from wheat bulb fly'. It is hoped that this matter will be carefully considered by our Central and State Governments before long-term programmes are undertaken in this country.

* * * *

Red Goral

In Miscellaneous Note No. 4 at page 792 above a reference is made to a bright red goral recently described from the Mishmi Hills in Assam. Members resident in that area and others who have the opportunity are requested to keep a look-out for this animal and to try and obtain a specimen for the Society's collection.

* * * *

Fall-out menace from Atom Bomb

In October 1961 the long-threatened atom bombs of gigantic proportions were tested by Russia on the island of Novaya Zemlya in the Arctic Circle, roughly 75° N., 56° E.

There have been several press reports in all parts of the world

stating that, in addition to atmospheric contamination by radio-active material, the bombing tests have raised the possibility of migrating birds being affected and carrying the contamination to other parts of the world.

Enquiries have been received by the Society about the advisability of shooting and eating duck and other game birds which visit India during the cold weather.

With our present knowledge of bird migration and the wide distribution of many species, it was impossible to select any birds which would be known to come definitely from the affected area, but single specimens of the Common Pochard (*Aythya ferina*) and the Pintail Snipe (*Capella stenura*) shot in Nasik District, Maharashtra State, on 3 December 1961, were sent to Dr. A. R. Gopal-Ayengar of the Biology and Medical Divisions, Atomic Energy Establishment Trombay, Government of India, Bombay.

Analysis carried out at the laboratories of the Atomic Energy Establishment have revealed no traces of radio-active contamination in any of these birds or the three other duck received from Bharatpur. The Atomic Energy Establishment is keeping a close watch on the activity levels of migratory birds and any harmful indication will be brought to the notice of the public.

* * * *

M.Sc. Degree in Field Ornithology

We are glad to be able to announce that the M.Sc. degree in Field Ornithology (Zoology) has been awarded by the University of Bombay to Shri Vijaykumar C. Ambedkar, who worked for the degree at the Bombay Natural History Society under the guidance of Dr. Salim Ali. The subject of his thesis was 'The Ecology and Breeding Biology of the Indian Weaver Birds with special reference to *Ploceus philippinus* (Linn.)'. Shri Ambedkar was the first student at the Society, which we believe is the first and only institution in India to be recognized for M.Sc. courses in Field Ornithology.

New Building for the Society

In the Annual Report for 1960/61 (page 843 below) we referred to negotiations with the Ministry of Scientific Research and Cultural

Affairs, Government of India, regarding funds for the construction of a building to house the Society and its collections. The Ministry have sanctioned an initial grant of Rs. 1,50,000 to the Prince of Wales Museum of Western India, Bombay, for the construction of a building in their grounds, which is to be let to the Society for a nominal rent. The plans are under preparation and it is hoped to commence work soon.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY
SOCIETY FOR THE YEAR 1960-61

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Mr. K. J. Nanavatty, I.P.

Mr. D. J. Panday

Mr. D. E. Reuben, I.C.S. (Retd.)

Dr. H. Trapido, M.D.

Ex Officio

ADVISORY COMMITTEE

Mr. H. G. Acharya, F.R.E.S. Ahmedabad

Mr. F. C. Badhwar, O.B.E. Calcutta

Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. (Retd.) .. New Delhi

Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D. Mysore

Mr. E. P. Gee, M.A., C.M.Z.S. Shillong

Dr. Bains Prasad, D.Sc., F.N.I. Dehra Dun

Mr. P. D. Stracey, I.F.S. Dehra Dun

Dr. M. L. Roonwal, M.Sc., Ph.D., F.N.I., F.Z.S.I. .. Calcutta

Lt.- Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E. Roorkee

HONORARY SECRETARY'S REPORT FOR THE YEAR 1960-61

At the last Annual General Meeting of the Society, I presented a report for the year ending 31st August 1960. The present report covers the period of 12 months thereafter.

THE SOCIETY'S JOURNAL

Volume 57 was concluded and contained 3 articles on Game Sanctuaries and Wild Life Preservation, 8 on birds, 1 each on fish and molluscs, 2 on arachnids, 4 on insects, and 14 on botany. During the current year, only one part of Volume 58 has been issued; we hope to catch up and issue the other two before long. The dearth of articles on general Natural History continues.

GENERAL

It is still not possible to report any definite progress regarding the negotiations with the Ministry of Scientific Research & Cultural Affairs regarding a grant for a new building for the Society in the Museum grounds.

The Society continues to assist Dr. Salim Ali in the bird migration study project to which I referred in my last report. Some 7500 birds have been ringed in the four seasonal efforts which have been made and some 20% of them were migrants. Activities are being now directed to duck and grey quail and it is hoped that this will increase the chances of recovery. The World Health Organization have made an additional grant of \$5000 and it should be possible to continue this work for some time.

In addition to several field trips into the Ghats near Bombay, members of the Society's staff were able to pay a short visit to Talewadi on the western borders of Belgaum District, in Mysore State. They have obtained several interesting bats and amphibians, some of which are welcome additions to our collections.

• During the year, some 800 additions were made to our vertebrate collections—21 mammals, 132 birds, 108 reptiles and 540 amphibians. Interesting additions include among birds the Spiny Babbler (*Turdoides nipalensis*), and among mammals specimens of Wroughton's Freetailed Bat (*Otomops wroughtoni*) collected after a lapse of 50 years at Talewadi, the type locality. At the same place, specimens of *Taphozous theobaldi* which in India has so far been recorded only from Nimar, Madhya Pradesh, were obtained. The identified reptiles include *Oligodon juglandifer* and *Bungarus bungaroides* and the amphibians *Indotyphlus battersbyi* (a new genus and species from Khandala, W. Ghats), *Tylotriton verrucosus*, *Megophrys major*, *Aelurophryne mammata*, *Rana annandalli*, *Philautus amandalli*, *Ramanella montana*, *R. variegata* and *Kaloula pulchra taprobanica*.

The additional steel cabinets, ordered during the year, have also been received and with the exception of the skins of the larger mammals, it is hoped that our vertebrate collections will soon be properly arranged

and become more easily accessible for examination and reference than they have been before.

During the year, 64 books were added to the Library which included 13 purchased, 7 received for review, and 44 presented; 30 journals have been bound, and 7 books rebound. We obtain 10 journals and/or magazines by subscription and 54 by exchange. The latter list is being revised and suggestions from members would be welcome.

PUBLICATIONS

The revised 6th edition of THE BOOK OF INDIAN BIRDS by Sálim Ali, and A SYNOPSIS OF THE BIRDS OF INDIA & PAKISTAN by Dillon Ripley were published in August this year. We have applied to the Ministry of Scientific Research & Cultural Affairs for financial assistance for THE BOOK OF INDIAN BIRDS and also to enable us to proceed with the publication of the 2nd edition of THE BOOK OF INDIAN ANIMALS, the typescript and pictures of which are ready.

The Ministry of Scientific Research & Cultural Affairs have authorised the Society to reprint a second edition of M. A. Smith's volume on Snakes in the FAUNA OF BRITISH INDIA series. This was published in 1943 but, after the first distribution in India, the stock was destroyed by enemy action in London. In the absence of any other work on this subject, the book is very badly needed in India. We hope to have it ready by the middle of next year.

NATURE EDUCATION

The Nature Education Scheme for children, financed by the Government of Maharashtra, is now in its 13th year. Tours of the Natural History Section of the Prince of Wales Museum and special talks on natural history subjects with the aid of exhibits and other specimens, films, and sometimes living animals, were continued and over 4500 children attended.

Eight field trips to different places in the Island of Salsette were arranged for members of Nature Study Clubs. The trips were followed by meetings at schools to help children to learn to collect and preserve specimens and to discuss items and topics experienced afield.

Three trips were arranged :

- (a) To study the plant life of Khandala, led by Fr. H. Santapau ;
- (b) To Bassein to study the geographical features of the area, led by Principal C. B. Joshi of Parle College ;
- (c) To study the geology of the hot springs at Vajreshwari, led by Prof. R. N. Sukheswala.

The English edition of the 5th booklet *OUR ANIMALS* in the 'Glimpses of Nature' series will be available shortly. The editions in the other languages are under preparation. We cannot help referring to the poor sales experienced by the publications, in spite of the low price and large number of coloured illustrations included therein.

MEMBERSHIP

The total membership of our books at the end of 1960 was 1101 including 235 life and 6 honorary members. Of the others, subscriptions were received from 680 members up to the end of July this year, leaving 180 who had either not informed us of their desire to resign or could not be traced. During the 12 months, 85 ordinary members and 4 life members were enrolled as against 29 resigned and 5 ordinary and 2 life members who died during the year.

With funds made available by the Rockefeller Foundation, an illustrated brochure depicting the history and the activities of the Society has been prepared and sent to persons and institutions likely to be interested. We hope to show an increase in membership during the current and ensuing years.

REVENUE ACCOUNT, 1960

During the year under review, the income of the Society, excluding the special grant received from the Government of Maharashtra for the maintenance of the Reference Collections, was Rs. 45,409.06 as against Rs. 57,657.40 in the previous year. This drop of Rs. 12,224.64 was partly (Rs. 2529.32) on account of fall in the income from subscriptions during 1960 and mainly as our popular publications were out of print.

The operations of the Society during 1960 showed a deficit of Rs. 8966.43 as against Rs. 2221.49 in 1959. Expenses during the year amounted to Rs. 54,376.29 as against Rs. 59,878.89 in the previous year.

You will notice that the Balance Sheet shows our stock of books as worth Rs. 49,439.37. This represents the value of 8 publications of which three, viz. *SOME BEAUTIFUL INDIAN TREES*, *BUTTERFLIES OF THE INDIAN REGION*, and the *Wall Charts for the Identification of Poisonous Snakes*, account for over Rs. 40,000.00. 2000 copies of the *Tree* books were published in 1955, and though we sold 551 copies in the first year, the sales have dropped to 139 copies in 1960. Similarly, only 70 copies of the *Butterfly* book were sold during the year. Your Committee are considering ways and means of improving the rate of sale, but meanwhile we have to contend with a very slow conversion of stock into cash, and to this extent are handicapped in undertaking additional publications. Members are requested to assist as much as possible in the sales of the Society's publications.

STAFF

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

ACKNOWLEDGEMENT

The Committee's thanks are due to Mr. J. L. Bernard who continues to look after the Society's interests in the United Kingdom.

THE BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT, 1950

• SCHEDULE VII [VIDE RULE 17 (1)]

BALANCE SHEET AS AT 31 DECEMBER 1960

FUNDS AND LIABILITIES	Rs nP	Rs nP	ASSETS	Rs nP	Rs nP
<i>Trust Fund or Corpus:</i>			<i>Immovable Properties</i>		nil
<i>Life Membership Fund:</i>			<i>Investments:</i>		
Balance as per last Balance Sheet ...	97,490.28		Rs. 14,000 4% Bombay Port Trust Bonds ...	10,700.00	
Add: Amounts received during the year ...	2,150.00		.. 15,000 4% Bombay Improvement Trust Bonds ...	11,400.00	
		99,640.28	.. 36,000 3% Funding Loan 1966-68 ...	35,812.02	
<i>Other earmarked Funds:</i>			.. 25,000 3% Conversion Loan 1946 ...	25,000.00	
<i>Field Work Fund:</i>			.. 2,000 5% First Development Loan 1970-75 ...	1,948.75	
Balance as per last Balance Sheet ...	1,859.97		.. 92,000 (Market value Rs. 82,797.50) ...	84,941.57	
<i>Expedition Fund:</i>	1,800.00		£ 460 3½% Defence Bonds ...	6,133.34	
<i>Wild Life Fund:</i>	715.25		At cost ...	91,074.71	
<i>Mammal Survey Fund:</i>			Less: Provision for Depreciation ...	3,700.00	87,374.71
Balance as per last Balance Sheet ...	3,071.64		<i>Furniture and Fixtures:</i>		
Less: Spent during the year ...	743.66	2,327.98	Balance as per last Balance Sheet ...	1,048.16	
<i>Building Fund:</i>			Add: Addition during the year ...	40.00	
Balance as per last Balance Sheet ...	30,000.00		Less: Depreciation during the year ...	1,08.16	552.14
Less spent during the year ...	850.00	29,150.00	<i>Loans: (Secured)</i>		
<i>Nature Education Trophy Fund</i> ...	500.00		Loan Scholarships	nil	nil
<i>Reserve for Snake Wall Courts</i> ...	3,000.00		Other Loans (to staff) ...	175.00	nil
<i>Unspent Grant of Government of Maharashtra:</i>					175.00
Transferred from Income and Expenditure Account ...			<i>Advances:</i>		
For Furniture and Equipment 1960-61 ...	7,000.00		To Trustees ...	nil	
Maintenance Grant 1960-61 ...	12,068.86	19,068.86	.. Employees ...	515.00	
<i>Unspent Grant World Health Organization:</i>			.. Contractors ...	430.71	
Transferred from Income and Expenditure Account ...	1,029.93	88,551.99	.. Lawyers ...	nil	
			.. Nature Education Scheme ...	1,964.41	
			.. Others ...	451.57	
					10,582.69
Carried forward ...		1,88,192.27	Carried forward ...		18,634.54

THE BOMBAY NATURAL HISTORY SOCIETY
THE BOMBAY PUBLIC TRUSTS ACT 1950

SCHEDULE IX (VIDE RULE 17 (1))

Dr. **INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1960** *Cr.*

EXPENDITURE	Rs nP	Rs nP	INCOME	Rs nP	Rs nP
<i>To Expenses in respect of Properties:</i>			<i>By Rent:</i> Accrued	nil	
Rates, Taxes, Cesses, Repairs, and Maintenance	nil		Realised ... ..	..	nil
Salaries ... ..	..		<i>Interest (Realised and Accrued)</i>		
Insurance ... ..	..		On Securities	3,252.66	
Depreciation (by way of provision or adjustments) ... ..	..		On Bank Account	1,295.14	
Other expenses ... ..	..	nil	<i>Dividends:</i>		4,547.80
			<i>Donations</i>		nil
<i>Expenditure from Grants:</i>			In Cash	nil	
Government of Maharashtra—Maintenance Grant 1959-60			In Kind	nil	
Salaries 2,899.69			Specific Donation by Mr. Loke Wan Tho	20,000.00	
Rent 250.00	3,366.53		<i>Grants:</i>		20,000.00
Miscellaneous 5,126.84			Government of Maharashtra—unspent Maintenance Grant for 1959-60 as per last Balance Sheet 11,656.85		20,000.00
Maintenance Grants 1960-61			Maintenance Grant for 1960-61 4,000.00		
Salaries 11,405.23			Less—Adjustment on account of unspent grant for 1959-60 3,290.50	31,709.70	
Rent 15,781.00	27,931.14		(Expended as per contra) Grant for Educational Activity 1960-61 4,800.00	52,366.53	
Miscellaneous 775.91			Government of Maharashtra for purchase of Furniture and Equipment		
	36,297.67		Balance for 1959-60 unspent as per last Balance Sheet 16,174.29		
Unspent Balance for 1960-61: Transferred to Balance Sheet	12,058.85	48,366.53	Grant for 1960-61 7,000.00		
Government of Maharashtra—for purchase of Furniture and Equipment—out of Grant for 1959-60	16,148.54		Less—Adjustment on account of unspent grant for 1959-60 25.75	6,974.25	23,148.54
Unspent Balance for 1960-61 transferred to Balance Sheet	7,000.00	23,148.54	(Expended as per contra)		
World Health Organization—for Bird Migration Survey expenditure during the year	,066.07		Government of India Journal Expenses—1960-61	7,000.00	
Unspent Balance transferred to Balance Sheet	30,029.93	38,096.00	World Health Organisation—for Bird Migration Survey		
Rockefeller Foundation—Expenditure during the year (including Rs. 15,759.93 for purchase of Furniture and equipment)		30,864.72	(Expended as per contra)	38,096.00	
<i>Expenditure from Specific Donation by Mr. Loke Wan Tho:</i>			Government of India Journal Expenses—1960-61	7,000.00	
Cost of Station Wagon	19,722.45		World Health Organisation—for Bird Migration Survey		
Expenses of Registration, Insurance, etc.	637.51	20,000.00	(Expended as per contra)		
Carried forward		1,60,475.79	Carried forward	1,20,611.07	24,547.80

BALANCE SHEET AS AT 31 DECEMBER 1960—(continued)

FUNDS AND LIABILITIES		Rs nP	ASSETS	Rs nP	Rs nP
Brought forward ...		1,88,142.27	Brought forward ...		98,834.54
<i>Liabilities:</i>			<i>Income Outstanding:</i>		
For Expenses (including purchases of			Rent	nil	
Furniture)	41,535.08		Interest (Accrued)	12,70.50	
Advances (Subscriptions)	88.10		<i>Other Income:</i>		
Sundry Credit Balances	270.94	41,655.10	Supplies and Services	8,514.50	
<i>Income and Expenditures Account</i>			Government of Maharashtra Grant	4,000.00	
Balance as per last Balance Sheet	27,584.85		Government of India Grant	7,000.04	20,784.8
<i>Less: Deficit as per Income and Expenditure Account</i>	8,066.45	18,618.40	<i>Stock of Books on hand: (At cost or under)</i>		
			As certified by the Honorary Secretary ...		49,439.37
			<i>Cash and Bank Balances:</i>		
			(a) <i>In Current Account with:</i>		
			National and Grindlays Bank Ltd.,		
			Bombay	45,881.17	
			National and Grindlays Bank Ltd.,		
			London (612.19.0)	8,172.89	
			Fixed Deposit with the Chartered		
			Bank, Bombay, (in the name of		
			the Bombay Natural History	5,000.00	
			Society)		
			(b) With the Trustee		
			(c) With the Cashier	350.00	79,437.05
Total ...		2,48,465.77	Total ...		2,48,465.77

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Properties and Assets of the Trust.

(Sd.) SURENDR LALL,
Trustee

As per our report of even date,
(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants

BOMBAY, 6th June, 1961

EXPENDITURE	Rs qP	Rs nP	INCOME	Rs nP	Rs nP
Brought forward ...		1,60,475.79	Brought forward ...	1,20,611.07	24,547.80
<i>To Establishment Expenses:</i>			<i>By Grants (cont'd)</i>		
Salaries (including Dearness Allowance)	21,227.93		Rockefeller Foundation—		
Society's contribution to Staff Provident Fund ...	1,079.00		Balance unspent as per last Balance Sheet ...	31,454.42	
Postages ...	1,332.56		Less—Unspent balance forfeited ...	589.70	
Printing and Stationery ...	1,409.45		(Expended as per contra)	30,864.72	1,51,475.79
Advertisement ...	103.00		<i>Income from other sources:</i>		
Editor's Travelling Allowance ...	400.00		Subscriptions ...	15,043.83	
Honorary Secretary's Travelling Allowance ...	3,070.00		Entrance Fees ...	445.00	19,488.83
Telephone call charges ...	503.49		<i>Publications:</i>		
Bank charges ...	160.00		Journal Sales ...	3,727.55	
Electric charges ...	169.16		<i>Books etc., Profits:</i>		
Meeting Expenses ...	159.26		Book of Indian Birds ...	109.04	
Convoynance to Staff ...	188.10	29,751.77	Some Beautiful Indian Trees ...	618.67	
Remuneration to Trustees ...			Some Beautiful Indian Climbers and Shrubs ...	1,206.31	
Remuneration (in the case of Math) ...			Butterflies of the Indian Region ...	412.66	
Legal Expenses ...			Game Birds of India, Burma and Ceylon Vol. III ...	79.80	
Audit Fees ...		753.00	Indian Molluscs ...	94.05	
Amounts written off:			Snake charts ...	865.07	
Bad Debts ...	nil		Calendars ...	2,961.17	
Loan Scholarships ...	nil		Other Publications ...	182.41	10,356.73
Irrecoverable Rents ...	nil		<i>Commission on Taxidermy work ...</i>		16.50
Other Items (Stock of Books—Circumventing the Mahseer and other Sporting Fish) ...	215.19	215.19	<i>Deficit carried to Balance Sheet ...</i>		8,965.43
<i>Miscellaneous Expenses:</i>					
General Charges ...	1,031.08				
Fire Insurance ...	110.30				
Custom Duty etc. on specimens received from U.S.A. ...	182.87				
Donation to Zoological Survey of London ...	66.45	1,390.68			
<i>Depreciation:</i>					
On Investments ...	nil				
“ Furniture ...	136.02	136.02			
<i>Expenditure on Objects of the Trust:</i>					
(a) Religious ...	20,811.86				
(b) Educational—Journal Expenses ...					
—Library Account (Subscription to other Societies) ...	595.00				
—Purchase of Books ...	475.95				
—Periodicals and binding charges ...	249.10				
(c) Medical relief ...	nil				
(d) Relief of Poverty ...	nil				
(e) Other Charitable Objects ...	nil				
Total ...		2,4,852.68	Total ...		2,14,852.08

As per our report of even date

For Bombay Natural History Society

BOMBAY, 5th June, 1961

(Sd.) A. F. FERGUSON & Co.,

(Sd.) SURENDR LA LL,

Chartered Accountants.

Trustee.

THE BOMBAY NATURAL HISTORY SOCIETY
NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31 December 1960

RECEIPTS	Rs	pP	PAYMENTS	Rs	pP
To Balance as at 1st January 1960 brought forward	82.51		By Repayment of Advance from Bombay Natural History Society	905.61	
.. Grant Government of Maharashtra 1960-61	6,840.00		.. Salaries of Nature Education Organiser	5,640.00	
.. Sales of Booklet No. I	411.06		.. Postages	78.91	
.. Sales of Booklet No. II	417.72		.. Printing and Stationery	174.26	
.. Sales of Booklet No. III	48.89		.. Cost of Booklet No. IV	3,233.00	
.. Sales of Booklet No. IV	255.67		.. General Charges	96.76	
.. Sales of Nature Study Pamphlets Line-drawings	12.06		.. Cash with the Cashier	51.00	
.. Bombay Natural History Society (Advance)	1,963.41		.. Bank Balance on 31 December 1960	32.72	
Total	10,271.32		Total	10,271.32	

BOMBAY, 6th June, 1961

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE
BOMBAY NATURAL HISTORY SOCIETY HELD IN THE
DURBAR (TOWN) HALL, BOMBAY, ON FRIDAY, 22ND
SEPTEMBER 1961 AT 6 P.M., WITH MR. G. V. BEDEKAR, I.C.S.
IN THE CHAIR

1. The Honorary Secretary's report for the year ending 31st August 1961 having been previously circulated to members was taken as read and adopted.

The Balance Sheet and Statement of Accounts presented by the Honorary Treasurer were approved.

The following were elected as members of the Executive and Advisory Committee for the year 1961 :

EXECUTIVE COMMITTEE

President

SHRI SRI PRAKASA, *Governor, State of Maharashtra*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S. (RETD.)

Rev. Fr. H. Santapau, S.J.

Mr. Humayun Abdulali (*Hon. Secretary*)

Mr. Surendr Lall (*Hon. Treasurer*)

Dr. D. V. Bal, M.Sc., Ph.D.

Mr. G. V. Bedekar, I.C.S.

R. S. Dharmakumarsinhji

Mr. Z. Futehally

Mr. R. E. Hawkins

Dr. C. V. Kulkarni, M.Sc., Ph.D.

Mr. D. N. Marshall

Mr. D. J. Panday

Mr. D. E. Reuben, I.C.S. (Retd.)

Dr. H. Trapido, M.D.

Ex Officio

ADVISORY COMMITTEE

Mr. H. G. Acharya, F.R.E.S.

Ahmedabad

Mr. F. C. Badhwar, O.B.E.

New Delhi

Sir Chintaman Dashmukh, Kt., C.I.E., I.C.S. (Retd.)

New Delhi

Rev. Fr. Dr. J. B. Freeman, M.A., L.T., Ph.D., D.D. . . .	Mysore
Mr. E. P. Gee, M.A., C.M.Z.S.	Shillong
Dr. Bains Prashad, D.Sc., F.N.I.	Dehra Dun
Mr. P. D. Stracey, I.F.S. (Retd.)	Shillong
Dr. M. L. Roonwal, M.Sc., Ph.D., F.N.I., F.Z.S.I. . . .	Calcutta
Lt.-Gen. Sir H. Williams, C.B., C.B.E., M.I.C.E., M.I.E.	Roorkee
Y. S. Shiyraj Kumar of Jasdán	Jasdán

4. The following Amendments to the Rules & Regulations of the Society, previously circulated with explanatory notes, were put to the vote and carried unanimously :

i. that the following paragraph be inserted at the end of the existing Rule 7 :

‘It shall also be permissible for the Committee to decapitalize such investments and use the proceeds as revenue, provided that the market value of the capital remaining invested in Government Securities after such transaction shall not be less than the amount of the contributions and compounded subscriptions paid by the then existing Life Members and corporate members who have compounded their subscriptions.’

ii. that the following words be deleted from the existing Rule 25 :
‘ and printed in two newspapers published outside Bombay ’.

5. The films BETWEEN THE TIDES and KEW GARDENS loaned by British Information Services were exhibited and greatly appreciated:

6. The meeting terminated with a vote of thanks to the British Information Services for the loan of the films, to the Asiatic Society for the loan of the premises, and to the Chairman of the meeting.



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