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The Breeding of the Grey or Spottedbilled Pelican, *Pelecanus philippensis* Gmelin

BY

E. P. GEE, M.A., C.M.Z.S.

(*With four plates*)

Where do pelicans breed in India? This is a question often asked, but an answer never seems to be forthcoming. I have been asking forest officers, sportsmen, and others in north-east India for many years now, but no pelicanry seems to exist in these parts.

Pelicans are quite common in this sub-continent, especially the Grey or Spottedbilled Pelican (*Pelecanus philippensis* Gmelin), and I have often seen them on the Brahmaputra and on *jheels* in Assam. I remember seeing several hundreds on a *jheel* in Kaziranga in December 1950, and there are usually a few dozen to be found in that sanctuary. On the Manas and Beki rivers in north-west Assam there always used to be about a hundred birds near the Bhutan border, though as a matter of fact this cold weather only three were to be seen.

It is an extraordinary fact that such a large and spectacular bird as the pelican, justly famed for being able to hold more in its beak than its belly can, should not be better known. In the last century Blanford deplored that of late years no authentic account of pelicans breeding in India had appeared, though Jerdon (writing in 1864) said he had visited a pelicanry in the Carnatic 'where the Pelicans have (for ages I was told) built their rude nests, on rather low trees in the midst of a village, and seemed to care little for the close and constant proximity of human beings'.

Whistler stated in 1928 that there was no known breeding haunt of the pelican in India. In Stuart Baker's book (1929) he mentions that 'there was formerly a breeding place in Sylhet, possibly still existing, where they did not begin to lay until July, when the floods had commenced to rise'; and it would be interesting to know if this pelicanry still exists in present-day East Pakistan.

Delving into the back numbers of the *Journal of the Bombay Natural History Society*, I find (in Vol. 14, page 401) that at the end of March 1890 a person named W. Howard Campbell found a large number of Grey Pelicans breeding in company with Painted Storks in a secluded valley in the extreme east of the Cuddapah District, in what is now Andhra State: 'The nests, of which there were several hundreds, were on neem and tamarind trees in a small village called Buchupalle. The people of the village were very much averse to any interference with the nests. The birds trusted them and they would not have them injured, they said.' It is not known if this small pelicanry still exists.

In June 1906 (in Vol. 17, page 806) C. E. Rhenius found a small pelicanry in the village of Kundakolam in the extreme south of Tinnevelly District, in Madras State. About twelve tamarind trees contained nests with fully-fledged young birds. There were also Painted Storks nesting there—the Pond Herons, Cattle Egrets, and Night Herons had left: 'The villagers looked on these birds as semi-sacred and would not allow anyone to disturb or molest them, so that they return to build there year after year, and have done so for years past.' In April 1944 (in Vol. 45, page 426) this very pelicanry was visited by C. G. Webb-Peploe, who saw only ten nests of pelicans with young birds in them (and also 200 nests of Painted Stork and many of Night Heron and Little Egret). The headman of the village protected them, he said, and the birds seemed to have been nesting there for 60-70 years at least. There is no further news of this diminutive colony of pelicans.

From all accounts pelicans breed in Ceylon in February and March; but the largest pelicanry in this part of Asia, if not in the whole world, is or was near Shwe-gyen on the Sittang River in Burma. This huge pelicanry, described as being some twenty miles long by five miles broad and as containing 'millions' of pelicans and Adjutant Storks, was discoverd by Oates in 1877. The nests contained eggs in November. Stuart Baker in 1929 reported that they still bred there in their hundreds of thousands in company with Adjutants. The area was again visited by Wickham in 1910 who found that 'countless millions of birds still bred over a vast area'. According

General view of part of pelicanry showing nests in palmyra and babool trees

Nesting activity on palmyra trees

Photos : E. P. Gee

Nesting activity where babool and palmyra trees intermingle, showing adults and very young chicks

Three incubating adults. Each nest contained two eggs. When excited, the birds extend their pouches.

Photos : E. P. Gee

to B. E. Smythies the birds were still there in 1935, but in 1946 'the immense colonies which Oates found on the Sittang have disappeared'. No recent news of this pelicanry has been received.

Now to return to India. In 1946 (Vol. 48, pages 656-666) K. K. Neelakantan of Trivandrum commendably discovered a pelicanry of considerable size near the Kollair Lake in West Godavari District of what is now Andhra State. It was close to the village of Aredu, and is reached by train on the main line from Calcutta or Madras, the station Tadepallegudem being 15 miles away. This same person made an official visit to the pelicanry in December 1959 on behalf of the Andhra Government, and was kind enough to supply me with all the latest information about the place, where to stay and so on.

Accordingly I visited the pelicanry in January of this year (1960), and found a remarkable sight. Probably not less than 3000 pelicans were nesting in an area of about two square miles of well-irrigated paddy fields. The nests were mainly in palmyra trees, and sometimes in babool or rain trees or coconut palms, which are planted along the irrigation bunds. Sometimes there were as many as twelve to fifteen nests in one tree, and often not far up from the ground. The villagers protect them as much as they can—partly because of the trust the visiting birds place in them, and partly because of the value of the guano or droppings as a fertilizer for the crops.

The birds this year have shifted their breeding ground from Aredu. There is a small colony of about 25 nests near Ganapavram, but the large colony of about 1500 nests is near Kolamuru village, about three miles from Aredu. When I was there from January 13th to 19th the small pelicanry contained half-grown young birds, while the nests of the larger one had eggs or else very young chicks. It was thus possible to see the breeding of this bird in all its stages.

I went there primarily for photography, both ciné and still, but managed to find some time for observation of the habits of these extraordinary birds. Although the pelican is a large and somewhat ungainly-looking creature, once it has managed to become airborne after much effort and flapping it flies very gracefully. With under-carriage of legs and webbed feet up, head well back on the shoulders, and large bill resting on the front of the neck it sails through the air with apparently little effort.

I thought at the time that I had stumbled on something new about the soaring of pelicans which is done regularly over the nesting area. Every day I saw this 'community soaring' going on, usually about 50-150 birds wheeling round and round on the thermal currents

in the same way as vultures do. They (probably the mates of the brooding birds) would fly from their nests and join the soaring at the lowest level, and soon attain a great height, eventually becoming tiny specks in the sky. I observed, however, on two days at about 2.30 to 3.30 p.m. that some pelicans left the 'community soaring' and went in for 'individual soaring' at a great height, wheeling round and round on their own. And then suddenly a bird would start to do aerobatics —twisting, turning, and rolling in a most peculiar and comical way. Out of sheer *joi de vivre*, I presume.

Most people know that the upper mandible of the pelican is long, slightly boat-shaped, and ends in a nail or hook. The lower mandible consists of two flexible arches which support a large elastic pouch. This pendant and distensible pouch of naked membrane forms an ideal landing net when the birds are fishing. I noticed that whenever the birds became excited in any way, the pouch was extended giving the beak a thick triangular appearance.

Many people must have seen pelicans fishing: like cormorants they do it together in a party, forming a line or semi-circle and driving the fish into the shallows where they scoop them up in their pouches. Talking about fish—how do pelicans choose a nesting site? How do pelicanries come into existence, to which pelicans will come from all parts of India and from which, after the breeding season is over, they will return to their respective haunts in all parts of India? The answer presumably is—fish supply. They must have a place where they can catch sufficient fish to feed themselves and their growing offspring. The amount of fish required to feed so many pelicans must be very large indeed, amounting to several tons per day.

From a cloth 'hide' fixed in a tree just above the level of some of the nests, I was able to observe and photograph the intimate family life of the pelicans in their home. The enjoyment derived from being only a few feet away from wild birds while they have not the faintest idea that you are there has to be experienced to be believed. After a short absence due to the alarm caused by your climbing into the 'hide', the huge birds return to their nests in twos and threes, wings outstretched and undercarriage of legs and webbed feet forward. Then the inevitable shuffling and bickering of birds breeding in a community. Then those with eggs settle down to brood, while those with chicks start to feed them.

The eggs are a dirty white, and the chicks are born naked. Soon a snow-white down covers their bodies, and this is gradually replaced by sprouting feathers of a brownish grey. The bills of the young

One of the unfortunate youngsters which had fallen from its nest. It was strutting up and down the ground below picking up what it could

Parent feeding very young chick, which is mostly inside the capacious pouch. The bulge where the bill of the chick is pressed against the membrane of the pouch can be plainly seen

Photos : E. P. Gee

A close-up of nests showing young bird about 2 to 3 weeks old at right

A nest with parents and young on top of a babool

Photos : E. P. Gee

birds are smallish—but the hooked nail and the pouch are there. The bills develop very quickly.

The pelican is renowned for being extremely devoted to its young. In heraldic and ecclesiastical symbols in England it used to be represented as standing above its nest with its wings outstretched and nourishing its young with its blood. It used to be described as 'a pelican in its piety' (piety here having the classical meaning of filial devotion). This legend that pelicans feed their young with their blood probably arose from the fact that these birds, like cormorants and darters, feed their young by regurgitating partly digested fish into the tops of their pouches for the young to feed on.

Almost spellbound I watched how a parent bird with wonderful tenderness and care nudges a youngster with the tip of its bill, and then the chick stands up and thrusts its bill and neck far into the parent's pouch. In the case of a young chick the whole of the youngster disappeared into the pouch, making the proverbial sword-swallower's act seem nothing at all. After one chick has had enough, and the parent seems to be the sole judge of this, another chick is gently nudged into feeding activity. If a previously fed chick tries to get a second helping, it is carefully pushed aside by the fair-minded parent—though I did see sometimes that two or three small chicks all got into the parent's capacious pouch at once!

In most trees the nests were contiguous, often looking like strings of large beads. And the chicks, two or three in a nest, often got mixed up with those of other nests. Once, while the parent birds were away due to my arrival at the tree, I got a boy to climb up and sort out the chicks by their age groups, putting the tiny naked ones together where they belonged and the larger ones in their nests and so on. But in no time at all they began to stagger about like drunks and got mixed up again. When the parent birds returned, I think they managed to identify their own babies before feeding commenced. One poor adult pelican seemed to have been unlucky in love, with no mate or nest of its own, and always got pecked by its neighbours before sitting down at the end of the branch on nothing at all . . .

Sometimes a chick lurches too far, and over it goes—down to the ground. When this happens, the chick is completely ignored by the otherwise devoted and 'pious' parents, which seem not to notice it and make no effort to help or feed it. If it is a young chick it is bound to perish either from starvation or from attack by a predator. If it is a larger chick it struts up and down below the nests, picking up what fish it can; and such a bird has a chance of surviving.

There were a few crows about, scavenging on what they could find and possibly stealing eggs at times. The number of Brahminy Kites was very great—these were living apparently on fish dropped or vomited by the pelicans or spilt from feeding at the nests. Pariah Kites were few in number. Both species of kites joined in the 'community soaring' of the pelicans.

The attitude of the local villagers to the pelicans was interesting. Some of them said to me, through an interpreter, that it was wrong to shoot or harm the pelicans which were visitors, coming every November. They brought good health to their villages, said some of them, and their excreta provided a good fertilizer for their fields. Others said they did not disturb or harm the pelicans, as these birds did no harm to them. One villager suspiciously thought that I was taking the blood out of the pelicans, but when it was explained to him that I was doing just the opposite he seemed to understand.

I was informed that small gangs of 'low-caste men' sometimes came from Bhimavaram at night, and speared roosting pelicans with long bamboo spears for selling to hotels. About a hundred birds, I was told, had been killed this season so far (mid-January). It is to be hoped that the State Government of Andhra will take appropriate steps to prevent this sort of thing, by declaring the pelican a protected species (at least during the breeding season), or else by constituting the pelicanry as a sanctuary or protected area.

Now for noises made by pelicans. When Oates visited the huge pelicanry in Burma in 1877 he commented on the silence of the place. His actual words were: 'Notwithstanding the millions of birds which breed in this forest, a most wonderful silence prevails. The pelican seems to be perfectly mute, and the adjutants only bellow at intervals. The only sound which is constantly heard, and after a time even this sound passes unnoticed, is a sort of Aeolian harp caused by the movement of the wings of innumerable birds high in the air.'

But in the Andhra colony the noise of the nesting pelicans could be plainly heard a quarter of a mile away. And when standing near the trees containing nests the noise was really loud: there were the long-drawn moanings, harsh throaty gruntings, and sharp yap-yaps like the yelping of a dog. Also every now and then a bird would open wide its bill and give a series of loud claps—two, three, or four claps were frequently heard. As evidence of the volume and variety of pelican noises, I made a recording—and the tape-recorder, like the camera, cannot lie.

What of the future? It is most reassuring to know that the villagers of those parts extend a sort of traditional welcome and pro-

tection to the visiting pelicans. I wonder if villagers in other parts of the country would do the same, should the pelicans have to move from their present colony?

For if the Kollair Lake is the main source of their fish supply, then the future of the present pelicanry is uncertain due to the fact that this lake is being drained in an agricultural project. I was told that in three or four years' time the lake would practically cease to be. So it seems that alternative nesting sites may possibly have to be found by the birds in the years to come. Perhaps some of the new sheets of water formed by the multi-purpose hydro-electric and irrigation projects in fast developing India may eventually help provide the answer to this problem.

Critical Notes on the Orchidaceae of Bombay State

III. THE GENUS *OBERONIA* LINDL.

BY

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

(*With five plates*)

[*Continued from Vol.* 57 (1) : 135]

The generic name *Oberonia* seems to be derived from Oberon, the King of Fairies, in reference to the strange and variable forms of the plants of this genus. This is one of the more difficult among orchid genera, mostly on account of the minute structure of the flowers. Identification of the genus is simple enough, for the plants are very distinctive in their general appearance ; identification down to the species level is rather difficult on account both of the very small size of the flowers and of their annoying variability.

The genus *Oberonia* is common in most parts of the former Bombay State, as it stood after Independence ; *Oberonia* is particularly common from about Bombay latitude southwards to N. Kanara and beyond. They are usually perennial herbs, but flower at various times in the year. We do hope that these notes with the diagrams of some of the species will be of help to other Bombay botanists.

OBERONIA Lindl.

OBERONIA Lindl. Gen. & Sp. Orch. Pl. 15, 1830, nom. cons. ; Endl. Gen. Pl. 188, 1837 ; Lindl. Fol. Orchid. Oberon. 1852 ; Benth. & Hook. f. Gen. Pl. 3 : 494, 1883 ; Pfitz. in Engl. & Prantl. Pflanzenfam. 2 (6) : 131, 1888 ; Hook. f. Fl. Brit. Ind. 5 : 675, 1898 ; King & Pantl. in Ann. R. Bot. Gard. Calcutta 8 : 2, 1898 ; Duthie, ibid. 9 (2) : 85, 1906 ; J. J. Smith, Fl. Buitenz. 6 : 233, 1905 ; Schlecht. Orchid. 156, 1927 ; Holttum, Rev. Fl. Malay. 1 : 208, 1953. *Iridorkis* Thou. in Nouv. Bull. Soc. Philom. Paris 1 : 319, 1809. *Iridorchis* Thou. Hist. Pl. Orch. 1822 ; O. Kuntze, Rev. Gen. Pl. 2 : 668, 1891.

Erect or pendulous *epiphytes*. *Stems* usually dense and short, occasionally long and slender. *Leaves* much laterally compressed, with broad overlapping sheaths at the base, ensiform, fleshy, leathery. *Inflorescence* in terminal, dense, sub-cylindric racemes or spikes, which

continue to grow at the base after the middle part has matured ; the uppermost flowers usually open first. *Flowers* up to 2 mm., often scarcely 1 mm. long, sessile or on a short stalk and bracteate ; the colour of the flowers is usually inconspicuous, often greenish or greenish yellow. *Sepals* free, nearly equal among themselves, erect or reflexed. *Petals* usually narrower and shorter. *Lip* sessile, concave at the base, fimbriate, entire or more or less 3-lobed. *Column* very short, footless ; clinandrium fairly prominent. *Anther* terminal, opercular, incumbent ; pollinia 4, waxy, yellow, in pairs without caudicles, often attached by a viscid substance at the apices. *Capsules* small, globose or shortly oblong, ridged.

It may be interesting to put down here some general points on the structure of the flowers. Hooker f. mentions that each bract supports 2 flowers ; in Bombay we have noted that each flower is supported by its own individual bract. Some of the species are described as having setaceous sepals and petals ; actually these setaceous structures are prominent hyaline glands which may appear as setae especially in moist flowers from dry herbarium specimens. The tips of the sepals are often curved inwards, and they then seem to be obtuse ; in fact they are sharply acute. In the normal position of the lip the lateral lobes are usually more or less folded over the column, and appear very small ; again careful observation will show that they are often fairly large ; but this can only be seen when the fresh lip is properly spread out. A careful examination of the structure of the lateral lobes is essential, since the separation of species is often based on such a structure.

Type species : *O. iridifolia* (Roxb.) Lindl.

KEY TO THE SPECIES OF *OBERONIA* OF BOMBAY

1. Sepals similar ; lateral lobes of lip not encircling the column ; midlobe of lip usually straight :
   2. Petals and lobes of lip deeply toothed :
      3. Small plants ; lvs. to 4 cm. long ; rachis terete ; flrs. orange, stalked ; sepals & petals erect ; lip clearly 3-lobed, the midlobe with broad oblong lobules .. .. *brachyphylla*
      3. Large plants ; lvs. to 15 cm. long ; rachis flattened ; flrs. golden yellow, ± sessile ; sepals & petals reflexed ; lip obscurely 3-lobed, midlobe 2-lobulate .. .. *iridifolia* var. *denticulata*

2. Petals & lobes of lip ± entire ;

4. Petals broad :

5. Spikes shorter than leaves ; petals and lip pubescent .. *ensiformis*

5. Spikes much longer than leaves ; petals and lip glabrous : ..

6. Lobes of lip large ; midlobe about equal to side lobes .. *recurva*

6. Lobes of lip very small or 0 ; midlobe 4-5 times larger than side ones :

7. Inflorescence rachis thickened in fruit, with a few minute scaly bracts ; flrs. ± embedded in rachis ; lip as broad as long, not lobed, denticulate *proudlockii*

7. Rachis not thickened in fruit, with large serrulate bracts at base ; lip broader across side lobes than across midlobe, which is entire, 2-lobulate .. .. *falconeri*

7. Rachis not thickened in fruit, with a few or 0 minute bracts ; midlobe broader than lip across side lobes ; midlobe divided at apex into 2 truncate lobules .. .. *verticillata*

4. Petals, narrow, ± linear :

8. Lvs. thin ; flrs. long-pedicelled ; lateral lobes of lip up to equal to midlobe, which is divided at apex into 2 diverging lobules *wightiana*

8. Lvs. fleshy ; flrs. sessile ; lateral lobes longer than midlobe :

9. Lip longer than broad ; lateral lobes broad, wing-like ; midlobe short ± quadrate, ± 3-lobed at margin .. *platycaulon*

9. Lip oblong-orbicular ; apex 2-lobulate, lobules orbicular .. .. *brunoniana*

9. Lip broadly 3-lobed ; midlobe much smaller than lateral lobes .. *santapaui*

1. Sepals unequal ; lateral lobes of lip encircling the column ; midlobe of lip usually folded upwards ;

10. Petals broad ovate ; lateral lobes of lip linear-lanceolate, ascending as erect horns around the column, slightly diverging at the tips or not *bicornis*

10. Petals narrow linear ; lateral lobes of lip elongated, filiform, ± aristate meeting beyond the column .. .. .. *tenuis*

ENUMERATION OF THE SPECIES OF *OBERONIA* OF BOMBAY STATE

1. **Oberonia brachyphylla** Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 257, t. 2, 1931 (See Plate XI A′-B′).

Small pendulous *epiphytes*. *Leaves* 0.6-4 × 0.3-1.4 cm. fleshy or thin, ovate to oblong or lanceolate, straight or more commonly the uppermost falcate. *Scape* adnate to the uppermost leaf, bracteate, about 2-5 mm. long, terete. *Inflorescence* 0.8-7 cm. long, somewhat decurved, dense or lax, many-flowered. *Flowers* about 2 mm. long, orange or yellowish orange, more or less whorled, bracteate, with long pedicels. *Bracts* shorter than the pedicels, lanceolate or ovate-lanceolate, acute or acuminate, irregularly erose, gland-dotted. *Sepals* about 0.75 × 0.5 mm., subequal, gland-dotted, acute-mucronulate, entire, erect ; the dorsal one ovate-oblong, the laterals obliquely ovate-subacuminate. *Petals* more or less equal to the sepals, oblong-obovate, narrowed to the base, or even oblong-orbicular, obtuse, slightly retuse, irregularly denticulate. *Lip* 1-1.25 mm., nearly twice the size of the sepals and petals, somewhat quadrangular in outline, 3-lobed, 3-nerved, distinctly gland-dotted ; lateral lobes broad, irregularly pectinate, the lip across the lateral lobes about equal to or slightly broader than across the midlobe ; midlobe 2-lobulate with a broad or narrow sinus in between the lobules, the latter slightly divergent, oblong, irregularly denticulate or pectinate at the apex or even all around. *Ovary* with pedicel about 1 mm. long. *Capsules* up to 5 mm. long, ovoid or obovoid, long-pedicelled.

Flowering and *Fruiting* : March.

Occurrence in Bombay : *Bell* ; *Kapadia* 1857, 2853-2857.

Distribution : Apparently endemic in N. Kanara.

Notes : Blatter & McCann described their species from detailed illustrations prepared by T. R. Bell and Miss Bell ; these illustrations were drawn directly from live specimens. As no type was designated for the species, and further as there is no type material at all, we hereby establish the specimen, *Kapadia* 2855, as the Neotype of *O. brachyphylla* Blatt. & McC.

2. **Oberonia iridifolia** Lindl. var. **denticulata** Hook. f. Fl. Brit. Ind. 5 : 676, 1890 ; Fischer, Fl. Pres. Madr. 1406, 1928. *O. denticulata* Wight, Icon. 5(1) : 3, t. 1625, 1851 ; Lindl. 2. (See Plate XII).

Erect or occasionally pendulous *epiphytes*. *Leaves* 4-15 × 1.5-2.5 cm., fleshy, broadly ensiform, ovate-oblong to oblong-lanceolate, often subfalcate, acute to subacuminate. *Scape* 2-5 cm. long, bracteate or ebracteate, flattened, 2-angled, somewhat twisted, often adnate to the uppermost leaf particularly in young plants. *Inflorescence* 7-20 cm. long, decurved or rarely straight, dense. *Flowers* about 2 mm. across, imbricating or in sub-verticils, golden yellow, bracteate, sessile. *Bracts* 2 × 1 mm., ovate to elliptic, acute, irregularly crenulate, convolute, sheathing the sessile ovary. *Sepals* 1 × 0.75 mm., equal, broadly ovate-rotund or suborbicular, acute-mucronulate, 1-nerved. *Petals* 1 × 0.6 mm., ovate-elliptic, obtuse to rarely subretuse, irregularly jagged, 1-nerved. *Sepals* and *petals* reflexed and resting on the ovary. *Lip* 1.5 × 2 mm., obscurely 3-lobed ; lateral lobes pectinately erose ; terminal lobe 2-lobulate with an unequal broad sinus, the lobules dentate or more often bidentate ; nerves of the lip 3, the lateral ones sinuous, the central one straight. *Column* stout, broad, sessile, over 1 mm. in length. *Anther* transversely oblong-orbicular with a small rounded apex, greenish-white. *Capsule* sessile, broadly ovoid, 5 × 2 mm.

Flowering : August to September. *Fruiting* : October to December.

Occurrence in Bombay State : KONKAN : T a n s a, *Santapau* 16030 ; *Kapadia* 731, 1638. N. KANARA : G u n d h, *Bole* 1497 ; *Kapadia* 1711-1717.

This species has been recorded from Bombay State for the first time.

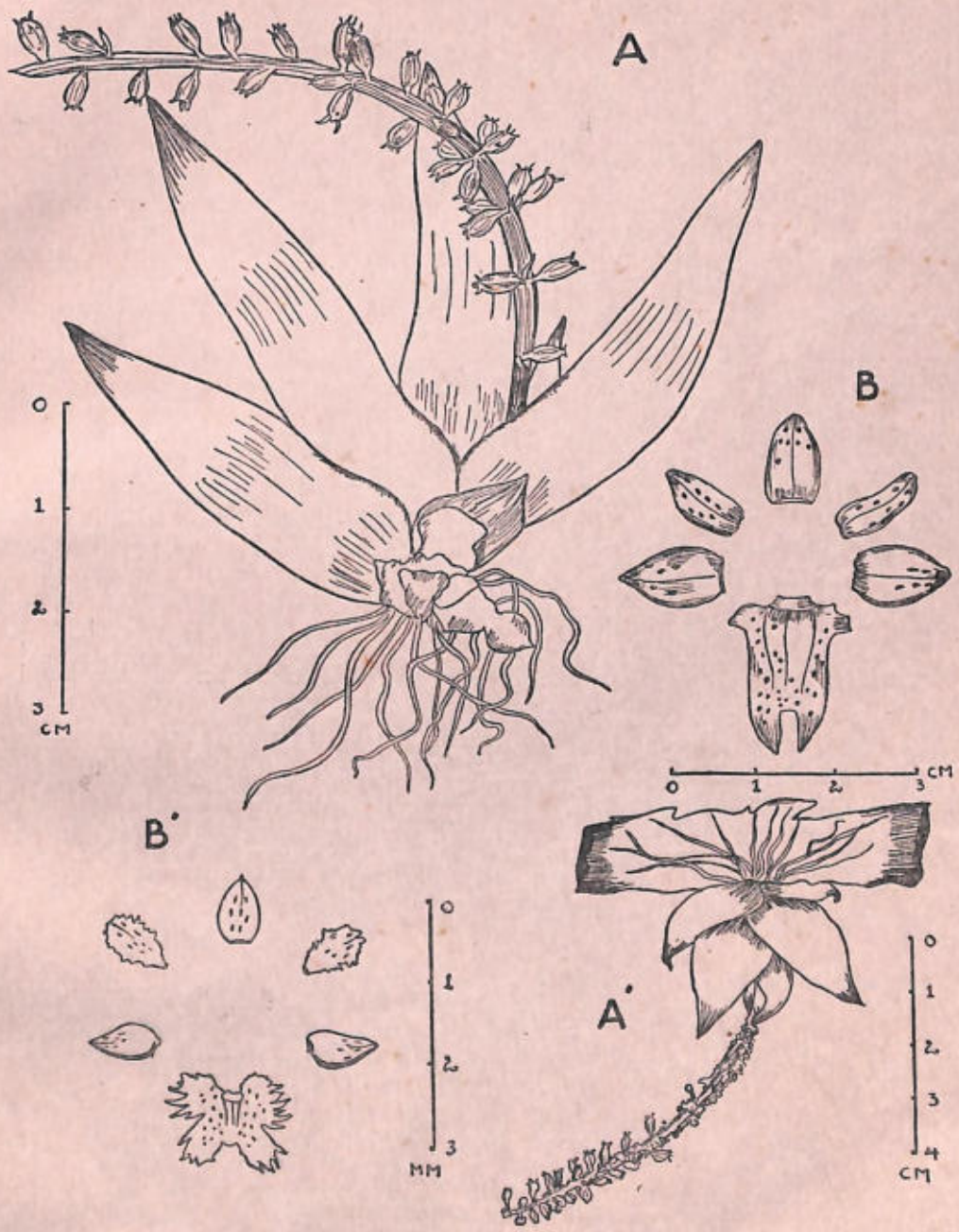
Distribution : *O. iridifolia* Lindl. is a very variable species and is widely distributed all over India. The var. *denticulata* Hook. f. is restricted to south India ; we have noted it in Bombay for the first time.

Notes : We have examined the specimen *Fischer* 3509 labelled *O. brunoniana* Wt. in 1920 ; the name was changed by Fischer himself to *O. lindleyana* Wt. The plant, however, belongs to *O. iridifolia* var. *denticulata* Hook. f.

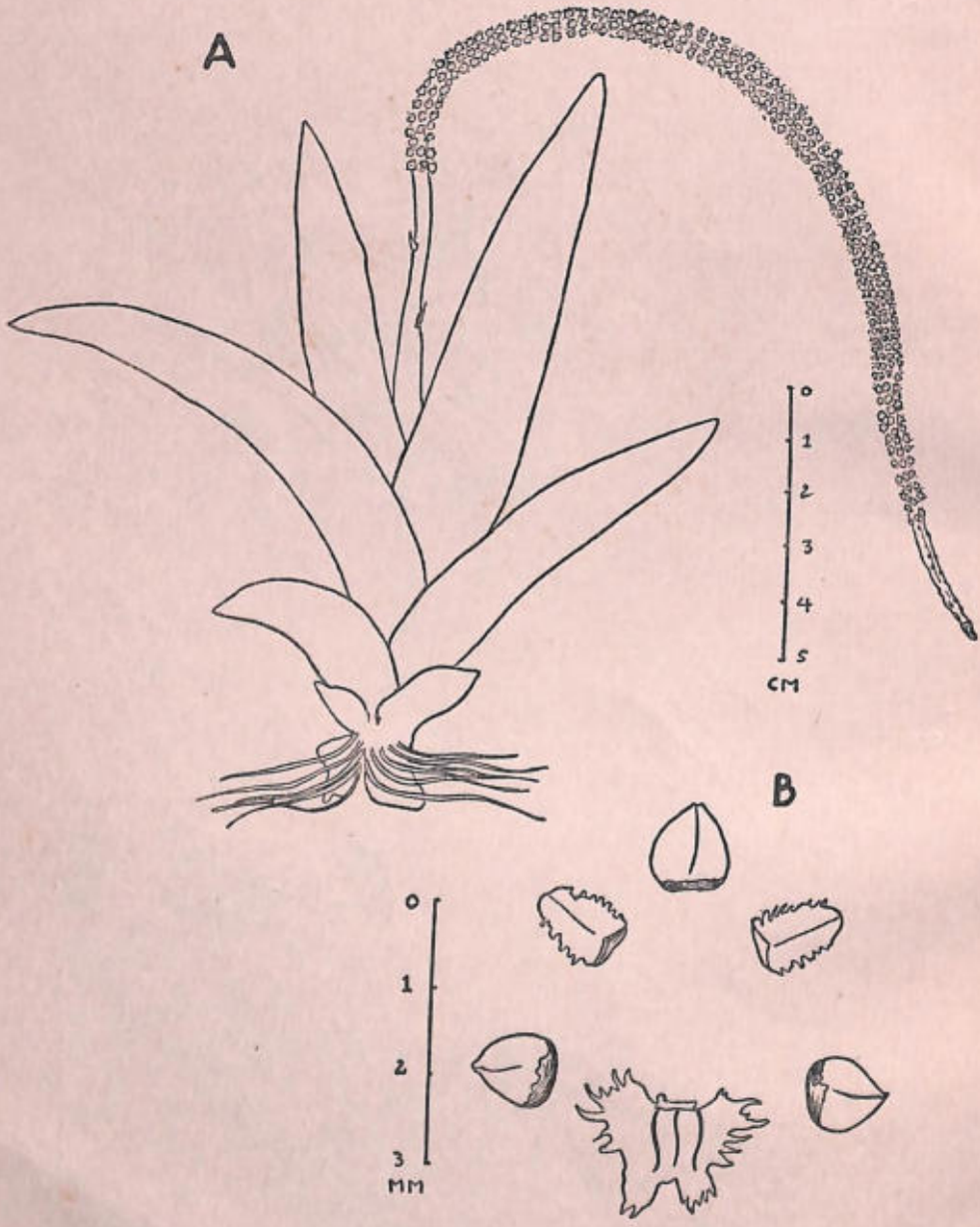
In Wight's description of *O. denticulata* there is no mention of the erose nature of the petals ; Wight's Icon 1625 shows the petals to be smoothly entire. We have observed the petals to be distinctly and irregularly jagged.

3. **Oberonia ensiformis** (Sm. ex Rees) Lindl. Fol. Orchid. Oberon. 4, 1852 ; Hook. f. 679 ; Grant, Orch. Burma 29, 1895 ; King & Pantl. 9, t. 9 ; Duthie 86 et Fl. Upp. Gang. Pl. 3 : 183, 1920 ; Brühl, Guide Orch. Sikk. 37, 1926 ; Fischer 1405. *Malaxis ensiformis* Smith in Rees, Cycl. 22 : n. 14, 1812 ; Reichb. f. in Walp. Ann. 6 : 212, 1861. *Oberonia trilobata* Griff. Notul. 3 : 273, 1851. *O. acaulis* Hook. Bot. Mag. t. 5056, 1858, (non. Griff. 1851). *Iridorchis ensiformis* O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891. (See Plate XIII).

Large pendulous *epiphytes*. *Leaves* 6-28 × 0.5-1.5 cm. fleshy,



A-B. *Oberonia falconeri* Hook. f.; A'-B'. *O. brachyphylla* Blatt. & McC.
A-A'. Whole plant; B-B'. Sepals, petals, and lip.



Oberonia iridifolia var. *denticulata* Hook. f.
A. Whole plant; B. Sepals, petals, and lip.

ensiform, acuminate, falcate or straight, generally all curving in one direction. *Inflorescence* much shorter than the leaves, 6-14 cm. long ; peduncle fleshy, pale brown, terete, sparsely bracteate ; bracts lanceolate, minute, pale yellow. *Flowers* about 2 mm. long, subsessile, bracteate, in more or less clear verticils. *Bracts* longer, ovate-oblong, erose, glabrous, completely sheathing the ovary, their apices acute and recurved. *Sepals* and *petals* reflexed on the ovary, gland-dotted, entire, subacute. *Sepals* subequal, broadly ovate, glabrous. *Petals* ovate, pubescent with blackish stiff bristles. *Lip* about twice as long as the sepals or petals, 3-lobed, of a much darker colour, turning somewhat black on drying ; lateral lobes fairly large, rounded, stiffly pubescent ; the terminal lobe somewhat obreniform in outline, 2-lobulate, pubescent with bristle-like black hairs, the lobules somewhat rounded, separated by a wide subtruncate sinus ; the terminal lobe is separated from the lateral ones by an oblong, completely glabrous mesochile, which has 2 blister-like projections on the sides. *Ovary* very shortly stalked, pale yellowish, ridged. *Capsule* 4-6 × 2-3 mm., ovoid, strongly ribbed, subsessile.

Fruiting : November onwards.

Occurrence in Bombay : N. KANARA D a n d e l i, *Kapadia* 1671-1672, 1682 ; Y e l l a p u r, *V. Patel* 1847 ; *Kapadia* 2350-2352 ; K u m b e l l i M i n e s, about 17 miles from Supa, *Kapadia* 2662-2663.

This species is of fairly widespread occurrence in N. Kanara ; strangely enough it has not been recorded for Bombay State by any of the earlier workers. It constitutes a new record for this area.

Distribution : *India* : Dehra Dun and up to 1000 m. on the adjacent Himalayas, extending eastwards to Sikkim and Khasia Hills, southwards to N. Kanara and the Nilgiris. *World* : India, Nepal.

Notes : This species is easily distinguished by its large ensiform leaves, all of which usually curve in the same direction, and by the stout inflorescence, which, however, is always much shorter than the leaves. It is closely allied to *O. ferruginea* Parish ex Hook. f. ; the latter has completely glabrous flowers.

4. **Oberonia recurva** Lindl. in Bot. Reg. misc. 8, 1839, et Fol. Orchid. Oberon. 5, 1852 ; Dalz. & Gibs. Bomb. Fl. 260, 1861 ; Hook. f. Icon. Pl. t. 1784 A, 1888, et Fl. Brit. Ind. 5 : 680, 1890 ; Gammie in J. Bombay nat. Hist. Soc. 16 : 564, 1905 ; Cooke, Fl. Pres. Bomb. 2 : 676, 1907 ; Fischer 1406 ; Blatt. & McC. 257 ; Santapau in Rec. Bot. Surv. Ind. 16 (1) : 288, 1953. *Oberonia setifera* Lindl. Fol. Orchid. Oberon. 3, 1852. *Malaxis recurva* et *setifera* (Lindl.) Reichb. f. in Walp. Ann. 6 : 210, 212, 1861. *Iridorchis recurva* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891.

Pendulous *epiphytes*. *Leaves* 0.5-5 × 0.3-1.7 cm., ovate to lan-

ceolate, at times subfalcate (particularly the uppermost one), acute to acuminate. *Peduncles* 0-1 cm. long, adnate to the uppermost leaf, with minute hyaline subulate bracts. *Racemes* 1-11.5 cm. long, straight or recurved, dense or rarely lax. *Flowers* 1.5-2 mm. across, imbricating, bracteate, pedicellate, pale orange to deep brick-red. *Bracts* 1-2 × 0.5 mm., shorter or slightly longer than the flowers, gland-dotted, 1-nerved, ovate-acuminate to subulate, subentire to erose, acuminate. *Sepals* 0.5-0.75 mm. long, subequal, ovate, entire, more or less gland-dotted, 1-nerved ; lateral sepals concave, very often mucronulate ; the dorsal one subconvex, ovate-oblong, obtuse, at times subacute. *Petals* 0.5-0.75 mm. obovate-oblong or obovate-spathulate, truncate or truncate-retuse or obtuse-retuse, subentire to erose, more or less gland-dotted along the single midnerve. *Lip* deep red, usually of a much darker colour than the petals and sepals, very variable in shape and size, 3-lobed, 0.75-1 mm. long, equal to or nearly twice as long as the sepals or petals, densely or very sparsely gland-dotted, with a small concave disc just below the anther, 3-nerved. Lateral lobes of lip large, rounded, rarely subtruncate, subentire, erose ; width of the lip across lateral lobes ± equal to that across the midlobe ; midlobe 2-lobulate, obcordate-oblong, subentire to erose ; apices of lobules acute to truncate or obtuse, subentire or erose ; sinus between the lobules broad or narrow, with or without a small apiculum in between. *Column* very small with a transversely oblong stigmatic surface. *Anther* opercular, yellowish green. *Ovary* with *pedicel* 0.75-1.5 mm. long. *Capsule* 2-5 × 2 mm., subrotund to obovate-oblong ; pedicel 0.5 mm. long.

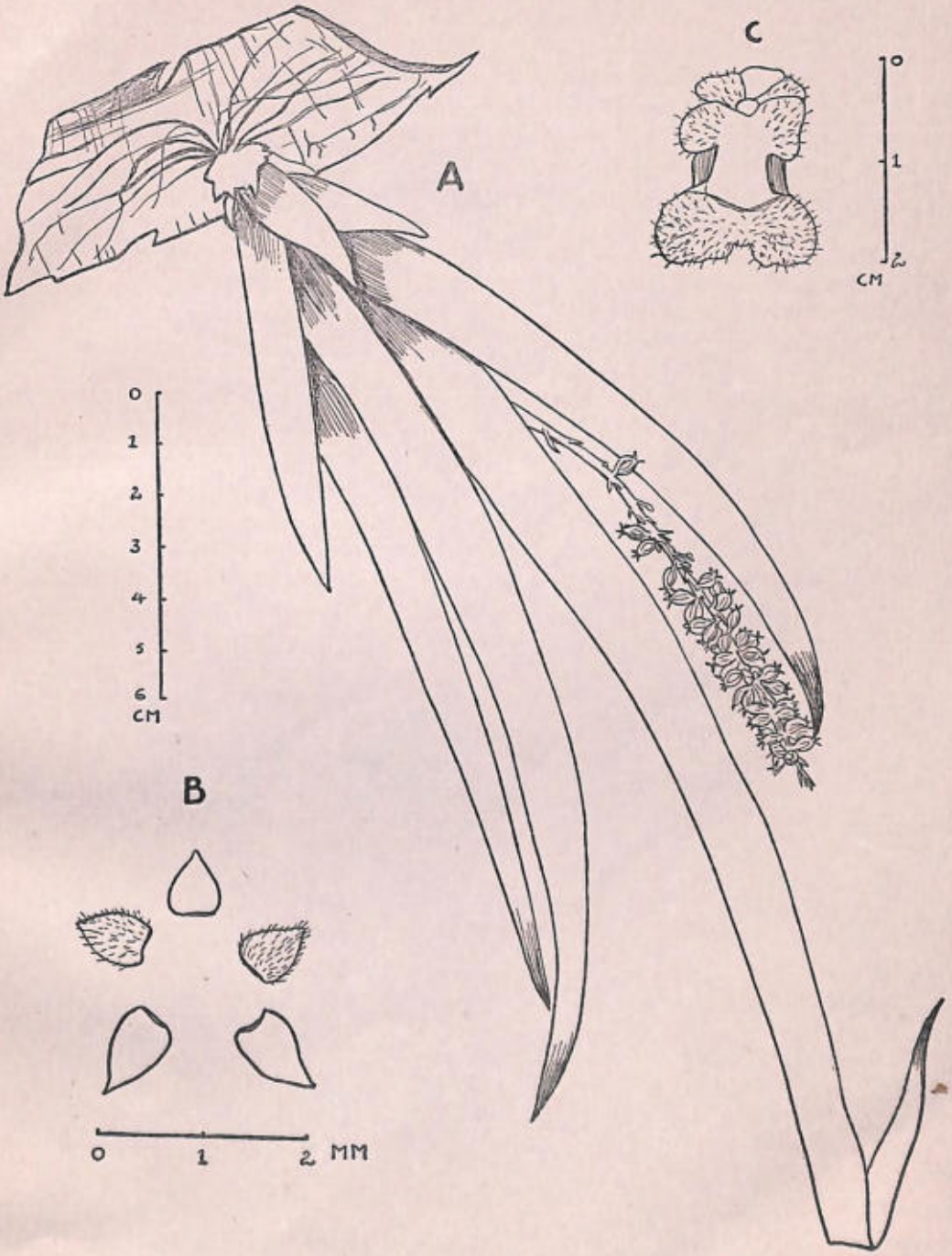
Flowering : November to February. *Fruiting* : December to July.

Occurrence in Bombay State : KONKAN : *Law* ; Thana, cultivated, *Kapadia* 1105. W. GHATS : Kasara, *Kapadia* 902 ; Khandala, *D. K. Patel* ; *Santapau* 233.4, 3622, 10788 ; *C. Saldanha* 1152 ; *Kapadia* 507, 529, 1062, 1834-1835 ; Lonavla, *Gammie* ; *Hallberg* ; *Kapadia* 538, 1047, 1054 ; Mahableshwar, *Cooke* ; *Santapau* 11819, 11913 ; *Kapadia* 500, 600-601, 983, 1928-1929 ; Mahableshwar-Pratapgad, *Agharkar* ; Pratapgad, *Bole* 1078. DECCAN : Koina Valley, *Kapadia* 2906-2907. N. KANARA : Londa, *Santapau* 10854 ; Kumbelli Mines, about 17 miles from Supa, *Kapadia* 2565-2567, 2675-2677, 2764-2766 ; Yellapur, *Kapadia* 2868 ; Castle Rock, *Santapau* 17655, 17831, 17909 ; *Kapadia* 2814 ; Anmod, *Kapadia* 1914 ; Dandeli, *Kapadia* .

Distribution : Konkan, W. Ghats, Deccan, N. Kanara, Travancore.

Notes : We have noticed this species epiphytic on *Careya arborea* Roxb., *Ficus* sp., *Carissa congesta* Wt., *Euphorbia neriifolia* L., *Randia brandisii* Gamble and *Ixora brachiata* Roxb. This species is very variable in the shape and size of the various floral parts.

Blatter & McCann and Santapau cite King & Pantling in Ann. R.



Oberonia ensiformis Lindl.
A. Whole plant ; B. Sepals and petals ; C. Lip.

Bot. Gard. Calcutta 8 : t. 9, for *O. recurva* Lindl. This plate is *O. ensiformis* Lindl., a totally different species ; *O. recurva* Lindl. has not been recorded from Sikkim Himalayas.

5. **Oberonia recurva** Lindl. var. **lingmalensis** (Blatt. & McC.) Sant. & Kapadia, stat. nov. *O. lingmalensis* Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 255, 1931.

After a very careful examination of a number of fresh plants collected from the type locality and a sheet in Sedgwick herbarium, *Sedgwick* 4626, identified by Blatter himself as *Oberonia lingmalensis* Blatt. & McC., we have come to the conclusion that the latter is but an intermediate form between *O. verticillata* Wt. and *O. recurva* Lindl. with greater affinities to the latter.

The only constant distinguishing characters between the present variety and *O. recurva* Lindl. are : (1) flowers in the variety have longer pedicels, and are placed in distinct verticils, not imbricating ; (2) the leaves in the variety are acute or acuminate. Often the lateral lobes of the lip are only slightly smaller than those normally met with in *O. recurva* Lindl., definitely not as minute as in *O. verticillata* Wt.; with the latter species it can be compared only in the arrangement of the flowers.

We have, then, reduced the plants with narrower and more acuminate leaves, and with verticillate or subverticillate, long-pedicelled flowers, to a variety of *O. recurva* Lindl.

Flowering and *Fruiting* : September to February.

Occurrence in Bombay State : KONKAN : Thana, *Bell.* W. GHATS : Mahableshwar, *Sedgwick* 4626 ; *Santapau* 12519, 13169 ; *Bole* 409 ; *Kapadia* 956, 967, 1832, 2065. N. KANARA : *Bell.*

Distribution : Konkan, W. Ghats, N. Kanara.

6. **Oberonia proudlockii** King & Pantl. in Journ. As. Soc. Bengal II, 66 : 580, 1897 ; Fischer 1407. *O. sedgwickii* Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 257, 1931.

Small pendulous *epiphytes*. *Leaves* 0.7-4 × 0.2-1.5 cm., very variable in shape and thickness, oblong to elliptic, or ovate to lanceolate, acute or rarely subacuminate, fleshy or rarely very thin. *Scape* 2-10 mm. long, adnate to the uppermost leaf, with minute, hyaline ovate or ovate-oblong bracts. *Inflorescence* 1-6 cm. long, straight or decurved ; rachis fleshy, considerably thickened in fruit. *Flowers* 1.25 × 1-1.25 mm., somewhat laxly imbricate, more or less sunk in the fleshy rachis and scarcely appearing out of the general outline, subsessile, bracteate. *Bracts* 1 × 0.75 mm., pale yellowish green, slightly longer than the ovary and completely sheathing it, ovate-oblong, irregularly serrulate, acute, gland-dotted. *Sepals* 0.75 × 0.5 mm., subequal, 1-nerved, gland-dotted ; the dorsal one ovate, acute or sub-obtuse ; the lateral obliquely broadly ovate-acuminate, reflexed, lying at right angles to the dorsal sepal

below the lip. *Petals* slightly shorter than sepals, reflexed, faintly 1-nerved, gland-dotted, entire or slightly erose, slightly dilated about the middle, somewhat spathulate, acute or subobtuse. *Lip* 0.6-0.75 × 0.75-1 mm., broader than the sepals, entire, gland-dotted, obovate-orbicular or quadrately-orbicular, erose or irregularly denticulate ; apex usually somewhat 2-lobulate with a broad or narrow sinus in between ; occasionally the lobules not distinct. Disc of the lip orbicular, distinct, 3-nerved. *Column* minute, yellow. *Anther* minute. *Ovary* together with the very short *pedicel* 0.75 × 0.5 mm., broadly obovate, ribbed. *Capsule* 3 × 1.5 mm., obovoid-oblong, ribbed.

Flowering and *Fruiting* : March.

Occurrence in Bombay : N. KANARA : Anmod, *Kapadia* 1863, 1906, 1915 ; Castle Rock, *Sedgwick* ; *Kapadia* 2781, 2796-2797.

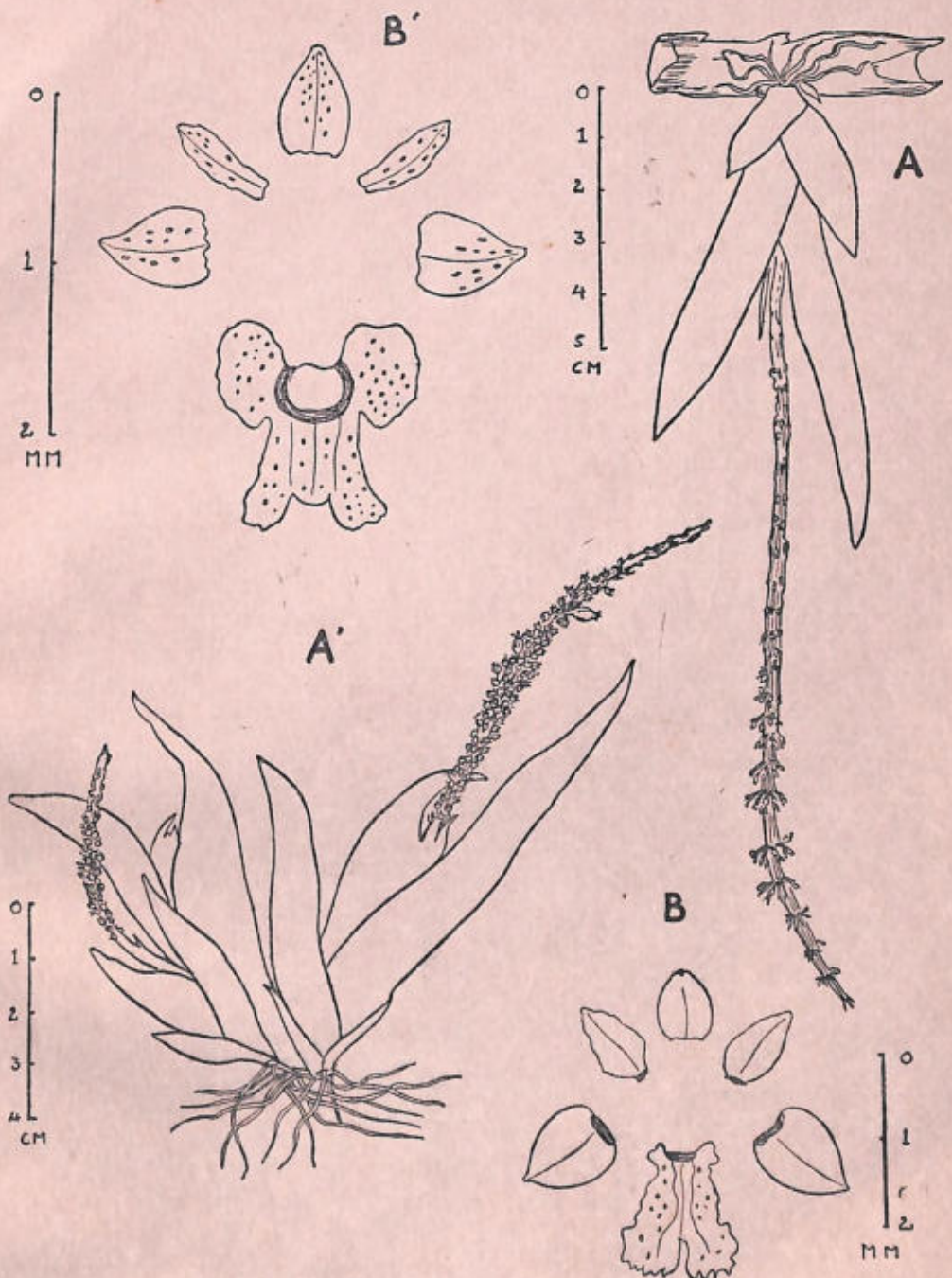
Distribution : N. Kanara, Nilgiris.

Notes : Our specimens have been collected from the type locality, Castle Rock, of *O. sedgwickii* Blatt. & McC. The latter species seems to be identical with *O. proudlockii* King & Pantling. It may be pointed out that certain characters, which are very distinctive of this species, have not been mentioned by Blatter & McCann such as (a) the considerably thickened rachis in fruits, (b) the peculiar way of the flowers being sunk in the fleshy rachis, (c) and the lip irregularly denticulate on the margin. Blatter & McCann describe the petals for their species as linear ; King & Pantling state they are ovate-lanceolate. A careful examination of a number of flowers has shown that the petals in their reflexed position appear narrowly linear, but actually on dissection they are broad, oblong, slightly dilated about the middle.

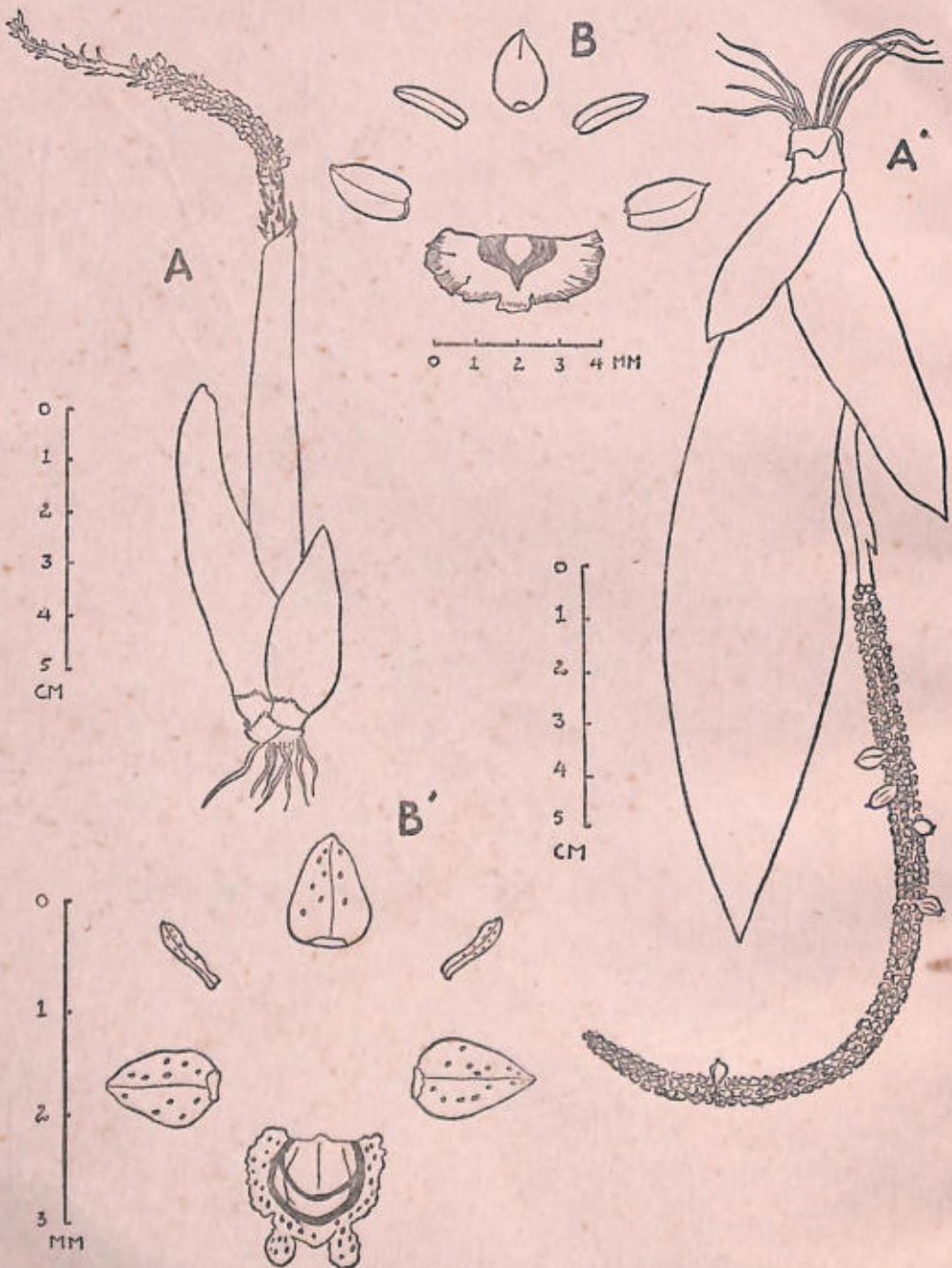
We have found this species to be epiphytic on *Careya arborea* Roxb. and *Terminalia* sp. in open deciduous forest.

7. **Oberonia falconeri** Hook. f. Icon. Pl. t. 1780, 1888, et Fl. Brit. Ind. 5 : 678, 1890 ; Prain, Beng. Pl. 1003, 1903 ; Gammie 564 ; Duthie 2, t. 94, et Fl. Upp. Gang. Pl. 3 : 183, 1920 ; Cooke 676 ; Haines, Bot. Bih. Or. 1164, 1924 ; Fischer 1406 ; Blatt. & McC. 256. *Iridorchis falconeri* (Hook. f.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891. (See Plate XI A-B).

Erect or pendulous *epiphytes*. *Leaves* 2-9 × 0.5 cm., coriaceous, oblong-lanceolate, subfalcate, acute or subacuminate. *Scape* short, covered by hyaline, subulate, irregularly serrulate bracts, more so at the base. *Inflorescence* 2-14 cm. long, erect or curved, laxly many-flowered ; rachis stout, strongly grooved, more so in fruit. *Flowers* spiral to subverticillate, about 1.5 mm. across, greenish yellow, bracteate, shortly pedicellate. *Bracts* 2.5-3.5 × 0.7-1 mm., hyaline, shorter or longer than the flowers, sheathing round the ovary, oblong-lanceolate, subulate, irregularly denticulate, glabrous, 1-nerved. *Sepals* 1.25 × 0.75 mm., yellow, obtuse, entire, faintly 1-nerved, sparsely speckled with glands to-



A-B. *Oberonia verticillata* Wt. A'-B'. *O. wightiana* Lindl.
A-A'. Whole plant ; B-B'. Sepals, petals, and lip.



A-B. *Oberonia platycaulon* Wt. A'-B'. *O. brunoniana* Wt.
A-A'. Whole plant ; B-B'. Sepals, petals, and lip.

wards the apex ; the dorsal one oblong-ovate, slightly narrower than the lateral ones ; the lateral sepals broadly ovate. *Petals* 1.2 × 0.5 mm., yellow, oblong-ovate, subfalcate, obtuse, entire, glabrous, 1-nerved, sparsely gland-dotted. *Lip* 2 × 1.5 mm., greenish-yellow, obovate-oblong or oblong in outline, 3-lobed ; the lateral lobes small, tooth-like, rounded, truncate, rarely subretuse ; midlobe broad, about 4-5 times as long as the lateral ones, oblong, faintly wavy on the margins, 2-lobulate about a third from the apex ; lobules parallel or incurved towards each other, subacute or obtuse, with a broad subtruncate sinus ; nerves of the lip 3, the lateral ones sinuate, middle one straight, practically up to the sinus. *Column* small, subquadrate, transversely oblong, yellow. *Anther* white, broadly ovate, truncate at the apex, rarely subretuse. *Capsule* 4 × 2 mm. obovoid, strongly ribbed, shortly stalked ; pedicels about 1 mm. long.

Flowering : September. *Fruiting* : October to December.

Occurrence in Bombay : DANGS : Waghai, *Santapau* 20103 ; *Kapadia* 1161, 1439 ; Susarda, *Kapadia* 713. KONKAN : *Law* ; *Woodrow* ; Thana, *Ryan* ; Kalyan, *Millard* ; Tansa, *Kapadia* 748. N. KANARA : Alnawal-Dandeli, *Kapadia* 1654 ; Dandeli, *Kapadia* 1668 ; Yellapur, *Kapadia* 1763, 1973, 2348-2349.

Distribution : *India* : Tropical Himalaya, Kumaon, Dehra Dun, Bihar, Chota Nagpur, Dangs, Konkan, N. Kanara, Mysore hills at 1000 metres, Rampa Hills at 600 metres. Vizagapatam hills at 700 metres. *World* : India, Nepal.

Note. This species can easily be distinguished by the strongly grooved rachis ; this is covered by hyaline, subulate, irregularly serrulate, loosely sheathing bracts at the base. It is usually found in open forest, epiphytic on *Tectona grandis* L.f., rarely on *Terminalia* sp.

8. **Oberonia verticillata** Wight, Icon. 5 (1) : 3, t. 1626, 1851 ; Lindl, 3, (excl. aliq. var.) ; Hook. f. 678 ; Fyson, Fl. Nilg. Puln. Hill-Tops 383, 1915 ; Fischer 1406 ; Blatt. & McC. 255. *Malaxis verticillata* (Wt.) Reichb. f. in Walp. Ann. 6 : 211, 1861. *Iridorchis verticillata* (Wt.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891. *Oberonia verticillata* var. *longibracteata* Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 255, 1931. *O. spiralis* Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 256, 1931 (non Griff. 1851, nec Lindl. 1852). (See Plate XIV A-B).

Pendulous *epiphytes*. Leaves 3-20 × 0.7-1.5 cm., oblong, narrowly ensiform, acuminate, fleshy. *Peduncle* about 3 cm. long, bracteate to the base, not joined to the uppermost leaf. *Inflorescence* up to 25 cm. long, falcately curved or nearly straight. *Flowers* in distinct verticils or spirals (each whorl about 2-3 mm. apart), shortly pedicelled, bracteate, yellow. *Bracts* 1.5-2 mm. long, slightly longer than the flowers or equalling them, oblong, acute or with a short acumen, much erose or

subfimbriate, ensheathing the ovary and the pedicel, sparsely gland-dotted. *Sepals* subequal; the dorsal one 0.75 × 0.75 mm., ovate-oblong, obtuse, mucronulate, 1-nerved, subconcave; the lateral ones bigger, 1 mm. long, nearly as broad, broadly ovate, mucronate, concave, 1-nerved. *Petals* slightly smaller than the lateral sepals, ovate, acute or subobtuse, crenulate or subentire, 1-nerved. *Lip* 1.75-2.25 mm. long, nearly twice the length of sepals or petals, cuneate-obovate in outline, 3-nerved, sparsely gland-dotted, 3-lobed; lateral lobes minute, ear-like, (not absent, as stated by Blatter & McCann); width of lip across lateral lobes less than half that across the midlobe; midlobe cuneate-obovate, crenulate, 2-lobulate towards the apex; lobules broad, rounded or truncate, dentate or erose at the apex, with usually a narrow sinus in between. *Column* small. *Anther* opercular, yellowish. *Ovary* with the short *pedicel* about 2 mm. long, greenish yellow.

Flowering: July to October. *Fruiting*: September onwards.

Occurrence in Bombay: N. KANARA: Yellapur, *Kapadia* 1991-1992, 2259, 2886-2887; Sirsi, *Hallberg & McCann* 35059; *Santapau* 18649; *Kapadia* 2446-2448.

Distribution: *India*: N. Kanara, W. Ghats of S. India, Nilgiris, Pulneys, Salem hills. *World*: Ceylon, India.

Notes: Our Yellapur specimens have floral bracts equal to or even slightly longer than flowers; this variation has been observed in the same inflorescence, and is of frequent occurrence in the genus *Oberonia*. This is why we have united var. *longibracteata* Blatt. & McC. with *O. verticillata* Wt.

Careful examination of fresh specimens from Yellapur (type locality of *O. spiralis* Blatt. & McC.) and Sirsi, has shown to us that in floral structure there is hardly any difference between *O. spiralis* Blatt. & McC. and *O. verticillata* Wt. Some of the plants have flowers in spirals, others in distinct verticils; in a few specimens the flowers are arranged in distinct spirals on the lower part of the rachis, while in the upper part they are in pure uninterrupted whorls.

9. **Oberonia wightiana** Lindl. in Bot. Reg. misc. 9, 1839; Wight, Icon. 5 (1): 3, t. 1627, 1851; Lindl. 5; Hook. f. Icon. Pl. t. 1784 B, 1888, et Fl. Brit. Ind. 5: 683, 1890; Fyson 383; Fischer 1407; Blatt. & McC. 258. *O. stachyoides* A. Rich. in Ann. Sc. nat. (ser. 2) 15: 15, t. 1 A, 1841. *O. arnottiana* Wight, Icon. 5 (1): 3, t. 1628, 1851; Blatt. & McC. 258. *Malaxis wightiana* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2: 669, 1891. (See Plate XIV A'-B').

Pendulous *epiphytes*. *Leaves* 4-9 × 0.7-1.5 cm., ensiform, often subfalcate, acute or acuminate, the uppermost often sub-subulate, thin, not fleshy. *Peduncle* practically 0, joined to the uppermost leaf. *Inflorescence* up to 10 cm. long, slightly curved; flowers in rather lax, subverti-

cillate racemes, pedicellate, bracteate. *Pedicel* with *ovary* about 2 mm. long. *Bracts* 1.5 × 0.75 mm., shorter than the pedicel, ovate-acuminate, (acumen often rather long drawn out), subentire or erose, gland-dotted. *Sepals* 1 × 0.75 mm., subequal, broadly ovate, gland-dotted, entire ; the lateral ones sharply acute or mucronulate, concave ; the dorsal sepal obtuse or subacute, not concave. *Petals* linear, shorter than the sepals, acute, entire or very slightly erose, gland-dotted. *Lip* 1.75 mm. long, nearly twice as long as the sepals, 3-lobed with a small concave disc ; nerves 3 starting from the disc and going up to the sinus ; lateral lobes 0.75 × 0.5 mm., rounded, somewhat oblong-reniform, subentire or erose, gland-dotted, more or less erect and enfolded over the column ; width of lip across the lateral lobes larger than that across the midlobe ; midlobe obcordate-oblong, 2-lobulate, sinus broad with or without a very small mucro within, lobules diverging, rounded, erose or denticulate. *Column* very small. *Anther* opercular, minute. *Capsules* 5 × 3 mm., pedicelled, obovoid ; pedicels about 1 mm. long.

Flowering and *Fruiting* : March.

Occurrence in Bombay State : N. KANARA : Yellapur, *Sedgwick* ; Haliyal, *Sedgwick* ; Anmod, *Sedgwick*, *Kapadia* 1872-1873.

Distribution : *India* : N. Kanara, Nilgiris, Pulneys. *World* : Ceylon, India.

Notes : This species is usually found pendulous on *Artocarpus* trees. As to the variations in the floral structure we quote Lindley (in *Fol. Orchid.*) : ' Flowers pale green. This seems to vary more than usual in the present genus, in the form of the lip, the front lobes of which are either ligulate and denticulate at the point or entire ; or short and acute ; and these differences seem to occur on the same or otherwise undistinguishable individuals. I can find nothing sufficient to separate my learned friend Wight's *O. arnottiana*, whose bracts appear exactly the same as in *O. wightiana* and by no means furnished with long cilia, as is represented by his draughtsman '.

10. **Oberonia brunoniana** Wight, Icon. 5 (1) : 3, t. 1622, 1851 ; Lindl. 2 ; Hook. f. 681 ; Grant, Orch. Burma 29, 1895 ; Cooke 677 ; Fischer 1406 ; Blatt. & McC. 257 (non t. 3, quae est *O. ensiformis*). *Malaxis brunoniana* (Wt.) Reichb. f. in Walp. Ann. 6 : 209, 1861. *Iridorchis brunoniana* (Wt.) O. Kuntze, Rev. Gen. Pl. 2 : 699, 1891. (See Plate XV A′-B′).

Erect or pendulous *epiphytes*. *Leaves* 4-15 × 1-3.5 cm., very succulent, obovate to linear-oblong, often subfalcate, acute, purplish-brown to brown in colour, not green. *Scape* 1.5-3 cm. long, 2-angled, usually furnished with a small leaf-like bract at its apex just below the inflorescence. *Spike* 5-20 cm. long, 5-6 mm. broad, erect or recurved, stiff ' like a rat's tail ' (Hooker f.). *Flowers* densely imbricate, ' olive-

brown in colour' (Wight), bracteate, subsessile, a little less than 2 mm. across. *Bracts* 1.5 × 1 mm., shorter than the flowers, oblong-ovate to ovate, acute, irregularly denticulate, 1-nerved, sparsely gland-dotted. *Sepals* 1 × 0.75 mm., subequal, gland-dotted, ovate, acute-mucronulate, entire, glabrous, 1-nerved; lateral sepals spreading, concave; dorsal sepal narrower. *Petals* 0.75 mm. long, shorter than the sepals, narrowly linear, acute or subobtuse, entire, glabrous, sparsely gland-dotted, 1-nerved. *Lip* 1.25 × 1.25 mm. quadrately-oblong, 3-lobed, densely gland-dotted outside the large concave disc, the latter extending practically up to the sinus; lateral lobes of lip oblong, obtuse, irregularly crenulate, longer than the midlobe; midlobe 2-lobulate, lobules rounded, sub-obclavate, irregularly crenulate, the sinus deep, wide, usually with a minute mucro; nerves 3, all within the disc. *Column* 0.5 × 0.5 mm., quadrate, with a transversely elliptical stigmatic surface. *Anther* small, obovate, yellowish. *Ovary* with short *pedicel* 1 × 0.5 mm., inversely flask-shaped, ribbed. *Capsule* 5 × 3 mm., ellipsoid on a very short stalk.

Flowering and *Fruiting*: February to March.

Occurrence in Bombay: N. KANARA: *Bell*; Kalanadi, *Ritchie*; Anmod, *Kapadia* 1877-1879; Castle Rock, *Kapadia* 2813.

Distribution: N. Kanara, Nilgiris, Pulneys, Malabar, Travancore.

Notes: We have collected this species in both dense and open forest, usually on *Mangifera* and *Artocarpus* trees; the leaves of all the plants are of a deep purplish brown or brown colour with no sign of green. It is interesting to note that this species together with *O. bicornis* Lindl. and *O. tenuis* Lindl. are the only species found by us with brown leaves.

11. **Oberonia platycaulon** Wight, Icon. 5 (1): 3, t. 1623, 1851; Lindl. 2; Hook. f. 628; Gammie 564; Cooke 677; Fischer 1407; Blatt. & McC. 257. *Malaxis platycaulon* (Wt.) Reichb. f. in Walp Ann. 6: 239, 1861. *Iridorchis platycaulon* (Wt.) O. Kuntze, Rev. Gen. Pl. 2: 699, 1891. (See Plate XV A-B).

Leaves 2-8 × 1-2 cm., ensiform, fleshy, oblong-lanceolate, acute. *Scape* arising from the central leaf, terete, bracteate. *Spike* 7 cm. long, about 0.5 cm. broad, somewhat curved. *Flowers* 3.5 × 1.5-2 mm., sessile, bracteate. *Bracts* 2 × 1.5 mm., oblong, ovate, acute, irregularly serrate, completely sheathing the ovary. *Sepals* 2 × 1.25 mm., subequal, acute or subobtuse, entire, 1-nerved, lying backwards along the ovary; the dorsal one ovate, the laterals ovate-oblong. *Petals* 2 × 0.5 mm., reflexed along with the sepals, narrow-linear, subobtuse or acute, 1-nerved. *Lip* with the lateral lobes folded inwards, parallel along the column, 4 × 2 mm. when spread out, 3-lobed; lateral lobes very broad, wing-like, 1.75 × 1.5 mm., oblong-orbicular, entire, wavy, longer than the midlobe; mid-lobe somewhat quadrate, obscurely 3-lobed, truncate or rarely slightly

retuse on the outer margin ; disc broadly oblong-orbicular, apiculate. *Column* 1 × 0.5 mm., oblong-subclavate, with an elliptic-orbicular stigmatic surface. *Anther* ovate, acute. *Ovary* 2 mm. long, sessile.

This species has been drawn and described from a specimen sent by Miss Evelyn Bowden from Travancore.

Occurrence in Bombay : This species is not definitely known to occur in the State. Hooker f. cites ' W. Ghats from the Konkan southwards ' ; Gammie lists it on the authority of Hooker f. ; Cooke has included it as doubtful in the State ; Blatter & McCann include it again on the authority of Hooker f. ; we have seen no specimens from Bombay.

Distribution : Konkan, W. Ghats (Mysore southwards). Nilgiris, Pulneys, High Wavy Mountains.

12. **Oberonia santapaui** Kapadia, nom. nov. *O. lindleyana* Wight, Icon. 5 (1) : 3, t. 1624, 1851 (non Brongn. ex Duperr. 1834) ; Lindl. 2 ; Hook. f. 681 ; Fischer 1406 ; Blatt. & McC. 258, t. 4. *Malaxis lindleyana* (Wt.) Reichb. f. in Walp. Ann. 6 : 210, 1861. *Iridorchis lindleyana* (Wt.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891.

We have seen no specimens of this species, and therefore give Wight's original description : ' Leaves ensiform, short, very succulent, slightly falcate ; stem compressed, spike drooping towards the apex, densely covered with innumerable small sessile flowers : bracts ovate, somewhat obtuse, sub-denticulate on the margin : sepals broad, ovate, obtuse entire : petals narrow linear : lip broad cordate at the base, crenate, two-lobed at the apex, with a minute tooth between ; all furnished with numerous minute opaque glandular (?) dots. Flowers straw colour, lip dull orange. Iyamally Hills near Coimbatore, flowering August and September. The leaves of this species are very succulent, and with its long drooping raceme afford good distinguishing marks, which are amply confirmed by an examination of the flowers. This species is remarkable on account of the opaque gland-like points scattered over the flowers. The bract is represented too pointed in the figure. I dedicate the species to the founder of the genus.'

Occurrence in Bombay: N. KANARA: In forests, *Bell* ; Anmod *Sedgwick*.

Distribution : N. Kanara, Nilgiris, Travancore hills.

Notes : *Ind. Kew.* lists a binomial *Oberonia lindleyana* A. Brongn. in Duperr. Voy. Coq. Bot. 200, t. 40, f. a, 1834, (*O. lindleyi* on the figure). The binominal *O. lindleyana* Wt. (1851) is, therefore, a later homonym in the sense of the Code and must be rejected.

I name this species after Rev. Father H. Santapau under whose unfailing guidance and tremendous enthusiasm the study of the Orchids of Bombay has been undertaken. It is with the greatest pleasure that I dedicate the species to one of India's most distinguished botanists. (Z. Kapadia).

13. **Oberonia bicornis** Lindl. Gen. Sp. Orch. 16, 1830, et Fol. Orchid. Oberon. 4 ; Hook. f. 682. *Malaxis bicornis* (Lindl.) Reichb. f. in Walp. Ann. 6 : 211, 1861. *Iridorchis bicornis* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891. *Oberonia umbonata* Blatt. & McC. in J. Bombay nat. Hist. 35 : 259, 1931.

Pendulous brown *epiphytes*. *Leaves* 1-8 × 0.3-0.8 cm., brown or mauve-brown, narrowly linear-oblong or linear-lanceolate, often falcate, acute or acuminate, often surmounted with a bristle. *Scape* 2-10 cm. long, brownish ; bracts 2 mm. long, sharp, bristle-like. *Inflorescence* 1.5-12 cm. long, straight or bent in the upper third. *Flowers* up to 2 mm. long in dense or lax verticils or subverticils, ochraceous-red, pedicellate, bracteate. *Bracts* 0.66-2 mm. long, usually longer than the flowers, lanceolate from a broad base, with a sharp, long acumen, or oblong, sharply acuminate, bristle-pointed, hyaline, gland-dotted. *Sepals* equal or subequal, pale ochraceous, 1-nerved, hyaline, gland-dotted ; the dorsal one more or less equal to the lateral sepals, convex, ovate or ovate-lanceolate or oblong-ovate, acute-mucronulate or obtuse with a minute sharp acumen ; lateral sepals convex, ovate-orbicular, mucronulate. *Petals* ochraceous, about equalling the lateral lobes of the lip, oblong-subtriangular or linear-oblong or narrowly obspathulate, subobtuse or acute, entire or very minutely serrulate, 1-nerved, hyaline, gland-dotted. *Lip* deep red, 3-lobed ; the width across the lateral lobes more or less equal to that across the midlobe ; lateral lobes erect, linear-lanceolate, coriaceous, surrounding the column, slightly incurved towards the apices ; midlobe of lip curving upwards along with the lateral lobes in flower ; the basal margin obscurely 3-lobed ; apex straight or pointing downwards, acute or obtuse-mucronulate. *Column* broad. *Anther* brownish white, transversely oblong-orbicular, mucronulate. *Ovary* with pedicel nearly 2 mm. long. *Capsule* 2.5 × 1.50 mm., pedicellate, nearly spherical ; stalk 1.2 mm. long.

Flowering and *Fruiting* : October to November.

Occurrence in Bombay: N. KANARA: Siddhapur, *Kapadia* 2389-2395 ; Siddhapur to Sirsi, *Hallberg & McCann* 35177.

Distribution : *India* : Khasia Hills, N. Kanara. *World*: India, Ceylon.

Notes: We found this species epiphytic on *Memecylon* sp.

After careful study of fresh flowers from Siddhapur (the type locality of *O. umbonata* Blatt. & McC.) we conclude that the latter is identical with *O. bicornis* Lindl. *O. bicornis* Lindl. is similar to *O. tenuis* Lindl., from which it can be distinguished by the former having (1) petals which are broadly ovate or obspathulate ; (2) lateral lobes of lip which are linear-lanceolate, erect, not filiform and incurved ; (3) midlobe of lip which is fleshy, cuneate, truncate or minutely apiculate, not broadly 3-lobed with the ends much prolonged.

14. **Oberonia tenuis** Lindl. Fol. Orchid. Oberon. 3, 1852 ; Hook. f. Icon. Pl. t. 1779 B, 1888, et Fl. Brit. Ind. 5 : 682, 1890. *Malaxis tenuis* (Lindl.) Reichb. f. in Walp. Ann. 6 : 211, 1861. *Iridorchis tenuis* (Lindl.) O. Kuntze, Rev. Gen. Pl. 2 : 669, 1891.

Pendulous brown *epiphytes*. *Leaves* 0.6-6 × 0.3-0.6 cm., brown, linear or linear-lanceolate, subfalcate or ovate-oblong, acute or acuminate, often bristle-pointed. *Scape* terete, yellowish brown, 2-5 cm. long, with spreading, hyaline, subulate bracts. *Inflorescence* 1.5-12 cm. long, squarrose, more or less straight. *Flowers* brownish red, bracteate. *Bracts* oblong-lanceolate to linear-lanceolate, subulate, acute or acuminate, entire, gland-dotted. *Sepals* subequal, gland-dotted, concave ; the dorsal sepal is narrow-lanceolate, at times ovate-lanceolate or ovate-oblong, hardly bigger than the lateral sepals, acute or subacuminate ; the lateral ones orbicular or orbicular-ovate, mucronulate. *Petals* narrow, linear, acute or subobtuse, gland-dotted, faintly 1-nerved. *Lip* 3-lobed ; lateral lobes erect, surrounding the column and meeting above it, narrowly filiform, aristate, shorter than the petals ; midlobe dextrously folded upwards along the lateral lobes, lunate, the tips much-prolonged, acuminate ; the midlobe obscurely or not at all 3-lobed on the basal margin. *Column* short. *Ovary* 1 mm. long, rarely slightly curved at the base. *Capsule* brown, strongly ribbed, orbicular or oblong-orbicular, with an equally long stalk.

Flowering and *Fruiting* : March.

Occurrence in Bombay : N. KANARA : Castle Rock, *Kapadia* 2821.

Distribution : *India* : N. Kanara. This species has been recorded for Bombay State and India for the first time ; up to now known only from Ceylon. *World* : India, Ceylon.

Notes : Hooker f. describes the leaves as linear-oblong, the lip with very small, hatchet-shaped midlobe and linear erect incurved sidelobes that form a circle round the ovary. In our specimen the leaves are linear-oblong, acuminate, often bristle-pointed, and the lateral lobes of the lip form a circle round the column (and not round the ovary as stated by Hooker f.) ; the midlobe is narrowly lunate with much-prolonged acuminate tips.

15. **Oberonia** sp. Large pendulous *epiphytes*. Leaves thin, oblong-lanceolate, up to 17 × 1.5 cm. *Inflorescence* arising directly from a narrowly linear, leaf-like peduncle. *Flowers* long-pedicelled, minute, densely imbricating, often in more or less distinct whorls. The flowers are too old and decayed for careful analysis.

Flowering : probably about September to October.

Occurrence in Bombay State : N. KANARA : Jog, *V. Patel* 1915 ; *Kapadia* 2425-2427.

Notes: This seems to be quite a distinct species, very unlike any of those discussed above ; scarcity of materials prevents us from a definite identification.

We found these plants to be fairly common along the way to the ferry, from the Bombay side of Jog falls.

Imperfectly known Species

16. **Oberonia bellii** Blatt. & McC. in J. Bombay nat. Hist. Soc. 35 : 256, f. 1. 1931.

This species was described and illustrated from Bell's manuscript notes ; no actual specimens were examined by the authors. We have not been able to locate it in Bombay.

The following is Blatter & McCann's original description :

'Pertains to section *Oberonia* proper. Approaching *Oberonia verticillata*, but differing in the 8-grooved rachis, bracts lanceolate, imbricate, slightly longer than the buds, flowers sessile, petals ovate-oblong, lip oblong, midlobe bifid erose ligulate, segments obliquely truncate at the apex.

'*Scape* together with raceme almost twice as long as longest leaf. *Leaves* narrow, ensiform, falcate or subfalcate, acuminate, broad at base, up to 10 × 1 cm. *Rachis* fairly stout with 8 grooves, and 8 rounded ridges between the grooves. *Buds* globose, apiculate. *Flowers* sessile, 2 mm. long, verticillate, one flower on each ridge, the ridge of one node being continued by a groove on the next. Internodes 2.5 mm. long. *Bracts* 2 mm. long, lanceolate, acute, membranous, broadest in the middle, fimbriate, slightly longer than the buds. *Sepals* ovate-acute, subequal. *Petals* narrower than the sepals, erose ; side lobes very small, rounded ; midlobe bifid with strap-shaped slightly divergent obliquely truncate segments ; sinus 1/3 of the whole lobe. *Ovary* 1 mm. long. *Column* merely a horse-shoe-shaped low wall, covered by a nearly circular, lowly convex, green, smooth little cap. *Pollinia* extremely minute, orange-yellow, pear-shaped ; point of attachment short and pointed (fixed to a minute surface at each end of horseshoe rim of column).

'The pollinia fall out when the flower is ready, the cap raising itself for the purpose. The hollow in the form of the column is square. (Bell).'

Flowering : March.

Occurrence in Bombay : N. KANARA : Yellapur, *Bell.*

Notes: There seems to be hardly any difference between this species and *O. verticillata* Wt., but absence of the type prevents us from attempting a definite identification.

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Butterflies of the Palni Hills: a Complementary List

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With a view to supplement the list of butterflies of the Palni Hills made by Evans (1910), the authors explored the entire Palni range at all elevations and at all seasons of the year over a period of ten years. This paper gives a list of 54 new recordings made in the course of the work.

Before we present our fresh data on the butterflies of the Palnis, a few lines on these hills and on the significance of our list may prove useful.

The Palnis (Madurai Dt., S. India) run parallel to and south of the Nilgiris. About 70 miles (110 km.) long and of an average breadth of some 15 miles (24 km.), they abut against the Western Ghats, rising gradually east-west up to a high tableland of 8000 ft. (2400 m.), 30 miles (48 km.) long, with Kodaikanal at 7000 ft. (2100 m.) The variety and abundance of the butterfly fauna of these hills vary obviously with the richness and kinds of vegetation. Without going into details about the latter, we may note in general that while the northern and southern slopes and valleys show great floral or forest luxuriance, the upper plateau west of Kodaikanal consists mainly of grasslands interspersed with some sholas. The eastern lower Palnis up to 4500 ft. (1400 m.) on the other hand cover large cultivated areas of plantains, oranges, lemon, coffee, cardamom, etc.

Taking this into account, we mention below a few places of particular interest to butterfly collectors :

(1) The Tope, 1000 ft., (300 m.) and Vengayaparai, 2300 ft. (700 m.) at the 5th and 8th mile respectively of the 'Old Coolie Road' from Peryakulam Town to Kodaikanal ;

(2) Thalayar Falls, 3000 ft. (900 m.), facing the 8th mile of the Motor Road, which links Kodaikanal Hill Station to the Kodaikanal Road-Peryakulam highway ;

(3) Perumal-Neutral Saddle, 5000 ft. (1515 m.), and Sacred Heart College, Shembaganur, 6000 ft. (1820 m.), at the 23rd and 27th mile on the Motor Road respectively ;

(4) Palar Dam, 4000 ft. (1210 m.), on the 7th-12th mile of the Coolie Path from Neutral Saddle to Palni Town ;
(5) Porandalar Valley, 3500 ft. (1160 m.), below Palanghi village ;
(6) Manalur, 3300 ft. (1000 m.), in the Lower Palnis ;
(7) Manjampatti-Tallungi 2200 ft. (670 m.), some 7 to 12 miles (11km. to 19 km.) up the Amaravati Dam.

Since Evans listed the butterfly fauna of the Palnis in 1910, little has been done as far as we are aware to confirm and complete his findings in this region. The advisability of a fresh survey was suggested by his own statement, in his article on the Palni Butterflies, that probably 'another 100 species' could easily be added to his recordings. It is this which impelled us, as permanent residents of these hills, to start working on our 'Complementary List'. As we were working on Evans's List of Palni Butterflies we have followed his nomenclature.

Whereas Evans collected mainly at the Tope or around Kodaikanal and this too for only 6 weeks (end of Aug. to early Oct.) supplementing his findings from other reliable sources, we have tried to explore the entire Palni Range, at all elevations and seasons of the year, over a period of some 10 years. While covering all the Palnis, however, our List lays a heavy emphasis on the Tope-Vengayaparai region ; for any one familiar with these hills will agree that this region, as Evans has also pointed out, still gives the best yield in both varieties and numbers of butterflies.

Our study has been carried out mostly with the help of the clerical (Jesuit) students of Sacred Heart College, Shembaganur. But we must also gratefully mention the valuable collaboration of the boys of High-clerc School, Kodaikanal, and of Mr. Alan Sharman of Madras.

Thanks to these combined efforts, we have been able to gather over 250 kinds of Heterocera and 228 species of Rhopalocera. Taking only the latter into account, we would like to note the following with reference to Evans (1910) :

(*a*) Our observations confirm 174 of Evans (1910) recordings ; though occasionally with not a few divergent data regarding location, elevation, and seasonal appearance of large numbers ;

(*b*) We have not as yet recorded 17 of Evans's listing in 1910. Of these, three appear on all accounts to belong to the Palnis, namely *Telicota concinna*, *Telicota gola*, and *Castalius ananda*. As for the remaining 14, recent taxonomic regroupings and modifications in nomenclature make it extremely difficult to say anything definite ;

(*c*) The few discrepancies between our findings and those of Evans may, to a large extent, be explained by the fact that the Palnis are not quite the same today as Evans knew them 50 years ago. For with ruthless cutting down of forests, species once apparently abundant have now become quite rare, not to say extinct ;

(*d*) In spite of this deforestation, our survey has given us 54 new records, not as yet the 100 predicted by Evans ! They are listed below, but it would be difficult in some cases to state exactly whether we are dealing with permanent or only migratory forms of the Palnis.

LIST OF NEW RECORDS

HESPERIIDAE

1. **Astycus pythias lanka** Evans

Two at Vengayaparai in Sept.-Oct. One at the 7½ mile of the Coolie Road in July.

2. **Baoris conjuncta narooa** (Moore)

Several at all elevations.

3. **Baoris guttatus bada** (Moore)

Two at Palar Dam in Feb.

4. **Bibasis sena** (Moore)

Three at Vengayaparai, one at the Tope in Feb., one at the 7½ mile of the Coolie Road in Nov.

5. **Caprona ransonnetti lanka** Evans

Common at lower elevations all through the year, more abundant at higher elevations in Feb.-Mar.

6. **Caprona ransonnetti taylorii** (de Nicéville)

At lower elevations all through the year, especially at Vengayaparai.

7. **Daimio bhagava bhagava** (Moore)

One at Porandalar Valley in July.

8. **Gangara thyrsis thyrsis** (Fabricius)

One taken by Highclerc students, one mile above the Palar Dam site in May.

9. **Hasora taminatus taminatus** Hübner

Not rare at Vengayaparai and at higher elevations in Aug.-Sept. A few stray ones may be taken at higher elevations in Nov.

10. **Ismene jaina fergussoni** de Nicéville

One at Vengayaparai along the stream in Nov. One ♂ caught and another ♂ seen by Mr. Sharman by the tope stream in March.

11. **Matapa aria** (Moore)

Not rare at higher elevations in July-Oct.

12. **Padraona cato** Evans

Common at Vengayaparai in Aug.-Sept.

LYCAENIDAE

13. **Amblypodia amantes amantes** Hewitson

Several along the stream from the Tope to Vengayaparai at all seasons, chiefly Aug.-Feb.

14. **Amblypodia centaurus pirama** (Moore)

Less common than *amantes*, though found in the same locality. A ♀ was taken by Mr. Sharman at the Tope stream in May also, four ♂♂ and three ♀♀ in July and many others both sexes seen.

15. **Bindahara phocides moorei** Frühstorfer

One ♂ and one ♀ at the 7½ mile of the Coolie Path along the stream at Palar Dam in July. Two ♂♂ were taken by Mr. Sharman at the Tope stream in March ; also, one ♀ seen at Vengayaparai in July. One ♂ at milestone 5/2 of the Motor Road in July.

16. **Charana jalindra** (Horsfield)

One ♂ at Shembaganur in Jan.

17. **Deudoryx epijarbas** (Moore)

Two ♂♂ taken at mile 6 and 7½ of the Old Coolie Road, along the stream, in Sept.

18. **Everes parrhasius** (Fabricius)

Common at all elevations all the year round.

19. **Horaga onyx** (Moore)

One in Sacred Heart College Museum, Shembaganur, but without exact records as to its location and season.

20. **Iraota timoleon arsaces** Frühstorfer

Several ♂♂ and ♀♀ were taken at 7½ mile of the Old Coolie Road, along the stream, in Sept. and May. Five ♀♀ taken by Mr. Sharman along the Tope stream in May ; also, one ♂ and three ♀♀ in July and several both sexes seen.

21. **Nacaduba beroe gythion** Frühstorfer

Two at Vengayaparai stream in Sept.

22. **Nacaduba dubiosa indica** Evans

Common along the stream from the Tope to Vengayaparai all through the year.

23. **Nacaduba helicon viola** (Moore)

Three ♂♂ and two ♀♀ at Vengayaparai in Aug.-Sept. and Apr.-June. One ♂ at mile 5/2 of the Motor Road in July.

24. **Nacaduba hermus nabo** Frühstorfer

Two ♂♂ and two ♀♀ between the 22nd and 23rd mile of the Motor Road in Oct.

25. **Nacaduba kurava canaraica** (Moore)

One ♂ and one ♀ in the same location as *nabo*.

26. **Pratapa deva deva** (Moore)

One ♀ in Shembaganur in Dec.

27. **Rapala melampus** (Cramer)

One ♂ taken by Highclerc students at Kodaikanal in Feb.

28. **Rapala schistacea** (Moore)

Not rare at the Tope stream, the ♂ being more common. Several ♂♂ and ♀♀ were taken at mile 5/2 of the Motor Road in July.

29. **Spindasis elima elima** (Moore)

Two ♂♂ taken by Mr. Sharman at the Tope in May.

30. **Spindasis ictis ictis** (Hewitson)

One ♂ in Sacred Heart College Museum, Shembaganur, but without exact records as to its location and season.

31. **Spindasis schistacea** (Moore)

Some ♂♂ at mile 5/2 (The Temple) of the Coolie Road in Sept. and Feb. One ♂ taken in Shembaganur in Feb.

32. **Tajuria cippus cippus** (Fabricius)

Several ♂♂ and ♀♀ at the Tope stream in July. ♂♂ were taken a few months later too.

33. **Tajuria melastigma** de Nicéville

One ♀ taken at the Tope by Mr. Sharman in May. One by us in July.

34. **Tarucus nara** (Kollar)

One ♂ and one ♀ at Palar Dam in Oct.

35. **Virachola isocrates** (Fabricius)

One ♂ at Manalur in Jan. Two ♀♀ at the Tope and Kodaikanal respectively in Feb.

36. **Zesius chrysomallus** (Hübner)

Two ♀♀ along the stream between the 5th and 6th mile of the Old Coolie Road, in Jan.

37. **Zizeeria trochilus putli** (Kollar)

Common at all elevations all through the year.

NYMPHALIDAE

38. **Biblia ilythia** (Drury)

Given by Evans 1910 for the plains (Peryakulam). One was taken in Shembaganur and another at the Tope in Sept.

39. **Cethosia nietneri mahratta** Moore

One ♀ at Vengayaparai in June.

40. **Doleschallia bisaltide malabarica** Frühstorfer

One at Shembaganur in Nov.

41. **Euthalia evelina laudabilis** Swinhoe

One ♂ and one ♀ at Vengayaparai and Thalayar Falls respectively, in Sept.-Oct. One ♂ at the Tope in July.

42. **Euthalia lubentina arasada** Frühstorfer

One ♂ taken at Vengayaparai and another along the stream at mile 6 of the Old Coolie Road in Oct. One ♀ seen at mile 19/3 of the Motor Road in Oct.

43. **Pantoporia selenophora kanara** Evans

One ♂ taken at Kodaikanal in Jan. and another at mile 20 of the Motor Road in March. One ♀ at Neutral Saddle in Sept.

44. **Precis atlites** (Linnaeus)

Several at Talungi in April.

PAPILIONIDAE

45. **Chilasa clytia clytia** (Linnaeus)

One ♂ at Neutral Saddle in May and another at Vengayaparai in Oct.

46. **Chilasa clytia dissimilis** (Linnaeus)

One ♂ taken a mile and a half after Palar Dam in June and another at mile 9 of the Old Coolie Road in Nov.

47. **Papilio paris tamilana** Moore

Several at Manalur in April. One was taken at Kodaikanal by the students of Highclerc in Sept.

48. **Pathysa nomius nomius** (Esper)

Several at Manjampatti in April and at the foot of Thalayar Falls in Oct.-Nov. A few were taken at the Tope in Oct. and Jan.

PIERIDAE

49. **Appias lyncida latifasciata** Moore

One ♂ at the Tope in Dec. One ♀ in Sacred Heart College Museum, but without records as to its location and season.

50. **Appias paulina wardii** (Moore)

Two ♂♂ and two ♀♀ at the Tope and Shembaganur in March and Nov. respectively.

51. **Catopsilia pomona** (Fabricius)

Very common at all elevations all the year round. Abundant in Kodaikanal in Dec.-Jan.

52. **Catopsilia pomona** var. **catilla** (Cramer)

Less common than the previous.

53. **Huphina nadina remba** (Moore)

One ♂ taken and another seen by Mr. Sharman at the Tope in May.

54. **Terias andersoni ormistoni** Watkins

Common at all elevations all through the year.

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[In addition to the new records from the Palnis mentioned above, Mr. A. J. Sharman adds the following :

HESPERIIDAE

1. **Tapena thwaitesi hampsoni** Elwes & Edwards.

One ♂ along the Tope stream in July.

LYCAENIDAE

2. **Pratapa cleobis** (Godart)

One ♀ in the Perumal Reserve Forest in May. [Fr. Ugarte also reports that since the paper was submitted the authors caught one ♂ of this species at the Motor Road milestone 19 in October.]

3. **Amblypodia abseus** Hewitson

One seen by the Tope stream in July.

—Eds.]

The Birds of Nepal

BY

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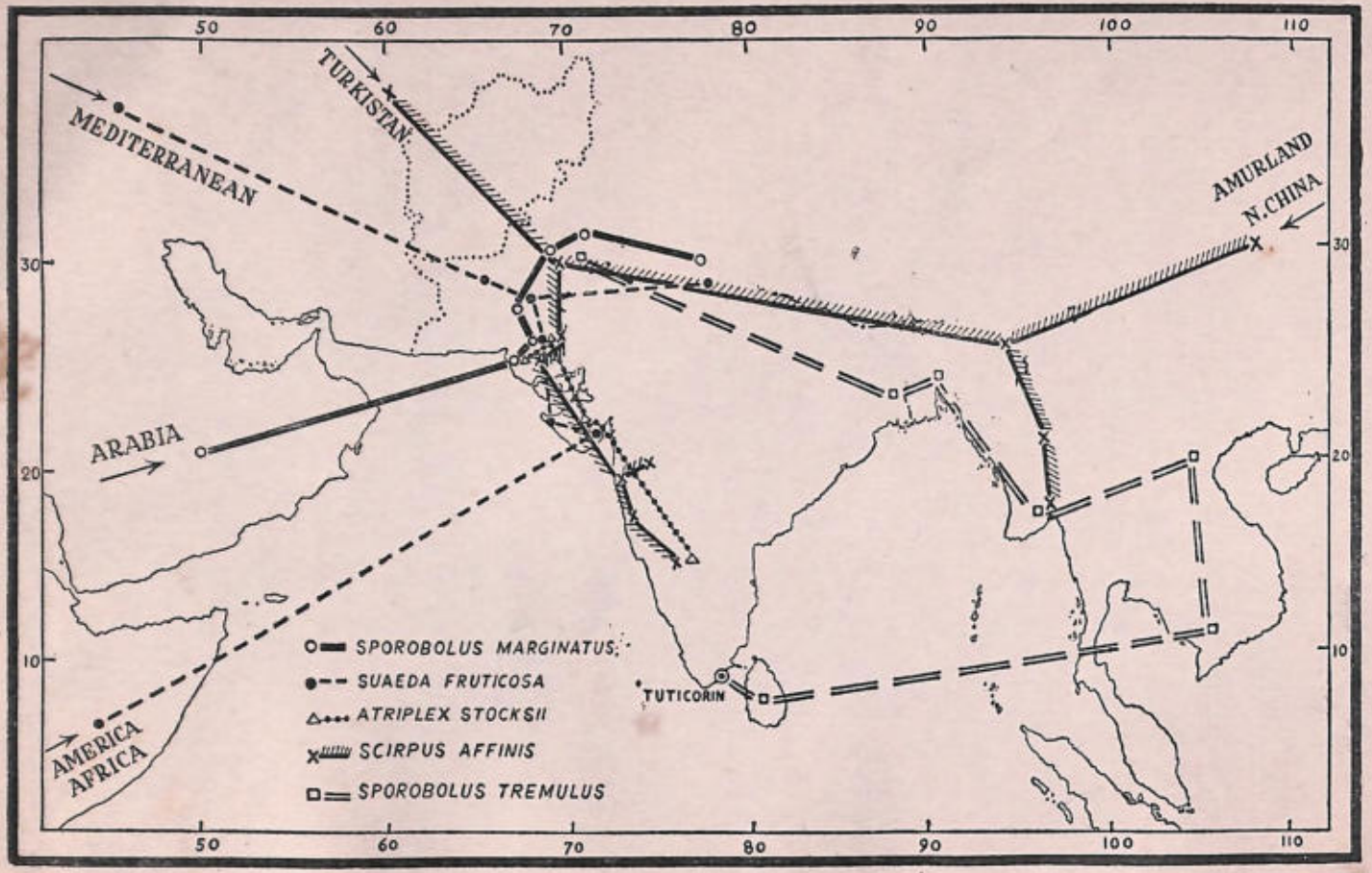
(With a map)

INTRODUCTION

Snug in the heart of the majestic grandeur of the Himalayas lies the little kingdom of Nepal—the naturalists' dreamland. The country spreads over a length of some 800 kilometres covering parts of both the western and the eastern Himalayas. The average breadth is merely 150 km. or so. Nevertheless, within this limited space one may travel from the Oriental Region to the Palaearctic—from flat alluvial plains to the highest points on earth, from hot steamy tropical valleys filled with luxuriant and almost impenetrable rain forests to the treeless, eerie wilderness of eternal snows, from bare rocky wastes to lush alpine meadows with their celestial floral carpets, let alone the crags and cliffs and other features which combine Nature's tenderest beauties with her most savage grandeur. Mountain-bound placid lakes, age-old untrodden glaciers, murmuring brooks, rippling rivulets, thundering waterfalls, tumultuous torrents winding through precipitous gorges of terrifying aspect, and great rivers carrying enormous quantities of water and debris to the plains present wide and complex differences in the landscape. Such a country of diverse contrasts shelters, as may be expected, a unique fauna, of which birds constitute the richest group both in number and in variety of forms.

Here in Nepal the indomitable British Resident Brian Hodgson, aptly called ' the father of Indian vertebrate zoology ', laid the foundation of the study of Indian vertebrates during the third decade of the nineteenth century, making avifauna his first choice. Since then the birds of Nepal continued to dominate the field of Indian ornithology until a number of additional bird students appeared on the scene to spread the focus to the less inaccessible parts of the country. The subsequent history of the ornithology of Nepal has been briefly summarized by Ripley (1950b) and by Rand & Fleming (1957).

In 1947, the present author who was then under training in Systematic Zoology at the Zoological Survey of India, had the opportunity to spend



Map showing the distribution pattern of some species

four months (March-June) in field work in Nepal, mainly ornithological study and collecting. This project was undertaken in co-operation with Dr. Walter Koelz, an American private collector of great experience. Dr. Koelz spent a little over five months (from March till early August) in Nepal. Those were the days when Nepal was still virtually closed to foreigners, so that our area of operation had to be restricted to the strip of country along the main road to Kathmandu from Raxaul in north Bihar, India, and to within 15 miles radius of Kathmandu. In spite of this limitation and of the season (the very heavy Himalayan monsoon from late May), the collection of birds made by the joint team totalled about 3500 specimens representing some 350 species and subspecies.

The birds of Nepal have great significance for Indian ornithology, mainly since this was the first area in the Indian Region to be explored on a large scale, and it is the type locality of nearly 10% of currently accepted forms of Indian birds.

In this paper the author has not only presented the data of the Koelz-Biswas collection, but has also attempted to give a complete list of birds known from Nepal so far, together with such information on the occurrence of each form as is available in the published literature. The species and subspecies have been serially numbered, and arranged in taxonomic sequence following Mayr & Amadon (1951), Biswas (1953), Mayr & Greenway (1956), and Vaurie (1959a). Forms whose occurrence in Nepal is doubtful, have not been given any serial number, but have been recorded in square brackets at the appropriate places in the sequence. Forms that were not found by the Koelz-Biswas team have been indicated by asterisks preceding the serial numbers. Since the original references to the various names are all available in standard books, they have been left out generally. However, wherever discrepancies have been noticed between the originals and those given in the standard literature, or whenever necessary for discussion, they have been retained.

It is proposed to include notes on the physiography, biotope, etc. of our collecting areas, and on the zoogeography of Nepal in the last instalment of this paper. For the present, however, the following explanation of the physiographical expressions used in the paper is given :

PLAINS—comprising the southernmost strip of flat plains indistinguishable from the plains of northern India adjoining Nepal. Heavily cultivated. Altitude up to about 150 m.

TARAI—comprising a belt north of the plains and consisting typically of thick forest interspersed with a large number of slow rivers. A great part of the tarai is cultivated at present. Altitude about the same as the plains.

BHABAR—comprising the strip from the edge of the tarai up to the Siwalik Hills. It is a heavily forested land (Sāl forest zone of Hodgson and of Scully) sloping southward. Altitude *c.* 150-300 m.

DUN—consisting of the zone of east-west valleys situated between the Siwaliks and the main Himalayan foothills. Heavily forested and interspersed with cultivation near scattered villages. Altitude *c.* 300-1370 m.

HIGHER RANGES—comprising the Himalayas proper. Heavily forested up to about 2740 m., but with extensive terraced cultivation near human habitation. Altitude over 1370 m.

In central Nepal the ' higher ranges ' zone has been further subdivided into :

(a) *Markhu Valley*—situated between the Mahabharat Range on the south and the Chandragiri on the north,

(b) *Chitlang Valley*—situated immediately to the south of the Chandragiri, and

(c) *Nepal Valley*—comprising the almost enclosed valley in which Kathmandu is situated. This valley has also been sometimes referred to simply as the Valley.

Various other places have been referred to according to the valleys in which they are situated.

For the sake of convenience of reference in this paper, Nepal has also been divided east-west into four areas (see Map), namely :

WESTERN—consisting of the part of the country from its extreme western border eastward up to long. 82°E.

WEST-CENTRAL—from long. 82°E. up to 84°E.

CENTRAL—from long. 84°E. up to 86°E.

EASTERN—from long. 86°E. to the extreme eastern edge of the country.

For the spellings of various geographical names, Survey of India maps have been generally followed.

ACKNOWLEDGEMENTS

I am thankful to the Government of Nepal for permitting us to make an ornithological collection there and for granting us all facilities in that connexion. My thanks are also due to the Government of India for bearing the major portion of the expenses of my study tour by awarding me an Overseas Scholarship. To three American friends who prefer to remain anonymous I am particularly indebted for providing me, through the American Museum of Natural History, with a scholarship that enabled me to carry on with my work during my last three months' stay in the U.S.A.

The authorities of the British Museum (Natural History) and the American Museum of Natural History, especially the staff of their ornithological departments, have been most helpful to me not only during the period I worked there, but even today, and I hereby tender them my grate-

ful appreciation. My thanks are also due to Dr. Walter Koelz for very kindly allowing me to work out his collection, and to the Bombay Natural History Society for lending comparative study material whenever it was needed.

I have been fortunate in receiving help in various ways from a large number of persons, among whom I must mention Dr. Sálim Ali, Dr. Dean Amadon, Professor J. L. Bhaduri, Mr. H. G. Deignan, Mr. J. Delacour, Mr. D. Goodwin, the late Capt. C. H. B. Grant, the late Dr. S. L. Hora, Mr. J. D. Macdonald, Mr. Daniel Marien, the late Mr. P. N. Mitra (who was my companion in Nepal), Mr. B. Roy, Mr. H. B. Usher, and Dr. Charles Vaurie.

I would be failing in my duty if I did not express my debt of deep gratitude to Professor Ernst Mayr who has not only rendered me constant inspiring guidance throughout this work, but also spent many hours of his extremely congested time in discussing various items, in reading through the manuscript, and helping me in other ways.

A complete list of references will be given at the end of this paper. Only a reference to some of the publications on Nepal ornithology cited frequently in the following pages is considered of relevance at this stage :

Biswas, B. (1960a) : Zoological results of the *Daily Mail* Himalayan expedition, 1954. Notes on some birds from Khumbu, eastern Nepal. [MS.]

Gray, J. E. (1863) : Catalogue of the specimens and drawings of mammals, birds, reptiles, and fishes of Nepal and Tibet, presented by B. H. Hodgson, Esq., to the British Museum (2nd ed.). London.

— — — & Gray, G. R. (1846) : Catalogue of the specimens and drawings of mammalia and birds of Nepal and Thibet, presented by B. H. Hodgson, Esq., to the British Museum. London.

Proud, D. (1949) : Some notes on birds of the Nepal Valley. *J. Bombay nat. Hist. Soc.* **48** : 695-719.

— — — (1952a) : Some birds seen on the Gandak-Kosi watershed in March, 1951. ibid. **50** : 355-366.

— — — (1952b) : Further notes on the birds of the Nepal Valley. ibid. **50** : 667-670.

Proud, D. (1955) : More notes on the birds of the Nepal Valley. ibid. **53** : 57-78.

Rand, A. L., & Fleming, R. L. (1957) : Birds from Nepal. *Fieldiana, Zool.*, **41** : 1-218.

Ripley, S. D. (1950a) : New birds from Nepal and the Indian region. *Proc. biol. Soc. Wash.* **63** : 101-108.

— — — (1950b) : Birds from Nepal 1947-1949. *J. Bombay nat. Hist. Soc.* **49** : 355-417.

Scully, J. (1879) : A contribution to the ornithology of Nepal. *Str. Feath.* **8** : 204-365.

Smythies, B. E. (1948) : Some birds of the Gandak-Kosi watershed, including the pilgrim trail to the sacred lake of Gosainkund. *J. Bombay nat. Hist. Soc.* **47** : 432-442.

— — — (1950) : More notes on the birds of the Nepal Valley. ibid. **49** : 513-518.

NOTE. In the Systematic List that follows

1. Forms that were not found by the Koelz-Biswas team have been indicated by asterisks preceding the serial numbers.
2. Forms whose occurrence in Nepal is doubtful have not been given any serial number, but have been recorded in square brackets at the appropriate places in the sequence.
3. All measurements are in millimetres. The wing and tail have been measured in the standard way. Unless otherwise stated, the bill size refers to the measurement in a straight line from the base of the bill on the skull to its tip. Numerical frequencies of measurements occurring more than once are given in parentheses.

Systematic List of Birds

Order PODICIPIFORMES

Family Podicipedidae

*1. **Podiceps ruficollis capensis** Salvadori. Indian Little Grebe.

The Indian Little Grebe was not found by us or by Rand & Fleming (1957), but Scully (1879, p. 364) found it to be tolerably common in the Nepal Valley between early September and mid-May, and Ripley (1950b, p. 363) noted it in the lower tarai near the Indian border.

*2. **Podiceps nigricollis nigricollis** C. L. Brehm. Blacknecked Grebe.

The Blacknecked Grebe was reported for the first time from Nepal by Rand & Fleming (1957, p. 48) who obtained a single specimen in west-central Nepal (Pokhara). Since then it has not been recorded from Nepal.

In view of the ruling on Opinion 406 (*Opin. int. Com. zool. Nom.*, 1956, **13** : 120) Brehm's name *Podiceps nigricollis*, 1831, must be retained for this species in preference to Hablizl's *Podiceps caspicus*, 1783.

*3. **Podiceps cristatus cristatus** (Linnaeus). Great Crested Grebe.

We were unable to find the Great Crested Grebe in Nepal, neither were Scully (1879) and Ripley (1950b), but Rand & Fleming (1957, p. 48) obtained three specimens in December and February in west-central Nepal (Pokhara), the only ones from that country since Hodgson's days.

Order PELECANIFORMES

Family Phalacrocoracidae

*4. **Phalacrocorax carbo sinensis** (Shaw). Large Cormorant.

The Large Cormorant was not seen by us in Nepal, or by Rand & Fleming (1957), but Scully (1879, p. 364) reported it from Trisul Ganga river, Nawakot district, central Nepal, in November, and Ripley (1950b, p. 363) found it on Karnali River in the dun of western Nepal early in January.

*5. **Phalacrocorax niger** (Vieillot). Little Cormorant.

Hodgson's collection (Gray & Gray, 1846, p. 149) provides the sole record of the occurrence of the Little Cormorant in Nepal.

*6. **Anhinga rufa melanogaster** Pennant. Darter.

The Darter was not obtained by us, but Scully (1879, p. 364) found it in the central bhabar in December, Ripley (1950b, p. 363) in small ponds

in the tarai, Rand & Fleming (1957, p. 48) in the western tarai in November. Proud (1955, p. 72) once saw a storm-driven example soaring over the Nepal Valley in April.

Family PELECANIDAE

*7. **Pelecanus philippensis philippensis** Gmelin. Spottedbilled Pelican.

The only record of the pelican from Nepal is provided by Hodgson's collection (Gray & Gray, 1846, pp. 148-149).

Order FALCONIFORMES

Family ACCIPITRIDAE

*8. **Elanus caeruleus caeruleus** (Desfontaines). Blackwinged Kite.

The Blackwinged Kite was not found by us or by Scully (1879) in Nepal. However, it was recorded by Ripley (1950b, p. 364) to be common in the tarai along the edges of forests, and by Rand & Fleming (1957, p. 52) as common in the lowlands of eastern and western Nepal in winter. Proud (1952b, p. 669) once saw it in the Nepal Valley in June. Biswas (1960a) reports it from *c.* 1370 m. in Chautara district, central Nepal, on January 31.

*9. **Aviceda leuphotes** (Dumont)[1]. Blackcrested Baza.

This baza was not found by us in Nepal, nor does it seem to have been recorded from that country since Hodgson's days.

10. **Pernis ptilorhynchus ruficollis** Lesson. Indian Crested Honey Buzzard.

TARAI : Simra : 1 subad. ♂ (March 5). DUN : Hitaura : 2 ♀♀ (July 20, 26).

The Crested Honey Buzzard was seen by us only in the tarai and dun of central Nepal, but Proud (1955, p. 71) found it to be common in the Nepal Valley from November to March. She also observed it in west-central Nepal. Scully (1879), Ripley (1950b), and Rand & Fleming (1957) did not record it from Nepal.

One of my female specimens (July 20) has the head and nape almost white with black shaft stripes, under plumage white with black shaft stripes on chin and throat, black central streaks (rather black drops) on breast and abdomen, fewer on the latter.

Measurements : 2 ♀♀ : Wing 408,—; tail 264, 270 ; bill 40 (2) ; culmen from the edge of cere 22.5, 23.

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[1] One of the two specimens obtained by Shri Gobind Bahadur Gurung at Bijaipur about 30 miles north of Biratnagar in eastern Nepal on 22 April 1959 for Klavs Becker-Larsen of Copenhagen is in the Society's collection.—EDS,

11. **Milvus migrans govinda** Sykes. Pariah Kite.

Although observed in the plains and tarai in March, no specimen of the Pariah Kite was obtained by us in Nepal. Ripley (1950b) did not find it in Nepal. Rand & Fleming (1957, p. 52) reported it from the lowlands. Biswas (1960a) found it up to *c.* 1520 m. in eastern Nepal. Some of Scully's (1879, pp. 227-229) specimens of the species, entered under three different names, undoubtedly represent this form.

12. **Milvus (migrans) lineatus** (J. E. Gray). Large Indian Kite.

DUN : Hitaura : 1 ♀, 1 subad. unsexed (May 14, June 2). MAHABHARAT RANGE : Chisapani Garhi : 1 ♀ (July 26). CHITLANG VALLEY : Chitlang : 1 subad. ♀ (April 21). NEPAL VALLEY : Kathmandu : 1 ♂ (April 6).

The Large Indian Kite is a common bird in central Nepal from the dun to the Valley. Lowndes (1955, p. 36) saw a pair at *c.* 3500 m. in Manangbhot, central Nepal, in July, and Biswas (1960a) collected it at *c.* 4260 m. and observed it once even at *c.* 5330 m. in Khumbu, eastern Nepal, in May.

My male specimen from Kathmandu (April 6) had somewhat swollen testes, and the female from Hitaura (June 2) had a shrunken ovary.

The Chisapani Garhi specimen has an additional abnormal structure on its bill, as has already been reported (Biswas, 1956).

Colours of soft parts : Iris dark brown, bill black with bluish slaty on base, cere pale yellow with bluish slaty on base, legs and feet dull bluish white, claws black, pads white.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
1 ♂ :	490	315	39	30
2 ♀♀ :	496, 498	307+, —	39, 41	29, —

13. **Haliastur indus indus** (Boddaert). Brahminy Kite.

DUN : Hitaura : 1 subad. ♀ (May 30).

During spring and summer, a few examples of the Brahminy Kite were found by us in the dun usually near streams, but none in the Nepal Valley. Scully (1879, p. 227) found it in the plains and tarai of central Nepal as a resident bird, and in the Nepal Valley in March, August, and September as a straggler. Proud (1949, p. 717), on the other hand, noted it to be a late summer (August-September) visitor to the Valley. Rand & Fleming (1957, p. 53) found it to be the common kite of the lowlands in winter. Biswas (1960a) reported it from the Pilua Khola Valley, eastern Nepal, at *c.* 1370 m. in June. Ripley (1950b) did not include it in his list.

*14. **Accipiter gentilis schvedowi** (Menzbier). Goshawk.

After Hodgson's collection the only record of the Goshawk from

Nepal is furnished by Scully (1879, p. 223) who did not obtain any specimen but found it to be a rare straggler to the Nepal Valley in winter.

15. **Accipiter badius dussumieri** (Temminck). Indian Shikra.

DUN : Hitaura : 3 ♂♂, 1 juv. ♂, 1 ♀ (May 30—June 16).

In central Nepal the Shikra appears to be fairly common in the dun, but rather scarce in the Nepal Valley.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
3 ♂♂ :	179, 180, 183	134, 139, 140	20 (2), 21	12.5, 13, 13.5
1 ♀ :	214	170	22	15

*16. **Accipiter trivirgatus indicus** (Hodgson). Northern Crested Goshawk

This goshawk was not obtained by us or by Scully (1879) in Nepal, but Ripley (1950b, p. 365) collected a single example in the eastern tarai in February, and Rand & Fleming (1957, p. 53) had a single specimen from west-central Nepal in December.

17. **Accipiter nisus nisosimilis** (Tickell). Asiatic Sparrow-Hawk.

DUN : Bhimphedi : 1 ♂ (March 12). NEPAL VALLEY : Kathmandu : 1 ♀ (March 24).

This sparrow-hawk was seen by us on several occasions in March chasing small birds in the outskirts of Kathmandu and about the villages on the Bhimphedi-Thankot trail. Proud (1949, p. 718) found it as a common winter visitor in the Nepal Valley, and Rand & Fleming (1957, p. 53) occasionally saw it in the lower hills (*c.* 900-1370 m.) of west-central Nepal during winter. Scully (1879) and Ripley (1950b) did not come across it in Nepal.

The female specimen (March 24) had paired granular ovaries, as has already been reported by Biswas (1960b), the largest ovum measuring 1.5 mm.

Colours of soft parts : Iris bright lemon yellow, cere greenish grey with yellowish tinge on base, bill bluish slaty with black tip, legs and feet yellow, claws black, pads yellow.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
1 ♂ :	215	154	20	12.5
1 ♀ :	245	182	24	15.5

*18. **Accipiter nisus melaschistos** Hume. Indian Sparrow-Hawk.

This sparrow-hawk was not obtained by us, or by Scully (1879) or by Rand & Fleming (1957). Ripley (1950b, p. 365), however, collected a specimen in eastern Nepal in February, and Biswas (1960a) found it in spring and summer between *c.* 3960 and 4570 m. in Khumbu, eastern Nepal.

19. **Accipiter virgatus affinis** Hodgson. Northern Besra Sparrow-Hawk.

CHITLANG VALLEY : Chitlang : 1 ♀ (June 28). NEPAL VALLEY : Thankot : 1 ♀ (April 11).

The Northern Besra Sparrow-Hawk was seen by us on several occasions in the Markhu and Chitlang valleys, but only a few were noticed in the Nepal Valley, although Proud (1955, p. 71) recorded it to be moderately common there throughout the year. Neither Scully (1879), nor Ripley (1950b) found it in Nepal. Rand & Fleming (1957, p. 53), who collected a single specimen at Kaski (? western Nepal) in December, noted it to be uncommon.

Both my specimens had remains of birds in their stomachs.

Measurements : 2 ♀♀ : Wing 199, 206; tail 164, 167; bill 23, —; culmen from the edge of cere 15.5, —.

*20. **Buteo rufinus rufinus** (Cretzschmar). Longlegged Buzzard.

Although Scully (1879, p. 225) recorded the Longlegged Buzzard as tolerably common in the plains, tarai, and Nepal Valley in winter, and Proud (1949, p. 717) as common in the Valley from September to April, it was not found in Nepal either by us or by Ripley (1950b) or by Rand & Fleming (1957).

*21. **Buteo hemilasius** Temminck & Schlegel. Upland Buzzard.

This buzzard was not found by us, nor by Scully (1879) or by Rand & Fleming (1957), but Ripley (1950b, p. 365) saw one at Thimi, Nepal Valley, in December.

*22. **Buteo buteo japonicus** (Temminck & Schlegel). Common Buzzard.

The Common Buzzard was not obtained by us or by Ripley (1950b) in Nepal. Scully (1879, p. 225) found it in the Nepal Valley in winter, and Rand & Fleming (1957, p. 54) recorded it from western and west-central Nepal (275 and 2440 m.) in winter.

23. **Butastur teesa** (Franklin). White-eyed Buzzard-Eagle.

DUN : Hitaura : 1 juv. unsexed (June 14).

The White-eyed Buzzard-Eagle was rarely seen by us in the tarai and dun, and never in the Nepal Valley. Scully (1879) did not record it from Nepal. Ripley (1950b, p. 365) obtained a single specimen in eastern Nepal at *c.* 1520 m., and Rand & Fleming (1957, p. 54) occasionally found it in eastern Nepal but rarely in western.

My specimen has the forehead, head, and nape rufous with dark brown to black shaft stripes, back and mantle rufous brown, under-side rufous brown with dark brown shaft stripes, but with no such stripe on the cheek or chin.

Its stomach contained the feet of a gallinaceous bird and meat.

*24. **Spizaëtus nipalensis nipalensis** (Hodgson). Hodgson's Hawk-Eagle.

The only record of Hodgson's Hawk-Eagle from Nepal since Hodgson's time appears to be that of Rand & Fleming (1957, p. 54) who occasionally saw it in the foothills.

25. **Spizaëtus limnaeetus limnaeetus** (Horsfield). Changeable Hawk-Eagle.

DUN : Hitaura : 1 ♀ (July 4).

This hawk-eagle was noticed by us on a very few occasions during spring and summer in the central dun. The above specimen appears to be the only example collected in Nepal since Hodgson's days. It had an exhausted ovary.

Measurements : 1 ♀ : Wing 433, tail 275 +, bill 46, culmen from the edge of cere 34.

*26. **Hieraaëtus fasciatus fasciatus** (Vieillot). Bonelli's Eagle.

The last record of Bonelli's Eagle from Nepal was made by Scully (1879, p. 224) who did not find it to be very common in the Nepal Valley.

27. **Aquila chrysaëtos daphanea** Severtzov. Central Asian Golden Eagle.

Post-Hodgsonian records of the Golden Eagle in Nepal appear to be very few. Thus, Smythies (1950, p. 517) observed it once on Nagar Jong (Nepal Valley) in December, where Proud (1955, p. 70) often found it soaring in winter ; and Biswas (1960a) noted it on a few occasions in eastern Nepal between *c.* 1830 and 3050 m. in winter. Besides, there is a doubtful record from Manangbhot, central Nepal, by Lowndes (1955, p. 36). No specimen of this eagle seems to have been collected in Nepal during the past 100 years or more.

*28. **Aquila heliaca heliaca** Savigny. Imperial Eagle.

Since Hodgson left Nepal the only record of the occurrence of the Imperial Eagle in that country appears to be that of Proud (1955, p. 71) who often observed it in the Nepal Valley in January-February.

*29. **Aquila rapax vindhiana** Franklin. Tawny Eagle.

Hodgson's (Gray & Gray, 1846, p. 40) is the only record for this eagle in Nepal.

*30. **Aquila nipalensis nipalensis** (Hodgson). Steppe Eagle.

Neither Ripley (1950b), nor Rand & Fleming (1957) or we found the Steppe Eagle in Nepal. Scully (1879, p. 223) saw it only once in the Nepal Valley, and Proud (1955, p. 71) has recorded it as fairly common there in winter.

*31. **Aquila clanga** Pallas. Greater Spotted Eagle.

The only records of the Greater Spotted Eagle from Nepal are Hodgson's (Gray & Gray, 1846, p. 40) and Rand & Fleming's (1957, p. 54). The last-named authors found it several times in the lowlands of both western and eastern Nepal.

32. **Ictinaëtus malayensis perniger** (Hodgson). Indian Black Eagle.

MARKHU VALLEY : Deorali : 2 ♂♂ (May 1). NEPAL VALLEY : Thankot : 1 ♂, 1 ♀ (March 23, 26).

The Black Eagle was not infrequently seen by us between Bhimphedi and the Nepal Valley. Proud (1949, p. 717) found it throughout the year over the ranges bordering the Nepal Valley, and Ripley (1950b, p. 365) saw it only in western Nepal at *c.* 1520 m. Biswas (1960a) observed it on a few occasions in central Nepal in January and in eastern Nepal in June. Neither Scully (1879), nor Rand & Fleming (1957) reported it from Nepal.

The March specimens had breeding gonads. One of the Deorali specimens had the remains of a bat in the stomach.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
3 ♂♂ :	563, 573, 580	315, 319, 326	40, 41, 43	28.5, 29, 30.5
1 ♀ :	600	350	46	32

It may be noted here that the measurements of the wing and tail as given by Baker (1928, p. 83) for this form, are much too small.

According to Baker (op. cit., p. 82), the 5th primary from outside is the longest in the genus *Ictinaëtus*. This, however, is not true for my specimens in which the longest primary is the 6th one from outside.

*33. **Haliaeetus leucoryphus** (Pallas). Pallas's Fishing Eagle.

We did not come across Pallas's Fishing Eagle in Nepal. Scully (1879, p. 225) observed a few examples in the Nepal Valley generally except during the winter months ; Ripley (1950b, p. 365) found it in the western lowlands in winter ; and Rand & Fleming (1957, p. 54) encountered it in the lowlands of both western and eastern Nepal.

*34. **Icthyophaga ichthyaetus** (Horsfield). Greyheaded Fishing Eagle.

This fishing eagle has not been reported from Nepal since Hodgson's days.

35. **Icthyophaga nana plumbea** (Jerdon). Himalayan Greyheaded Fishing Eagle.

DUN : Hitaura : 3 ♂♂, 1 ♀, 1 unsexed (May 17—June 3).

The Greyheaded Fishing Eagle was frequently seen by us in the dun, particularly along the larger rivers, such as the Rapti and Samri. Biswas (1960a) found it at *c.* 850 m. in central Nepal in January, and in eastern

Nepal at *c.* 3655 and 4420 m. in May. It was not reported from Nepal by either Scully (1879), or Ripley (1950b), or Rand & Fleming (1957).

My female specimen (June 3) is very worn, with its tail moulting.

Colours of soft parts : Iris golden yellow, bill black, plumbeous on base and lower mandible, cere slaty, legs and feet dull white with bluish tinge at ' knees ' and on the digits, claws black, pads dirty white.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
3 ♂♂ :	426, 428, 441	215, 216, 228	43, 45 (2)	34 (2), 35
1 ♀ :	—	—	45	34.5
1 unsexed :	467	238	48	36.5

The unsexed bird appears to be a female from size.

36. **Torgos calvus** (Scopoli). Black Vulture.

BHABAR : Amlekhganj : 1 ♂, 1 ♀ (August 4).

The Black Vulture is not uncommon in the Nepal Valley, being usually found near burning ghats on rivers. It does not, however, appear common in the tarai, bhabar and dun as about Kathmandu.

It has been reported as a permanent resident in the Nepal Valley (Scully, 1879, p. 217 ; Proud, 1949, p. 716), and as winter visitor to the plains, tarai, duns, and the Markhu Valley (Scully, loc. cit.). Ripley (1950b) did not find it in Nepal. Rand & Fleming (1957, p. 55) noted it in the lowlands and foothills in winter. Biswas (1960a) reported it from eastern Nepal at *c.* 1980 m. in early February and at *c.* 1520 m. in June.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
1 ♂ :	566	248	66+	47+
1 ♀ :	592	250	–	–

*37. **Aegypius monachus** (Linnaeus). Cinereous Vulture.

The Cinereous Vulture was not found by us in Nepal, nor did Ripley (1950b) record it thence. Scully (1879, p. 217) noted it as scarce in the Nepal Valley, and Rand & Fleming (1957, p. 55) found it in the eastern Nepal foothills as an uncommon bird in winter.

*38. **Gyps fulvus fulvescens** Hume. Griffon Vulture.

Gyps fulvescens Hume, 1869, My Scrap Book **1**: 15, 19. [Punjab, northern Rajasthan and ' North-West Provinces ' (= Uttar Pradesh), north and west of Etawah = Gurgaon, Punjab, according to Baker, 1928, p. 11.]

The only records of the Griffon Vulture from Nepal are Hodgson's (Gray & Gray, 1846, pp. 37-38) in the hills, and Scully's (1879, p. 218) in the Nepal Valley in winter.

39. **Gyps himalayensis** Hume. Himalayan Griffon.

Gyps himalayensis Hume, 1869, My Scrap Book 1: 12, 15. (Himalayas from Kabul to Bhutan=Simla, according to Baker, 1922c, p. 583.)

The Himalayan Griffon was seen by us only once, and that was in Kathmandu, Nepal Valley, in mid-March. Scully (1879, p. 218) found it in small numbers in the Valley during winter; Lowndes (1955, p. 36) observed a pair in Manangbhot, central Nepal, in June-July; Rand & Fleming (1957, p. 55) found it in the eastern Nepal foothills during winter; Biswas (1960a) reported it from Khumbu, eastern Nepal, at *c.* 3660 m. in February. Ripley (1950b) does not mention it in his list.

40. **Gyps indicus tenuirostris** G. R. Gray. Himalayan Longbilled Vulture.

This vulture was seen by us on a few occasions only in the Nepal Valley, mainly near villages. Scully (1879, p. 219) reported it to be tolerably common in the Valley where Smythies (1950, p. 517) and Ripley (1950b, p. 366) also observed it. Rand & Fleming (1957, p. 55) found it to be common in the western tarai in winter.

41. **Gyps bengalensis** (Gmelin). Whitebacked Vulture.

DUN: Hitaura: 1 ♀ (June 3).

This is the commonest vulture of the Nepal Valley and the dun. Proud (1949, p. 716) observed that it became scarcer in the Valley during the coldest months. Stevens (1925c, p. 874) recorded it from the Mai Valley, eastern Nepal, at over 2440 m. in March.

My specimen had non-breeding gonad.

Measurements: 1 ♀: Wing 555, tail 238, tarsus 94, bill 62 [*cf.* Baker's (1928, p. 19) 'tarsus 108 to 124 mm.; culmen 71 to 81 mm.' evidently errors].

42. **Neophron percnopterus ginginianus** (Latham). Smaller Scavenger Vulture.

BHABAR: Amlekhganj: 1 unsexed (June 8).

The Scavenger Vulture was seen by us in the plains, tarai, and bhabar. Scully (1879) and Ripley (1950b) did not report it from Nepal.

My specimen has a light greyish wash all over.

Measurements: 1 unsexed: Wing 434, tail 210, bill 57 [*cf.* measurements given by Baker (1928, p. 23) wing 443-482, tail 228-251, culmen 72-85].

*43. **Gypaëtus barbatus hemachalanus** Hutton. Himalayan Lämmergeier.

The Lämmergeier or Bearded Vulture was not found by us or by Rand & Fleming (1957). Nevertheless, it was observed in the Nepal Valley once by Scully (1879, p. 221) in winter and occasionally by Proud (1949, p. 716); in the northern central Nepal in the Gandak-Kosi watershed once in autumn by Smythies (1948, p. 442) and once in spring by Proud (1952a, p. 366), and several pairs in Manangbhot during May-

September by Lowndes (1955, p. 36) ; once in winter in eastern Nepal about Dhankuta by Ripley (1950b, p. 366), and several times in Solu-Khumbu between February and May by Biswas (1960a).

*44. **Circus cyaneus cyaneus** (Linnaeus). Hen-Harrier.

We did not come across the Hen-Harrier in Nepal, nor did Ripley (1950b) or Rand & Fleming (1957). Scully (1879, p. 226) recorded it to be fairly common in the Nepal Valley during winter, but Proud (1949, p. 717) found only a few specimens there during March-April, none in autumn or winter.

*45. **Circus macrourus** (S. G. Gmelin). Pale Harrier.

Neither Rand & Fleming (1957) nor we found the Pale Harrier in Nepal, but Scully (1879, p. 226) recorded it in winter in the Nepal Valley where Proud (1949, p. 717) also found it occasionally on passage in spring, and Ripley (1950b, p. 366) reported it from eastern Nepal in winter.

*46. **Circus pygargus** (Linnaeus). Montagu's Harrier.

We were unable to find this harrier in Nepal, and so were Scully (1879) and Ripley (1950b), but Proud (1949, p. 717) recorded it in the Nepal Valley on passage in April and November, and Rand & Fleming (1957, pp. 55-56) noted it as an uncommon bird in the eastern Nepal tarai in winter.

*47. **Circus melanoleucos** (Pennant). Pied Harrier.

The Pied Harrier was not come across by us, but it has been reported in winter from the plains and tarai of central Nepal by Scully (1879, p. 226) and Ripley (1950b, p. 366), and from the tarai of eastern Nepal by Rand & Fleming (1957, p. 56).

*48. **Circus aeruginosus aeruginosus** (Linnaeus). Marsh Harrier.

The Marsh Harrier was not found by Ripley (1950b) or by us. Scully (1879, p. 226) reported it to be common during winter in the Nepal Valley, central tarai, and plains ; Proud (1949, p. 717) noted it to be the commonest harrier of the Nepal Valley in autumn and winter ; and Rand & Fleming (1957, p. 56) observed it in the western and eastern lowlands in winter.

*49. **Circaëtus gallicus** (Gmelin). Short-toed Eagle.

Hodgson's collection (Gray & Gray, 1846, p. 41) furnishes the sole record of this eagle from Nepal.

50. **Spilornis cheela cheela** (Latham). Crested Serpent Eagle.

DUN : Hitaura : 1 ♂, 1 ♀, 1 subad. ♀ (May 18, June 1, 18). NEPAL VALLEY : Thankot : 1 ♀ (April 2).

In the Nepal Valley the Serpent Eagle was seen on several occasions near the crests of the hills surrounding it—above Thankot, Godavari, and Burhanilkantha. In the central dun, however, it was more common. Scully (1879, p. 224) found it tolerably common in the Valley throughout the year, but Proud (1949, p. 717) observed that it appears to leave that area in winter.

The subadult female specimen (June 1) is very worn and just beginning to moult. Its oviduct showed immature condition. The adult female from Thankot (April 2) was laying.

The stomachs of the Hitaura specimens contained frogs.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
1 ♂ :	477+	300	46	32
2 ♀♀ :	480+, 516	292+, 330	47, 47.5	35, 36

Family FALCONIDAE

51. **Microhierax caerulescens caerulescens** (Linnaeus). Himalayan Falconet.

BHABAR : Amlekhganj : 1 ♂ (March 9). DUN : Hitaura, Kusumtar : 3 ♂♂, 3 juv. ♂♂, 1 ♀, 3 juv. ♀♀ (May 19, June 2-19, July 12-28).

The Himalayan Falconet was found by us in the forests of the central bhabar and dun only, and it did not appear to be particularly common there. Rand & Fleming (1957, p. 57) also noted it to be an uncommon bird, and Scully (1879) did not report it at all.

One of my adult male specimens (Hitaura, May 19) has the crown in moulting condition. A female specimen on June 4 had an exhausted ovary and a shrivelled oviduct.

The juvenile specimens taken July 12-13 have the forehead and supercilium chestnut, chin to abdomen white, and dirty yellow bill with black on the anterior half of culmen. The juvenile specimens taken later have, however, more black on bill. The stomachs of the juvenile specimens had grasshoppers and dragonflies.

Measurements :

	Wing	Tail	Culmen from the edge of cere
4 ♂♂ :	102 (3), 104	60, 62, 64, 65	10, 10.5 (2) 11
1 ♀ :	109	65	11

*52. **Falco cherrug milvipes** Jerdon. Cherrug Falcon.

The Cherrug Falcon has so far been taken in Nepal only by Hodgson (Gray & Gray, 1846, p. 43).

*53. **Falco jugger** J. E. Gray. Laggar Falcon.

The Laggar Falcon was not met with by us or by Ripley (1950b). Scully (1879, p. 222), however, recorded it once in the Nepal Valley in

winter, and Rand & Fleming (1957, p. 57) also found it once (two specimens) in the eastern lowlands in winter.

*54. **Falco peregrinus calidus** Latham. Peregrine Falcon.

The post-Hodgsonian records of the Peregrine Falcon in Nepal are those of Scully's (1879, p. 221) and Proud's (1949, p. 716) both of whom found it as a winter visitor in the Nepal Valley.

*55. **Falco peregrinus peregrinator** Sundevall. Shahin.

The only record of the Shahin from Nepal is Hodgson's (Gray & Gray, 1846, p. 44).

*56. **Falco subbuteo subbuteo** Linnaeus. Hobby.

Hodgson's collection (Gray & Gray, 1846, p. 44) provides the sole record for the Hobby in Nepal.

*57. **Falco severus severus** Horsfield. Oriental Hobby.

Since Hodgson's time the only specimen of the Oriental Hobby from Nepal was taken by Rand & Fleming (1957, p. 57) who found it several times in the western lowlands during winter. Proud (1949, p. 716) describes it as a summer visitor in the Nepal Valley.

58. **Falco chicquera chicquera** Daudin. Redheaded Merlin.

TARAI : Simra : 1 ♂, 1 ♀ (March 4).

The Redheaded Merlin is not an uncommon bird in the Nepal Valley or in the central tarai, but not many are seen in the dun of central Nepal. It seems to prefer places not very far from villages. Ripley (1950b) has not recorded it from Nepal.

It was breeding early in March.

Measurements :

	Wing	Tail	Bill	Culmen from the edge of cere
1 ♂ :	206	134	22.5	14.5
1 ♀ :	230	148	25	16

*59. **Falco vespertinus amurensis** Radde. Redlegged Falcon.

The only record of this falcon from Nepal is the single skin taken by Hodgson (Gray & Gray, 1846, p. 45), obviously on passage.

*60. **Falco tinnunculus tinnunculus** Linnaeus. European Kestrel.

The European Kestrel was not found by us or by Ripley (1950b). Scully (1879, p. 223) reported it as a winter visitor in central Nepal from the Nepal Valley down to the plains except the bhabar. Proud (1949, p. 717) observed it as a winter visitor in the Valley. Rand & Fleming (1957, p. 57) obtained it in winter between *c.* 275 and 2285 m. both in western and in eastern Nepal. They, however, noted it to be commoner in the east.

61. **Falco tinnunculus interstinctus** McClelland. Himalayan Kestrel.

CHITLANG VALLEY : Chitlang : 2 ♂♂ (April 26, 27).

The Himalayan Kestrel is not uncommon in the tarai and dun up to the Nepal Valley in spring. Biswas (1960a) reported it from eastern Nepal at *c.* 1525 m. in June.

Measurements : 2 ♂♂ : Wing 235, 252 ; tail 153, 169 ; bill 20, 21 ; culmen from the edge of cere 14, 15.

Family PANDIONIDAE

*62. **Pandion haliaetus haliaetus** (Linnaeus). Osprey.

We were unable to find the Osprey in Nepal, so were Scully (1879) and Ripley (1950b). However, Proud (1949, p. 716) observed it on and off throughout the year in the Nepal Valley, and Rand & Fleming (1957, p. 56) came across it occasionally in the lowlands in winter.

Order CICONIIFORMES

Family ARDEIDAE

*63. **Ardea insignis** Hume. Great Whitebellied Heron.

Ardea insignis 'Hodgson' Hume, 1870, Str. Feath. 6: 470. (Sikkim tarai, Bhutan duars) ex *Ardea insignis* Hodgson, 1844, *nom. nud.* Hume's name is available, since its citation as a synonym of *Ardea nobilis* Blyth and *Ardea sumatrana* Raffles are based on misidentification.

The only record of the Great Whitebellied Heron from Nepal is based on Hodgson's collection (Gray & Gray, 1846, p. 133).

*64. **Ardea cinerea rectirostris** Gould. Eastern Grey Heron.

Ardea rectirostris Gould, 1843, Proc. zool. Soc. Lond. (11) : 22. (New South Wales ' =India ? ', according to Stone & Mathews, 1913, p. 142 ; restricted to India by Ripley, in press).

The Grey Heron was not obtained by us or by Scully (1879). Ripley (1950b, p. 363) found it in the tarai during winter, and Rand & Fleming (1957, pp. 48-49) who identified their specimens as *A. c. cinerea* Linnaeus, came across it on a few occasions in the lowlands of western and eastern Nepal between *c.* 275 and 915 m. in winter.

*65. **Ardea purpurea manilensis** Meyen. Eastern Purple Heron.

The Purple Heron was not met with by us or by Scully (1879). Smythies (1950, p. 518) reported it from the Nepal Valley. Ripley (1950b, p. 363) saw it in the tarai in winter, and Rand & Fleming (1957, p. 48) found it on a few occasions only in the lowlands in winter. I am unable to trace any breeding record from Nepal to support Ripley (in press).

66. **Butorides striatus chloriceps** (Bonaparte). Indian Little Green Heron.

Ardea chloriceps 'Hodgs.' Bonaparte, 1857, Consp. Gen. Av. 2 : 129. (Nepal, restricted to Hitaura, Chisapani Garhi district, by Biswas, 1959a, p. 288.)

BHABAR : Amlekhganj : 1 ♂, 1 juv. ♀ (March 10). DUN : Hitaura, Kusumtar : 3 ♂♂, 2 subad. ♂♂, 1 ♀ (May 17-31, June 14).

The Little Green Heron is found during spring and summer in small numbers in the central bhabar and dun, usually perched on riverside trees with dense foliage. It is generally found singly, but on several occasions we observed it in pairs. Scully (1879) did not include it in his list of Nepal birds. Ripley (1950b, p. 363) found it in eastern Nepal, and Rand & Fleming (1957, p. 49) in western and west-central Nepal.

Remains of fishes and frogs were found in the stomachs of some of my specimens.

It was breeding in May. A male taken on May 31 had much enlarged testes, and a female had fully formed eggs on May 20.

The subadult males (May 26, June 14) still have some dark brown streaks on chin.

Colours of soft parts : Iris yellow ; orbital skin green ; upper mandible black ; lower mandible green on base, black along the edges, sides of basal and anterior third, and pale dull yellowish green elsewhere ; legs and feet dull brownish yellow with chrome yellow on the hinder aspects of legs; claws horny ; pads chrome yellow.

Measurements :

	Wing	Tail	Bill from posterior edge of nostril
4 ♂♂ :	171, 181 (2), 183	60.5, 63, 65, 66	57.5, 60, 62 (2)
1 ♀ :	182	64	61

Regarding the use of Bonaparte's name for this bird, see Biswas (loc. cit.).

67. **Ardeola grayi** (Sykes). Pond Heron.

DUN : Hitaura : 2 ♂♂ (May 19, June 5). NEPAL VALLEY : Thankot, Karmanasa river (south of Patan) : 2 ♂♂ (April 13, May 9).

The Pond Heron is common at suitable places from the plains of central Nepal up to the Nepal Valley. Rand & Fleming (1957, p. 49) reported it from western and west-central Nepal.

It was breeding in May. A male taken May 9 had fully developed testes.

My breeding male specimens each has four long greyish white lanceolate feathers on the anterior dorsal side of the neck, which have not been mentioned by Baker (1929, p. 354). Moreover, all my breeding male specimens have the occipital crests buff and not white as stated by Baker (loc. cit.).

Colours of soft parts: Iris lemon yellow ; orbital skin greenish yellow ; bill greenish yellow with blue on base, horny on the middle part of culmen, and black on the top and sides of the anterior third ; legs and feet dull green ; claws pale horny ; pads dingy yellowish white.

Measurements : 4♂♂ : Wing 218, 221, 226, 233 ; tail 75, 83, 85, 87 ; bill from the posterior edge of nostril 56, 60, 62 (2).

68. **Bubulcus ibis coromandus** (Boddaert). Cattle Egret.

NEPAL VALLEY : Kathmandu, Harisidhi, Godavari : 5 ♂♂, 1 subad. ♂, 3 ♀♀ (May 9-12, July 1).

The Cattle Egret is a common bird of central Nepal from the plains up to the Nepal Valley. A large breeding colony was observed by us in the Valley at Harisidhi on a *Ficus* tree in May. Rand & Fleming (1957, p. 49) reported it from the eastern Nepal tarai.

My subadult specimen (Godavari, May 12) is completing a general moult to attain the adult breeding dress, but without any trace of orange-buff plumes from the interscapular region. Its gonads, moreover, were small in size, the right one measuring 7 × 5 mm., and the left 10 × 5.5 mm. (cf. measurements of breeding testes given below). All the adult birds are in full breeding plumage, except two Kathmandu specimens (♂♀, July 1) which have only traces of orange-buff here and there on the plumage.

Some of the July specimens are worn, but a male bird is particularly so. Its wing and tail are very much worn, with the central rectrices in moult.

The May 9 specimens from Harisidhi all had breeding gonads. The male had the right testis measuring 22 × 12 mm., and the left 27 × 13 mm., one of the females had a 30 × 19 mm., ovary with the largest ova 11.5 and 12 mm., the other female had a 17 × 14 mm. ovary, the largest ovum of which was 7 mm.

Measurements :

	Wing	Tail	Bil from the posterior edge of nostril
5 ♂♂ :	252, 252+, 255 262,—	90, 92, 93, 100,—	47.5, 52, 53 (2), 54
3 ♀♀ :	241, 242, 255	88, 91, 95	50, 51,—

Since the habits and behaviour of the Cattle Egret are very different from those of the Pond Heron, I am unable to agree with Bock (1956, pp. 18, 36) in placing both of them in the genus *Ardeola* (see also Ripley, in press).

*69. **Egretta alba modesta** (J. E. Gray). Eastern Large Egret.

The Large Egret was not found by us. Scully (1879, p. 360) recorded it as a winter visitor to the Nepal Valley and Nawakot district (central Nepal) but not in the plains, while Ripley (1950b, p. 363) found it in winter only in the tarai and not higher, and Rand & Fleming (1957, p. 49) noted it in the lowlands in winter.

*70. **Egretta garzetta garzetta** (Linnaeus). Little Egret.

We did not come across this egret in Nepal. Scully (1879, pp. 360-361) found it to be a bird of the tarai, plains, and parts of the Nawakot

district, central Nepal, and saw only a few stray ones in the Nepal Valley in autumn. Proud (1949, p. 719), on the other hand, records it as a resident species of the Valley. Ripley (1950b, p. 363) took a single specimen in the Valley at Thankot in spring, and Rand & Fleming (1957, pp. 49-50) found it between *c.* 275 and 915 m. in west-central Nepal in winter.

*71. **Egretta intermedia palleuca** Deignan. Smaller Egret.

We were unable to find this egret in Nepal, and so were Hodgson, and Rand & Fleming (1957). It was Scully (1879, p. 360) who first reported the species from Nepal. He found it in the Nepal Valley between September and December only, in the Nawakot district in November, and in the plains and tarai in December. Ripley (1950b, p. 363) observed it in winter in the tarai but not higher.

Regarding the use of Deignan's name for this bird, see Ripley in press.

72. **Nycticorax nycticorax nycticorax** (Linnaeus). Night Heron.

Although Scully (1879, p. 361) and Proud (1949, p. 719) both record the Night Heron as a very common resident bird of the Nepal Valley, we observed it in spring and summer only on a few occasions on trees in the neighbourhood of water. Ripley (1950b) and Rand & Fleming (1957) do not report it from Nepal.

[**Ixobrychus minutus minutus** (Linnaeus). Little Bittern.

Nepal has been included within the range of this species in almost all the standard works on Indian avifauna. Although it might possibly occur there, I am unable to trace any authentic record to support it.]

*73. **Ixobrychus sinensis** (Gmelin). Yellow Bittern.

The occurrence of the Yellow Bittern in Nepal is known only from Hodgson's collection (Gray & Gray, 1846, pp. 134-135).

74. **Ixobrychus cinnamomeus** (Gmelin). Cinnamon Bittern.

DUN : Hitaura : 3 ♂, 1 ♀ (June 19, July 28, August 1).

This appears to constitute the first record of the occurrence of the Cinnamon Bittern in Nepal. It was found by us in summer only in the dun of central Nepal. It occurs in small numbers in deep cover of reed beds, especially in shady parts of dense forests.

Measurements :

	Wing	Tail	Bill from the posterior edge of nostril
3 ♂♂ :	151, 152, 154	44, 46, 48	45, 46, 47
1 ♀ :	145	45	45

*75. **Botaurus stellaris stellaris** (Linnaeus). Bittern.

The Bittern is known from Nepal only through Hodgson's collection (Gray & Gray, 1846, p. 135).

Family THRESKIORNITHIDAE

*76. **Threskiornis melanocephala** (Latham). White Ibis.

The White Ibis was not found by us or by Scully (1879) or by Ripley (1950b), but Rand & Fleming (1957, pp. 50-51) observed it occasionally in the lowlands of eastern Nepal. Hodgson's collection (Gray & Gray, 1846, p. 137) from the tarai is the only other record of this bird from Nepal.

77. **Pseudibis papillosa papillosa** (Temminck). Indian Black Ibis.

TARAI : Simra : 1 ♂ (March 5). DUN : Hitaura : 1 ♂ (June 2).

The Black Ibis was met with by us sparsely near cultivated areas in the central tarai and dun. Scully (1879) did not find it in Nepal, and Ripley (1950b, p. 363) observed it but once at *c.* 150 m. in western Nepal ; nevertheless, Rand & Fleming (1957, p. 51) seem to have found it fairly common in open fields of the western tarai.

Measurements : 2 ♂♂ : Wing 370, 392 ; tail 174, 185 ; bill from the anterior edge of nostril 126, 132.5.

*78. **Plegadis falcinellus falcinellus** (Linnaeus). Glossy Ibis.

*79. **Platalea leucorodia major** Temminck & Schlegel. Spoonbill.

Hodgson's collection (Gray & Gray, 1846, pp. 135-136) of the Glossy Ibis and Spoonbill, the latter from the tarai, represent the only records of these species from Nepal.

Family CICONIIDAE

*80. **Ibis leucocephalus** (Pennant). Painted Stork.

Hodgson's (Gray & Gray, 1846, p. 136) is the only record of the Painted Stork from Nepal.

*81. **Anastomus oscitans** (Boddaert). Openbill.

The occurrence of the Openbill in Nepal is based solely on Ripley's (1950b, p. 364) record from the tarai.

82. **Ciconia episcopus episcopus** (Boddaert). Whitenecked Stork.

DUN : Hitaura : 1 ♂ (May 21).

The Whitenecked Stork was found by us only on a few occasions around Hitaura in the central dun on the bank of the Rapti River in summer. Scully (1879, p. 360) reported it common in the Nepal Valley from May to December and in the Nawakot district in November. Proud (1949, p. 719) occasionally found it in the Valley throughout the year.

Ripley (1950b, p. 364) saw it in the tarai in winter as an uncommon bird, but Rand & Fleming (1957, p. 50) record it as the commonest stork from the plains up to *c.* 610 m. in western Nepal in winter.

Measurements : 1 ♂ : Wing 507, tail 182, bill from the posterior edge of nostril 139.

*83. **Ciconia nigra** (Linnaeus). Black Stork.

The Black Stork was not met with by us or by Ripley (1950b), but Scully (1879, p. 359) recorded it to be common in the Nepal Valley and Nawakot district from September to December, and Rand & Fleming (1957, p. 50) occasionally found it in the eastern lowlands up to *c.* 915 m. in winter.

*84. **Xenorhynchus asiaticus asiaticus** (Latham). Blacknecked Stork.

The only record of the Blacknecked Stork from Nepal since Hodgson's time is Ripley's (1950b, p. 364). He found it in the tarai as an uncommon bird.

*85. **Leptoptilos dubius** (Gmelin). Adjutant.

The post-Hodgsonian records of the Adjutant from Nepal have been made by Ripley (1950b, p. 364) who found it in the tarai but not as a common bird, and by Biswas (1960a) who observed a pair in eastern Nepal at *c.* 1525 m. in June. There is also a doubtful sight record by Rand & Fleming (1957, p. 50) from the western lowlands.

*86. **Leptoptilos javanicus** (Horsfield). Lesser Adjutant.

The only authentic record of this adjutant from Nepal is due to Rand & Fleming (1957, p. 50) who found it in the eastern lowlands in winter.

Order ANSERIFORMES

Family ANATIDAE

*87. **Anser anser rubrirostris** Swinhoe. Greylag Goose.

The only record of the occurrence of the Greylag Goose in Nepal is based on Hodgson's collection (Gray & Gray, 1846, p. 144).

*88. **Anser indicus** (Latham). Barheaded Goose.

The post-Hodgsonian records of the Barheaded Goose from Nepal are due to Ripley (1950b, p. 364) who saw it on the Karnali River, western Nepal, in December, and Biswas (1960a) who observed a flock on passage northward along the Dudh Kosi River, Khumbu, eastern Nepal, at over 3650 m. on April 5.

*89. **Cygnus cygnus cygnus** (Linnaeus). Whooper Swan.

Hodgson's collection (Gray & Gray, 1846, p. 144) represents the only record of the Whooper Swan in Nepal.

*90. **Dendrocygna javanica** (Horsfield). Lesser Whistling Teal.

Scully (1879) did not find this whistling teal in Nepal, but Rand & Fleming (1957, p. 51) recorded it, though not as a common bird, in the eastern lowlands. There is also a doubtful sight record from the eastern lowlands by Ripley (1950b, p. 364).

*91. **Tadorna ferruginea** (Pallas). Ruddy Sheld-duck, or Brahminy Duck.

Scully (1879, p. 362) found the Brahminy Duck in the Nepal Valley from late September to mid-December and from mid-March to April, in the Nawakot district in November, and in the central plains and tarai in December. Ripley (1950b, p. 364) reported it in the western tarai in December, and in the Valley in April. Rand & Fleming (1957, p. 51) recorded it as very common in the lowlands during winter. Biswas (1960a) found it preparing to breed in small numbers on high altitude lakes (*c.* 5030-5330 m.) of Khumbu, eastern Nepal, in May.

*92. **Tadorna tadorna** (Linnaeus). Common Sheld-duck.

Hodgson's collection of the Common Sheld-duck furnishes the only record of the species from Nepal.

*93. **Anas acuta** Linnaeus. Pintail.

Scully (1879, p. 363) found it to be the commonest duck of the Nepal Valley during winter, especially during September-November and March-April. Ripley (1950b, p. 364) observed it in the Valley in winter. Rand & Fleming (1957) do not report it from Nepal.

94. **Anas crecca crecca** Linnaeus. Common Teal.

The Common Teal was found by us in a tank in Kathmandu in mid-March and early April, but no specimen was collected. It was recorded as common in winter in the Nepal Valley by Scully (1879, p. 363), but Proud (1949, p. 719) noted it on passage during August-October, and as remaining in the Valley only for a short time. Ripley (1950b, p. 364) reported it from both the Valley and eastern tarai (Kosi River) during November-April. Rand & Fleming (1957, p. 52) found it the commonest teal in winter.

*95. **Anas poecilorhyncha poecilorhyncha** Forster. Spotbill Duck.

This duck is known from Nepal only through Hodgson's collection (Gray & Gray, 1846, p. 146).

*96. **Anas platyrhynchos** Linnaeus. Mallard.

After Hodgson, only Rand & Fleming (1957, p. 51) have recorded the Mallard from Nepal. They found it only once (four specimens) on the Kali Gandak River at *c.* 2740 m., west-central Nepal, in November.

*97. **Anas strepera strepera** Linnaeus. Gadwall.

Scully (1879, p. 362) found that the Gadwall did not remain in the Nepal Valley throughout the winter, but that it was pretty common in September-November and again in March-April. Ripley (1950b, p. 364) observed it both in the Valley and in eastern Nepal (Kosi River) from November to April. Rand & Fleming (1957) did not find it in Nepal.

*98. **Anas penelope** Linnaeus. Wigeon.

Both Scully (1879, p. 363) and Ripley (1950b, p. 364) observed the Wigeon in the Nepal Valley during winter. Proud (1949, p. 719) saw a single specimen (a male) there shot by local people in May. Lowndes (1955, p. 37) came across a single male example in full breeding dress in Manangbhot, central Nepal, in June. Biswas (1960a) found it in high altitude lakes (*c.* 5030-5330 m.) of Khumbu, eastern Nepal, in May. Rand & Fleming (1957) did not include this species in their list.

99. **Anas querquedula** Linnaeus. Garganey.

We observed the Garganey in a tank in Kathmandu, Nepal Valley, in mid-March and early April. It was recorded from the Valley in winter by Scully (1879, p. 363), Ripley (1950b, p. 364), and Proud (1955, p. 72); the last-named author observed, however, that most were on passage in September-October. Rand & Fleming (1957, p. 51) found it in the eastern lowlands in winter.

*100. **Anas clypeata** Linnaeus. Shoveller.

Although Scully (1879, p. 362) noted the Shoveller as a winter visitor to the Nepal Valley, being commonest on passage in October-November, the species has not since been recorded from Nepal.

*101. **Rhodonessa caryophyllacea** (Latham). Pinkheaded Duck.

The Pinkheaded Duck has not been reported from Nepal after Hodgson. Incidentally, this species is said to be recently extinct or nearly so, the last authentic record from the wild state having been made some 25 years ago. For a short history of this bird, see Ripley (1952a, pp. 903-904).

*102. **Netta rufina** (Pallas). Redcrested Pochard.

Ripley's (1950b, p. 364) is the only post-Hodgsonian record of the Redcrested Pochard from Nepal. He found it around the Nepal Valley during November-April.

*103. **Aythya ferina** (Linnaeus). Common Pochard.

The first record of the occurrence of the Common Pochard in Nepal is to be credited to Proud (1949, p. 719) who found a single male specimen

in the Nepal Valley in January. Later, Ripley (1950b, p. 364) noticed it around the Valley between November and April ; and Lowndes (1955, p. 37) observed a small party with the males in breeding plumage, on June 10, in Manangbhot, central Nepal. Rand & Fleming (1957), did not find it in Nepal.

It may be noted, however, that no specimen of this species has yet been taken in Nepal.

*104. **Aythya nyroca** (Güldenstädt). White-eyed Pochard.

Scully's (1879, p. 363) is the last record of this pochard from Nepal. He found it in the Nepal Valley on passage and as a very common bird around Bichiakoh, central bhabar, in December.

*105. **Aythya fuligula** (Linnaeus). Tufted Duck.

Scully (1879) did not find the Tufted Duck in Nepal, but Ripley (1950b, p. 364) observed it in the Nepal Valley during November-April ; Rand & Fleming (1957, p. 52) found it fairly common in the lowlands in winter ; and Biswas (1960a) recorded it in May on high altitude lakes (*c.* 5030-5330 m.) in Khumbu, eastern Nepal.

*106. **Aythya marila marila** (Linnaeus). Scaup.

I am unable to trace any post-Hodgsonian record of the Scaup in Nepal.

*107. **Nettapus coromandelianus coromandelianus** (Gmelin). Cotton Teal.

After Hodgson's collection, Rand & Fleming's (1957, p. 52) is the only record of the Cotton Teal in Nepal. They found it fairly common in the tarai in winter.

*108. **Mergus merganser orientalis** Gould. Eastern Goosander.

Scully (1879, p. 364) observed it only on the Tadi river, Nawakot district, central Nepal, in winter, and Ripley (1950b, p. 364) found it common along the Karnali River, western Nepal, and in the dun, both in winter.

Order GALLIFORMES

Family PHASIANIDAE

*109. **Lerwa lerwa lerwa** (Hodgson). Snow Partridge.

The Snow Partridge was not found either by us or by Scully (1879) or Ripley (1950b), but Rand & Fleming (1957, p. 58) obtained specimens in the Kali Gandak Valley (*c.* 4570-4875 m.), west-central Nepal, in December. Smythies (1948, p. 442) observed it in the Gandak-Kosi watershed (*c.* 3660 and 4875 m.), central Nepal, in autumn ; and Biswas

(1960a) reported it from Khumbu (*c.* 4420-5790 m.), eastern Nepal, in February, March, and May.

*110. **Tetraogallus tibetanus aquilonifer** R. & A. Meinertzhagen. Sikkim Snow Cock.

The first record of the Sikkim Snow Cock from Nepal was made by Rand & Fleming (1957, p. 58) who obtained it in the Kali Gandak Valley (*c.* 4875 m.) west-central Nepal, in winter. Biswas (1960a) found it not uncommon between *c.* 4270 and 5330 m. in Khumbu, eastern Nepal, from February to May.

*111. **Tetraogallus himalayensis himalayensis** G. R. Gray. Himalayan Snow Cock.

Hodgson's single specimen of this snow cock from the ' Snowy Regions of Nepal ' (Gray & Gray, 1846, p. 126) was listed as coming from Kumaon by Ogilvie-Grant (1893, p. 107) without any apparent reason. However, it was left to Rand & Fleming (1957, p. 59) to provide the first indisputable record of its occurrence in Nepal. They found it between *c.* 4875 and 5180 m. in the Kali Gandak Valley, west-central Nepal, in winter.

*112. **Alectoris graeca chukar** (J. E. Gray). Chukor.

Perdix Chukar J. E. Gray, 1830, Illustr. Indian Zool. **1** (2) : 54. (India = Nepal, according to Baker, 1922e, p. 849, but = Srinagar, Dehra Dun district, Uttar Pradesh, according to Hellmayr, 1929, p. 136. The latter seems more reasonable.)

We did not come across the Chukor in Nepal, nor did Ripley (1950b). Scully (1879, pp. 348-349) noted it as common on certain parts of the hills bordering the Nepal Valley (*c.* 1525-1825 m.) during March-October. Lowndes (1955, p. 37) observed that it was plentiful in fields of Manangbhot, central Nepal, between *c.* 3050 and 3960 m. in summer. Rand & Fleming (1957, p. 59) found it in west-central Nepal from *c.* 2745 to 2895 m. in winter.

113. **Francolinus francolinus asiae** Bonaparte. Indian Black Partridge.

DUN : Hitaura : 9 ♂♂, 1 ♀ (May 15—June 23). NEPAL VALLEY : Thankot : 2 ♂♂ (April 14).

The Black Partridge is not found to be a common bird of the Nepal Valley, but is fairly abundant in the central dun in grassy patches near rivers and in cultivated fields. In May-June its call could be heard in all directions.

The Thankot specimens had much enlarged testes (26-28 mm. long), and one of the Hitaura males (June 4) had the right testis measuring 20 × 13 mm., and the left, 26 × 13 mm.

Remains of maggots were found in the stomach of a Thankot bird.

Colours of soft parts : Iris dark brown, bill black, legs and feet orange-brown, claws horny, pads dingy white.

Measurements :

	11 ♂♂	1 ♀
Wing :	150, 152, 153, 155 (3), 157, 158, 159 (3)	147
Tail :	78, 82, 83+, 85 (3), 85+, 86(2), 86+, 88+	80
Bill :	26 (3), 26.5, 27 (5), 28, 29	26

The birds from central Nepal tend somewhat towards the eastern race *melanotus* in having a little more black on the upper side than do specimens from the western Himalaya. The spotting on the underside does not seem to be a good taxonomic character. While the western Himalayan birds are generally with more spots than those from the eastern Himalaya, this difference is appreciable only in a series and only on an average ; and individual variation of this character in the western birds is very great.

Eastern Nepal has been included within the range of the eastern subspecies *F. f. melanotus* Hume by Baker (1928, p. 411), followed by Peters (1934, p. 69) and Ripley (in press). Although it may possibly occur there, I am unable to trace any authentic record.

*114. **Francolinus pondicerianus interpositus** Hartert. Northern Grey Partridge.

The only post-Hodgsonian record of the Grey Partridge from Nepal is due to Rand & Fleming (1957, p. 60). They found it in the west-central tarai in February. Ripley's (1950b, p. 366) specimen was actually taken in India across the south-western Nepali border.

*115. **Francolinus gularis** (Temminck). Swamp Partridge.

Rand & Fleming's (1957, p. 60) is the only record of this partridge from Nepal after Hodgson's. They found it in the western tarai in winter.

*116. **Perdix hodgsoniae hodgsoniae** (Hodgson). Tibetan Partridge.

We did not find the Tibetan Partridge in Nepal, nor did Scully (1879), or Ripley (1950b). Lowndes (1955, p. 37) recorded it from *c.* 4270 m. in Manangbhot, central Nepal, in July ; and Rand & Fleming (1957, p. 60) from *c.* 3960-4420 m. in west-central Nepal in winter.

*117. **Coturnix coturnix coturnix** (Linnaeus). Common Quail.

The Common Quail was not met with by us or by Ripley (1950b) in Nepal. Scully (1879, p. 350) reported it in October-December and March-April from the Nepal Valley, in November from the Nawakot district, and in December from the plains. Rand & Fleming (1957, p. 60) found it in the western and west-central tarai in winter.

*118. **Coturnix coromandelica** (Gmelin). Blackbreasted, or Rain Quail.

*119. **Coturnix chinensis chinensis** (Linnaeus). Bluebreasted Quail.

*120. **Perdicula asiatica** (Latham) subsp. ? Jungle Bush Quail.

The records of the occurrence of these three quails in Nepal are based on Hodgson's collection (Gray & Gray, 1846, p. 128) only.

*121. **Arborophila torqueola torqueola** (Valenciennes). Common Hill Partridge.

Although recorded from the hills round the Nepal Valley (Scully, 1879, p. 349 ; Smythies, 1950, p. 518 ; Proud, 1955, p. 71 ; Rand & Fleming, 1957, p. 61), from west-central Nepal (Rand & Fleming, loc. cit.), and from the Mai Valley, eastern Nepal (Stevens, 1925c, p. 889), the Common Hill Partridge was not found by us or by Ripley (1950b).

122. **Arborophila rufogularis rufogularis** (Blyth). Rufousthroated Hill Partridge.

DUN : Hitaura : 1 ♂, 1 chick in down (May 26, 27).

The Rufousthroated Hill Partridge was found by us once in the Nepal Valley on Phulchauki Range above Godavari at *c.* 1980 m. early in May, and on a very few occasions in the central dun in May-June.

Ripley (1950b, p. 367) noted it as a common bird in western Nepal at *c.* 1525 m., but Rand & Fleming (1957, p. 61) ' seldom came across it in western ' and west-central Nepal at *c.* 915-1825 m.

The chick in down has a broad reddish brown stripe on each side from the forecrown passing above the eyes, including the sides of the crown, to nape, the stripes of the two sides meeting anteriorly on the forecrown. Its ear coverts and an indistinct collar are black, and the remainder of the upper plumage chocolate brown. On the underside, it has the chin, throat, and upper breast brownish cream, the breast and flanks chocolate brown but paler than in the upper plumage, and the abdomen brownish cream.

Measurements : 1 ♂ : Wing 138, tail 53+, bill 23.

[**Galloperdix spadicea spadicea** (Gmelin). Red Spurfowl.

Although the Red Spurfowl has been mentioned as occurring in the Nepal tarai (Murray, 1890, p. 547, followed by Baker, 1928, p. 358 ; Peters, 1934, p. 106 ; and Ripley, in press), I am unable to trace any definite record of its occurrence there. It is however, likely to be found in the western Nepal tarai.]

*123. **Ithaginis cruentus cruentus** (Hardwicke). Nepal Blood Pheasant.

Scully (1879, p. 343) reported having seen only snared birds. Lowndes (1955, p. 37) observed it at *c.* 3660 m. in Mananghbot, central Nepal, in summer. Biswas (1960a) found it fairly common in Khumbu (*c.* 3660-4270 m.), eastern Nepal, during February-May.

*124. **Tragopan satyra** (Linnaeus). Crimson Horned Pheasant.

Meleagris Satyra Linnaeus, 1758, Syst. Nat., 10th ed., **1** : 157. (Bengal.)[1]

The Horned Pheasant was not found by us. Scully (1879, p. 343) had specimens brought to him from the hills north of the Nepal Valley. Ripley (1950b, p. 367) saw only feathers at *c.* 2740 m. in eastern Nepal in winter. Rand & Fleming (1957, p. 61) found it in the Kali Gandak Valley, west-central Nepal, at *c.* 2740 m. in winter. Biswas (1960a) recorded it in the Dudh Kosi and Hongu Valleys, eastern Nepal, at *c.* 2740-3050 m. in April and June.

Gray & Gray (1846, p. 125) listed also the Western Horned Pheasant, *Tragopan melanocephalus* (J. E. Gray), among Hodgson's collection from Nepal. However, Ogilvie-Grant (1893, pp. 274-275) did not include any specimen of that species from Nepal, nor has it ever been recorded east of Kumaon.

*125. **Pucrasia macrolopha nipalensis** Gould. Nepal Koklas Pheasant.

The Koklas Pheasant was not found by us or by Ripley (1950b). Scully (1879, p. 344) had specimens brought to him from western Nepal ' not far from the snows '. Rand & Fleming (1957, p. 63) collected specimens in the Kali Gandak Valley, west-central Nepal, at *c.* 2435-2740 m. in winter.

*126. **Lophophorus impejanus** (Latham). Monal Pheasant.

We did not come across the Monal Pheasant in Nepal, nor did Ripley (1950b). Scully's (1879, p. 342) specimens were brought for him from ' the interior of Nepal at higher elevations '. In northern-central Nepal, it was found by Smythies (1948, p. 442) at *c.* 3350-4570 m. in autumn, and by Proud (1952a, p. 366) at *c.* 3350-3660 m. in spring, both in the Gandak-Kosi watershed ; and by Polunin (1955, p. 895) at *c.* 2740-4880 m. in the Langtang Valley in summer. Rand & Fleming (1957, p. 62) reported it from the Kali Gandak Valley, west-central Nepal, at *c.* 2590 m. in December. Biswas (1960 a) found it in Khumbu, eastern Nepal, at *c.* 3810-4270 m. during February-May.

127. **Gallus gallus murghi** Robinson & Kloss. Red Junglefowl.

TARAI : Simra : 2 ♀♀ (March 4, 5). BHABAR : Amlekhganj : 1 ♂ (March 10). DUN : Hitaura : 2 ♂♂, 1 juv. ♂, 4 ♀♀, 1 subad. ♀, 1 juv. ♀ (May 12—June 5, 22).

The Red Junglefowl is common in the tarai, bhabar, and dun of central Nepal.

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[1] Peters (1934, p. 109), followed by Ripley (in press), stated that the type locality Bengal was an error, because ' the drawing on which Edward's plate was based was probably made from a specimen from Nepal '. This assumption seems to me to be too far fetched, especially because Nepal was almost ' terra incognita ' in the 18th century, while this bird has always occurred in the Darjeeling district of Bengal.

The subadult female specimen (Hitaura, May 12) is downy on the chin and throat, and smaller in size, but otherwise similar to the adult.

The juvenile male and female specimens (Hitaura, June 22) are similar in coloration, except that the male has the nape concolorous with the crown, and has a few blackish feathers on the breast and abdomen. Both of them have the chin and throat white. The male has no spur.

Measurements :

	Wing	Tail	Bill from the anterior edge of nostril
3 ♂♂ :	226+, 227+, 231	300, 327,—	14, 15, 15+
6 ♀♀ :	192, 193 (2) 195 200, 202	135+, 137, 139, 144, —(2)	13, 13.5 (2), 14 (3)

*128. **Lophura leucomelana hamiltoni** (J. E. Gray). Whitecrested Kalij Pheasant.

Phasianus hamiltoni J. E. Gray, 1829, in Griffith, Anim. Kingd. 8 (Aves, 3) : 27. (India=Simla, according to Baker, 1922e, p. 842.)[1]

The Whitecrested Kalij Pheasant was not found in Nepal by Scully (1879) or Ripley (1950b), or by us. Rand & Fleming (1957, p. 63), however, observed a flock in west-central Nepal at *c.* 915 m.

129. **Lophura leucomelana leucomelana** (Latham). Nepal Kalij Pheasant.

DUN : Hitaura : 1 ♂, 1 subad. ♂, 1 ♀ (May 21—June 2). MARKHU VALLEY : Deorali : 1 ♂ (April 30). NEPAL VALLEY : Thankot, crest of Chandragiri above Thankot : 1 ♂, 1 subad. ♂ (April 3, 18).

This kalij is found fairly commonly both in the dun and the Nepal Valley on the surrounding ranges. We usually saw it in the early mornings and late afternoons when it came out in the open parts of the forests to feed. It also appeared for feeding, irrespective of time of day, immediately after showers during early monsoon when insects also came out in great abundance. Biswas (1960a) observed a pair of this kalij a little below 3660 m. in Khumbu, eastern Nepal, in May — the highest recorded elevation for this bird.

The adult female specimen (Hitaura, May 21) has a small crest consisting of only a few feathers, concolorous with the back, but pale (white) shafted. The early June birds (1 ad. and 1 subad.♂) are very worn and their body plumage is in moult.

April birds were breeding. One male (April 18) had the right testis 17×11 mm., and the left 16.5×9 mm.

Measurements :

	Wing	Tail	Bill
2 ♂♂ :	230, 232	255+, 305	37,—
1 ♀ :	208	208	35

[1] There is no definite evidence to set aside Baker's designation of the type locality, which Kinnear (Peters, 1934, p. 112, followed by Ripley, in press) did on mere conjecture that ' the type probably came from Nepal '.

*130. **Lophura leucomelana melanota** (Hutton). Blackbacked Kalij Pheasant.

The Blackbacked Kalij was first recorded for Nepal by Stevens (1925c, p. 887) who found it in the Mai Valley, eastern Nepal. I have not been able to trace any other report of its occurrence in Nepal.

*131. **Catreus wallichii** (Hardwicke). Cheer Pheasant.

The Cheer Pheasant was not found by us or by Ripley (1950b). Scully (1879, p. 345) saw only snared birds from the hills north of the Nepal Valley. Rand & Fleming (1957, p. 63) found it in the Kali Gandak Valley, west-central Nepal, at *c.* 2130 m. in December.

132. **Pavo cristatus** Linnaeus. Indian Peafowl.

DUN : Hitaura : 1 ♂, 1 subad. ♂, 1 juv. ♂, 1 fledgling ♂, 1 fledgling ♀ (June 5-9, July 6).

The Peafowl is common in the central dun. It is usually found in dense riverine jungles, tall grass jungles as well as in the cultivated land close by. Scully (1879, p. 342) found it only in the central bhabar, and Rand & Fleming (1957, p. 63) recorded it up to *c.* 305 m. only. Curiously, it is not listed in Hodgson's earlier collection from Nepal (Gray & Gray, 1846), nor shown in Ripley's (1950b) list.

Both my adult and subadult male specimens (June 7, 9) are worn and have their body feathers moulting, the latter being a second year bird. The adult female (June 6) is also worn and moulting. The juvenile male (June 5) has the tail in moult, and the fledglings (July 6) are undergoing a general moult.

Measurements :

	Wing	Tail	Bill	Train
1 ♂ :	458	483	50	1600
1 ♀ :	374+	300	44	—

Marien (1951) utilized the specimens under report here for his studies.

(To be continued)

Some useful and medicinal plants of Naini Tal in the Kumaon Himalayas

BY

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INTRODUCTION

Naini Tal, a beautiful health resort in the Kumaon Himalayas, is situated at latitude 29°24′ north and longitude 79°28′ east, and is the summer capital of Uttar Pradesh. Studies on the flora and vegetation of this part have already been made by the author and published separately (1958, 1959). While making floristic studies some interesting observations on the medicinal and other uses of the plants of this area were made by the author ; they are being described in these pages.

Plants from this area were collected in their flowering seasons and are preserved in the herbarium of the Government College, at Naini Tal.

LIST OF THE PLANTS

Ranunculaceae

1. **Thalictrum foliolosum** DC.

Name : Barmat (Kumaon), Pilijari (Hindi). Habit : Perennial herb. Flowers : White-purple, July.

Uses : The roots are used in collyrium, opthalmia, piles, and skin diseases.

2. **Delphinium denudatum** Wall.

Name : Judwar (Hindi). Habit : Annual herb. Flowers : Blue, April-June.

Uses : The roots are used as a cure for cough and diseases of blood.

3. **Paeonia emodi** Wall.

Name : Udsalap (Hindi). Habit : Perennial herb. Flowers : Blue, April-June.

Uses : The tubers are used in uterine disorders. Infusion of the flowers is used in diarrhoea.

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Menispermaceae

4. **Cissampelos pareira** Linn.

Name : Harjori (Hindi). Habit : Climbing herb. Flowers : Green, June-July.

Uses : The roots are used in affections of the bladder. The leaves are used externally in sores and abcesses.

5. **Berberis lycium** Royle

Name : Chitra, Daruhaldi (Hindi), Kilmora (Kumaon). Habit : Tall erect shrub. Flowers : Yellow, April.

Uses : The extract of the bark gives *rasot* which is sold in the market and is used as a cure for jaundice, diseases of the spleen, intestines, and eye. Locally this extract mixed with rose-water is used as a medicine in eye sores.

6. **Berberis aristata** DC.

Name : Kingora, Kilmora (Kumaon), Daruhaldi (Hindi). Habit : Erect shrub. Flowers : Yellow, May-June.

Uses : The extract of the bark gives *rasot* and is used for the same purpose as the other species.

Cruciferae

7. **Capsella bursa-pastoris** Medic.

Habit : Annual erect herb. Flowers : White, April-October.

Uses : The plant is used in diarrhoea and dropsy. It lowers the blood pressure, and checks haemorrhage.

Violaceae

8. **Viola canescens** Wall.

Name : Thungtu (Kumaon), Banefsha (Hindi). Habit: Annual herb. Flowers : Blue, April-November.

Uses : The flowers are sold in the market as *gulbanefsha* and are used for curing fever, bronchitis, and asthma. The syrup of the flowers is used in Yunani medicine for the same purposes. Oil prepared from the plant is also used medicinally.

Polygalaceae

9. **Polygala crotalarioides** Buch.-Ham.

Habit : Perennial herb. Flowers : Purple, April-October.

Uses : The plant is used in catarrhal affections and is chewed to expel phlegm from the throat and provoke coughing.

Malvaceae

10. **Malva rotundifolia** Linn.

Name : Khubasi, Sonchala (Hindi). Habit : Annual herb. Flowers : Pale lilac, July-October.

Uses : The leaves are used in dysentery and nephritic troubles, in piles and skin diseases.

Geraniaceae

11. **Geranium wallichianum** Sweet

Name : Mamiran (Hindi). Habit : Perennial erect herb. Flowers : Purple, July-September.

Uses : The rootstock of the plant is used in eye troubles and as a cure for toothache. It is also used as a substitute for *Coptis teeta* Wall.

12. **Geranium nepalense** Sweet

Name : Bhand (Kumaon). Habit : Perennial diffused herb. Flowers : Pink, May-September.

Uses : The herb is used for renal troubles.

13. **Geranium lucidum** Linn.

Habit : Annual diffused herb. Flowers : Pink, May-August.

Uses : The plant is used as a diuretic and astringent.

14. **Oxalis acetosella** Linn.

Name : Amrul, Chalmori (Kumaon). Habit : Perennial pubescent herb. Flowers : Purple, June-July.

Uses : The herb is used as refrigerant and forms a drink, in fever. The leaves are used as salad.

15. **Oxalis corniculata** Linn.

Name : Amêlda, Tipatia (Kumaon). Habit : Annual procumbent herb. Flowers : Yellow, April-November.

Uses : The plant is used as an appetiser, and in dysentery, diarrhoea, and fever. Fresh leaves in the form of a poultice are applied to inflamed parts.

Rutaceae

16. **Zanthoxylum alatum** Roxb.

Name : Timru (Kumaon), Têjphal (Hindi). Habit : Prickly shrub. Flower : Yellow, April-June.

Uses : The seeds are used in abdominal troubles, and in diseases of eye, ear, and in leucoderma. Locally the seeds are used for curing toothache and removing foul smell from the mouth. The twigs form the tooth brush used locally.

17. **Skimmia laureola** Thunb.

Name : Nehar (Kumaon), Gurlpatta (Garhwal). Habit : Erect shrub. Flowers : Yellow, April-May.

Uses : The leaves and flowers are aromatic and are used as incense locally.

Celastraceae

18. **Euonymus tingens** Wall.

Name : Konkon (Kumaon), Bhambéli (Hindi, Garhwali). Habit : Small tree. Flowers : Yellow, April-June.

Uses : The plant is a gastro-intestinal stimulant and increases the flow of bile and other secretions. The bark is used in eye diseases.

19. **Rhamnus virgatus** Roxb. syn. *Rhamnus dahuricus* Pall.

Name : Chédul (Kumaon), Chanda (Hindi). Habit : Spinous shrub. Flowers : Green, April.

Uses : The fruits are emetic and purgative and are used in affections of the spleen.

Sapindaceae

20. **Aesculus indica** Coleb.

Name : Pângar (Kumaon). Habit : Tree. Flowers : White-yellow, April-May.

Uses : The fruits are given to horses in colic, and are eaten in times of scarcity. Oil from the seeds is used in rheumatism.

Anacardiaceae

21. **Rhus chinensis** Miller syn. *Rhus semialata* Murray

Name : Dhamili (Hindi). Habit : Small tree. Flowers : Pale yellow, green, April-June.

Uses : The fruits are used in colic and diarrhoea.

Coriaraceae

22. **Coriara nepalensis** Wall.

Name : Makol (Kumaon), Masuri (Hindi). Habit : Glabrous shrub. Flowers : Green, March-April.

Uses : The leaves are used as a purgative.

Leguminaceae

23. **Crotalaria sericea** Retz.

Name : Jhun-jhunia (Hindi). Habit : Silky pubescent shrub. Flowers: Yellow, February-March.

Uses : The plant is used for scabies.

24. **Melilotus alba** Lamk.

Name : Aspurk (Hindi). Habit : Annual herb. Flowers : White, June-September.

Uses : The plant is used externally for fomentation in pain. The fruits are carminative and useful in leucoderma.

25. **Desmodium tiliaefolium** Don.

Name : Chamlai (Kumaon). Habit : Tall erect shrub. Flowers : Pale lilac, July-October.

Uses : The root is used as a diuretic and in bilious complaints.

26. **Moghania strobilifera** (Linn.) St. Hil. ex Jacs. syn. *Flemingia strobilifera* R.Br.

Name : Kasraut (Hindi). Habit : Spreading shrub. Flowers : Red, August-October.

Uses : The roots are used to induce sleep and relieve pain with no ill effect. The leaves are used as a vermifuge.

27. **Lathyrus aphaca** Linn.

Name : Jangli matar (Hindi). Habit : Annual herb. Flowers : Yellow, April-May.

Uses : The seeds are used as green peas when young, but when ripe are narcotic and produce headache.

Rosaceae

28. **Prinsepia utilis** Royle

Habit : Spinous shrub. Flowers : White, December-April.

Uses : The seeds are used locally to extract oil which is used for application in rheumatism and pains from over-fatigue.

29. **Geum urbanum** Linn.

Habit : Perennial herb. Flowers : Yellow, May-July.

Uses : The herb is used in fevers, and is excellent cardiac sudorific in chills.

30. **Potentilla nepalensis** Hook. f.

Name : Rattanjot (Hindi). Habit : Perennial herb. Flowers : Red, April-September.

Uses : The ashes of the roots mixed with oil are used for curing burns.

31. **Potentilla fulgens** Wall.

Name : Bajra-danti (Garhwali, Kumaon). Habit : Perennial herb. Flowers : Yellow-orange, August-October.

Uses : The roots are said to strengthen gums and teeth.

32. **Agrimonia eupatorium** Linn.

Habit : Perennial herb. Flowers : Yellow, July-October.

Uses : The roots are astringent and are used in cough and diarrhoea. The leaves are used as a vermifuge.

33. **Pyracantha crenulata** (Don.) Roemer syn. *Crataegus crenulata* Roxb.

Name : Ghingaru (Kumaon, Garhwal). Habit : Large spiny shrub. Flowers : White, April-May.

Uses : The plant is not used medicinally, but the wood is valued for making walking sticks.

34. **Cotoneaster microphylla** Wall.

Habit : Procumbent much-branched shrub. Flowers : White-pink, April.

Uses : The stolons of this plant are astringent.

35. **Fragaria nubicola** Lindl. syn. *Fragaria vesca* auct. non Linn.

Habit : Perennial herb. Flowers : White, May.

Uses : The leaves are diuretic and are used in diarrhoea and affections of urinary organs. The fruit is astringent and diuretic.

36. **Rosa brunonii** Lindl. syn. *Rosa moschata* Mill.

Name : Kunja (Kumaon, Garhwal). Habit : Climbing prickly shrub. Flowers : White, April.

Uses : The flowers are useful in diseases of the eye and can be used like cultivated rose for all purposes.

Saxifragaceae

37. **Bergenia ligulata** (Wall.) Endl. syn. *Saxifraga ligulata* Wall.

Name : Silpharwa (Kumaon), Silphar, Pakhanbêd (Hindi). Habit : Perennial shrub with stout rootstock. Flowers : White-pink, April-May.

Uses : The rhizome is a renowned remedy in fevers and for removing gravel from the intestines and bladder. It can also be used as diuretic, astringent, and in spleen enlargement, diseases of liver, lungs, and chest.

Umbelliferae

38. **Bupleurum falcatum** Linn.

Habit : Perennial herb. Flowers : Yellow, July-August.

Uses : The roots are used in liver troubles and as a diaphoretic.

39. **Hydrocotyle javanica** Thunb.

Habit : Prostrate herb. Flowers : Yellow-green, July.

Uses : The plant is used in diseases of skin and blood.

40. **Hedera nepalensis** K. Koch syn. *Hedera helix* auct. non Linn.

Name : Bânda (Kumaon), Mithiari (Jaunsar). Habit : Climbing shrub. Flowers : Green, September-October.

Uses : The leaves are used for fomentation in glandular enlargement. Infusion of the berries is used in rheumatism.

Rubiaceae

41. **Galium aparine** Linn.

Habit : Trailing herb. Flowers : White-green, July-October.

Uses : The plant is diuretic, refrigerant, and alterative. It has been reported to reduce arterial pressure to 50% in a dog without slowing the pulse.

42. **Galium rotundifolium** Linn.

Habit : Trailing herb. Flowers : White-green, June-August.

Uses : The plant is used in sore throat and chest complaints.

43. **Rubia cordifolia** Linn. var. **munjista** Miquel syn. *Rubia cordifolia* Linn. p. p.

Name : Manjith (Hindi). Habit : Climbing herb. Flowers : Red, July-October.

Uses : The roots are useful in eye sores, liver complaints and spleen enlargement. The plant is also used in rheumatism, pleurisy, and other chest complaints.

Valerianaceae

44. **Valeriana jatamansi** Jones syn. *Valeriana wallichii* DC.

Name : Shumeo (Kumaon), Tagar (Hindi). Habit : Perennial herb. Flowers : White-pink, March-May.

Uses : The roots are aromatic and used in diseases of eye, blood, liver, spleen, and nervous system. Bath of valerian is useful in rheumatism.

Compositae

45. **Solidago virga-aurea** Linn.

Habit : Annual herb. Flowers : Yellow-pink, August.

Uses : The dried plant is used in dropsy.

46. **Gnaphalium luteo-album** Linn.

Habit : Erect softly woolly herb. Flowers : Yellow, June-August.

Uses : The leaves of the plant are used as an astringent and vulnerary. The tomentum below the surface of the leaves is used as tinder.

47. **Siegesbeckia orientalis** Linn.

Name : Litchkura (Hindi). Habit : Annual herb. Flowers : Yellow, September-October.

Uses : The plant is used in fevers, rheumatism, and renal colic. Externally it is applied to ulcers and ringworms.

48. **Bidens biternata** (Lour.) Merr. & Sherff. syn. *Bidens pilosa* Linn. p.p.

Habit : Annual herb. Flowers : White-yellow, September-October.

Uses : The plant is used in eye diseases. The roots are used in toothache.

49. **Galinsoga parviflora** Cav.

Habit : Annual herb. Flowers : White-yellow, January-December.

Uses : The plant is useful against nettle stings, when rubbed against the body.

50. **Gerbera lanuginosa** Benth.

Habit : Annual herb. Flowers : Pink, March.

Uses : White cotton-like coating on the undersurface of the leaves is used as tinder and for stanching wounds in times of emergency in the forest.

51. **Artemisia nilagirica** (Clarke) Pamp. syn. *Artemisia vulgaris* auct. non Linn.

Habit : Shrub-like herb. Flowers : Green-yellow, August-October.

Uses : The plant is used as a vermifuge. The leaves and flower tops are used in asthma.

52. **Emilia sonchifolia** DC.

Habit : Annual herb. Flowers : Purple, August-October.

Uses : The juice of the plant is considered as cooling as rose-water.

53. **Taraxum officinale** Wigg.

Name : Dudhli (Garhwal). Habit : Perennial herb. Flowers : Yellow, March-November.

Uses : The roots are used as diuretic and in complaints of the liver, kidneys, and digestive organs.

54. **Lactuca scariola** Linn.

Name : Kahu (Hindi). Habit: Annual herb. Flowers : Yellow, March-November.

Uses : The plant is used in bronchitis and asthma.

55. **Sonchus arvensis** Linn.

Name : Sadhi (Hindi). Habit : Succulent herb. Flowers : Yellow, August-September.

Uses : The plant is used as a diuretic and in fevers.

56. **Eclipta prostrata** Linn. syn. *Eclipta alba* Hassk.

Name : Bhargra (Hindi). Habit Herb, roughly pubescent. Flowers : August-September.

Uses : Plant is useful in hepatic and spleen troubles, externally it is applied for diseases of the skin.

Ericaceae

57. **Lyonia ovalifolia** (Wall.) Drude syn. *Pieris ovalifolia* D. Don.

Name : Ayar (Kumaon, Garhwal). Habit : Small tree. Flowers : White, May-June.

Uses : The leaves are poisonous to goats and sheep and are used to kill insects. Infusion of the plant is useful in skin diseases.

Myrsinaceae

58. **Myrsine africana** Linn.

Name : Ghani (Kumaon), Rikhdalmi (Garhwal). Habit : Small shrub. Flowers : Green, March-May.

Uses : The fruits are sold in the market as *baibharang* and are used as vermifuge and cathartic.

Styraceae

59. **Symplocos chinensis** (Lour.) Druce. syn. *Symplocos crataegoides* Buch.-Ham.

Name : Lodh (Kumaon). Habit : Small tree. Flowers : White, April-June.

Uses : The leaves are used as an astringent in diarrhoea.

Oleaceae

60. **Jasminum officinale** Linn.

Name : Jai (Kumaon), Chambeli (Hindi). Habit : Shrub. Flowers : White, May-July.

Uses : The flowers are used in diseases of heart, skin, and blood.

61. **Jasminum grandiflorum** Linn.

Name : Chambéli (Kumaon). Habit : Shrub. Flowers : White-purple, May-September.

Uses : The juice of the leaves is used to soften corns between the toes. Oil from the leaves is also used medicinally in skin diseases.

62. **Jasminum humile** Linn.

Name : Pilijai (Kumaon, Hindi). Habit : Shrub. Flowers : Yellow, May-October.

Uses : The leaves are used for the same purposes as the other species of jasmine.

63. **Fraxinus floribunda** Wall.

Name : Angu (Kumaon). Habit : Tree. Flowers: Green, April-May.

Uses : The bark is used as a laxative and an astringent.

Asclepiadaceae

64. **Cryptolepis buchanani** Roem. & Schult.

Name : Dudhi-bél (Kumaon). Habit : Twining herb. Flowers : Purple, April-June.

Uses : The plant is used for curing rickets of children.

Gentianaceae

65. **Swertia chirata** Buch.-Ham.

Name : Chirata (Kumaon, Hindi). Habit : Herb. Flowers : Yellow-green, September-November.

Uses : The dried twigs are used as a remedy in malarial and other fevers.

Solanaceae

66. **Solanum nigrum** Linn.

Name : Makoi (Hindi). Habit : Annual herb. Flowers : White, June-October.

Uses : The leaves are used in diseases of the liver. Paste of the green leaves is used in ringworm disease.

67. **Solanum indicum** Linn.

Name : Bhatkatya (Hindi). Habit : Shrub. Flowers : Blue, May-October.

Uses : The juice of the leaves is given to stop vomiting.

68. **Solanum xanthocarpum** Schrad. & Wendl.

Name : Kataili, Satyanashi (Hindi). Habit : Diffused shrub. Flowers : Blue, May-October.

Uses : The roots are used in cough, asthma, and catarrhal fevers. Fumigation with the vapours of burning seeds is a cure for toothache.

69. **Nicandra physalodes** Gaertn.

Habit : Annual herb. Flowers : Blue, July-September.

Uses : The plant is used as a diuretic.

70. **Datura stramonium** Linn.

Name : Dhatura (Kumaon). Habit : Annual herb. Flowers : White, June-October.

Uses : The leaves are used as a cure for asthma. The seeds are narcotic.

Scrophulariaceae

71. **Verbascum thapsus** Linn.

Name : Gidartambaku (Garhwal, Kumaon). Habit : Hairy annual herb. Flowers : Yellow, May-September.

Uses : The dried leaves and flowers are smoked for curing asthma.

Labiatae

72. **Origanum vulgare** Linn.

Name : Sahtra (Hindi). Habit : Annual herb. Flowers : Pink, July-September.

Uses : The leaves are used as a blood purifier.

73. **Nepeta elliptica** Royle

Name : Tukhammalanga (Hindi). Habit : Annual herb. Flowers : Blue, July-September.

Uses : Infusion of seeds in cold water is useful in dysentery.

74. **Ajuga bracteosa** Wall.

Name : Rathpatha (Kumaon). Habit : Annual hairy herb. Flowers : Blue, April-October.

Uses : The plant is anthelmintic and purgative and used in fever and skin diseases.

Plantaginaceae

75. **Plantago major** Linn.

Name : Luhuriya (Hindi). Habit : Perennial herb. Flowers : Green, July.

Uses : The seeds are laxative and used in dysentery. The roots and leaves are used against intermittent fevers.

Amaranthaceae

76. **Achyranthes bidentata** Bl.

Name : Chirchita (Kumaon), Apamarg (Hindi). Habit : Annual herb. Flowers : Green-purple, May-October.

Uses : The plant is used as a diuretic in renal troubles. The ashes of the plant are rich in potassium and are used in curing asthma and cough.

Polygonaceae

77. **Polygonum plebejum** R.Br.

Name : Raniphul (Hindi). Habit : Annual herb. Flowers : Pink, May-October.

Uses : The plant is used in pneumonia.

78. **Fagopyrum cymosum** Meissn.

Name : Banagal (Kumaon, Garhwal). Habit : Annual herb. Flowers : White, July-September.

Uses : The grains of the plant are used in diarrhoea and in colic. The leaves are used as a vegetable.

79. **Rumex nepalense** Spreng.

Name : Bhilmora (Kumaon). Habit : Annual herb. Flowers : Green-red, May-October.

Uses : The leaves are used in colic.

Lauraceae

80. **Cinnamomum tamala** Nees

Name : Dalchini (Garhwal, Kumaon), Tejpat (Hindi). Habit : Small tree. Flowers : White, February-May.

Uses : The bark and leaves are used as a condiment and medicinally in rheumatism and diarrhoea.

Elaeagnaceae

81. **Elaeagnus umbellata** Thunb.

Name : Geowain (Kumaon). Habit : Thorny shrub. Flowers : White, April.

Uses : The flowers are used as an astringent and the seeds in pulmonary affections.

82. **Hippophae rhamnoides** Linn. syn. *Hippophaë salicifolia* Don. Servettez.

Name : Chu (Kumaon). Habit : Thorny shrub. Flowers : Orange, June-July.

Uses : The fruits are used in pulmonary affections.

Loranthaceae

83. **Viscum album** Linn.

Name : Banbanda (Kumaon). Habit : Parasitic shrub. Flowers : Green, March-May.

Uses : The berries are used in enlargement of liver and spleen.

Santalaceae

84. **Osyris wightiana** Wall. ex Wight. syn. *Osyris arborea* Wall.

Name : Bakarja (Kumaon). Habit : Shrub. Flowers : Yellow, August-April.

Uses : Infusion of the leaves is used as powerful emetic.

Euphorbiaceae

85. **Andrachne cordifolia** Muell.-Arg.

Name : Bharti (Garhwal). Habit : Small shrub. Flowers : Green, May-September.

Uses : The plant is poisonous and kills cattle when browsed.

Urticaceae

86. **Cannabis sativa** Linn.

Name : Bhangla (Garhwal, Kumaon), Bhang (Hindi). Habit : Annual herb. Flowers : Green, July-August.

Uses : The leaves are intoxicating and the bark is used for hydrocele and other inflammations.

87. **Urtica parviflora** Roxb.

Name : Bitchu ghass (Kumaon, Garhwal). Habit : Annual herb. Flowers : Green, July-August.

Uses : The plant is used as a diuretic in nephritic troubles. Young leaves are made into a vegetable and taken as a cure for sciatica, rheumatism, and heart trouble.

88. **Girardinia heterophylla** Dcne.

Name : Bitchu ghass (Kumaon). Habit : Annual herb. Flowers : Green, February-April.

Uses : The leaves are astringent and are used as a remedy for scrofula.

Myricaceae

89. **Myrica esculenta** Ham. ex Don. syn. *Myrica nagi* Thunb.

Name : Kaiphal (Kumaon, Garhwal). Habit : Small tree. Flowers : Green, October-December.

Uses : The bark is anthelmintic and used in cholera. The fruits are edible.

Cupuliferae

90. **Quercus incana** Roxb.

Name : Ban, Banj (Kumaon, Garhwal). Habit : Tree. Flowers : Green, April-July.

Uses : The acorns are astringent and diuretic, and are used in asthma and diarrhoea.

Salicaceae

91. **Populus ciliata** Wall.

Name : Pahari-pipal (Kumaon, Garhwal). Habit : Tall tree. Flowers : Green, February-April.

Uses : The bark is used as a blood purifier.

Orchidaceae

92. **Satyrium nepalense** D. Don.

Name : Salabmisri (Hindi). Habit : Terrestrial herb. Flowers : Purple, July-August.

Uses : The pseudobulb of the plant is used as a tonic.

Scitaminaceae

93. **Roscoea procera** Rose.

Name : Sufedmusli (Hindi). Habit : Perennial herb. Flowers : Purple, July-August.

Uses : The roots are tuberous and are used as a tonic and in diseases of seminal debility.

94. **Hedychium spicatum** Buch.-Ham. var. **acuminatum** Wall.

Name : Kapur-kachri (Garhwal). Habit : Perennial herb. Flowers : White-pink, July-August.

Uses : The rootstocks are used in asthma, bronchitis, and as incense for burning.

Iridaceae

95. **Iris nepalensis** Don.

Habit : Perennial herb. Flowers : Lilac, April-June.

Uses : The roots are used as a diuretic.

96. **Iris kumaonensis** Wall. ex Don.

Habit : Perennial herb. Flowers : Lilac, June.

Uses : The roots and leaves of the plant are used in fevers.

Liliaceae

97. **Asparagus filicinus** Buch.-Ham.

Name : Kaunta (Kumaon), Satawar (Hindi). Habit : Perennial herb. Flowers : White, June.

Uses : The roots are tonic and used in chronic dysentery, dyspepsia, and diarrhoea.

Commelinaceae

98. **Commelina obliqua** Buch.-Ham.

Name : Kanjura (Kumaon). Habit : Annual herb. Flowers : Blue, July-August.

Uses : The roots are used in fever and bilious affections.

Filicales

99. **Dryopteris filix-mas** (Linn.) Schott. syn. *Aspidium filix-mas* Sw.

Uses : The plant is anthelmintic and is used to kill worms.

100. **Adiantum venustum** Don.

Uses : The fronds are emetic and are used as a decoction for chest and pulmonary affections.

101. **Botrychium ternatum** Sw.

Uses : The plant is used in healing cuts and wounds.

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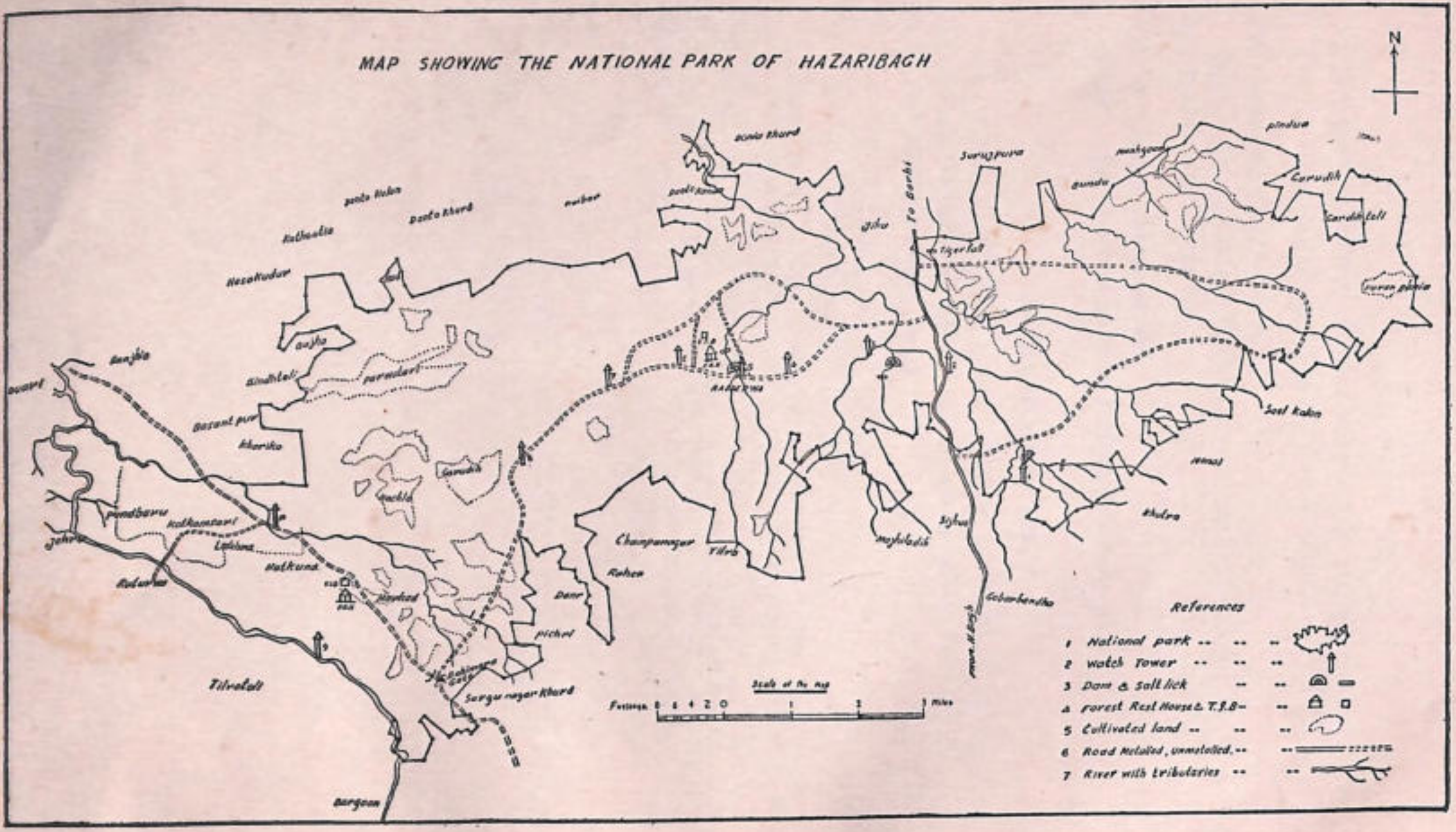
MAP SHOWING THE NATIONAL PARK OF HAZARIBAGH
N
To Barhi
Champanagar
Tilrafall
Bargaon
Surgurnagar Khurd
Soel kalan
Khutra
Gobarbandha
Sijhua
Korikia
Rabarwa
References
1 National park
2 Watch Tower
3 Dam & Salt lick
4 Forest Rest House & T.J.B.
5 Cultivated land
6 Road Metalled, unmetalled.
7 River with tributaries

A Cursory Ecological Survey of the Flora and Fauna of the Hazaribagh National Park (Bihar)

BY

JAMAL ARA

(With a map)

SYNOPSIS

An ecological survey of the Hazaribagh National Park in Bihar, carried out in two attempts, one from December 12 to December 22, 1959, and the other from January 8 to January 16, 1960, revealed a distinct correlation between forest types and the distribution of the fauna, in respect of both the larger animals and the birds. The survey was carried out by intensively sampling 20% of the area of the National Park in which all the forest types were represented. The results show that the population of both animals and birds is low; there being only some 60 species of birds and the larger mammals totalling about 300 individuals. In addition the fauna is very shy, and in spite of five years of protection has not shed its fear of man.

In the case of the Whitefaced Wagtail and the Blackheaded and Rufousbacked Shrikes, the sub-species can be easily separated in the field by sight alone. In these cases, therefore, trinomials have been used without specimens actually having been collected.

1. GENERAL

The idea of creating a National Park in Bihar was first mooted in December 1952, and the present site was tentatively suggested. This site at first was not considered ideal and several alternative sites were also explored. In the end, considering the factors of accessibility and the presence of a reasonable number of wild life, the present location was deemed to be the best. In 1953, therefore, a proposal was submitted to the State Government and the matter was also discussed at a meeting of the State Wild Life Board held in April 1954. In August 1954 the State Government issued an executive

order creating a sanctuary only, with the intention of eventually converting it into a National Park after the policy in respect of National Parks had been decided by the Indian Board for Wild Life. In the same order Government sanctioned staff comprising one Assistant Game Warden of the rank of a Forest Ranger and 10 Game Guards. 2 Foresters were also sanctioned at a later date. The Divisional Forest Officer of the Hazaribagh Forest Division was appointed as the Game Warden.

The policy in respect of National Parks was decided at the meeting of the Indian Board for Wild Life held at Calcutta in February 1955, and some time later the Board also circulated model legislation for National Parks. But no action at all was taken in Bihar in respect of this area. Even though in all official and non-official descriptions it is called a National Park, the actual position is that it is only a sanctuary created by executive order. It appears that not even the Forest Department have taken any steps to persuade Government to convert it into a full-fledged National Park by enacting legislation. Until that is done the legal position is rather precarious.

Though the carrying of arms into the area is forbidden there is no legal sanction behind this order, and if anybody refuses to hand over his arms the forest staff have no powers to enforce it. Again shooting in self-defence is permitted by the law even inside sanctuaries and it is a wonder that nobody has as yet taken advantage of this lacuna. Another shortcoming is the lack of visible demarcation of the limits of the Park at the spot. The boundary where it coincides with natural features or roads etc. is clear, but elsewhere it is not possible to find out where the limits are. I understand that, when planned, the idea was to fence it all round with barbed wire so as to limit ingress or egress to recognised gates, but this has not been done so far. Whilst barriers have been erected on all the roads leading into it from the National Highway, there is nothing to prevent a poacher from entering on a jeep at places away from these barriers.

2. Location

The National Park is situated in the Hazaribagh district astride the Patna-Ranchi National Highway, between 7 and 11 miles (11 and 18 km.) from Hazaribagh town proceeding towards the Grand Trunk Road, which passes through Barhi, 22 miles (35 km.) north of Hazaribagh and 248 miles (400 km.) west of Calcutta. It comprises the old reserved forests of the Ramgarh Raj which were nationalised

under the Bihar Land Reforms Act. These forests cover an area of 77 square miles or 20,000 hectares approximately, and are completely free from any kind of right whatsoever. Though these were reserved forests, yet the Ramgarh Raja had extensive shoots for himself, his guests, and British V.I.Ps. At a later date live tigers were also trapped for sale. A tiger trap used in those days is still to be seen, but is maintained merely as a curiosity. In the result, though ordinary persons could not shoot in this area, yet heavy shikar by the owner himself led to a steady depletion of the fauna. Also, poaching by villagers was not very strictly controlled.

3. Amenities

After conversion into a sanctuary the Forest Department undertook large scale construction work. Today there are about 40 miles (64 km.) of motorable gravel roads traversing the entire area. There are also 3 dams for storing water since there is a shortage of water in the hot weather. 10 Watch Towers strategically located provide vantage points for observation. There are two Forest Rest Houses and a 4-roomed Tourist Lodge. The rents are Rs. 6 per room per day in the Forest Rest House and Rs. 4 in the Tourist Lodge. Though a khansama is provided no foodstuffs are available with him. If, however, the raw materials are supplied he can turn out a meal, though the standard of cooking is not very high. Intending visitors will be well advised to carry foodstuffs with them and not depend on local supplies. The tariff of meals hung up in the Tourist Lodge is completely misleading as not a single item mentioned on it can ever be supplied by the khansama. Bed linen, mattresses, pillows, mosquito nets, and towels are provided; visitors have to carry only blankets.

4. Topography

The longest axis of the Park lies east and west and extends on either side of the National Highway. The maximum length is 16 miles or 26 kilometres and the average is between 12 and 13 miles (19 km. to 21 km.). The width varies considerably from a maximum of 6 miles (9.5 km.) in the middle just west of the National Highway to a minimum of 1½ to 2 miles (2.4 to 3.2 km.) on both the eastern and the western extremities. Inside the Park itself there are few villages and none of them of any considerable extent, but the southwestern part over an area of approximately 9 to 10 square miles (2300 to 2900 hectares) is honeycombed with them.

Apart from this area there are also tiny patches of cultivation elsewhere, though none of them is more than an acre or two in extent. On the whole it is comparatively free from the dangers of illicit felling and poaching by villagers except on its fringes. In this connection it may be mentioned that the Government did not accept the proposal of the Forest Department to have a buffer zone 5 miles (8 km.) wide all along the boundaries of the Park and declare it a sanctuary.

The general slope lies from south to north, and both from the east and the west to the middle, the National Highway running through the trough of the area. The bench marks decrease from 1888 feet (575 m.) above sea-level at the boundary of the National Park in the south to 1511 feet (460 m.) at the northern end. The average slope from the east to the National Highway is greater, falling from over 1900 feet (575 m.) in the extreme east to the level of the Highway itself. West of the Highway the slope is not so marked and the watershed lies at approximately 1900 feet (580 m.) some 2 to 3 miles (3.2 km. to 4.8 km.) west of the Highway. From here the country slopes down to about 1750 feet (530 m.) and rises again to about 1900 feet (580 m.) in the extreme west. The highest point is a spot height 2086 feet (635 m.) above sea-level situated between the villages of Gurudih and Nachle in the extreme west approximately 8½ miles (13.6 km.) from the National Highway.

The general direction of flow of almost all the streams is from south to north and there are no streams penetrating the watershed lying west of the National Highway. Two drainage basins lie on either side of this watershed and they both flow south for quite some distance before meeting at a gap on the northern boundary. East of the Highway the area is not so well watered and there are only two perennial streams which unite and give rise to the Tiger Falls just short of the northern boundary about 2 furlongs (400 metres) west of the Highway.

The underlying strata are mostly shales, which crumble and weather easily but do not give rise to a rich soil. Shales in Bihar are invariably associated with a poor site quality for *Shorea robusta* and therefore, even at its peak, this area is not capable of any crop better than good Quality III Sal. Correspondingly, at no time will it be possible for this area to have many soft-fruited trees. Villagers or contractors do not usually fell *Ficus* trees, but even today the Park is very short of them. I could not see a single mango tree throughout the area and there were very few *Madhuca latifolia*

(Mahua) trees as well. This may perhaps account for the comparative paucity of bird species. The odd *Ficus* tree where it occurs always attracts large mixed hunting parties. For example, a lone *Ficus glomerata* tree near the Forest Rest House was always teeming with barbets, bulbuls, parakeets, and others.

The area has not been sub-divided into blocks and compartments, which renders locations extremely difficult to describe. The only fixed points are the roads and watch towers, and using them as reference points has not been found to be very satisfactory, but in the circumstances is the only way available for the purpose.

5. Ecology

The forest type is B-3 Dry Peninsular Sal according to the classification of Champion with the general conditions more xerophilous. As a matter of fact there is a complete absence of evergreen species and even along the streams no evergreen patches exist. *Terminalia* trees are rather scarce and no *Michelia champaca* or *Anthocephalus cadamba*, the usual moist associates of Sal, were seen.

The Sal crop itself is entirely in the pole stage and no trees of 4 feet (1.21 m.) girth or above exist. The crop itself is remarkably uniform in age and averages 30-40 years. It appears to be the result of heavy selection fellings as there is no record of this area having been subject to extensive shifting cultivation within the last 50 years. In fact Hazaribagh district as a whole was never subject to shifting cultivation in a large degree at any time.

Due to the immature nature of the crop estimation of quality classes proved difficult, but the northern aspects carry a good Quality III crop whereas the southern aspects carry a poorer crop. The usual associate of Quality I Sal, *Clerodendrum infortunatum* was not seen at all.

The associates of Sal vary very widely, and even within a small area showed remarkable changes. Thus on the road leading from Watch Tower 4 to 5 the southern aspects had a very large proportion of *Boswellia serrata* (Salai) forming at places practically pure patches. Signs of heavy grazing in the past are provided by the presence of *Nyctanthes arbortristis* (Harsinghar). The northern aspects on this road have a large number of bushes of *Flemingia chappar*, indicative of a good site quality for Sal. In this area too the stream banks carry some *Eugenia heyneana* (Kat Jamun).

On the other hand along the Bahimar road the proportion of *Boswellia serrata* is very low, even on the southern aspects.

Generally speaking the conditions are more tropophilous than on the other road and *Bauhinia vahlii* is rather common, forming at places a pure bushy undergrowth.

The third road is the one leading from the Forest Rest House to the National Highway. Here the forest is a blend of the other two types described above, but on the whole tending towards xerophilous conditions. *Boswellia serrata* is present in much smaller numbers and there is an increase in the number of *Acacia catechu* (Khair) trees. Elsewhere the *A. catechu* is very isolated but here it can be found in small groups forming an association. Remarkably enough, however, the only large stream flowing here carries large numbers of *E. hyneana* both along the banks and on the islands.

The Sal appears to be in the stage of a precarious climax, the condition being comparable to that obtaining in the Baresand Block of the Palamau Forest Division though neither the flora nor the fauna is as rich as in that block. Here also any large scale opening of the canopy leads to a heavy invasion by *Heteropogon contortus* (Spear grass), completely inhibiting Sal regeneration and smothering any advance growth that is present. This is nowhere more evident than on the view strips being cut along the roadsides, where the fellings are almost in the nature of clear-fellings. The few Sal trees that have been left in these clearings, probably to serve as seed-bearers, are likely to suffer from excessive insolation whereas the chances of their inducing Sal regeneration are precisely nil. How far these fellings are ecologically desirable both for the flora and the fauna is extremely debatable. Floristically they are definitely introducing seral retrogression, and they do appear to have the effect of driving wild life more into the interior due to a lack of cover.

Based on these observations the following ecological subtypes can be distinguished:

TYPE A: A *Shorea robusta-Boswellia serrata* association confined to southern aspects, with the *B. serrata* occurring in pure patches on the drier and more exposed slopes. The shrubs here comprise *Nyctanthes arbortristis*, *Gardenia* spp., *Colebrookia oppositifolia*. The grass is invariably *H. contortus*. Large shrubs, and even small trees of *Flacourtia ramontchi* are found in this type, particularly near the tops of the ridges. The spines on it are persistent, and give evidence of heavy fellings in the past.

SUB-TYPE A1: Occurring on the Bahimar Road. In this sub-type the proportion of *B. serrata* is much reduced. Instead bamboos (*Dendrocalamus strictus*?) and on the higher slopes and ridges

Diospyros spp. are found. There is not much difference in the shrubby growth.

TYPE B: A Sal-*Terminalia* association occurring on the northern slopes and valley bottoms. In this type Sal of a superior quality is found, and the undergrowth is sharply divided. On the Bahimar Road there is a profusion of *Bauhinia vahlii* forming at places dense bushes and *Indigofera pulchella*, an indicator of a good site for Sal. The commonest *Terminalia* was *T. tomentosa* though *T. belerica* and *T. chebula* also occur as isolated trees. On the road from Watch Tower 4 to 5 the undergrowth is *Flemingia chappar*, and *Bauhinia vahlii* does not occur in such profusion.

TYPE C: Along nullahs and perennial streams. Some of the streams have a growth of *E. hyneana* and its associate is usually *Saccharum narenga* (in bloom). In the streams where *E. hyneana* is not found *Saccharum spontaneum* (?) and *S. narenga* occur.

A common feature of all types is the presence of *H. contortus* in varying degrees. Where the canopy is open or has been opened this grass has formed a dense impenetrable mat choking and suppressing all other kinds of vegetation. Sal regeneration is usually absent from all the types, and it is doubtful if any will be established until the canopy is allowed to close and the *H. contortus* wiped out.

A dangerous sign is the stray occurrence of *Lantana* sp. bushes. Since lantana also thrives where the canopy is open, a combination of *Lantana* and *H. contortus* will eventually wipe out every other kind of vegetation. This is all the more reason why fellings in this area should be carried out with great caution so as to avoid permanent gaps in the canopy. Even thinnings should not be heavier than grades B/C. Another danger is that of forest fires. Dry *H. contortus* is as inflammable as tinder, and during the hot weather can catch fire spontaneously. Whilst fire tracing of all view strips and roadside areas is done annually by early burning, it is well known that this is only poor insurance against hot weather fires. Early burning cannot be done beyond March, and after that there is enough time available before the monsoon breaks for the spear grass to grow up again. Forest fires in a National Park are disastrous from every point of view, particularly for the fauna. It may even lead to depletion by driving out the larger animals and ground game. It must be mentioned that during the landlord's ownership forest fires were an annual occurrence in this area. How far the position has improved, if at all, cannot be said as I could not gain access to the fire records of the Forest Department.

All in all the evidence leads to the conclusion that the entire area has been felled over in the past but not according to a properly drawn up working plan or scheme. The growth that is seen now is probably second growth forest. The presence of *Flacourtia ramontchi* in fair numbers confirms this conclusion because this tree is typical of second growth forests recovering from past maltreatment.

6. Sampling Methods

A preliminary reconnaisance of the area made it clear that the best results would be obtained by intensively sampling a percentage of the National Park rather than an overall survey through strips or small sampling units distributed over the entire area. Accordingly an area of more or less 15 square miles (4000 hectares) was selected at random and intensively sampled, i.e. 20% of the total area.

All roads, stream beds, and foot-paths were gone over more than once as also several cross country transects were run between well-defined landmarks or from one road to another or from one foot-path to another. Particular attention was paid to salt licks which showed signs of being in use, as also frequented water holes and drinking places as revealed by footprints and pug marks. Observations were carried out after dark as well, but due to the intense cold these had to be terminated by 9 p.m. After that hour it became physically impossible to stay out of doors. There was a deposit of hoar frost on several nights.

Counting of animals was done both from those actually seen and from footprints and pug marks. Duplication was avoided by not recording footprints observed in the vicinity of any area where any herd of animals had been actually seen. It must, however, be made clear that duplication of numbers in a survey of this nature cannot be eliminated completely, and some allowance has to be made for this fact. No attempt at counting birds was made and in their case information is given as very common, common, frequent, rare, etc. Of course, such birds of which only a few specimens were seen have the number given against them.

7. Distribution of Fauna by Forest Types

The maximum concentration of fauna within the area sampled lies in the valley between the Bahimar Road and the opposite hills, through the bottom of which runs an abandoned road. South of this valley the concentration is good though less than within the valley itself. This valley comprises Type B of the ecological sub-types

listed above. In this valley a herd of Spotted Deer (*Axis axis*). Muntjac (*Muntiacus muntjak*) and a Tiger (*Felis tigris*) were observed. Though no Sambar (*Rusa unicolor*) were actually seen yet one herd was identified from its hoof-prints along water courses, as also from damage caused at night to a plantation of Arhar (*Cajanus indicus*) near the staff quarters. I estimate the numbers as spotted deer 10, muntjac 4, tiger 1, and sambar about 6. This area contains the largest numbers of Treepie (*Dendrocitta vagabunda*), Ring Dove (*Streptopelia decaocto*), Whitebellied Drongo (*Dicrurus caerulescens*), and Roseringed Parakeet (*Psittacula krameri*). The streams at the bottom of the valley had a flock of Large Crowned Willow Warbler (*Phylloscopus occipitalis*). 4 Crested Serpent Eagles (*Haematornis cheela*) circle it mostly in their flights and rarely go outside.

In forest Type B on the road from Watch Tower 4 to 5 Nilgai (*Boselaphus tragocamelus*) and Bison (*Bibos gaurus*) exist. The bison number about 4, but the nilgai appear isolated and could not be counted with any degree of accuracy. This area has more Black Partridges (*Francolinus francolinus*) than the other areas.

TYPE A: This type provides the richest bird life and the largest mixed hunting parties. The pure *B. serrata* patches have a party of Rufousbacked Shrike (*Lanius schach nipalensis*), Eastern Orphean Warbler (*Sylvia hortensis*), Grey Shrike (*Lanius excubitor*), Redvented Bulbul (*Pycnonotus cafer*), Magpie Robin (*Copsychus saularis*), Whitebrowed Fantail Flycatcher (*Rhipidura aureola*), Redwhiskered Bulbul (*Pycnonotus jocosus*), and the Large Crowned Willow Warbler (*Phylloscopus occipitalis*). Spotted Deer (*Axis axis*) and Nilgai (*Boselaphus tragocamelus*) are found in this type; as a matter of fact since the forest is more open the number of spotted deer is larger, and I place their numbers at about 20 in this area.

In Type A 1 hares (*Lepus ruficaudatus*) and pigs (*Sus cristatus*) occur in larger numbers than in the other type, otherwise it has no special ecological significance.

TYPE C: On the artificial lake behind the dam the only pair of Redwattled Lapwings (*Lobivanellus indicus*) and Common Sandpipers (*Actitis hypoleucos*) were seen. These roost also in the same area. The stream beds generally have a greater abundance of Wagtails (*Motacilla*) and Warblers (*Phylloscopus*).

The road leading from the Forest Rest House to the National Highway has forests falling in types A and B, but the structure of the fauna is rather unique. Along here the only specimens of Crimsonbreasted Barbet (*Megalaima haemacephala*), Stone Chat (*Saxicola caprata*), Verditer Flycatcher (*Muscicapa thalassina*), Blue

Rock Pigeon (*Columba livia*), Blackheaded Shrike (*Lanius schach tricolor*) were seen. A couple of leopards (*Panthera pardus*) were also observed in long grass along a stream bed. Leopards generally are scarce in the National Park.

8. Results

MAMMALS. The mammal population has been estimated by multiplying the number found in the area sampled by 5; since the sampling unit was 1/5th of the total area of the Park. In other words the sampling intensity has been assumed to be 20%. Whilst no mathematical justification can be given for this assumption, yet it was the only basis on which the survey could be carried out. The results are given below:

Species	No. in sampling area	No. in Park	Remarks
1. Common Langur (*Semnopithecus entellus*)	not seen	not seen	Reported by staff to be present in large numbers near villages.
2. Tiger (*Felis tigris*)	2	10	Staff estimate the number at 15.
3. Leopard (*Panthera pardus*).	2	10	Staff estimate the number at 9.
4. Mongoose (*Herpestes edwardsii*)	4	20	—
5. Jackal (*Canis aureus*)	not seen	not seen	Reported by staff as entering the villages.
6. Fox (*Vulpes bengalensis*)	Frequent	Frequent	Numbers not estimated.
7. Wild Dog (*Cuon alpinus*)	not seen	not seen	Reported by staff as visiting sometimes.
8. Sloth Bear (*Melursus ursinus*)	6	30	Staff estimate the numbers at 25.
9. Palm Squirrel (*Funambulus pennanti*)	2	10	—
10. Common Hare (*Lepus ruficaudatus*)	very common	very common	—
11. Bison (*Bibos gaurus*)	4	20	Appears to be an over estimate. Probably there is only one herd of 4.

Species	No. in sampling area	No. in Park	Remarks
12. Nilgai (*Boselaphus tragocamelus*) ..	3	15	—
13. Sambar (*Rusa unicolor*) ..	6	30	—
14. Spotted Deer (*Axis axis*) ..	30	150	—
15. Muntjac (*Muntiacus muntjak*) ..	4	20	—
16. Wild Boar (*Sus cristatus*) ..	common	common	—

A remarkable feature was the complete absence of the Primates. Though the staff reported that the Langur was present in large numbers, not even one was seen by me either in the area sampled or outside. Probably the Lynx (*Caracal caracal*) was seen but as it disappeared very quickly and did not allow me to get close enough, I could not identify it with certainty. It has, however, been reported as present by Mr. N. N. Sen, Chief Conservator of Forests, Rajasthan, who saw a single specimen in December, 1957, vide *J. Bombay nat. Hist. Soc.* (1959) **56** (2): 317.

All the animals are extremely shy and even after five years of protection disappear on the slightest noise. Their fear of man has not been overcome to the smallest extent, and they are as shy and wary as in any forest area where animals are not specially protected. In this connection I received reports that poaching by privileged persons has not been completely stopped. Rather I learnt from a fairly reliable source that a local potentate shot within the Park 6 Spotted Deer in a single night, 2 of which were hinds.

BIRDS. The following birds were seen:

1. Night Heron, *Nycticorax nycticorax*—3. There was a heronry near Watch Tower 5.
2. Whitenecked Stork, *Ciconia episcopus*—1. Probably a straggler.
3. Common Sandpiper, *Actitis hypoleucos*—2. Winter visitor.
4. Redwattled Lapwing, *Lobivanellus indicus*—2.
5. Black Partridge, *Francolinus francolinus*—Frequent.

6. Red Junglefowl, *Gallus gallus*—Common, but very shy.
7. Peafowl, *Pavo cristatus*—1, but staff report it as frequent on the western fringes of the Park.
8. Ring Dove, *Streptopelia decaocto*—Very common.
9. Spotted Dove, *Streptopelia chinensis*—Infrequent.
10. Blue Rock Pigeon, *Columba livia*—4.
11. Crested Serpent Eagle, *Haematornis cheela*—4.
12. Dusky Horned Owl, *Bubo coromandus*—Common.
13. Mottled Wood Owl, *Strix ocellata*—1.
14. Common Indian Nightjar, *Caprimulgus asiaticus*—Common.
15. Whiterumped Spinetail, *Indicapus sylvaticus*—A flock of about 6.
16. Whitebreasted Kingfisher, *Halcyon smyrnensis*—Frequent.
17. Common Kingfisher, *Alcedo atthis*—Frequent.
18. Green Bee-eater, *Merops orientalis*—4.
19. Indian Roller, *Coracias benghalensis*—one pair.
20. Roseringed Parakeet, *Psittacula krameri*—Very common.
21. Large Indian Parakeet, *Psittacula eupatria*—Frequent.
22. Crimsonbreasted Barbet, *Megalaima haemacephala*—Common.
23. Green Barbet, *Megalaima zeylanica*—Frequent.
24. Goldenbacked Woodpecker, *Dinopium benghalense*—Common.
25. Pigmy Woodpecker, *Dendrocopos nanus*—Frequent.
26. Mahratta Woodpecker, *Dendrocopos mahrattensis*—Common.
27. Tickell's Flowerpecker, *Dicaeum erythrorhynchos*—Frequent.
28. Purple Sunbird, *Nectarinia asiatica*—Very common.
29. Eastern Grey Wagtail, *Motacilla caspica*—Frequent. Winter visitor.
30. Whitefaced Wagtail, *Motacilla alba leucopsis*—Frequent. Winter visitor.
31. Common Swallow, *Hirundo rustica*—A flock of about 9. Winter visitor.
32. Common Myna, *Sturnus tristis*—One pair, probably stragglers.
33. Golden Oriole, *Oriolus oriolus* (*kundoo*)—Frequent.
34. Jungle Wren Warbler, *Prinia sylvatica*—Common.
35. Large Crowned Willow Warbler, *Phylloscopus occipitalis*—Frequent. Winter visitor.
36. Green Willow Warbler, *Phylloscopus trochiloides*—Frequent. Winter visitor.
37. Eastern Orphean Warbler, *Sylvia hortensis*—Rare. Winter visitor.

38. Tailor Bird, *Orthotomus sutorius*—Common.
39. Whitebellied Drongo, *Dicrurus caerulescens*—Very common.
40. Black Drongo, *Dicrurus macrocercus*—Rare.
41. Small Minivet, *Pericrocotus cinnamomeus*—Common.
42. Blackbacked Pied Shrike, *Hemipus picatus*—Frequent.
43. Rufousbacked Shrike, *Lanius schach nipalensis*—Frequent.
44. Blackheaded Shrike, *Lanius schach tricolor*—Frequent.
45. Grey Shrike, *Lanius excubitor*—Frequent.
46. Whitebrowed Fantail Flycatcher, *Rhipidura aureola*—Common.
47. Verditer Flycatcher, *Muscicapa thalassina*—1. Winter visitor.
48. Tickell's Blue Flycatcher, *Muscicapa tickelliae*—Common.
49. Redbreasted Flycatcher, *Muscicapa parva*—Common. Winter visitor.
50. Magpie Robin, *Copsychus saularis*—One pair.
51. Indian Robin, *Saxicoloides fulicata*—Common.
52. Stone Chat, *Saxicola caprata*—Frequent.
53. Redwhiskered Bulbul, *Pycnonotus jocosus*—Rare.
54. Redvented Bulbul, *Pycnonotus cafer*—Very common.
55. Goldfronted Chloropsis, *Chloropsis aurifrons*—Common.
56. Common Iora, *Aegithina tiphia*—Common.
57. Yelloweyed Babbler, *Chrysomma sinensis*—Common.
58. Jungle Babbler, *Turdoides somervillei*—Very common.
59. Treepie, *Dendrocitta vagabunda*—Very common.
60. Jungle Crow, *Corvus macrorhynchos*—Common.

The following mixed hunting party invariably gathered in a small area between the Forest Rest House and the Tourist Lodge, both in the morning and the evening. It almost seemed as if this party assembled in the morning just before dispersing and again in the evening just before roosting.

Treepies, Redvented Bulbuls, Jungle Babblers, Redbreasted Flycatchers, Crimsonbreasted Barbets, Ioras, Whitefaced Wagtails, Eastern Grey Wagtails, Common and Whitebreasted Kingfishers, Jungle Crows, Common Mynas, Tailor Birds, Goldfronted Chloropses, Goldenbacked and Mahratta Woodpeckers, and Indian Robins. The entire party had a strength of from 70 to 80 birds.

The above list shows that bird life is poorly represented. As against only 60 species as many as 108 were recorded in the Kodarma Sanctuary lying only some 35 miles to the north. That too in a survey that was very sketchy compared to the intensity of the present one. The absence of game birds of all kinds, particularly Grey Partridge, Spurfowl, and Quail, is noticeable. I saw only one peafowl

which is surprising. Even common birds like egrets, kites, hornbills, and practically all the birds of prey are missing. Except for a pair of Common Mynas, which too showed signs of having strayed in, no members of the genus *Sturnus* were recorded. Even a very common bird like the Pied Myna was absent.

The place of the Black Drongo has been taken here by the Whitebellied Drongo. I saw only 2 pairs of Black Drongos, whereas the Whitebellied ones were very plentiful. Again the Spotted Dove appears to have been supplanted by the Ring Dove. In spite of the area being very well watered waders were absent.

9. Acknowledgements

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Female European Goldfinch regurgitating seeds

Nest and eggs of Himalayan Goldfinch

Photos : R. S. P. Bates

The Nesting Habits of the Goldfinch *Carduelis carduelis* (Linn.) & *C. caniceps* Vigors

BY

R. S. P. BATES

(*With a plate*)

The Goldfinch, a truly delightful bird in every way, in dress, in voice, and in habits, has a wide range over the greater part of Europe and a good slice of Asia, inclusive of the frontier hills of West Pakistan and thence in India along the western Himalayas to about Kumaon. The genus is divided into two species, the typical *carduelis* and the eastern *caniceps*, both subdivided into races of which the Himalayan bird is the most easterly form of all.

On coming into close contact with Goldfinches here in England after meeting their counterparts in Asia I find myself wondering what lies behind this separation into two different species. One realises that a vast range with its consequential differences in climatic and other conditions is bound to result in the production of numbers of somewhat differing forms, so that the Himalayan Goldfinch at one extreme is almost bound to possess some striking difference from the English bird, in this case the lack of any black about the face. Nevertheless I find the ways of both species so strikingly similar, inclusive of the choice of nesting site, the architecture of the nest and the material, manner of its construction, incubation and feeding, movements after nesting, the delightful call notes, joyous song, and so on, that I find it difficult to believe that there really are two true species. Indeed would not, I wonder, individuals picked up at random from anywhere along this long line, whether belonging to *carduelis* or *caniceps*, be perfectly happy to breed together? In short, could not the whole lot belong in reality to but one species?[1] This is of course probably nothing more than wishful thinking on my part and I would not really presume to contradict the taxonomists,

[1] In A SYNOPSIS OF BIRDS OF INDIA AND PAKISTAN by Prof. S. Dillon Ripley (in press) both the British and the Himalayan Goldfinch are recognized as races of *Carduelis carduelis*. EDS.

who with their access to large collections and far more literature than I am ever likely to see, do not have to rely on a few impressions and consequently have probably got the strongest of reasons for carving up our palaearctic goldfinches. I could, I suppose, even be wrong in crediting the different forms with identical ways, and therein lies my whole object in putting this article on paper: someone may like to pull my ideas to pieces and show up the error of my ways. My contacts with the Indian bird on the north-west frontier of West Pakistan and in Kashmir, though pretty frequent, admittedly have always been of short duration, and I never had the chance of following a pair of goldfinches right through their nesting cycle as I have just done this summer in my garden in Surrey.

In the Vale of Kashmir the Himalayan Goldfinch is common enough the year through, and in early spring plenty of nests are to be found in a variety of situations. I have come upon them in willows lining water channels, in fruit trees in the orchards, and of course amongst the smaller branches of fir and pine trees, but I believe the pine wood on the Takht-i-Suleiman, mentioned by almost every ornithologist who has written about them, first dwindled and then disappeared altogether some years ago. In the summer numbers of goldfinches move up the side valleys to quite high elevations, many of the young then produced probably being second broods, and it was one of these higher elevation pairs which produced the most striking nest I have ever seen. I found it on June 22nd at an elevation of about 10,400 ft. between Bal Tal and the Zoji La Pass into Ladakh. The site was typical, being about 3 ft. out and 15 ft. from the ground on a horizontal branch of a small pine tree, and the general construction was quite normal, a beautifully soft affair containing the usual thick inner wad of felted vegetable down finished off with a somewhat scant inner lining of hair. The outer materials were perhaps a little unconventional for, to quote from my remarks about this nest in my diary: 'Two-thirds of it were exclusively of Edelweiss and forget-me-nots quite fresh-flowering stems which I suppose the bird had cut itself? Then came a thick layer of dandelion down. Finally it was lined with horse-hair but inside on the bottom was a further limited quantity of dandelion down . . . On the way back from the Zoji La saw three pairs of goldfinches on the ground near the same place. It does seem, by the way, that where there is one pair nesting there may well be a number spread over a very limited area.' Later I wrote: 'The eggs have a transparent appearance unmarked and white when blown, but they are by

no means as fragile as they look.' I came upon one other unmarked clutch in a nest near Nagmarg above the Wular Lake.

Shortly after returning to England in 1946 I had a couple of sessions at a goldfinch's nest in a hawthorn tree and watched, but failed to photograph, the transference of predigested food from the male to the sitting female; and noted too how a beautiful nest, neat, soft and cosy-looking, became within a week of the young being hatched, an offensive ring of droppings through lack of attempt at nest sanitation. Nests noted since then were either in situations unsuitable to deal with, or came to an untimely end thanks to the appalling increase in predators during and immediately following the war; magpies, jays, and Grey Squirrels in the main, the latter more fittingly called tree-rats, real horrors and not in the least lovable as are India's confiding little rascals, the Striped Palm Squirrels.

At last in the first week of July this year I found I had a goldfinch's nest only 9 ft. from the ground, hidden in a cup of small shoots near the top of an apple tree in our own garden. We also had two others, one of them hopelessly placed amongst the outer branches of a tall Sweet Chestnut tree and the second in a cedar which I did not spot until too late and which was probably the earlier nest of the pair I was now to deal with. Although I had of course heard and seen the goldfinches moving about the orchard—the bright plumage and mellow call-notes incessantly indulged in saw to that—I had not realized that this second nest was already in being. It contained, in fact, 2 eggs and incubation seemed already to have commenced. Basically the nest was constructed just like others I have come across, whether in the Himalayas or in Britain. The outer parts contained one or two thin twigs, but in general it seemed to be made of dry grass and soft weed stems, the inner felted cup being about one-third of an inch thick made of some vegetable down khaki in colour. This was rounded off with a final scanty lining of white hairs belonging to one of our Cocker spaniels. An interesting point was that amongst them was not one single hair from the Golden Cocker's coat which would, in fact, have matched the felt core instead of contrasting with it.

On the 7th I found a third egg had been deposited, but it is in no way unusual for goldfinches, British goldfinches anyway, to begin incubation before the deposition of the full clutch, which in this case proved to be one of three eggs only.

The next few days were spent in getting the sitting bird thoroughly used to traffic and other noises so that my wife and I could eventually talk and move about directly below the nest without causing her the least embarrassment. When I erected a pylon hide on a triangular

platform made by resting a couple of planks on a rung of a vertical aluminium ladder with their other ends through the garage windows she did not bother to leave the nest until I got on to the platform to put up the hiding tent within 4 ft. of her. By the way the Bal Tal bird was just as tame and returned to within 6 inches of the nest while my head was still almost level with her.

Early on the morning of July 18th I found that two of the eggs hatched, but it was some time in the afternoon of the 19th before the third chick arrived. I replaced the dummy lens with the reflex equipped with an 8-inch Cooke lens, and getting inside the hide let off the focal plane shutter a few times to test the effect on the sitting bird. She jumped once or twice at the snap of the falling blind, but soon took no notice of it whatsoever. Unfortunately from beginning to end the male reacted unfavourably every time the blind dropped, and usually made off like a scalded cat. He always did leave with unexpected suddenness anyway, and never gave me a chance of two exposures during any one visit.

I already have good photographs of an incubating female, so wished to concentrate on the passing of food by the visiting male. The female seldom leaves the nest except, I suspect, for the purpose of drinking, being relieved of any such necessity by being fed by the male by regurgitation. You see goldfinches are typical finches in that they have strong, though in their case rather long, conical bills specially adapted for crushing seeds. This does not mean that they eat nothing else, but seeds do form by far the greater proportion of their diet. Numbers of finches however feed their youngsters, like so many small birds do, on insects, but goldfinches and some others of the family have got over the dangers of giving their chicks tummyache through feeding hard seed to them by predigesting this type of food and storing it up in their own crops to feed to the young in bulk. This means of course that the nest need only be visited at infrequent intervals, a practice which has its disadvantages as will in due course be seen.

At 11 o'clock the male appeared on the rim of the nest and was greeted by the sitting bird at once soliciting food with head thrown back and bill well opened. He promptly sank his own bill well into her throat, but I could at times see a stream of matter of the consistency and colour of thick cream flowing into her gape. The flow lasted an appreciable time with a slight raising and lowering of his head which was why I could occasionally see the flow. The female did not immediately pass on this gruel to the young ones but covered them for another seven minutes. She then stood up and so far as

I could tell fed her two offspring. Unfortunately the chicks were so tiny that their heads did not come above the rim of the nest.

By the 20th it had become evident that the male's visits were at intervals of not less than half an hour, and that the female usually passed on the food within from 5 to 10 minutes of a visit. On one occasion, however, more than 40 minutes elapsed between visits. This time the female fed the young twice, that is 5 minutes after his visit and again half an hour later. It seems therefore that she can retain the food in her crop at the right consistency for some time. Once the female seemed to regurgitate a small seed which I could see her holding in the tip of her bill before feeding it to one of the chicks. On another occasion, but after the male had commenced to supply the chicks direct, he produced what I am almost certain was a spider still with its legs intact.

The change over to direct feeding of the young by the male was most interesting and I was indeed lucky to be in the hide to witness it. On the 21st before entering the hide I had snipped off one or two leaves above the nest which were throwing awkward shadows. In so doing I inadvertently dropped a tiny bit of debris into the nest cup. The female returned almost as soon as I was comfortably settled in and brooded the young for quarter of an hour. Then she stood up and for 5 minutes or so cleaned up the nest and attended to the young. The rim of the nest was still absolutely free from excreta. She appeared indeed at this stage still to be swallowing the faecal sacs. The chicks in any case were too small to be able to eject excreta on to or over the rim. So here is a passing thought: how is the mother bird at one moment able to swallow faeces yet very soon afterwards bring up food for the young?

I could see her nibbling something in the bottom of the nest then she picked up my bit of debris and flew away with it. Shortly afterwards the male flew in. Finding his mate absent he just stood on the edge of the nest looking rather non-plussed. Then the three chicks showed their open gapes dithering in the sunlight below him. The spell was broken; he soon started to feed them but, his method at once changed. No longer was it a rather deliberate process of continual regurgitation. He fed them in strict rotation with quick dabs of the bill into each open gape, repeating the round two or three times. Halfway through this the female appeared on the back of the nest and at once solicited food for herself. He merely included her in the rotational round, using the same dabbing motion for her as for the chicks. From then on both parents started to feed the growing family though on one occasion the male arrived when his wife was

brooding the chicks who now took up sufficient room in the cup to necessitate her sitting rather perched up in the air. He fed her in the old deliberate manner stretching well up to enable him to insert his bill into her up-turned gape though there was a certain amount of up and down movement involved. Unfortunately I waited a little too long for a favourable moment to press the release and lost the opportunity altogether. As the young grew, I expected the parents' visits to increase in frequency but the minimum interval of half an hour was maintained throughout. The fact that both parents were now employed in food collection provided, I suppose, the necessary increase in supply. There appeared to be no co-ordination between the parents as to the spacing of their visits. At times both would arrive almost together with much melodious calling to one another; sometimes the intervals would be more or less evenly spaced. In other words, the times of arrival were quite fortuitous. Both birds had their fixed lines of approach, the female always directly on to the back of the nest while the male flew in from another apple tree to my right but alighted on the left front side of the nest. I wonder if this had anything to do with the youngsters' choice in the location of their latrine?

I have already said that the female kept the nest clean so long as she was continuously brooding the callow young. She continued to do so for two or three days after she had joined the male in food collection. From the 25th, however, I began to notice that droppings were commencing to soil that quarter of the rim to my right front and no attempt was made by either parent to remove them—the male never had taken an interest in nest sanitation anyway. What happens appears to be this: anything falling inside the cup is removed by the female, but as soon as the young are big and strong enough to deposit the faeces beyond the inner cup itself, no matter how near to it, they are ignored. By the 29th the young filled the whole cup and when one wished to defecate there would be a general upheaval, the chick concerned pushing its brethren around until it could raise its tail end roughly in the right direction, that is towards my right front. The droppings were ejected with a certain amount of force but never with sufficient vim to clear the nest altogether with the result that by the time the young flew there was a sticky congealed mass bulging out from the side of the nest in the most favoured spot by a good inch, and the whole of that sector of the nest facing me had become soiled in some measure.

On the 31st the male suddenly changed his line of approach—possibly because his pet perch had become dirty and slippery—and

started to land on the extreme right front of the nest. This was a nuisance so far as I was concerned as part of his body was shielded from the lens by one or two leaves on an upward-growing spur starting just below the nest. The young were now practically ready to leave, the two first-hatched frequently indulging in vigorous wing-whirring exercises. I felt I could get better photographs of this and of the male on his new perch by removing the masking spur, so when my wife arrived to call me in for a meal I asked for her secateurs. I thought that if I cut off this twig at its base below the nest the young would not be able to see me and so would not take alarm. All went well and the offending thing was nearly severed when the secateurs went through the last bit of wood with an unfortunate click. To my horror the whole nestful 'exploded', the three young taking off in different directions but fortunately all landing safely in a plum tree and some bushes behind a herbaceous border. Moral: do any gardening likely to be necessary before the young become fear-conscious.

Fortunately there was still a chance of recording the fledglings' plumage. In front of the house there is a lily-pond with a stone bird-bath close beside it. I had noticed that another goldfinch family consisting of the adults with one surviving juvenile visited this bath very frequently so I at once moved the hide, placing it on the narrow strip of grass between the pond and the wall and 7 ft. from the bath. Therein I made a grave mistake: for a solid week nothing came near that bath, not even the cheeky sparrows. Thinking things over I concluded that the hide must be blocking the birds' usual lines of approach and departure but it was not easy to put the hide elsewhere. I could not place it to the north of the bath for the light would have been all wrong. The only way out of the dilemma was to put it right up against the wall so that most of the tent was on top of the wall with its front panel just far enough out to allow me to lean back against the wall with the toes of my shoes just peeping out, one leg of the camera tripod leading under my left armpit on to the grass on the top of the wall into which it was firmly pegged, the other two legs sticking out on either side of the front panel just by my feet. My position in the hide was by no means uncomfortable—I had of course to stand all the time, but the wall sloped back slightly so I could rest against it.

Birds are queer things! Although the hide was now closer to the bath every bird in the garden appeared to be satisfied with the change. The weather was hot and brilliant so bathing and drinking became the order of the day with practically all species. If I had

been able to stay in the hide all day and every day my list of captures would undoubtedly have been of considerable length. Alas, I had other jobs to attend to at times, and food to get down me. My annoyance can be imagined when in the middle of lunch the bath was visited first by a pair of Yellow Buntings and immediately afterwards by a nightingale with one of its fledglings. But I must not wander at the moment from my main theme. Unfortunately the abortive week turned the scales against me. A change was coming over the behaviour of the finches in general and the goldfinches in particular. For one thing the harvest had begun and this was probably a contributory factor to the change in the behaviour of many species as well as the fact that no longer were so many of them tied to one small area through having nests to think about. Of course I often heard the goldfinches and greenfinches in the garden, but just as often they went further afield and also joined up into flocks with other family parties. No longer did the goldfinch parents with one juvenile appear so regularly and indeed their visits soon petered out altogether. To cut a long story short I never did get that juvenile plumage photograph.

On one occasion I was in the tent the whole morning during which I photographed Willow Warbler, Blue Tit, Robin, and cock House Sparrow bathing, and in addition a whole family of greenfinches the members of which came a number of times, once with an adult goldfinch, but at last I had to pack up. Pulling a polythene bag over the camera I undid the press-studs down one side of the tent and prepared to leave. To my utter confusion just as my posterior was sticking out into the open air like the Rock of Gibraltar emerging from the sea, with much twittering my whole goldfinch family descended on to the rim of the bird bath. Needless to say I made a frenzied effort to get back to cope with the situation but they left as suddenly and joyfully as they had arrived just as I finished focussing and picked up the shutter release! And so my last opportunity ended in failure.

I learnt quite a lot of things from the bird bath attempts, one being, as of course one might expect, that seed-eaters in general and goldfinches and greenfinches in particular, and I might also add crossbills, drink very frequently. Blackbirds drank hardly at all, the moisture they required coming mainly from our fallen apples, and only once did I see a Blackbird take a bath—they prefer to sun-bathe. Song Thrushes too drink infrequently, probably getting their moisture from snails and other soft food, but they bathe rather more frequently. The cheeky sparrows in spite of their hoydenish ways seemed to love

the water more than any other bird, both bathing and drinking at very frequent intervals.

And now one last tip for bird-photographers. For more than four weeks I left the camera, at times with a plate in position, in the hide in all weathers—indeed sometimes the hide was flooded out. Its sole protection night and day when I was absent was a polythene bag pulled right over the lens, camera, and tilting-top, held together underneath by a tight rubber band. I had no trouble from condensation either on the focussing screen or on the lens and found I could be quite ready for action within a couple of minutes of getting into the hide, only having to check up on the exposure, stop, and focussing, to ensure that all was in order.

Aspects of Vegetation of Church Island off Tuticorin Port in South India

BY

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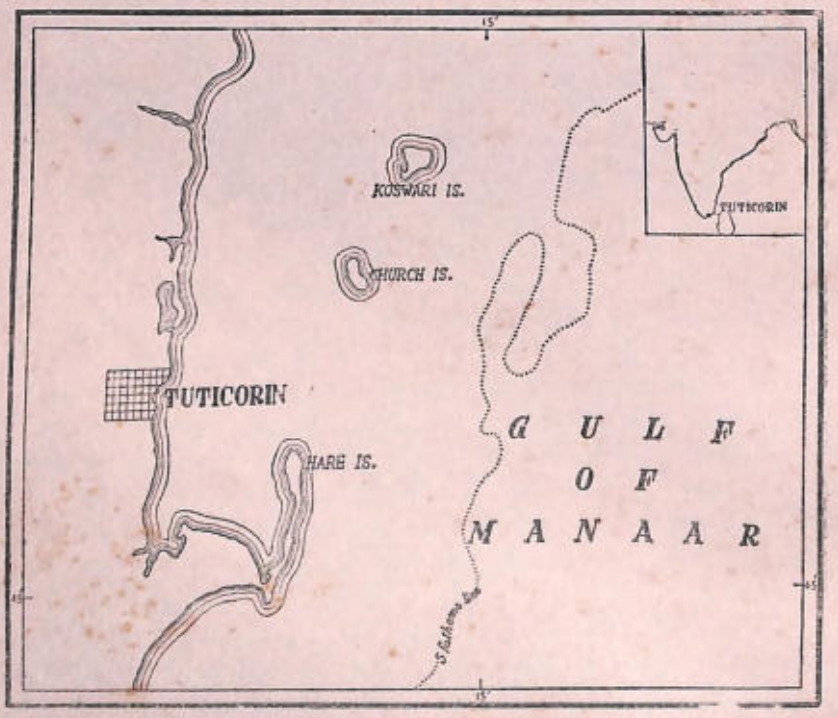
(*With one text map and three plates*)

Tuticorin (8° 48′ N. & 78° 11′ E.) is an important sea-port in Tinnevelly District (Madras) in south India. Off Tuticorin coast and east of it in the Gulf of Manaar there are a few islands, the more



Map showing the situation of Church Island, off Tuticorin coast, S. India

popular among them being Hare Island, Church Island, and Koswari Island (text map). Having had lately an opportunity of examining the floristic features of Church Island in December 1957 during a deep-sea marine algal collection trip to the Gulf of Manaar, I record here

the results of my observations on the flora of the island, as practically no previous record is available on the same.

The island, the flora of which is described here, would appear to be geologically a portion of the stretches of coral islands in the Gulf of Manaar. Among the group of islands in the area, Hare Island is perhaps the largest. It is about 4.83 km. away from Tuticorin port and has about 58.85 hectares of land area. There is a lighthouse at the northern extremity. This island is connected with the mainland through a marshy tract, which during high tide is submerged at least in part. At other times communication is possible along this tract, and the island can be reached from Tuticorin by the land route which is about 11.26 km. long. The island is practically uninhabited except for the lighthouse personnel.

Church Island lies north of Hare Island and about 6.44 km. from the Tuticorin coast. When compared with Hare Island, it is much smaller and deep ocean channels separate it from the mainland and from the other islands. The island is uninhabited except for occasional visits of fishermen, fuel-gatherers, and coral stone cutters, who come to this and other neighbouring islands.

Church Island is practically flat and is only a few feet above mean sea-level with perceptibly no major undulations of sand dunes. The entire area of the island is practically covered with vegetation, though of restricted types. As a result, the whole island appears green throughout. Strangely enough, there are no trees of any appreciable size on this island. The vegetation is, thus, mainly characterised by low scrub or groups of shrubs and herbs, and small tussocks of grasses and sedges.

General Aspect of Vegetation

At the foreshore and well above the high-tide mark, *Sesuvium portulacastrum* Linn. forms extensive patches of creeping succulents with deep reddish colour in stems and older leaves. In places this species forms a more or less pure community. In other areas, *Suaeda fruticosa* Forsk. was met with along with *Sesuvium*, in sandy places as low bushes together with *Suaeda monoica* Forsk. A little to the interior and behind the *Sesuvium-Suaeda* belt, *Cyperus pachyrrhizus* Nees appears as a tall plant with large flower heads. Grasses and sedges were noted as most frequent from the foreshore to the very centre of the island. *Pycreus odoratus* Urb. was not uncommon just behind the belt of *Cyperus pachyrrhizus* Nees. In more or less open situations and on substrate which is

composed of broken shells, dead corals, and coarse-grained sand, *Sporobolus tremulus* Kunth was noticed as wiry prostrate or spreading plants with erect panicles. Nearer shore, on small mounds, *Sporobolus indicus* R. Br. occupied large areas. Where the sand is more even and shells and dead corals not in such abundance as to characterise the area, *Bulbostylis barbata* Kunth with its needle-like leaves and tufted habit was most characteristic. This species was also noticed in various other situations and all over the island. *Spinifex littoreus* (Burm. f.) Merr. extends from the foreshore to the interior of the island, but occurs only here and there as a minor formation. Likewise, *Ipomoea pes-caprae* (Linn.) Sweet is seen in many places but nowhere does it cover large areas to form pure or major formations. In the midst of *Spinifex littoreus* (Burm. f.) Merr. and *Ipomoea pes-caprae* (Linn.) Sweet, *Launaea sarmentosa* (Willd.) Alston (=*Launaea pinnatifida* Cass.) was fairly common. In places, some distance from the foreshore and in association with *Ipomoea pes-caprae* (Linn.) Sweet, *Scaevola plumieri* Vahl. forms low bushes. Here and there in this belt, *Dichanthium annulatum* (Forsk.) Stapf was noticed as a tall and stiff grass together with *Cyperus arenarius* Retz. The latter extends also to the foreshore, where it occurs in larger numbers. At other situations, a little into the interior of the island but not far from the coast, *Halopyrum mucronatum* Stapf was observed growing more or less prostrate with its somewhat rigid and stiff flowering axis erect. In somewhat protected areas *Scirpus affinis* Roth. was noticed on shingly ground. *Sporobolus marginatus* Hochst. ex A. Rich. (=*Sporobolus arabicus* Boiss.) was also common here and there in many areas. On sandy mounds and uneven undulations, not far from the coast, *Atriplex stocksii* Boiss. was found forming more or less open communities. In certain restricted places *Arthrocnemum indicum* Moq. was also growing on sandy tracts and mounds.

More to the interior and towards the central portion of the island the vegetation changes somewhat to low scrub and bushes, with herbaceous species intermixed. Towards the outer limits of this belt, on shingly ground with hard shells and dead corals, *Enicostemma verticillatum* (Linn.) Engl. (=*Enicostemma littorale* Bl.) is met with. *Salvadora persica* Linn. forms low and thin thickets here and there. *Oldenlandia umbellata* Linn. is another species found in many places in these parts of the island where the soil is firm and hard. The middle or central portion of the island was, to a very large extent, covered by *Indigofera oblongifolia* Forsk., forming a more or less pure stand or community in the island. The plants were stiff and low bushes so close together as to form thickets;

[Figs 1-6]

1. *Bulbostylis barbata* Kunth; 2. *Enicostemma verticillatum* (Linn.) Engl.; 3. *Atriplex stocksii* Boiss.; 4. *Sporobolus indicus* R. Br.; 5. *Suaeda fruticosa* Forsk.; 6. *Halopyrum mucronatum* Stapf.

20 mm.
[Fig.-7]

20 mm.
[Figs. 8-10]

7. *Cyperus pachyrrhizus* Nees.; 8. *Pycreus odoratus* Urb.; 9. *Sporobolus tremulus* Kunth; 10. *Scirpus affinis* Roth.

under these *Bulbostylis barbata* Kunth was common. *Indigofera viscosa* Lam. was also noticed with *I. oblongifolia* Forsk. Here and there small *Acacia* plants were noticed. In shady situations seedlings of *Euphorbia* sp., *Acacia* sp., *Phaseolus trilobus* Ait. were also noted. Right in the centre of the island, and at the *Indigofera oblongifolia* Forsk. belt, there were two or three open patches of ground wherein *Aloe barbadensis* Mill. grew in numbers in almost pure formations; most plants were flowering profusely, their flowering tops with several scarlet flowers standing high above the general level of the vegetation of the island. They could easily be detected even from a distance.

Special Features of the Vegetation

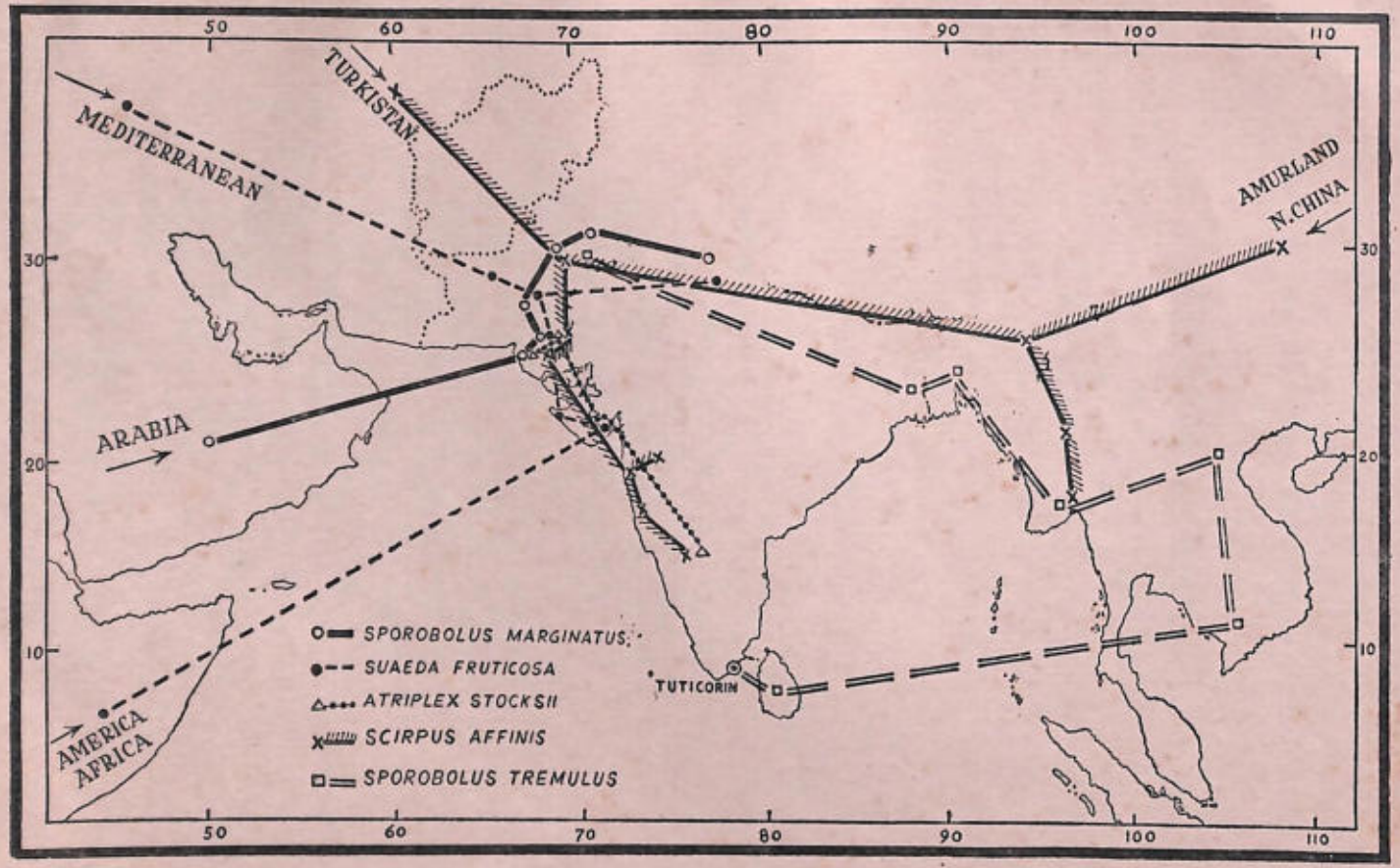
Absence of trees is characteristic of the island. The vegetation in the island is of a very open type, owing evidently to human interference. Although Church Island is very near to Hare Island, which again is not far off from the mainland, many of the species of Hare Island have apparently not succeeded in establishing themselves in Church Island so far. Thus, for example, *Thespesia populnea* Corr., *Acacia planifrons* W. & A., *Zizyphus jujuba* Lamk., *Jatropha glandulifera* Roxb., *Gloriosa superba* Linn., *Arthrocnemum fruticosum* var. *glaucum* Moq., *Cyperus aristatus* Rottl., *Chloris virgata* Sw., *Solanum xanthocarpum* Sch. & Wendl. are conspicuously absent from Church Island. Similarly *Cassia auriculata* Linn. and *Cissus quadrangularis* Linn., which were found growing over very extensive areas in Hare Island, were not seen in Church Island. Likewise Mangrove species have not set in in this island, obviously because the situations favourable for mangrove vegetation are not yet present in the island. It is interesting to note also that such conspicuous species as *Pandanus* and *Borassus*, which are present in other islands in the Gulf of Manaar, are not seen in Church Island.

Among the species now recorded from Church Island *Sporobolus marginatus* Hochst. ex A. Rich. (=*Sporobolus arabicus* Boiss.) *Scirpus affinis* Roth., *Atriplex stocksii* Boiss., and *Suaeda fruticosa* Forsk. would seem not to have been reported so far from the east coast of India, although their occurrence in the Punjab, Sind, and western Peninsula is recorded by Hooker and Cooke in the FLORA OF BRITISH INDIA and THE FLORA OF THE BOMBAY PRESIDENCY respectively. The occurrence of the species in Church Island is, thus, of considerable distributional interest.

Similarly, though species like *Sporobolus tremulus* Kunth, *Pycreus odoratus* Urb., *Dichanthium annulatum* (Forsk.) Stapf, are

reported by Gamble from the Madras Presidency and the eastern peninsula of India, they are not reported by Cooke or Hooker in their respective floras, which would seem to suggest a restricted distribution in the eastern parts of south India.

From the accompanying map (Plate III) which indicates the general distribution pattern of the species referred to above within India, the following points would emerge. Among the species with westerly distribution in India, *Sporobolus marginatus* Hochst. ex A. Rich. (=*Sporobolus arabicus* Boiss.) has perhaps the least range, being confined to Sind, Punjab, and Baluchistan. *Suaeda fruticosa* Forsk. has also a more or less restricted distribution being confined to NW. India, W. Punjab, and W. India. It is perhaps *Scirpus affinis* Roth. that has the greatest range among the species, extending from Punjab in the west to Assam in the east. *Atriplex stocksii* Boiss. and *Scirpus affinis* Roth. show greater southerly distribution, extending to Hyderabad and Deccan. Some of the species of the western parts of India have their distribution extended to Arabia (*Sporobolus marginatus* Hochst. ex A. Rich.), Africa, and westwards to America (*Suaeda fruticosa* Forsk.), and to the Mediterranean (*Suaeda fruticosa* Forsk.). *Scirpus affinis* Roth., however, shows an opposite tendency extending further in the east to Burma, north China, and north Asia. It would seem to suggest that migrations from these parts of these species into north-east and west India in the past have not progressed much in the wide distribution of these species within India, except that *Atriplex stocksii* Boiss. and *Suaeda fruticosa* Forsk. have advanced further south. Likewise, *Sporobolus tremulus* Kunth, which has its distribution in Cambodia in the east, has advanced westwards to India and is now found in upper India as well as in all districts in Madras, except the west coast of India and the Ghats. Thus the occurrence in Church Island of the species with the hitherto known westerly distribution in America, Mediterranean, Africa, and Arabia, and confined to western and north-western parts of India, and the species known hitherto from the eastern Peninsula with the distribution in the east in north Asia, Cambodia, etc. would seem to suggest that, in this part of the Peninsula, there is perhaps a convergence of the species native to the regions eastern and western relative to India.



Map showing the distribution pattern of some species

ACKNOWLEDGEMENT

The author wishes to express his grateful appreciation to Rev. Fr. H. Santapau, S.J., for his helpful suggestions and kind criticisms of the paper.

CHECK LIST OF THE SPECIES

LEGUMINOSAE
Indigofera viscosa Lam.
I. oblongifolia Forsk.
Phaseolus trilobus Ait.
Acacia sp.

AIZOACEAE
Sesuvium portulacastrum Linn.

RUBIACEAE
Oldenlandia umbellata Linn.

COMPOSITAE
Launaea sarmentosa (Willd.) Alston.

GOODENIACEAE
Scaevola plumieri Vahl.

SALVADORACEAE
Salvadora persica Linn.

GENTIANACEAE
Enicostemma verticillatum (Linn.) Eng.

CONVOLVULACEAE
Ipomoea pes-caprae (Linn.) Sweet.

CHENOPODIACEAE
Atriplex stocksii Boiss.
Arthrocnemum indicum Moq.
Suaeda monoica Forsk.
S. fruticosa Forsk.

EUPHORBIACEAE
Euphorbia sp.

LILIACEAE
Aloe barbadensis Mill.

CYPERACEAE
Pycreus odoratus Urb.
Cyperus pachyrrhizus Nees.
C. arenarius Retz.
Bulbostylis barbata Kunth.
Scirpus affinis Roth.

GRAMINEAE
Spinifex littoreus (Burm. f.) Merr.
Dichanthium annulatum (Forsk.) Stapf.
Halopyrum mucronatum Stapf.
Sporobolus tremulus Kunth.
S. marginatus Hochst. ex A. Rich.
S. indicus R. Br.

A Study of the Seasonal Foods of the Black Francolin[1] [*Francolinus francolinus* (Linnaeus)], the Grey Francolin[1] [*F. pondicerianus* (Gmelin)], and the Common Sandgrouse (*Pterocles exustus* Temminck) in India and Pakistan

BY

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The conservation and wise use of our natural resources is important to everyone. The value of good soil, adequate water, and abundant forests to the country, although well known to the technical man, is just beginning to be understood by a small part of the general public. Only a handful of people appreciate the need for protecting and maintaining our birds and mammals, especially the species that provide hunting and are used for food.

No plan for making our renewable natural resources more productive can succeed for long unless it is based on an adequate study of the factors that produce these resources. For example, with game species one must know not only how much hunting pressure they can take and still produce a good crop of game the following year, but also where they live, what they eat, how they are affected by floods and drought, and what are their natural enemies. Only when one has reliable information on these and other factors, can a well-thought-out plan be developed.

[1] The popular names in use in India and Pakistan for *F. francolinus* and *F. pondicerianus* are Black Partridge and Grey Partridge respectively. In this paper the authors have used the names Black Francolin and Grey Francolin in order to avoid confusion with certain other species existing in America and spoken of there as partridges.—EDS.

It was with this in mind that the authors made a study of the food habits of three species of game birds that are common in India and Pakistan. Except for C. W. Mason, an entomologist, who in 1912 reviewed the few references available and contributed an excellent list of insects found in the crops of Black Francolin, very little definite information is available. The other authors, listed in the references, either mention the food habits of the francolins and the sandgrouse in general terms or list one or two specific species which are commonly eaten.

The data here presented are based on an examination of the crop contents of 23 Black Francolin [*Francolinus francolinus* (Linnaeus)], 54 Grey Francolin [*Francolinus pondicerianus* (Gmelin)], and 47 Common Sandgrouse (*Pterocles exustus* Temminck). These birds were collected mostly in Sind (Pakistan) in 1956-57, and Rajasthan (India) in 1959-60, during the spring, summer, fall, and winter months. Though additional crops are desirable it is felt that the records so far obtained indicate the general food habits of the species involved and should be of beneficial use to the wildlife manager. Our hope is that this paper will, even in a modest way, stimulate additional studies which will lead towards a balanced game management programme for these species.

Since the collection of crops was made only as opportunity offered, the distribution of birds collected by seasons leaves room for further investigation. The seasons utilized were chosen after consultation with appropriate Government officials and local naturalists. In the areas concerned, spring and fall blend into summer and winter more quickly than in more temperate climates. Plants reflect these changes. Accordingly spring was designated as occurring between March 1-April 15; summer, April 16-September 15; fall, September 16-October 31; and winter, November 1-February 28. Based on this, the following is the distribution of birds collected by seasons:

Species	*Number collected by seasons*				
	Spring	*Summer*	*Fall*	*Winter*	*Total*
Black Francolin	5	8	1	9	23
Grey Francolin	0	28	7	19	54
Common Sandgrouse	6	14	11	16	47

Since no adequate collection of the seeds of wild plants was available for reference it was necessary to check many of the identifications by actually collecting the same seeds from wild plants in the countryside. In some cases the seeds taken from the crops of the birds were planted

first in pots and identified only after the resulting plant had grown to maturity. The identification of the insects eaten are given, in most cases, down to the order and family.

Food of the Black Francolin

All the Black Francolin examined were collected from Sind (West Pakistan). The study indicates clearly that this species is omnivorous. A total of 19 different genera of plants and 4 orders (including 12 species) of insects were found in the crops examined. In addition, one bird had eaten an earthworm, one a spider, two more had fed almost entirely on human excrement, and one, collected after a rainstorm, had swallowed an inch and a half toad. Of the 23 birds examined two had consumed insects only, 9 plants only, and 12 had eaten both.

Insects are eaten at all seasons of the year. Ants and beetles were commonly found in the crops, although wasps and flies were also identified. One bird, collected in August, had eaten 21 ants, 1 earthworm, 4 unidentified larvae, about 500 small pink midges, and a spider.[1]

Plants, however, make up the bulk of the food of the Black Francolin throughout the year. Seeds of mustard (*Brassica campestris*), wild pea (*Lathyrus sativus*), cultivated grain, and grass seed were most commonly eaten. Parts of 20 different species of plants were identified which included seeds, fruits, tubers, grains, leaves, and a small amount of roughage in the form of twigs, husks, and dried grasses.

In winter the wild pea and the common mustard are favourite foods. One bird shot in February had made a meal of 250 wild peas ; another, of over 300 mustard seeds with some leaves from the same species.

In spring, with the harvesting of the winter grains underway, the birds often turn their attention to wasted wheat (*Triticum vulgare*), barley (*Hordeum* sp.), and rice (*Oryza sativa*) whenever they are available, although other seeds are by no means avoided. One bird, collected in April, had scratched up and eaten 12 large tubers of a desert sedge (*Cyperus arenarius*) and others had fed largely on wild peas.

It is during the summer and fall, however, that the Black Francolin seeks out a great variety of plant foods. Most of those mentioned above were commonly found in the crops examined, but the largest number of seeds and inflorescences were from four genera of grasses that ripened at this time. One individual, collected in September, had a full crop of 1850 grass seeds representing four species, 250 seeds of Indian mallow (*Abutilon* sp.), one seed of *Rhynchosia* sp., and five other seeds, still unidentified. Another bird, shot in October, had consumed about 1000 seeds of *Setaria verticillata* and 54 seeds of three other grass species.

Table I gives the seasonal analysis of foods eaten.

[1] Grasshoppers were commonly found in the crops of Black Francolin collected by one of the authors in Iraq in 1951. Ticehurst, Buxton, & Cheesman (1922) record one crop that was crammed with the harmful locust *Decticus albifrons*.

TABLE I

Foods eaten by the Black Francolin according to Season and number of Crops in which each was found

Food		Parts eaten	Season			
			Spring	Summer	Fall	Winter
PLANT						
Abutilon sp. ..	Indian Mallow	Seeds		1		
Brassica campestris ..	Mustard	Seeds				2
Cephalandra indica ..	a cucurbit	Seeds		1		
Cyperus arenarius ..	Flat Sedge	Rhizome	1			
Dactyloctenium aegyptium	a grass	Seeds		1		
Dactyloctenium scindicum..	a grass	Inflorescence		1		
		Seeds		1	1	
Echinochloa colonum ..	Jungle Rice	Peduncle			1	
		Seeds		2	1	
Eriochloa procera ..	a wild millet	Inflorescence		2		
Hordeum sp. ..	a barley	Seeds	3			
Lathyrus sativus ..	Wild Pea	Seeds	1			7
Lathyrus sp. ..	a pea	Seeds	1			
Launaea nudicaulis ..	a compositae	Inflorescence				1
		Leaves				1
Mukia scabrella ..	a cucurbit	Fruits		2		
		Seeds		2		
Oryza sativa ..	Rice	Seeds	3	3		
Panicum miliaceum ..	Broom Corn Millet	Seeds	1			
Pennisetum typhoideum ..	Bajra, a millet	Seeds	1			
Phaseolus mungo ..	Pulse	Seeds		1		
Rhynchosia sp. ..	a legume	Seeds		1		
Setaria verticillata ..	Bristlegrass	Seeds		1	1	
Solanum nigrum ..	Black Nightshade	Fruit				1
Triticum vulgare ..	Wheat	Glumes	1			
		Leaves				1
		Seeds	2	1		
ANIMAL						
Hymenoptera ..	Small black ants	Whole		3		
	Medium black ants	Whole	5	1		1
	Large black ants	Whole	1	1		
	Red ants	Whole	1	1		
	Wasp	Whole		1		
Diptera ..	Fly	Whole		1		
	Midge	Whole		1		
Coleoptera ..	Small black beetles	Whole		1		1
	Medium black beetles	Whole		1		
	Large black beetles	Whole	1	1		
	Striped beetle	Whole				1
	Brown beetle	Whole	2			
Araneae ..	Spider	Whole		1		
Pheretima sp. ..	Earthworm	Piece		1		
Bufo sp. ..	Toad	Whole	1			
MISCELLANEOUS						
	Human excrement					2
	Grit					1

Food of the Grey Francolin

Of the 54 birds examined 38 were collected from western India and 16 from West Pakistan. Like the Black, the Grey Francolin is omnivorous. Of the crops examined 23 contained only plant material, one only insects, and in 30 both plant and animal items were found. From these, 33 species of plants and 7 orders of insects were identified. Miscellaneous items eaten included fragments of coal, baked bricks, grit, and snail shells. Animal material, other than insects, was limited to a few solifugids and spiders.

A great variety of weed seeds with some cultivated grain made up the bulk of the plant food. Members of the grass family are also well represented. Seeds were the prominent form of the plant food eaten. The variety and quantity of food taken is surprising. For example, one crop collected in upper Sind on February 26 contained 1 wheat seed (*Triticum vulgare*), 1 of wild melon (*Citrullus colocynthis*), 1500 of *Dactyloctenium scindicum*, 2000 of jungle rice (*Echinochloa colonum*), 4 of *Abutilon* sp., 5 of cockscomb (*Celosia* sp.), 1 unidentified seed, 1 green leaf, 1 large black beetle, 1 small beetle, and 2 termites. Another crop collected in Rajasthan in July contained green grass blades, hundreds of termite larvae (white ants), 6 cutworms, 18 tenebrionids, 3 carabids, 8 hydrophillids, 3 weevils, and grit.

Insect food was taken abundantly in the summer with the Grey Francolin showing a high preference for ants and termites. Interestingly enough beetles, some of which were of large size, comprised a substantial portion of the diet. In winter, where mustard is available, it is a favourite food.

The analysis of foods eaten in summer, fall, and winter is presented in Table II. No birds were collected in the short period represented by spring.

Table II

Foods eaten by the Grey Francolin according to Season and number of Crops in which each was found

Foods		Parts eaten	Season		
			Summer	Fall	Winter
PLANT					
Abutilon sp. ..	Indian Mallow	Seeds	1		2
Acacia sp. ..		Seeds	4		
Brassica campestris ..	Mustard	Flower buds			3
		Flowers			2
		Pods			1
		Seeds			2
		Leaves			4
Capparis aphylla ..		Seeds	9		4
Celosia sp. ..	Cockscomb	Seeds			4
Cephalandra indica ..	a cucurbit	Fruit skin	1		
		Seeds	1		

Food		Parts eaten	Season		
			Summer	Fall	Winter
Citrullus colocynthis ..	Wild Watermelon	Seeds	2		1
Cyperus rotundus ..	Flat Sedge	Rhizome	1		
Dactyloctenium aegyptium	a grass	Seeds	1		
Dactyloctenium scindicum	a grass	Spikelets			1
		Seeds	1		4
Echinochloa colonum ..	Jungle Rice	Seeds	4		2
Eragrostis minor ..	a lovegrass	Seeds		3	
Eriochloa procera ..	a wild millet	Seeds	4		2
Farsettia jacquemontii ..	a cruciferae	Flower buds			3
		Pods			4
		Seeds	1		1
Gynandropsis gynandra ..		Seeds	3		2
Indigofera sp. ..	Indigo	Seeds		-	2
Lathyrus sativus ..	Wild Pea	Seeds			1
Launaea nudicaulis ..	a compositae	Inflorescence			3
		Leaves			1
Mukia scabrella ..	a cucurbit	Fruit skin	2		
		Seeds	2		
Panicum antidotale ..	Panicgrass	Seeds	1		1
Panicum turgidum ..	Panicgrass	Seeds	8	5	1
Pennisetum typhoideum ..	Bajra, a millet	Seeds	6		4
Phaseolus aconitifolius ..	Pulse	Seeds	1		3
Phaseolus radiatus ..	Pulse	Seeds			2
Rhynchosia sp. ..	a legume	Seeds			1
Scirpus sp. ..	Bullrush	Rhizome	2		
Setaria verticillata ..	Bristlegrass	Seeds	1		
Solanum nigrum ..	Black Nightshade	Fruit			1
Sorghum sp. ..	Sorghum	Seeds	4	3	1
Tephrosia purpurea ..	a legume	Seeds			3
Tribulus sp. ..		Seeds			1
Triticum vulgare ..	wheat	Seeds	2		1
Zizyphus sp. ..	Jujube	Fruit	4		
Unidentified ..	Grass	Blades	8	3	1
ANIMAL					
Hymenoptera ..	Ants	Whole	10	1	5
Isoptera ..	Termites—adult and larvae	Whole	10		1
Coleoptera ..	Beetles	Whole			3
Scarabidae ..	a beetle	Whole	4		2
Tenebrionidae ..	a beetle	Whole	5	1	
Hydrophyllidae ..	a beetle	Whole	5	1	
Carabidae ..	a beetle	Whole	5	1	
Elateridae ..	Click beetles	Whole	1		
Buprestidae ..	a beetle	Whole	1		
Curculionidae ..	Weevils	Whole	4		
Lepidoptera ..					
Noctuidae ..	Cutworms	Whole	3	1	
Orthoptera ..	Grasshoppers, Crickets	Whole	2		1
Homoptera ..	Bugs	Whole	2		
Diptera ..	Flies	Whole	1		
Solifugae ..		Whole	2		
Araneae ..	Spiders	Whole	1		
MISCELLANEOUS					
	Grit	Pieces	9	4	4
	Snail shells	Whole	1		
		Pieces			2
	Coal	Pieces			2
	Baked brick	Pieces			2

Food of the Common Sandgrouse

Seven of the Common Sandgrouse examined were collected within 40 miles of Karachi (West Pakistan) and 40 were from western India, mostly from about Jodhpur, Delhi, and Poona.[1] This sample indicates that the food habits of this species are much different from those of the francolins previously examined. No insects were found, the diet, apparently, being restricted almost entirely to seeds.[2] Interestingly enough the majority of the seeds eaten were leguminous, and those species most abundantly taken (the *Indigoferae*) are extremely small seeds. In contrast to the francolins which take some cultivated grains and seeds of weeds often associated with agriculture, the sandgrouse prefers the seeds of wild plants. Thus the bird is in no way dependent upon agriculture and can therefore inhabit the more arid regions of India and Pakistan. The sandgrouse does not entirely ignore cultivated grains, however, as is shown by the presence of several cultivated seeds (*Phaseolus* and *Cyamopsis*) in minor quantities. The *Tephrosiae* which offer a fair-sized seed in contrast to the minute *Indigoferae* are also one of the favourite foods.[3]

Substantial quantities of seeds are consumed as can be seen by the following examples. In the crop of one bird, collected on March 12 near Karachi (Pakistan), there were about 5600 seeds of *Indigofera cordifolia*, 51 seeds of *Tephrosia tenuis*, 89 of *Indigofera uniflora*, and 9 of *Indigofera anabaptista*. The crop of another bird, collected on February 8 at Sambhar Lake, Rajasthan (India), contained about 10,000 seeds of *Indigofera linifolia*, 350 of *Crotalaria* sp., 1 of *Tephrosia strigosa*, 2 of *Panicum* sp., 1200 of *Gynandropsis gynandra*, 1 of *Tephrosia purpurea*, 5 of *Phaseolus radiatus*, and slightly over 100 seeds of species as yet unidentified.

The analysis of the foods eaten in the spring, summer, fall, and winter is presented in Table III.

Relation of these Species to Agriculture

In considering the food eaten by any wild bird or mammal one of the questions frequently raised is its effect on agriculture. Misconceptions on this point are common and many game mammals and some birds are often killed in the mistaken notion (or the excuse) that they seriously damage farm crops.

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[1] The authors gratefully acknowledge the considerable assistance of Fr. Joe Rodrigues in collecting sandgrouse for examination from the country east of Poona, his work being carried out with the aid of funds received by him from the Bombay Natural History Society out of a grant received by the Society from the Rockefeller Fund.

[2] Hume & Marshall (1880) found two insects in the crop of Common Sandgrouse.

[3] Jerdon (1864) records the Common Sandgrouse as feeding on various hard seeds especially those of various *Alysicarpi*, *Desmodium*. Hume & Marshall (1880) say that 'no small seeds seem to come amiss'; Baker (1921) mentions 'hard seeds and grain'; and an anonymous author refers to the seeds of the common thistle as a favourite food.

TABLE III

Foods eaten by the Common Sandgrouse according to Season and number of Crops in which each was found

Foods		Parts eaten	Season			
			Spring	Summer	Fall	Winter
PLANT						
Alysicarpus sp. ..		Seeds	2	3	5	
Amaranthus sp. ..	Amaranth	Seeds				1
Crotalaria sp. ..	Rattlewort	Seeds	1			6
Cyamopsis psoralioides ..		Seeds				2
Desmodium sp. ..	Beggarweed	Seeds				3
Euphorbia sp. ..	Spurge	Seeds		1		
Gynandropsis gynandra ..		Seeds				5
Heliotropium strigosum ..	a heliotrope	Seeds	2	6	7	4
Indigofera anabaptista ..	an indigo	Seeds	1	3		
Indigofera cordifolia ..	an indigo	Seeds	2	5	1	1
Indigofera enneaphylla ..	an indigo	Seeds			2	2
Indigofera linifolia ..	an indigo	Seeds	4	7	8	9
Indigofera uniflora ..	an indigo	Seeds	1	4	6	
Panicum antidotale ..	Panicgrass	Seeds				
Panicum sp. ..	Panicgrass	Seeds				5
Panicum turgidum ..	Panicgrass	Seeds			1	
Phaseolus aconitifolius ..	Pulse	Seeds				1
Phaseolus radiatus ..	Pulse	Seeds				4
Tephrosia purpurea ..	a legume	Seeds	4	6	3	6
Tephrosia sp. ..	a legume	Seeds			1	
Tephrosia strigosa ..		Seeds			5	10
Tephrosia tenuis ..	Hoary Pea	Seeds	2	2		
Unidentified ..	Grass	Blades	2	1		
MISCELLANEOUS ..	Grit	Pieces	3	5	6	6

None of the three species here considered normally falls in this category. Farmers, generally, are glad to have or are indifferent to the presence of francolin and sandgrouse on their lands. Their good judgment in this respect is amply borne out by the results of this study. These birds do very little, if any, damage to farm crops and the good, in terms of weed seeds and insects consumed by them, is not to be overlooked. From the food habits as well as the sporting point of view they are among the most desirable game birds resident on the Indian subcontinent.

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Notes on Shipworms from Visakhapatnam Harbour[1]

BY

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(*With four text-figures*)

In the course of a detailed study of the Teredinidae of Visakhapatnam harbour, the author (1955) was able to describe thirteen species belonging to the genera *Teredo* and *Bankia*. Though Teredines have been extensively studied in various countries, our knowledge of the tropical forms is very meagre. From Cochin harbour, Erlanson (1936) noted the occurrence of five species. Nair (1954, 1955a, and 1955b) reported seventeen species of shipworms from the Madras coast. Roonwal (1954) recorded the occurrence of *Bactronophorus thoracites* from the Sunderbans. Palekar & Bal (1955) described four species of *Teredo* and three species of *Bankia* from Bombay harbour. Nair & Gurumani (1956, 1957) described a new species of *Teredo* from south India.

The present communication deals with ten more shipworms collected from Visakhapatnam harbour. Out of these, five species are the first records from Indian waters. In the treatment of the species the classification given by Bartsch (1922) and Roch (1953, 1955) was followed.

Collections of specimens were made in the Visakhapatnam harbour waters during the years 1953-57 from timber jetties, catamaran logs used for fishing, and standard test boards of deal wood of various convenient sizes.

All drawings were made with the aid of the camera lucida.

SYSTEMATIC TREATMENT OF THE GROUP

Genus **Teredo** Linnaeus

Subgenus TEREDO Linn

1. **Teredo (Teredo) bensoni** Edmondson

Subgenus COELOTEREDO Bartsch

2. **Teredo (Coeloteredo) singaporeana** Roch

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[1] Formed part of the thesis for the D.Sc. Degree of Andhra University. Contribution from the Zoology Department, Andhra University, Waltair.

Subgenus DACTYLOTEREDO Roch

3. **Teredo (Dactyloteredo) juttingae** Roch

Subgenus LYRODUS Gould

4. **Teredo (Lyrodus) milleri** Dall, Bartsch, & Rehder
5. **Teredo (Lyrodus) malaccana** Roch

Genus **Bankia** Gray

Subgenus LILIOBANKIA Clench & Turner

6. **Bankia (Liliobankia) campanellata** Moll & Roch

Subgenus BANKIELLA Bartsch

7. **Bankia (Bankiella) carinata** Gray

Subgenus PLUMULELLA Clench & Turner

8. **Bankia (Plumulella) thielei** Roch
9. **Bankia (Plumulella) lineata** Nair

Genus **Nausitora** Wright

10. **Nausitora dunlopei** Wright

Genus **Teredo** Linnaeus

1758. *Teredo* Linnaeus, in Syst. Nat., ed. 10, p. 651.
1922. *Teredo* Bartsch, in *Bull. U.S. Nat. Mus.* **122** : p. 17.

Pallets are either paddle- or spoon- shaped. They may be distally cupped or not.

Subgenus TEREDO Linn.

1758. *Teredo* Linn., in Syst. Nat., ed. 10, p. 651.
1922. *Teredo* Bartsch, in *Bull. U.S. Nat. Mus.* **122** : p. 17.

Pallets paddle-shaped with the blade cupped distally terminating laterally in sharp points.

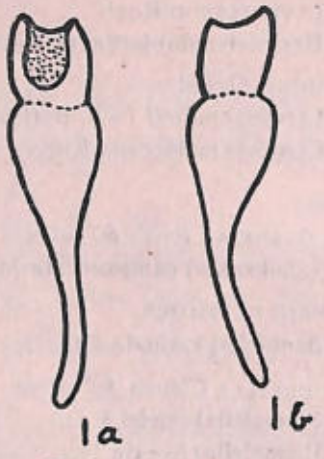
Teredo (Teredo) bensoni Edmondson

1946. *Teredo* (*Teredo*) *bensoni* Edmondson, in *Occas. Papers B.P. Mus.* **18** : p. 213.

Pallets paddle-shaped with stout, curved stalk ; blade short, broad and its basal portion gradually merges into the stalk. The distal portion of the blade excavated deeply on the outer surface, inner surface is smooth. Dark brown periostracum covers the blade nearly to its base.

Measurements : Pallets : total length 4.2 mm., out of which 3.5 mm. belongs to the stalk.

Distribution : Honolulu harbour ; very rare in Visakhapatnam harbour.



Teredo (Teredo) bensoni
Fig. 1a : Outer view of pallet × 13 ; Fig. 1b : Inner view of pallet × 13.

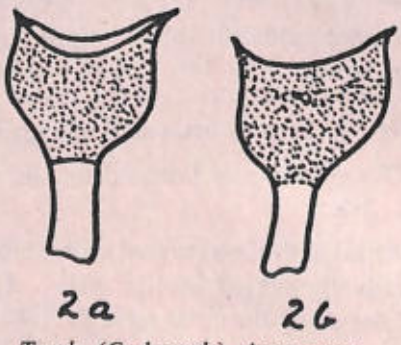
Subgenus COELOTEREDO Bartsch

1953. *Coeloteredo* Bartsch, in *Proc. Biol. Soc. Wash.* **36** : p. 99.

In this subgenus the blade of the pallet forms a hollow cone ; that is, the outer portion is convex while the inner portion of the blade is almost flat.

Teredo (Coeloteredo) singaporeana Roch

1935. *Teredo* (*Coeloteredo*) *singaporeana* Roch, in Roch & Moll *Sitz. Ber. Akad. Wien. Wiss. Math. Natw. Kl. Abt.* I. **144** : p. 266.



Teredo (Coeloteredo) singaporeana
Fig. 2a : Pallet outer view × 12 ; Fig. 2b : Pallet inner view × 12.

Pallets with decidedly cup-shaped depression at the distal end. The distal portion is covered with a dark epidermis, which terminates in the form of two lateral horns. Stalk is shorter than the blade and is very stout at the base.

Measurements: Length of stalk 1.3 mm., length of blade 1.7 mm.

Distribution: Singapore, Sumatra, Madagascar, East Africa, Malacca ; rarely found in Visakhapatnam harbour.

Subgenus DACTYLOTEREDO Roch

1941. *Dactyloteredo* Roch, in Moll *Sitz. Ber. Ges. Natforsch. Freunde* **10** : p. 193.

1952. *Dactyloteredo* Roch, in Moll *Inst. Franç. Afrique Noire Catalogue* **8** : p. 83.

Pallets are oblong and leaf-shaped and provided with more or less nail-like depression on the outer side of the distal end of the blade.

Teredo (Dactyloteredo) juttingae Roch

1955. *Teredo* (*Dactyloteredo*) *juttingae* Roch, in *Zool. Meded.* **34**: p. 135.

Pallets with a blade which is shaped like a finger-nail but it is, however, comparatively smaller in area and does not extend up to the two side walls of the pallet. On the inner side, the blade is concave and smooth and shows a rib running through its centre very much as if the stalk portion extended towards the tip through the pallet. The stalk is very short and stout.

Measurements: Pallets : length of the blade 8 mm. ; length of the stalk 1.5 mm.

Distribution: Sumatra, Philippines, Samoa ; fairly common species in Visakhapatnam harbour and confined to the regions of higher salinities in the harbour area. It was also collected from Kakinada.

Subgenus LYRODUS Gould

1870. *Lyrodus* Gould, in *Invert. Mass.* p. 33.

In this subgenus the terminal portion is not cupped, but ends in two lateral forks, covered with a periostracum.

Teredo (Lyrodus) milleri Dall, Bartsch, & Rehder

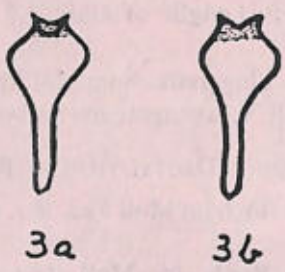
1924. *Teredo affinis* Miller, in *Univ. Calif. Pub. Zool.* **26** : p. 148.

1938. *Teredo* (*Cornuteredo*) *milleri* Dall, Bartsch, & Rehder, in *B.P. Mus. Bull.* **153** : p. 210.

1942. *Teredo* (*Cornuteredo*) *milleri* Edmondson, in *Occas. Papers B.P. Mus.* **17** (10) : p. 114.

1955. *Teredo* (*Lyrodus*) *milleri* Roch, in *Riv. Biol. Colon.* **13**.

Pallets with slender stalk ; blade consisting of a short, urn-shaped, calcareous base, surmounted by a dark brown periostracum which is typically two pointed.



Teredo (*Lyrodus*) *milleri*
Fig. 3a : Outer view of pallet × 17 ; Fig. 3b : Inner view of pallet × 17.

Measurements : Pallets : total length 1.4 mm. ; stalk 0.8 mm.

Distribution : Hawaii ; very rare in Visakhapatnam harbour.

Remarks : Only ten young immature specimens were collected from the test boards at Naval base in Visakhapatnam harbour.

Teredo (Lyrodus) malaccana Roch

1935. *Teredo* (*Lyrodus*) *malaccana* Roch, in *Sitz. Ber. Akad. Wiss. Wien. Math. Natw. KI. Abt.* I. **144** : p. 269-270.

1955. *Teredo* (*Lyrodus*) *malaccana* Roch, in *Zool. Meded.* **34** : p. 136-139.

Teredo (*Lyrodus*) *malaccana*
Fig. 4 : Pallet, inner view × 10.

Pallets slender and typically of *Lyrodus* shape ; blade covered by dark brown periostracum which occupies greater portion of calcareous blade and is not produced into distinct lateral forks.

Measurements : Pallets : total length 4.1 mm. ; length of stalk 2.2 mm.

Distribution : Malaya, Indonesia, very few forms collected from the Visakhapatnam harbour.

Genus **Bankia** Gray

1840. *Bankia* Gray, in Synop. Brit. Mus. Ed. **42** : p. 154.
1922. *Bankia* Bartsch, in *Bull. U.S. Nat. Mus.* **122** : p. 7.

The pallets consisting of a series of cone-in-cone structures which give them the appearance of the ear of wheat.

Subgenus LILIOBANKIA Clench & Turner

1946. *Liliobankia* Clench & Turner, in Johnsonia **2** : p. 17.

Pallets have a moderately wide and smooth margin of periostracum which is produced laterally to form wide, blunt awns. The embryonic cones are not crowded at the tip of the pallet but are distally spaced.

Bankia (Liliobankia) campanellata Moll & Roch

1931. *Bankia* (*Liliobankia*) *campanellata* Moll & Roch, in *Proc. Malac. Soc. Lond.* **19** : p. 215.
1955. *Bankia* (*Liliobankia*) *campanellata* Roch, in *Zool. Meded.* **34** : p. 140.

Pallets consisting of a series of widely spaced cones ; calcareous portion of each cone funnel-shaped ; periostracal margin of the outer surface slightly U-shaped and smooth while the inner margin is flat ; laterally the periostracum is produced into wide, blunt awns which are curved upwards.

Measurements : Pallets : total length 30 mm., of which 15 mm. go to form the stalk.

Distribution : Malaya Archipelago, Sumatra ; most common species of *Bankia* in Visakhapatnam harbour.

Subgenus BANKIELLA Bartsch

1921. *Bankiella* Bartsch, in *Proc. Biol. Soc. Wash.* **34** : 26.

Pallets consisting of a series of cone-in-cone elements covered by a thin membrane which is neither fimbriated nor denticulated at the free margin, but entire.

Bankia (Bankiella) carinata Gray

1827. *Bankia carinata* Gray, in *Phil. Mag.* **2** : p. 411.
1954. *Bankia* (*Bankiella*) *indica* Nair, in *Rec. Ind. Mus.* **52**, (2-4) : p. 393-396.
1955. *Bankia* (*Bankiella*) *carinata* Roch, in *Zool. Meded.* **34** : p. 139.

Pallets with cone-in-cone type joints which are funnel-shaped ; the blade consists of well-spaced cups, the rims of which are covered by brown periostracum ; the outer side of the blade is convex and the inner side flat.

Measurements: Pallet length 9.5 mm.; length of stalk 5.0 mm.

Distribution: Indonesia, Malacca; in India this species was previously recorded from Calcutta, Bombay, and Madras; very rare in Visakhapatnam harbour.

Subgenus PLUMULELLA Clench & Turner

1946. *Plumulella* Clench & Turner, in Johnsonia **2**: p. 24.

Pallets have long serrated awns. The periostracal margins on both the inner and outer surfaces of each cone are finely to coarsely serrated.

Bankia (Plumulella) thielei Roch

1935. *Bankia* (*Plumulella*) *thielei* Roch, in Roch & Moll *Sitz. Ber. Akad. Wiss. Wien. Math. Natur. Abt.* I. 144: p. 275.

1955. *Bankia* (*Plumulella*) *thielei* Roch, in *Riv. Biol. Colon.* **13**.

Pallets consisting of closely-spaced cones; the periostracal margin of the outer and inner surfaces is coarsely-serrated; stalk is approximately of equal size as the blade of the pallet.

Measurements: Pallets: total length 11 mm., of which 5.8 mm. go to form the stalk.

Distribution: Madagascar; only two pallets were collected once at entrance channel in Visakhapatnam harbour.

Bankia (Plumulella) lineata Nair

1955. *Bankia* (*Neobankia*) *lineata* Nair, in *J. Madras Univ.* **25**: p. 109.

This species was first described by Nair (1955) and included under the subgenus *Neobankia*; but according to the classification given by Clench and Turner (1946) for the genus *Bankia*, it belongs to the subgenus *Plumulella*, as the pallets possess long serrated awns.

Pallets feather-shaped with a cylindrical stalk; the blade consists of distinct cone-in-cone structures, the lateral borders of which are drawn out into slender awns; the inner margin of each cone forms a slender cup while the outer margin is deeply concave.

Measurements: Pallet length 9.2 mm.; length of stalk 4.0 mm.

Distribution: Madras; only few pallets were collected from naval base in Visakhapatnam harbour.

Genus **Nausitora** Wright

1864. *Nausitora* Wright, in *Trans. Linn. Soc. Lond.* **24**: p. 456.

Pallets consisting of a series of cone-in-cone elements which are not entirely free at their distal ends, but fused on the exterior surface.

Nausitora dunlopei Wright

1864. *Nausitora dunlopei* Wright, in *Trans. Linn. Soc. Lond.* **24** : p. 451.

Pallets with a cylindrical stalk which is curved and tapers to a fine sharp point ; the outer surface of the blade is convex and roughly imbricated ; on the inside the blade shows a series of transverse laminae.

Measurements: Pallets : length of blade 8 mm. ; length of stalk 5 mm.

Distribution: Australian waters ; rare in Visakhapatnam harbour, also recorded from Madras and Hooglee River.

Summary

The present survey extends our knowledge of shipworms from Visakhapatnam harbour over previous records by listing ten more species. Of these five species *Teredo* (*Teredo*) *bensoni*, *Teredo* (*Coeloteredo*) *singaporeana*, *Teredo* (*Lyrodus*) *milleri*, *Teredo* (*Lyrodus*) *malaccana*, and *Bankia* (*Plumulella*) *thielei* are recorded for the first time from Indian waters.

Teredo (*Dactyloteredo*) *juttingae* and *Bankia* (*Liliobankia*) *campanellata* are of very common occurrence in Visakhapatnam harbour.

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The Vegetation of Marshes, Swamps, and Riverside in Khandwa District (Madhya Pradesh)

BY

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INTRODUCTION

Although floristic and ecological studies on other types of Indian vegetation have been pursued in our country, the vegetation of rivers, marshes, and swamps has not received enough attention. This type of vegetation is of great botanical interest, and investigations carried out in England and America have yielded useful and significant results on the floristic composition, ecology, distribution, and phenology of this interesting group of plants (see Arber, 1920 ; Fassett, 1940 ; Muenscher, 1944). On Indian hydrophytes, except for the works of Dudgeon (1920), Saxton (1924), Biswas & Calder (1937), Misra (1940), and Mirashi (1954, 1957, 1958), there seems to be very little work done on the aquatic and marsh flora, and particularly there is no record of any ecological or floristic work on the aquatic and marsh plants of new Madhya Pradesh. In fact, the systematic study of the flora in this State has received very scant attention. There are exhaustive floras for Bihar, Madras, Bombay, and Uttar Pradesh. There is none for Madhya Pradesh (*see* Hewetson, 1951), and only partial check-lists have been prepared by Hole (1906), Biscoe (1910), Graham (1911, 1913), Witt (1911, 1916), Haines (1916), and Tiwari (1954, 1955).

It was, therefore, thought proper to make a detailed floristic survey of the aquatic and marsh vegetation of the various parts of Madhya Pradesh. A beginning has been made with the study of the hygrophilous vegetation of Khandwa district.

The present work is based on a number of excursions made by me at various seasons during the years 1958 and 1959, and is confined mainly to the angiospermic flora of the district.

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Geography, Climate, and Forest Vegetation

The Khandwa plateau is situated between 21° 50′-22° 25′ N. and 75° 57′-77° 13′ E. in the Narbadda Division of Madhya Pradesh. It is bounded on the north by the old Indore State, on the west by Indore and the Khandesh district of Bombay, on the south by Khandesh, Amraoti, and Akola districts of the new Bombay State, and on the east by the Hoshangabad and Betul districts. The fertile valleys of the Abna and Sukta rivers lie in the southern part of the Khandwa district. The main range of the Satpuras crosses the district in the southern part, with a width of about eleven miles and rather low elevation, from which a few peaks including that of Asirgarh rise conspicuously. The Khandwa plain has an elevation of about 850 ft. (260 m.) above sea-level.

The Khandwa climate is somewhat cooler than that of Nagpur in the summer and has practically the same temperature during the rains. The cold weather, though not bracing, is distinctly pleasant and lasts from the beginning of November to the middle of March. The hot winds usually begin about the middle of April and blow steadily from directions between north-west and west. Table I gives the climatic data on rainfall and temperature for the years 1950 to 1957. The maximum rainfall for the years given in Table I occurred in 1955, with 44.2 inches or 1121.7 mm., the minimum in 1953 with 15.9 inches or 403 mm. ; the average for these years is 31.9 inches or 812.6 mm., of which more than three-fourths falls between June and October. January is the coldest month of the year. In this month, the mean maximum and mean minimum temperatures are lowest being 29.4° C. and 10.7° C. respectively. The highest maximum temperature of 43.2° C. was recorded in the month of May 1954. The data on relative humidity were not available, as there is no recording station in the area surveyed by me. However, the area is one of the driest in the State and is characterized by low relative humidity.

Table I

Climatological data for 1950-1957 [1]

Year	Annual Rainfall in mm.	Maximum temp. in degrees C.	Minimum temp. in degrees C.
1950	1092.7	41.8	11.7
1951	765.8	42.0	8.8
1952	721.6	42.5	11.0
1953	403.0	41.9	10.1
1954	767.0	43.2	11.5
1955	1121.7	41.9	10.8
1956	1064.0	40.9	11.0
1957	564.9	41.0	12.0

[1] The data were supplied by the District Statistical Office, Nimar, M.P.

General Description of Vegetation

The common habitats of the aquatic and marsh species in this area are a number of natural and artificial tanks and 'kunds' (Rameshwar, Suraj, Padma, and Bhim Kunds), the rivers Abna, Sukta, and Bham and their tributaries, irrigation channels, temporary ponds, and puddles. The Abna and Sukta rivers flow in the southern part of the Khandwa district and maintain a rich, hydrophytic flora. The plants, to name some of them, *Ottelia alismoides* Pers., *Vallisneria spiralis* L., *Hydrilla verticillata* Royle, *Ceratophyllum demersum* L., *Potamogeton perfoliatus* L., *P. indicus* Roxb., *P. pectinatus* L., *Zannichella palustris* L., *Naias minor* All., *Nymphoides cristatum* Ktze., *Lemna paucicostata* Hegelm., *Marsilea quadrifolia* Linn., *Hygrorhiza aristata* Nees, *Ipomoea aquatica* Forsk., *Rottboellia exaltata* L., *Hemarthria compressa* R. Br., *Ischaemum rugosum* Salisb., *Saccharum spontaneum* L., *Scirpus tuberosus* Desf., *S. erectus* Poir., *Cyperus alopecuroides* Rottb., *C. pygmaeus* Rottb., *C. difformis* L., *Fimbristylis complanata* Link, *F. dichotoma* Vahl, *Bacopa monnieri* Penn., *Phyla nodiflora* Greene, *Eclipta prostrata* L., *Exacum pedunculatum* L., *Canscora diffusa* R. Br., *Enicostemma verticillatum* Engl., *Hoppea dichotoma* Willd., *Polygonum plebejum* R. Br., *P. glabrum* Willd., and *P. hydropiper* L., mainly constitute the vegetation of Abna and Sukta rivers and their embankments.

In the neighbourhood of temporary ponds, puddles, and ditches, a rich marsh flora is recognizable. The common species are : *Justicia quinqueangularis* var. *peploides* C.B.Cl., *Hoppea dichotoma* Willd., *Marsilea quadrifolia* L., *Asteracantha longifolia* Nees, *Ammannia baccifera* subsp. *baccifera* Cuf., *Caesulia axillaris* Roxb., *Ageratum conyzoides* L., *Xanthium strumarium* L., *Eclipta prostrata* L., *Polygonum plebejum* R.Br., *Ludwigia parviflora* Roxb., *Alysicarpus bupleurifolius* DC., *Sesbania bispinosa* F. &. R., *Bacopa monnieri* Penn., *Sopubia delphinifolia* G. Don, *Heliotropium strigosum* Willd., *Ipomoea aquatica* Forsk., *Alternanthera sessilis* R.Br., *Euphorbia hypericifolia* L., *Phyllanthus maderaspatensis* L., *Commelina benghalensis* L., *C. hasskarlii* Cl., *Lemna paucicostata* Hegelm., *Wolffia* sp., *Scirpus roylei* Park., *Scleria tessellata* Willd., *Fimbristylis dichotoma* Vahl, *Cyperus iria* L., *C. compressus* L., *Andropogon pumilus* Roxb., *Brachiaria eruciformis* Griseb., *Eriochloa procera* Hubb., *Paspalum distichum* L., *Paspalidium flavidum* A. Camus, and *Echinochloa colona* Link. However, plants like *Justicia quinqueangularis* var. *peploides* C.B.Cl., *Caesulia axillaris* Roxb., *Xanthium strumarium* L., *Bacopa monnieri* Penn., *Alternanthera sessilis* R.Br., *Commelina hasskarlii* Cl., *Lemna paucicostata* Hegelm., *Wolffia* sp., and *Andropogon pumilus* Roxb. occur in pure stands, and the following communities are characteristic of the marsh flora of Khandwa :

(1) *Caesulia axillaris* community.

(2) *Asteracantha-Caesulia* community.

(3) *Justicia-Caesulia-Alternanthera* community.
(4) *Xanthium strumarium* community.
(5) *Andropogon pumilus* community.
(6) *Coix-Scleria* community.

Ecological Classification

The hydrophytes of Khandwa can be classified into the following six life-forms on the basis of their contacts with soil, water, and air :

(1) *Free-floating hydrophytes.* These are in contact with water and air only. They are represented by algae like *Spirogyra*, ferns like *Azolla pinnata* R.Br., and angiosperms like *Lemna paucicostata* Hegelm., *Wolffia*, *Trapa bispinosa* Roxb., *Hygrorhiza aristata* Nees, and *Pistia stratiotes* L., *Ipomoea aquatica* Forsk., an amphibious herb, grows only in shallow water forming a dense network of branches.

(2) *Suspended hydrophytes.* These are rootless, submerged hydrophytes that are in contact with water only, e.g. *Ceratophyllum demersum* L. This species grows in shallow waters, often forming a pure association.

(3) *Attached submerged hydrophytes.* These are, entirely or for the most part, in contact with soil and water only. In some of these, e.g. *Naias minor* All., even the flowers are completely submerged. Others, like *Hydrilla verticillata* Royle, *Vallisneria spiralis* L., *Potamogeton crispus* L., and *P. perfoliatus* L., have their vegetative shoots under water, but the flowers are raised to or slightly above the surface of water. These species occur in pure stands, forming tangled masses of vegetation.

(4) *Attached hydrophytes with floating leaves.* These are in contact with soil, water as well as air. Here are included species like *Potamogeton indicus* Roxb., *Nymphoides cristatum* Ktze., and *Ottelia alismoides* Pers., which are either heterophyllous or possess only the floating leaves.

(5) *Emergent, amphibious hydrophytes.* The root, the lower part of the stem and, in some cases, even the lower leaves of these hydrophytes are usually submerged under water. *Sesbania bispinosa* F. & R., *Scirpus tuberosus* Desf., *Cyperus alopecuroides* Rottb., *Hemarthria compressa* R.Br., and *Ischaemum rugosum* Salisb. are some of the characteristic species of this group.

(6) *Wet-land hydrophytes.* These are rooted to the soil that is usually saturated with water, at least in the early part of their life. Here are included a large number of species of the Khandwa flora. *Ammannia baccifera* subsp. *baccifera* Cuf., *Caesulia axillaris* Roxb., *Eclipta prostrata* L., *Hoppea dichotoma* Willd., *Heliotropium strigosum* Willd., *Bacopa monnieri* Penn., *Justicia quinqueangularis* var. *peploides* Cl., *Asteracantha longifolia* Nees, *Phyla nodiflora* Gr., *Alternanthera sessilis* R.Br., *Polygonum plebejum* R.Br., *Commelina benghalensis* L., *C. hasskarlii* Cl.,

Cyperus pygmaeus Rottb., *C. difformis* L., *Scleria tessellata* Willd., *Fimbristylis dichotoma* Vahl, and *Andropogon pumilus* Roxb., are some of the characteristic species of this class of hydrophytes. Some of them continue to thrive even after the substratum has considerably dried up.

Taxonomic Data

The aquatic and marsh vegetation of Khandwa comprises a rich and varied assemblage of vascular hydrophytes, besides a large number of algal forms including species of *Chara* and *Nitella*, which are usually found in association with the higher aquatic plants. On the basis of the author's own collections, the following taxonomic data are presented for the vascular hydrophytes of Khandwa:

Phylum	Class	Families	Genera	Species
PTERIDOPHYTA	Hydropteridineae	2	2	2
ANGIOSPERMAE	1. Dicotyledones	20	42	48
	2. Monocotyledones	9	35	47

ENUMERATION OF SPECIES

I. PTERIDOPHYTA

1. **Marsilea quadrifolia** L. An aquatic, amphibious herb. Common throughout in shallow water in ditches, moist banks of ponds, rivers, and marshy places.

2. **Azolla pinnata** R.Br. A free-floating aquatic plant. Common in Abna, Sukta, and Bham rivers, often associated with *Lemna* and *Wolffia*.

II. ANGIOSPERMAE

DICOTYLEDONES

Cruciferae

3. **Rorippa indica** (DC.) Hochreut. An erect, glabrous or hairy annual. Flowers yellow. Found in marshes and swamps near ponds and puddles.
   Local name : Khubkalan.
   Flowers and Fruits : Dec.-July.

PORTULACACEAE

4. **Portulaca oleracea** Linn. A prostrate or ascending, succulent, glabrous herb. Flowers yellow. Common in marshes and swamps.
Local name : Nonia ; Golia.
Flowers and Fruits : Major part of the year.

TILIACEAE

5. **Corchorus olitorius** Linn. An erect, shrubby plant. Flowers yellow. Common along the margins of rivers and in marshes.
Local name : Sanp-ki-patti.
Flowers and Fruits : Sept.-Nov.

6. **Corchorus fascicularis** Lam. An erect, much-branched, glabrous herb. Flowers yellow. Common along the margins of ponds, puddles and ditches.
Flowers and Fruits : Sept.-Dec.

PAPILIONACEAE

7. **Sesbania bispinosa** (Jacq.) Fawc. & Rend. An erect, weak-stemmed shrub. Flowers yellow. Common along canal banks in marshes.
Local name : Chichida ; Jangli imli ; Dhandhan ; Silabhri.
Flowers and Fruits : Sept.-Nov.

8. **Desmodium triflorum** DC. A gregarious, trailing herb. Flowers pink or purplish. Occurs along the banks of rivers and canals.
Flowers and Fruits : During rains and early winter.

9. **Alysicarpus bupleurifolius** DC. A diffuse or ascending herb. Flowers pink. Common along canal banks.
Local name : Sewra ; Gahun-khad.
Flowers and Fruits : Aug.-Oct.

LYTHRACEAE

10. **Ammannia baccifera** L. subsp. **baccifera** Cuf. in *Bull. Jard. Bot. Brux. Suppl.* 29 (fasc. 3) : 607, 1959. An erect, glabrous herb. Flowers in condensed, axillary racemes or clusters. Capsules red when ripe. Common in marshes and along canal banks, often associated with sedges.
Flowers and Fruits : Sept.-Jan.

11. **Rotala tenuis** (Wt.) Koehne. A moisture-loving, tufted, elegant herb. Flowers rosy pink. Common on wet cliffs and rocky surfaces along the banks of Abna River.
Flowers and Fruits : Oct.-Feb.

ONAGRACEAE

12. **Ludwigia parviflora** Roxb. An erect, glabrous herb. Flowers yellow. Common along the banks of temporary ponds and puddles.
Flowers and Fruits : Aug.-Oct.

HYDROCARYACEAE

13. **Trapa bispinosa** Roxb. An aquatic herb. Flowers white. Cultivated in ponds for its edible fruit which is eaten raw or cooked.
Local name : Singhara.
Flowers : Sept.-Oct. *Fruits* : Sept.-Dec.

COMPOSITAE

14. **Gnaphalium luteo-album** L. subsp. **pallidum** (Lamk.) Maheshwari, comb. nov.
Gnaphalium pallidum Lamk. Dict. 2 : 750, 1790 ; Wall Cat. 2953, 1828, nomen ; DC. Prod. 6 : 230, 1837.
Gnaphalium orixense Roxb. in Hort. Beng. 101, 1814, nomen ; Fl. Ind. 3 : 425, 1832.
Gnaphalium luteo-album L. var. ∝ C. B. Clarke in Comp. Ind. 114, 1876.
Gnaphalium luteo-album L. var. *pallidum* Hook. f. in Fl. Brit. Ind. 3 : 288, 1881 ; Hochreut. in Candollea 5 : 313, 1934.

This plant is listed in our floras under the name of *Gnaphalium luteo-album* L. var. *pallidum* Hook. f. Recently, Koster (in Blumea 4 : 484, 1941), following C. B. Clarke (loc. cit.) and Hochreutiner (loc. cit.), has shown that there are two subspecific entities under *G. luteo-album* L. The above new combination is proposed for the plant which is found throughout the Gangetic plains and in central India. It also occurs in west Java, Australia, New Guinea, Philippines, Indo-China, Madagascar, Mauritius, Africa, and Europe.

The differences between the two subspecies are as follows :

Involucral bracts citrine to golden yellow ; capitula 3-3.5 mm. long ; a montane plant, rare on the plains....	*G. luteo-album* ssp. *affine* Kost.
Involucral bracts pale to dark brown or reddish brown ; capitula 3.5-4.5 mm. long ; common on the plains.	*G. luteo-album* ssp. *pallidum* Mahesh.

An erect, annual, woolly herb. Leaves 2.5-5 × 0.5-1 cm., lanceolate to oblong-spathulate, white-woolly on both surfaces. Capitula 3.5-4.5 mm. long, shining, in terminal and axillary corymbs or fascicles,

heterogamous. Involucral scales pale to dark brown or reddish brown, oblong, obtuse. Common along the banks of rivers and near temporary ponds.

Flowers and Fruits : Cold and early summer seasons.

15. **Gnaphalium indicum** L. An erect or bent, white-woolly, polymorphic herb. Heads pale brown. Found along the banks of Abna and Sukta rivers in moist, sandy soils.
Flowers and Fruits : Dec.-April.

16. **Ageratum conyzoides** L. An erect, hairy, annual herb. Heads white, fragrant. Common along the banks of Abna River and other irrigation channels.
Flowers and Fruits : Oct.-June.

17. **Caesulia axillaris** Roxb. A prostrate or suberect, marshy herb. Florets whitish. Common in marshy places near temporary ponds, forming either pure or mixed communities ; in the latter case associated with *Asteracantha longifolia* Nees, *Alternanthera sessilis* R. Br., and *Justicia quinqueangularis* var. *peploides* Cl.
Flowers and Fruits : Oct.-April.

18. **Xanthium strumarium** L. A scabrous, erect, tall herb or undershrub. Common in the seasonal marshes of temporary ponds ; often gregarious. The leaves are eaten by goats.
Local name : Ghokhru ; Bhatoi ; Kateya.
Flowers and Fruits : Sept.-Nov. ; April.

19. **Eclipta prostrata** L. An erect or prostrate, rough annual. Heads white. Common in marshes, swamps, and riversides.
Local name : Jangli suraj-mukhi.
Flowers and Fruits : Throughout the year.

GENTIANACEAE

20. **Hoppea dichotoma** Willd. A small, glabrous annual. Flowers pale yellow. Common in marshes, swamps, and along the banks of Abna River ; often gregarious.
Flowers and Fruits : Oct.-Feb.

21. **Exacum pedunculatum** L. An erect, slender herb. Flowers pinkish violet or violet. Occurs along the banks of rivers and irrigation canals.
Flowers and Fruits : Oct.-Feb.

22. **Canscora diffusa** R.Br. A slender, elegant herb. Flowers rosy pink. Common on way to Jeswadi, in marshes and swamps along the banks of Abna and Sukta rivers.
Flowers and Fruits : Oct.-April.

23. **Enicostemma verticillatum** Engl. An erect or procumbent, glabrous herb. Flowers white. Common along the banks of Abna River as well as in shallow marshes.
Flowers and Fruits : Sept.-May.

24. **Nymphoides cristatum** O.Ktze. An aquatic, floating herb. Flowers white. Found near the margins of Abna River and its tributaries. Also grown in freshwater ponds and tanks.
Flowers : Summer and rainy seasons.

BORAGINACEAE

25. **Heliotropium strigosum** Willd. A prostrate or procumbent herb. Flowers white. Common along the banks of canals and temporary ponds.
Flowers and Fruits : During and after rains.

CONVOLVULACEAE

26. **Ipomoea aquatica** Forsk. An aquatic, trailing, amphibious herb. Flowers pale rosy. Common in ponds, canals, ditches, and muddy ground.
Local name : Kalmisag.
Flowers and Fruits : Oct.-May.

27. **Merremia emarginata** Hal. f. A prostrate, creeping herb. Flowers yellow. Common along the banks of Abna, Sukta, and Bham rivers.
Flowers and Fruits : Sept.-Nov.

SCROPHULARIACEAE

28. **Bacopa monnieri** Penn. A semi-aquatic or marshy, prostrate herb. Flowers bluish purplish or violet. Common in marshy or wet places near canals, ponds, and lakes ; often growing profusely and dominating the ground vegetation.
Flowers : Aug.-Oct. *Fruits* : Nov.-Feb.

29. **Sopubia delphinifolia** G. Don. A tall, erect herb, elegant when in full bloom. Flowers rose-coloured or light purple. Common in marshes and ditches of low-lying areas.
Flowers and Fruits : Rainy and cold seasons.

30. **Verbascum chinense** Sant. (*Verbascum coromandelianum* O.K. ; *Celsia coromandeliana* Vahl). An erect, pubescent annual. Flowers yellow. Common along the banks of Abna, Sukta, and Bham rivers.
Flowers and Fruits : Cold and summer seasons.

31. **Stemodia viscosa** Roxb. An erect, aromatic, viscid herb. Flowers violet. Common in swamps and along the banks of canals and rivers.
Flowers and Fruits : Cold and summer seasons.

32. **Veronica anagallis-aquatica** L. An erect, succulent herb. Flowers pale purple or white. Occurs in moist situations along the banks of canals and rivers.
Flowers and Fruits : Feb.-June.

33. **Sutera dissecta** Walp. A diffuse or suberect, glandular annual. Flowers white. Common along the banks of canals and ditches.
Flowers and Fruits : Cold season.

GESNERIACEAE

34. **Didymocarpus pygmaea** C.B.Cl. A small, delicate, pubescent herb. Rare ; found along the banks of Abna and Sukta rivers on wet rocks.

ACANTHACEAE

35. **Rungia repens** Nees. A spreading or procumbent herb. Flowers violet or pinkish. Common in small patches near river banks.
Flowers and Fruits : Oct.-Jan.

36. **Justicia diffusa** Willd. An erect herb. Flowers pink or pale purple. Common throughout in marshes as well as along the banks of rivers and canals.
Flowers and Fruits : Aug.-Oct.

37. **Justicia quinqueangularis** var. **peploides** C.B.Cl. A prostrate or ascending herb. Flowers rose-coloured. Common in marshes or wet places near canals, ponds, and lakes.
Flowers and Fruits : Oct.-Apr.

38. **Asteracantha longifolia** Nees. An erect, hispid, stout herb. Flowers bright blue to bluish purple. Gregarious along the banks of fresh or stagnant water ditches and swamps.
Local name : Untkatara.
Flowers and Fruits : Oct.-Feb.

39. **Hygrophila serpyllum** T. Anders. A procumbent, glabrous herb. Occurs in marshes near Shankar Ghat.
Flowers : Cold season.

VERBENACEAE

40. **Phyla nodiflora** (L.) Greene. A creeping herb. Flowers pale pink. Gregarious in marshes as well as along the banks of Abna River.
Local name : Bakanbuti.
Flowers and Fruits : April-Aug.

LABIATAE

41. **Salvia plebeia** R.Br. An erect, deep-rooted annual. Flowers bluish white. Common along the banks of Abna River and irrigation channels.
Flowers and Fruits : Winter and summer seasons.

AMARANTHACEAE

42. **Alternanthera sessilis** R.Br. A prostrate, spreading, polymorphic herb. Flowers white. Common in damp places along the borders of ponds and tanks, or grows as an aquatic in ponds and canals with shallow water.
Local name : Bhaji ; Narhi-ki-bam.
Flowers and Fruits : During and after rains.

POLYGONACEAE

43. **Polygonum plebejum** R.Br. A prostrate, diffusely-branched herb. Flowers rosy. Common in damp places along the borders of ponds, tanks, and canals.
Local name : Machechi.
Flowers and Fruits : Cold and summer seasons.

44. **Polygonum glabrum** Willd. An erect or decumbent, stout annual. Flowers pink. Found in marshes and along canal banks.
Local name : Nali.
Flowers and Fruits : Sept.-March.

45. **Polygonum hydropiper** L. A glabrous, robust herb. Flowers pink. Occurs in marshes and along canal banks.
Flowers and Fruits : Oct.-March.

46. **Polygonum barbatum** L. An erect, glabrous annual. Flowers white. Rare along the banks of rivers.
Local name : Jalbahar.
Flowers and Fruits : Aug.-May.

47. **Rumex dentatus** L. An erect, glabrous annual. Flowers green. Uncommon. Near canal banks.

Local name : Jangli palak.
Flowers and Fruits : Jan.-June.

EUPHORBIACEAE

48. **Euphorbia hypericifolia** L. An erect or decumbent herb. Common along canal banks as well as in marshes.
Flowers and Fruits : July-Oct.

49. **Phyllanthus maderaspatensis** L. A glabrous herb. Common in marshes of temporary ponds and on black cotton soil.
Local name : Hazarmani.
Flowers : Aug.-Oct.

CERATOPHYLLACEAE

50. **Ceratophyllum demersum** L. A submerged, rootless aquatic. Common in the still water of ponds, ditches, and canals.
Flowers and Fruits : After rains.

MONOCOTYLEDONES

HYDROCHARITACEAE

51. **Hydrilla verticillata** Royle. A submerged, freshwater herb. Common and abundant in still or slowly running water of ponds, ditches, and canals.
Flowers : Sept.-Nov.

52. **Vallisneria spiralis** L. A submerged, tufted, dioecious perennial. Common in the bottom of ponds, ditches, and canals.
Flowers and Fruits : Aug.-Oct.

53. **Ottelia alismoides** Pers. A succulent, flaccid herb. Flowers white. Common in tanks and slow-running waters.
Flowers : Oct.-Feb.

COMMELINACEAE

54. **Commelina benghalensis** L. A diffuse or straggling herb with dimorphic flowers. Common in marshes and along canal banks. The leaves are used as a vegetable.
Local name : Kan-kawwa.
Flowers and Fruits : June-Nov.

55. **Commelina hasskarlii** Cl. A glabrous or pubescent herb. Flowers blue. Gregarious in marshes near temporary ponds and ditches.
Local name : Gahun-kenya.
Flowers and Fruits : Sept.-Nov.

56. **Cyanotis axillaris** Schult. f. A trailing or erect herb. Flowers pale violet. Occurs along canal banks in moist situations.
Flowers and Fruits : Oct.-Dec.

ARACEAE

57. **Pistia stratiotes** L. A floating herb. Common in tanks and jheels.
Flowers : July-Nov.

LEMNACEAE

58. **Lemna paucicostata** Hegelm. Common throughout in canals, ponds, puddles, and stagnant water collected near waste places.
Local name : Chowpatti.
Flowers : After rains.

59. **Wolffia** sp. Common throughout in ponds, puddles, and stagnant water ponds and canals, either growing alone and forming a green felt or associated with *Lemna* and *Azolla*.
Flowers : After rainy season.

POTAMOGETONACEAE

60. **Potamogeton indicus** Roxb. A floating or marshy, aquatic herb. Common in Abna, Sukta, and Bham rivers.
Flowers : Cold season. *Fruits* : Hot season.

61. **Potamogeton perfoliatus** L. A stout, submerged, aquatic herb. Common near Bhim Kund, along the margins of Abna River.
Flowers : Dec.-Feb.

62. **Potamogeton crispus** L. A slender, submerged, aquatic herb. Common in shallow, temporary water ponds, and canals of Abna and Sukta rivers.
Flowers and Fruits : Cold and hot seasons.

63. **Potamogeton pectinatus** L. A filiform, grass-like, aquatic herb. Common in the canals of Abna, Sukta, and Bham rivers.
Flowers and Fruits : Cold and hot seasons.

NAIADACEAE

64. **Naias minor** All. A small, aquatic herb. Common in still, fresh water of ponds and rivers.
Flowers : Dec.-Feb.

ZANNICHELLIACEAE

65. **Zannichellia palustris** L. Common in quiet or slowly running water of Abna, Sukta, and Bham rivers, and ponds.
Flowers and Fruits : Oct.-Feb.

CYPERACEAE

66. **Cyperus alopecuroides** Rottb. An erect, stout, marshy sedge. Common along the banks of rivers and ponds.
Flowers and Fruits : Aug.-Jan.

67. **Cyperus pygmaeus** Rottb. A very tufted, prostrate or erect herb. Common in marshes and beds of Abna River.
Flowers and Fruits : Oct.-July.

68. **Cyperus iria** L. Common in marshy lands and ditches.
Flowers and Fruits : Aug.-Apr.

69. **Cyperus compressus** L. Common in marshes and along the banks of streams.
Local name : Dhongli.
Flowers and Fruits : June-Oct.

70. **Cyperus difformis** L. An erect, tufted herb. Common along the banks of Abna River.
Flowers and Fruits : After rains.

71. **Fimbristylis dichotoma** Vahl. A tufted annual. Common in marshes and along the banks of rivers. The fresh roots emit a fragrant smell.
Flowers and Fruits : Feb.-June.

72. **Fimbristylis complanata** Link. Common in marshes and swamps.
Flowers and Fruits : Oct.-Feb.

73. **Scirpus roylei** Parker (*Scirpus quinquefarius* Buch.-Ham.). An erect, tufted sedge. Common in marshes near canals and streams.
Flowers and Fruits : Sept.-Dec.

74. **Scirpus erectus** Poir. Common along the banks of Abna, Sukta, and Bham rivers, often growing on wet rocks.
Flowers and Fruits : Late winter and summer seasons.

75. **Scirpus tuberosus** Desf. in Fl. Atl. 1 : 50, 1798-1800 ; Beetle in Amer. Jour. Bot. 29 : 84, 1942. (*Scirpus maritimus* Linn., *pro parte*). This plant is listed in our floras under the name of *Scirpus maritimus* Linn. Recently Beetle (loc. cit.) has shown that true *S. maritimus* Linn. is a European plant, found occasionally in Asia, and it includes two specific entities. The correct name for the Asiatic species is, therefore, *Scirpus tuberosus* Desf. (loc. cit.). For a complete synonymy of this plant, *see* Beetle (op. cit.).
An erect, variable sedge, 30-100 cm. high, with creeping rhizomes

and woody tubers. Stems trigonous. Umbels simple or compound. Spikelets 3-8 or solitary on each ray, dark brown. Bristles present. Nuts plano-convex, polished. Common along the banks of Abna, Sukta and Bham rivers, forming dense patches in Chhoti Nadi. The sedge is amphibious as it occurs either in water or on marshy soil.
Flowers and Fruits : Oct.-July.

76. **Scleria tessellata** Willd. Common in marshes and along canals.
Flowers and Fruits : Sept.-Dec.

GRAMINEAE

77. **Saccharum spontaneum** L. Common near canals, ponds, and marshy places.
Local name : Kans.
Flowers and Fruits : Sept.-Dec.

78. **Imperata cylindrica** Beauv. Common near ponds and canals of Abna River, often becoming abundant and dominating the vegetation.
Flowers and Fruits : June-Oct.

79. **Hemarthria compressa** R.Br. A hygrophilous, perennial grass. Occurs in marshes and along the banks of Abna River.
Flowers and Fruits : June-Sept.

80. **Paspalum distichum** L. Common along the banks of Abna River and near ponds and puddles.
Flowers and Fruits : June-Sept.

81. **Paspalidium flavidum** A. Camus. Common along canal banks and ponds. A good fodder grass.
Local name : Kel-chara.
Flowers and Fruits : May-Oct.

82. **Echinochloa colonum** Link. Very common in ditches.
Local name : Saonria.
Flowers and Fruits : June-Oct.

83. **Echinochloa crus-galli** Beauv. Common along irrigation channels and margins of ponds.
Local name : Panad ghas.
Flowers and Fruits : July-Nov.

84. **Leptochloa panicea** Ohwi. A slender, annual grass. Common near canals and ponds.
Flowers and Fruits : June-Sept.

85. **Eriochloa procera** Hubb. Common near canals, ponds, and ditches.
Flowers and Fruits : Aug.-Dec.

86. **Setaria tomentosa** Kunth. Common near canals, ponds, and ditches.
Local name : Chich-larha.
Flowers and Fruits : Aug.-Oct.

87. **Cynodon dactylon** Pers. Common and abundant in marshes and swamps.
Local name : Dub.
Flowers : Throughout the year.

88. **Aristida depressa** Retz. Common near banks of Abna River, forming dense tufts in local patches.
Local name : Sukli.
Flowers and Fruits : July-Oct.

89. **Sorghum halepense** Pers. A perennial, tall grass. Found sporadically along the banks of canals. The culms are used as pens for writing purposes.
Local name : Baru.
Flowers and Fruits : Sept.-Feb.

90. **Andropogon pumilus** Roxb. A small, copper-coloured grass. Gregarious in marshes and swamps.
Flowers and Fruits : Oct.-Feb.

91. **Apluda mutica** L. A small grass with delicate culms. Occurs in moist situations near canals, ponds, and puddles.
Local name : Phulria ; Phuli.
Flowers and Fruits : Sept.-Nov.

92. **Brachiaria eruciformis** Griseb. A very weak grass. Common in marshes, and swamps.
Local name : Sirput.
Flowers and Fruits : Sept.-Nov.

93. **Coix lachryma-jobi** L. A tall, densely tufted grass. Gregarious along watercourses, irrigation channels, and ditches.
Local name : Panad ; Barru.
Flowers : Sept.-Dec. *Fruits* : Feb.-April.

94. **Dinebra retroflexa** Panz. A small, trailing grass. Common along the banks of Abna River.
Flowers : Sept.-Nov.

95. **Rottboellia exaltata** L. Common in marshes, swamps, and along the banks of rivers.
Flowers : Aug.-Nov.

96. **Ischaemum rugosum** Salisb. Common along the banks of marshes and canals.
Local name : Badawar.
Flowers : Oct.-Feb.

97. **Hygrorhiza aristata** Nees. A floating grass. Common in still or slow running water of Abna River.
Flowers : Cold and summer seasons.

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Reviews

1. INSECT MIGRATION. By C. B. Williams. Pp. xiii+235 (21.5×14.5 cm.). 11 coloured plates, 22 photographs in black and white, and 49 maps and diagrams. The New Naturalist series. Collins, London, 1958. Price 30*s.* net.

In 1938 Dr. Williams wrote an article on Butterfly Migration in India (*J. Bombay nat. Hist. Soc.* **40**: 439-457) which summarised the existing records, hoping thereby to stimulate collectors' interest in the subject and to get further observations from them. His own interest was aroused much earlier, in 1916, when in British Guiana he happened upon a migration of *Phoebis statira*. Since then he has not only observed himself, but has with a few enthusiastic helpers collected a vast body of information scattered through the literature. Migration is now regarded as a much more generalised phenomenon than was previously realised. In this book Dr. Williams discusses butterfly migration in relation to those of other insects and to those of vertebrates, and gives the reader some idea of the magnitude of the problems involved.

The New Naturalist series is primarily concerned with British natural history, but to quote the dust jacket '. . . INSECT MIGRATION deals with the subject on an international basis, with Britain . . . as the natural peg on which a biological problem belonging to the whole world can be hung'.

Insect migration is more difficult to tackle by direct means than is bird migration. Several attempts have been made to mark migrating butterflies but, in every case, of thousands marked only one or two have been recovered, and those fairly close to the point of release. The only exception to this was in 1952, when Urquhart in Canada marked Monarch Butterflies (*Danaus plexippus*) and recovered 2 individuals from 450 and 480 miles to the south. Only once has the start of a migration been observed—that of the Painted Lady (*Vanessa cardui*). In 1869 Sketcherley observed vast numbers emerging from their chrysalids in the desert by the Red Sea. They dried their wings, and flew eastwards towards the sea. The production of locust swarms is better understood. It has been shown that the migratory form is produced when intense breeding leads to overcrowding of young hoppers. But even here there is ambiguity, because it has been shown that the solitary form can also migrate over some hundreds of miles.

Insects have been shown to be capable of some incredible feats—for example the tiny moth *Plutella maculipennis*, barely half an inch across, flies over the North Sea to Britain from Europe. Spectacular flights involving many thousand individuals and continuing for days on end are known in many parts of the world. Sometimes they have become part of local folklore. Our *Euploea core* migrates regularly along the coast at Ratnagiri, and the local inhabitants have come to regard it as the forerunner of the monsoon.

The problems raised are many and various. For example the question arises of how butterflies navigate. If they do so by the position of the sun, do they compensate for the shift in its position during the day? The instinct to go in a straight line is so strong that butterflies on migration will rise and fly over an obstacle rather than go round it. Wind does not affect the direction of flight—the insects shift the axes of their bodies to compensate for the drift, and continue to fly in the same direction as before. One could go on quoting from this fascinating book for a long time. All collectors should read it; they have a real opportunity to make a contribution to the subject.

R.R.

2. THE MYSTERY OF THE FLAMINGOS. By Leslie Brown. Pp. 116 (14×21.5 cm.). 23 photographic plates, 2 maps, 1 diagram. Country Life, London, 1959. 25*s*. net.

In recent years the name of Leslie Brown has become a byword for East African flamingo lore. Those who have had the privilege of seeing his magnificent colour film of African flamingos, or read his account of the breeding of the Greater Flamingo in Kenya (*Ibis*, 1958) need no introduction to his competence as a field naturalist. For several years he has dedicated himself with exemplary zeal, and one may even say exemplary foolhardiness, to the study of flamingos in order to unravel some of the puzzling problems connected with these large and spectacular birds.

The brackish soda lakes of the Great Rift Valley of East Africa —Nakuru, Hannington, Natron, Elementeita, and others—have long been known as the home of the Lesser Flamingo (*Phoeniconaias minor*) and traveller after traveller has extolled the breath-taking spectacle of its gigantic concentrations. But owing to the extremely inhospitable and difficult nature of the terrain no serious exploration or study of the birds had been undertaken until 1953 when Leslie

Brown, an officer of the Kenya Agricultural Department, appeared on the scene. While these African lakes were known to be the principal breeding grounds of the Lesser Flamingo, it was only within recent years that the Greater Flamingo (*Phoenicopterus ruber*) was also reported to breed there on a limited scale. It is to the author's credit that by an unremitting onslaught of reconnaissances by land and air he contrived to visit and acquaint himself not only with practically all the haunts and breeding places of both the African flamingos, but also to discover intimate details of their life histories which had hitherto remained hidden. That in the process he more than once nearly lost his life in unenviable circumstances, and taught himself to fly an aeroplane so that he could probe into the remotest fastnesses of the birds, are incidentals in the remarkable story which the book tells.

The discovery of large breeding colonies of the Greater Flamingo —one of about 5000 pairs—at Lake Elmenteita, on rocky islands and without the orthodox mud-cone nests, is significant for us in India. Observations in the Great Rann of Kutch had indicated that in years of drought, or when the water level and other natural conditions are inappropriate, breeding of flamingos does not take place here at all. The birds, after concentrating at the traditional site, disperse again. Since there is no other known breeding place in India, it was conjectured that the birds either skipped a lean year, or years, completely, or that they betook themselves to some alternative area outside the country for the purpose. Although there are some known breeding places nearer home (e.g. Ab-i-istadeh in Afghanistan, and in the Persian Gulf and Iraq) these are not large enough to accommodate the enormous rebound from the Rann of Kutch. The Camargue and southern Spain had been postulated, but they seemed too distant for a last-minute makeshift. The hypothesis of alternative breeding grounds now derives some support from the discovery of these large nesting colonies on the East African lakes, and our birds may well migrate there to breed at times when conditions in the Rann are unfavourable. However, this is all mere speculation which can only be tested by a large scale marking of the birds on their breeding grounds in a manner that would enable their recognition at a distance, without the necessity of recapture. In spite of the swarms of non-flying young available in the more populous nesting colonies, those with any experience will admit that marking the chicks is a less simple affair than it would appear!

The detailed observations on the ecology and various life phases of the flamingos—some original, others amplifications of what was

imperfectly known before—are important contributions to scientific ornithology in general, and to flamingo lore in particular. They cover every aspect of the birds' life-history—food, feeding habits, breeding cycle including courtship and mating behaviour, and others. The observations are doubly valuable for the comparisons they afford between the Lesser and the Greater Flamingo, so similar in outward appearance and general habitat, yet each with its own special food and feeding habits and morphological adaptations which permit such vast numbers of both to subsist side by side without competing for the food supply.

In his previous books, BIRDS AND I (1946) and EAGLES (1955) Brown had given ample proof of being a first class field ornithologist and an expert bird photographer. The present volume sustains and enhances that reputation. The photographs of both the Greater and the Lesser Flamingo are without doubt the finest the reviewer has seen, and are truly admirable in their purposefulness as illustrations besides. This is a book that no bird lover should miss.

S.A.

3. THE ARK IN OUR MIDST. The Story of the Introduced Animals of Britain: Birds, Beasts, Reptiles, Amphibians, Fishes. By R. S. R. Fitter. Pp. 320 (20×13 cm.). 18 plates (16 of photographs and 2 of drawings). Collins, London, 1959. Price 18*s*.

Ten years of research have gone into the preparation of THE ARK IN OUR MIDST, the first book which covers all known attempts to introduce new animals into Britain and to extend the range of indigenous species. In 1860 Frank Buckland brought together a group of enthusiasts under the grandiose title of 'The Society for the Acclimatisation of Animals, Birds, Fishes, Insects and Vegetables within the United Kingdom'. But introductions were being made long before this. These were mainly by sporting land-owners who restocked their estates with foreign deer, game birds, and game fishes. However, there have been many attempts made simply to enrich the local fauna with attractive alien species—the American robin (*Turdus migratorius*), and the green tree-frog (*Hyla arborea*) for example. Most attempts have ended in failure, and it is not difficult to see why. Climate, lack of suitable breeding places, competition from established species, predators, all combine against an introduced species. Considerable perseverance is sometimes needed before success is achieved. For instance, Waterton decided in 1841 that the

Little Owl (*Athene noctua*) would be useful as a destroyer of snails and other vermin. Accordingly, he bought a dozen in Rome. Of these five survived shipwreck and other hazards to reach England, but they did not establish themselves. In 1876 there was another unsuccessful attempt by Lord Kimberley. Over the next ten years or so, many Little Owls were released in various places, and by the end of the century they were breeding in four counties, and by 1950 had begun to spread to Scotland.

Little Owls encountered much prejudice as suspected game-chick killers, although they were shown to feed mainly on insects, mice, and small song-birds. All introductions have not been so innocuous, however. Ironically enough, great pains were taken to introduce the rabbit (*Oryctolagus cuniculus*) into Scotland, where it rapidly became a pest. Some of the most successful aliens have been accidental introductions. The house mouse (*Mus musculus*) originated in southern Russia, and seems to have followed the spread of agricultural civilisation. It reached Britain by the route Iran-Iraq-Syria-Palestine-N. Africa-Mediterranean, and probably arrived in a shipload of grain, or in a traveller's baggage. More recently another harmful alien, the musk rat (*Ondatra zibethica*) escaped from fur farms and rapidly established itself. Fortunately prompt action by the authorities resulted in extermination.

To facilitate the recognition of the fascinating strangers whose fortunes are described by Mr. Fitter, one could wish for more illustrations like those of deer and pheasants in the two plates of drawings.

R.R.

4. SOME COMMON SNAKES AND LIZARDS OF AUSTRALIA By David R. McPhee. Pp. 125 (13×10 cm.). 51 illustrations. Brisbane, 1959. Jacaranda Press. Price 12*s.* 6*d.*

This little booklet deals with 25 each of the lizards and snakes of Australia. Some of the genera in both the groups are common to India, but the lizards including the Knobtailed and Leaftailed Geckos, the Bearded and Frilled Lizards with large frills round the neck, and the famous Agamid (*Moloch horridus*) with large and grotesque spines scattered all over the head and upper parts appear to be more curious and varied than those found with us. Each form is illustrated by a photograph and, while all of them are not very satisfactory, the accompanying text is in most cases sufficient to permit a layman to identify the animal.

A general note on lizards and snakes precedes each section, but it is nowhere stated how many kinds of snakes or lizards are known in Australia. It would be useful to inform and warn beginners that this is not a complete list and that many more kinds may be encountered.

As in India, many curious beliefs and fallacies exist regarding reptiles. The author states (p. 68) that it is anatomically impossible for a snake to suck milk from a cow but, in recent correspondence, a retired officer of the Indian Forest Service claims to have personally seen it done. Again, American scientists are said to have experimentally revealed (p. 66) that a fast moving snake at top speed does not exceed $3\frac{1}{2}$ miles per hour. The author believes that some Australian snakes can travel faster, and we have no doubt that a man would have to trot, if not run, to keep up with a fast travelling Indian dhaman on level ground.

This kind of book is badly needed in India. Very little is known about the lives and habits of the 300 kinds of lizards and the almost equal number of snakes found in India, and the gaps in our knowledge can only be filled by more people giving the subject their attention. Once a person is familiar with even the more common species he will notice differences among the others and will enquire more closely and intelligently into their identity and habits whenever an opportunity arises.

H.A.

5. BUMBLEBEES. By John B. Free and Colin G. Butler. Pp. 208 (21×14 cm.). 1 colour illustration, 24 plates in black and white, and 3 figures. The New Naturalist series. Collins, London, 1959. Price 25*s*.

The value of honeybees as plant pollinators is well known. It is less generally known that bumblebees are sometimes more effective pollinators. The pollinating value of a single bumblebee is equal to that of several honeybees, since bumblebees not only work faster, but for longer, and in worse weather. Self-sterile species of plants are more likely to be pollinated by bumblebees because of their habit of visiting only a few flowers on one plant before flying on to the next. One such self-sterile plant, Red Clover, is of considerable economic importance. It was because of their value in pollinating the Red Clover crop that bumblebees were introduced into Australia and New Zealand, where they are not indigenous.

Bumblebees live in colonies whose social organisation is halfway between the solitary bees and the highly evolved honeybee colonies. Bumblebee colonies are annual, at least in the temperate zone. The old queen, workers, and males die off at the approach of winter, and only young mated queens survive to form new colonies in the spring. Very little is known about what happens to bumblebee colonies in the tropics. Observations made in Mexico seem to indicate that colony growth can take place all through the year, although brood production is greatly reduced during the dry season. Unlike the queen honeybee, who is little more than an egg-laying machine, the queen bumblebee is physically similar to her workers apart from being larger, and she carries out many tasks throughout her life, such as building eggcells, incubating and feeding brood, as well as laying eggs.

Bumblebees do not seem to have developed any form of communication to compare with the elaborate dance language of honeybees. When a bumblebee out foraging discovers a rich source of nectar she may return to it again and again, but she does not bring back companions. A great deal is known about what attracts individual bees to flowers. Kugler demonstrated that sight was more important than scent when a bumblebee is flying towards a flower. He did this by covering a plant with a tall glass cylinder, open at the top. Approaching bees flew not to the top of the cylinder, where they could smell the flowers, but to the middle, where they could see them. However scent is important, since bees can be trained to models having a particular scent. Bumblebees sometimes also recognise the general form of a plant. Bees working Houndstongue, which has small inconspicuous flowers, will sometimes fly to a plant having no flowers. On the other hand bees visiting Foxgloves, whose flowers are large and conspicuous, do not fly to flowerless plants. Apparently they have learnt to react to the flowers and not to the form of the plant.

Another respect in which bumblebees and honeybees differ is in their mating behaviour. Male bumblebees fly from their nests when between two and four days old and do not return. In some species they hover round the entrances of nests of their own species and pounce on young queens as they emerge. The males of other species establish routes for themselves which they scent-mark every day, and fly round them waiting for young queens to cross their paths. One male was observed to complete his circuit seventy-seven times in a day.

The monograph ends with two appendices by Ian H. H. Yarrow.

One is an introduction to the collection and maintenance of bumblebee colonies. The other is a simplified key to the identification of British bumblebees. All books of this kind should include information of this type if they are intended to act as intellectual apéritifs rather than nightcaps.

R.R.

ADDITIONS TO THE SOCIETY'S LIBRARY

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Parker, B. M. TOADS AND FROGS. Row, Peterson & Co., Evanston, Illinois, 1957.

Parker, B. M. TREES. Row, Peterson & Co., Evanston, Illinois, 1957.

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Miscellaneous Notes

1. IN DEFENCE OF THE TIGER

A few days ago I read in one of the daily newspapers that in the Damini forests of Chhattisgarh region 'three tigers were bagged in five minutes'. This may be considered a remarkable and even a commendable feat by some, but I feel constrained to write a few words in defence of this grand animal whose disappearance from our forests will be a sad thing for our country—and disappear he will unless public opinion comes to his rescue.

The tiger has been an unfortunate victim of persecution for many years, particularly so since the advent of the powerful modern cordite rifle, the jeep, and the spot-light. In his natural dominion—the undisturbed forests away from human habitation—he is not a dangerous animal, and he causes much less harm or damage to man and his property than is generally supposed. It is only when man destroys his local and natural food supply, the wild pig and the various kinds of deer, that the 'Lord of the Jungle' is forced to quit his normal habitat and habits and takes to killing domestic cattle which graze near and sometimes in the outer fringe of the jungle. Much more rarely, after being wounded by man or for some other specific reason, he may become first a mankiller and then a maneater—but this is extremely rare when counted against the many tigers living a normal and natural life deep inside the jungle.

In the incident mentioned above three tigers met their death one after the other in a beat at the hands of a 'shikari'. One of the three animals was mentioned as having been 8 ft. 8 in. in length. Since the measurements of the other two were not given, I presume that they were smaller. The average size of a full-grown male tiger is between 9 ft. and 9 ft. 6 in., and the tigress is about a foot smaller. These lengths would be from the tip of the nose to the tip of the tail as measured 'between pegs', as against the more common and less definite way of measuring 'round the curves' which gives results a few inches more than the 'between pegs' measurement. My second guess, therefore, in respect of the incident under reference is that the animal measuring 8 ft. 8 in. was a tigress.

Unlike the lion, the male tiger, except in the mating season, does not remain with the tigress or the cubs. As a matter of fact as soon as the cubs are born the tigress will resent the presence of their

father, and the latter also is then no longer interested in his family. It follows, therefore, that outside the mating season, whenever two or more tigers are seen together they are usually, if not invariably, a tigress and her cubs. The cubs remain with their mother for as long as they are not able to fend for themselves, this period of dependence lasts till they are about two years old. My third guess about the episode is that the other two tigers killed were cubs of under two years of age.

The tigress does not produce a litter every year as is commonly supposed. Because the cubs remain with her for about two years, she has her babies usually every third year, for as long as she is young enough to have them. I am speaking of tigers in the jungle and not of zoo tigers where owing to artificial conditions the natural routine is upset. The cubs require about five years to attain full maturity and size, the first two years of which are spent under the care and protection of their mother. A two-year-old tiger in respect of behaviour and appetite would be much like a boy of twelve or thirteen. I remember when I was of that age I was almost perpetually hungry. I would say that the 'teens period of a tiger's life is when he is between two and four years old. A hungry tiger is much more hungry than a hungry boy, and therefore during this period it is difficult for a tigress to provide enough food for herself as well as for her ever-hungry children. As soon as the cubs are capable of making independent kills and fending for themselves they separate from their mother and from each other, or if they are lazy and not exerting themselves enough, after a period of maternal patience and spoon-feeding, they are chased away by the exasperated mother. Now, the point of all this is that if cubs are found with their mother they are probably under two years old. At this age they are so entirely dependent on their mother that, if she is killed, they would not desert her immediately. In their bewilderment and confusion they will remain in the vicinity of their dead mother and get killed themselves, if the 'shikari' shows no compassion. I feel this is what happened in the incident under reference.

To say nothing of killing immature cubs, I would say that one should, as far as possible, abstain from killing the female of any species—including the tiger. This is not for any medieval notions of 'chivalry' about the female sex, but because that is the most effective way of exterminating a species.

What goes to the credit of a big game hunter is not the mere number of tigers or any other animals that he has bagged in his career as a sportsman, in one year, in one trip, or 'in five minutes';

what matters is the discrimination and the sense of fair play which he shows in selecting what he shoots—and more important than that, the manner in which he shoots his big game.

I have said above that the normal jungle-dwelling tiger does no harm to man in any way but helps to maintain the balance of life in the jungle. He kills only when he is hungry because it was the will of God that he shall live in this manner. When tigers take to the slaughter of domestic animals, and even to the quite unnatural diet of human flesh, the fault almost invariably lies with man in one way or another—and in rare exceptions is due to some accident or sheer old age resulting in the tiger's inability to procure his natural food.

Not so long ago I had the memorable experience of watching for a long time a tigress and her few-months-old cub feeding on a dead bullock. Particularly amusing and delightful to watch were the antics of the young cub who had a bigger appetite than his mother but not her ability and strength for tearing off chunks of meat from the carcass. Unlike the unfortunate three which were killed in five minutes, these two are still alive, I hope, somewhere on the borders of Bhutan, adding to the wealth and charm of those beautiful jungles.

I can do no better than repeat the words of Jim Corbett, that great hunter and lover of wild animals: 'A tiger is a large-hearted gentleman with boundless courage and when he is exterminated—as exterminated he will be unless public opinion rallies to his support—India will be the poorer by having lost the finest of her fauna.'

1, J. & K. Militia,
c/o 56, A.P.O.,
April 10, 1960.

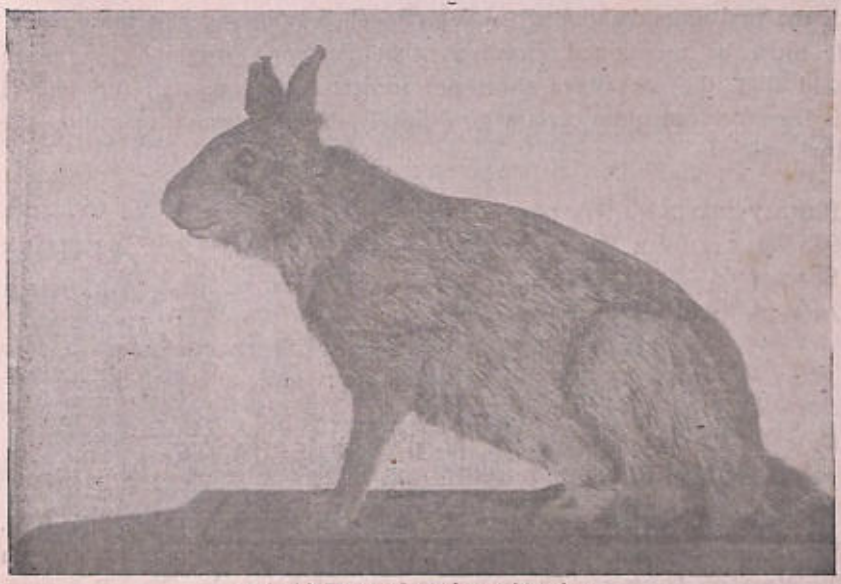
M. M. ISMAIL,
Lt.-Col.

2. THE HISPID HARE, *CAPROLAGUS HISPIDUS* (PEARSON)

(*With a photo*)

Jerdon, Sterndale, and Blanford all refer to the occurrence of the Hispid Hare (*Caprolagus hispidus*) in the terai from Gorakhpur to Assam extending south to Dacca. It weighed about 5½ lb. and Hodgson was informed by the Mechis that its food consisted chiefly of roots and bark of trees. E. B. Baker (1887) in SPORT IN BENGAL said that it was 'unfit for the table and not worth shooting

except as a curiosity; nor does it give the greyhounds the chance of a course, sticking as it does to thick coverts'.



Hispid Hare, *Caprolagus hispidus*

Jerdon said that it frequented jungly places along coarse bamboos etc., shunning observation, and that its flesh was white like a rabbit's. Sterndale added that it burrowed like a rabbit, but according to Hodgson was not gregarious, living in pairs. He did not know if the young were born blind and naked.

Simson (1886) in LETTERS ON SPORT IN EASTERN BENGAL referred to the skin tearing very easily and his failure therefore to preserve a single skin.

Though we have specimens in our collection obtained by J. C. H. Mitchell in Assam, date unknown, and from north Kheri, U.P., by L. D. W. Hearsey on 16-3-1926 and C. H. Stockley on 30-1-1930, this animal was not obtained by the Bombay Natural History Society's Mammal Survey and it is generally held in the same category of rareness as the Pigmy Hog and the Pinkheaded Duck. Inglis, Travers, O'Donel and Shebbeare in 'A Tentative List of the Vertebrates of Jalpaiguri District, Bengal' (*J. Bombay nat. Hist. Soc.* **26**: 825) said it was 'not so common as formerly owing to the decrease in grass jungle in the district'. It may therefore be interesting to note that in the course of recent correspondence Dinesh Pratap Singh, Raja of Kasmanda, mentions that his late father shot one in 1938 in the North Kheri Forest Division on the Kheri, U.P.-Nepal border. Another was

shot in March 1951 in Bellrien Forest range in North Kheri Forest Division near the Bela Parsua Rest House when beating through grass bordering a small lake with a line of elephants. A photograph of the first animal mounted by Van Ingen & Van Ingen is reproduced. It must be mentioned, however, that Pearson's original description said that 'the ears were short not projecting beyond the fur' and it is therefore not quite certain how closely the photograph resembles the live animal.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD,
BOMBAY 6,
July 14, 1960.

EDITORS

3 'TUSKS OF INDIAN ELEPHANTS'

With reference to my letter of April 4, 1956 (*J. Bombay nat. Hist. Soc.* **53**: 690-1) on the subject of big tusks, I have since heard from the Raja of Talcher. The measurements of his tusks (No. 2), shown by me in the statement of big tusks, should stand corrected as follows:

No.	Length outside curve	Greatest circumference	Weight
2	8′ 11″ R (8′ 6″) 8′ 9″ L (8′ 6″)	20″ 19″	1 md. 19 sr. = 120 lb. (92 lb.) 1 md. 16 sr. = 114 lb. (92 lb.)

The weights of the large Assam pair (No. 1) should be shown as 101 lb. each (91 lb. 13 ch.).

Thus, the record for *girth* and *weight* goes to the Raja of Talcher, while the record for *length* goes to the Assam pair.

NEW FOREST P. O.,
DEHRA DUN,
May 14, 1960.

P. D. STRACEY

[The figures earlier recorded are menioned in parentheses.—EDS.]

4. WILD LIFE IN SOME AREAS OF SOUTH INDIA

Humayun Abdulali's rather depressing accounts of wild life in Madhya Pradesh have prompted me to submit a short note on what I have seen of game in areas near the Nilgiri and Biligirirangan hills in Madras State in two recent visits to India, in January and February 1958, and at the same time in 1960.

I had not been in India between 1931 and 1958, and in my boyhood I had little knowledge of the game in these areas other than the fact that I used often to see sambar when walking about on the downs near Ootacamund, and I once saw a tiger in a shola five miles from Ooty. In both 1958 and 1960 I was given the most depressing account of the status of game animals in both these areas by people who should have known. I was told that game had been decimated since Independence, largely by the efforts of poachers armed with guns, licensed ostensibly for crop protection but in practice used for shooting without authority in reserved forests. In 1958 game was stated to exist but in much reduced numbers, while in 1960 I was informed that the Bandipur jungles, once so famous, had been shot out although they were supposed to be a sanctuary. The general consensus of opinion in both years was that 'the sambar and chital won't last long'.

In 1958 I spent a week in the jungles round Mavanhulla in the Nilgiri area, and another ten days in the Biligiris. At Mavanhulla I saw every possible species of game animal I could see except a tiger, and the basic stock of game appeared to be satisfactory; not a day passed without seeing a minimum of fifty chital and ten sambar, with other species such as gaur and jungle sheep[1] in smaller numbers. Five bears, a panther, and a wild elephant completed the list. There was a tiger in the area, which I disturbed, but did not see as he left the thicket in which I had located him literally on my heels. I was told by one of the officers there that the adjacent Mudumallai wild life sanctuary contained at least 1000 chital, 300 gaur, and twenty tigers, and at the time this seemed quite possible in view of the numbers of game actually seen in a much smaller area near by. In the Biligiris there was much less game to be seen than in the Mavanhulla area, but there appeared to be a fair head of gaur and sambar, while we located the haunts of at least three separate tigers. It may only have been a travesty of former abundance, but

[1] The Barking Deer, *Muntiacus muntjak* (Zimmermann) is commonly known by this name in southern India.—EDS.

the game was certainly not eliminated. In the Nilgiris, on the high plateau sambar were few, but I saw without difficulty a herd of 16 Nilgiri Tahr.

In 1960 I made actual counts of the game I saw and related these to the ecology of the area and to the total area which I could claim to have covered. The latter was estimated by noting the number of miles walked and the mean visibility on both sides, so that the sample covered a strip of country; where larger areas were overlooked from the top of a hill area was reckoned from a 1-inch survey map and added in. The results are presented in the table below:

Area	Chital	Sambar	Gaur	Jungle sheep	Area sampled in sq. miles	Density per sq. mile
Mavanhulla ..	105	22	10	1	5.2	26
N. Coimbatore ..	14	5	2	11	6.5	4.8

The Mavanhulla area is largely fairly open *Anogeissus-Heteropogon* grass woodland with thickets of *Lantana* and *Acacia* in gullies, bamboo on river banks, and a good deal of *Zizyphus* on the fruits of which bears were feeding. Since I kept out of the thicker cover it is certain that I did not see all the game there was, and the figure for density of large herbivores per square mile should probably be rather higher. There were in addition at least five hundred head of buffaloes and cattle grazing in the area. The game stock appeared to be about the same as, or slightly higher than, in 1958, and is certainly very satisfactory. At any rate I can think of no area in Africa with so many human beings in it which would carry anything like this stock of game. The carrying capacity of the area was probably inherently higher than in similar savannah in Africa because of relatively abundant and well-distributed water supplies; no animal would have had to go more than two miles to get water and most not more than one mile. Taking the domestic animals into account, and equating the smaller herbivores at three chital per stock unit, the total stocking works out at about one stock unit per 4½ acres—which I should judge as near the maximum that such country could hold without danger of overgrazing (which was occurring in some areas near cattle sheds).

On the evidence of tracks, there were at least two tigers in this small area, one an old male, the other also a male but young. The

old male had the reputation of killing domestic stock and not returning to his kills. There were also reports of panthers, droppings of bears, one of which I saw, and an odd elephant.

The North Coimbatore area comprised parts of the Satyamangalam and Tallamalai forest ranges, the former closed to shooting but apparently carrying no more game than the latter. The whole area was said to be 'poached out'. The country was hilly, chiefly covered with *Anogeissus-Cymbopogon* grass woodland, with denser forest and bamboo in river valleys, and here and there, on poorly drained soils, close-cropped maidans studded with *Zizyphus* trees. Although the cover was thicker and the actual bulk of herbage greater per unit area than in Mavanhulla, the great majority of the grass was *Cymbopogon*, a species most unpalatable except when very young after a burn. It was not anything like such a good game habitat naturally as the Mavanhulla area, but nevertheless I formed the conclusion that it ought to have carried more than it did since there were areas of palatable grass quite untouched. I saw not a single mature stag of either sambar or chital in the area, and there were no young calves in the small herds of chital I saw. There were a good many elephants in the area but only one was seen. Again there were probably more game animals than I actually saw owing to the dense cover and the prevalence of patches of forest. There were also herds of cattle and buffaloes, which were probably aggravating the fire problem in these forests by eating down the palatable grasses and so permitting the increasing dominance of the *Cymbopogon*, thus creating a splendid medium for fierce and destructive grass fires.

I saw one tiger in this area. I watched it walk along a path at about ten in the morning from the top of a hill, and had it in view for a quarter of an hour. It behaved precisely like a dog on a round of lamp-posts, sniffing the boles of trees carefully, and sometimes urinating with its tail curled over its back. It was a large male and appeared very well nourished. The range officer, Tallamallai, told me that tigers were not shot by local shikaris, but that poachers made serious inroads into the deer population; this agreed with my own observations.

These figures were of course only collected over a short period, and the game may migrate from place to place in both the areas concerned. Possibly I met an unusual concentration at Mavanhulla, and it certainly appeared that more gaur would be found in the North Coimbatore areas at other times of the year (there were old tracks of larger herds). However, I believe that the figures given represent

something like the relative carrying capacity of the two areas; a noteworthy feature is the abundance of barking deer in *Cymbopogon* grassland.

Elsewhere in South India I saw few game animals, despite walking about a good deal in potentially good game country. On Anaimudi, the highest peak of the High Range I saw twenty tahr in 3 herds, and in passing I would say that it seems strange that this animal, which does not appear to be confined to cliffs or even rocky country, is not very much more numerous than it is. On the Palni Hills, for instance, there appears to be a very large area of habitat suitable for it, but I saw none.

In the Mavanhulla area the first suggestion that was made to me by a shikari that I engaged was that I should go out and shoot a tiger in the lights of my car. The Nilgiri Game Association's report remarks, however, that night shooting from cars is on the decrease in the areas they control. Certainly there is no evidence of wholesale butchery and I did not hear a shot while I was there. The Association is to be congratulated on the head of game it has managed to maintain, at least in the areas I visited.

On the wider question of wild life preservation in India generally, it appears that there are 109 million acres[1] of reserved forest in India, and a further 255 million acres not available for cultivation. Some of the latter will be roads, tanks, villages, and small patches of waste land, but it must also include large areas of hillsides not at present reserved, and which are unsuitable for cultivation. Supposing that a proportion of this area could become game habitat, it seems possible that there might be 200 million acres of possible game ground, which at even the Tallamallai density would support over 1,500,000 large herbivores, and at 10 to the square mile over 3 million. Data must exist, or could be gathered which would enable an assessment of the total potential game population on an ecological basis to be made, which could serve as a target figure to be achieved in any future conservation programme.

A basic stock of game seems to exist even in areas which are said to be very heavily poached—shot out in fact by local account; in fact these areas are less denuded of game than many areas of Africa where game was abundant some 20 years ago. The position is similar to that reached in the United States where through uncontrolled hunting the game animals reached a very low ebb. Severe

[1] 1 acre = 0.41 hectares.

restrictions on hunting built up the stocks again until in several states there are now too many deer for the range to carry in winter, and the problem is to get enough shot each year. At any rate it is inescapable arithmetic that the potential game stock of India will stand only a certain kill each year, and that the existing stock will stand only a far smaller kill at present. If restrictions are not placed on shooting at present there will be no game for future generations to shoot.

India has at least one priceless advantage, that there is a religious objection to killing on the part of a large proportion of the people. If either of the areas I visited were inhabited by African tribes I would wager there would not by now be a single game animal left alive. With this in favour I would agree with Humayun Abdulali that there should be no reason why India's game stock should not be built up again and to do so would be in accordance with sound forest management. One appreciates that the control of poaching with guns supposed to be for the protection of crops is a difficult problem, but at least India does not have the poisoned arrow to contend with, carried by every able-bodied male among hundreds of thousands all over Africa. The right of a peasant to protect his crops against marauding game must be admitted, but there is no reason why he should not be required to keep his gun permanently on his farm or person. This nettle will have to be grasped if the remaining stock of India's game is to be preserved and built up again, and the shikari who hunts for sport will have to be restricted to the potential kill in any area.

The tourist who visits India may wish to see the Taj Mahal, or he may wish to shoot a tiger; in either case he will have paid several hundred pounds to reach India before he begins, and will be inclined to take the attitude that he is certainly entitled to get what he came for. The unscrupulous will undoubtedly kill their tiger in the light of a tractor's headlight if given the chance, but experience in Kenya is that sportsmen from overseas are prepared to submit to restrictions on what they may kill if they can see that these restrictions are imposed in the interests of preserving a stock of game for future generations. If, on the other hand, he pays for a licence and other expenses and hears unlicensed guns banging off all round he may be expected to feel resentful, and determine to get his tiger by hook or by crook. Licences should probably be for individual animals, on a ticket system, returnable if the animal is not shot. I myself have been glad to pay the small licence fees required for hunting in the

Nilgiri area and elsewhere in the knowledge that I have thereby been contributing in the only way possible towards the survival of Indian wild life.

KAREN,
KENYA COLONY,
April 27, 1960.

LESLIE BROWN

5. THE EASTERN CALANDRA LARK (*MELANOCORYPHA BIMACULATA*) IN KUTCH

On 5 February 1960 I went to Bada (near Mandvi) and on the mudflats there I saw several flocks of larks which looked distinctly larger and quite different from the Short-toed Lark (*Calandrella brachydactyla*) which come in large numbers to Kutch in winter. On closer inspection with the help of field glasses I was certain that I had once again come across a bird which had not yet been recorded in Kutch. After this a specimen was shot by M. K. Shivbhadrasinhji of Bhavnagar, who was with me that day, and on closer examination later I found that it was the Eastern Calandra Lark (*Melanocorypha bimaculata*). This lark is said to spend the winter months in the Punjab, U. P., Rajasthan, Sind, etc., and therefore it is likely to stray into Kutch also, but somehow it seems to have escaped the notice of bird watchers.

BHUJ,
KUTCH,
March 31, 1960.

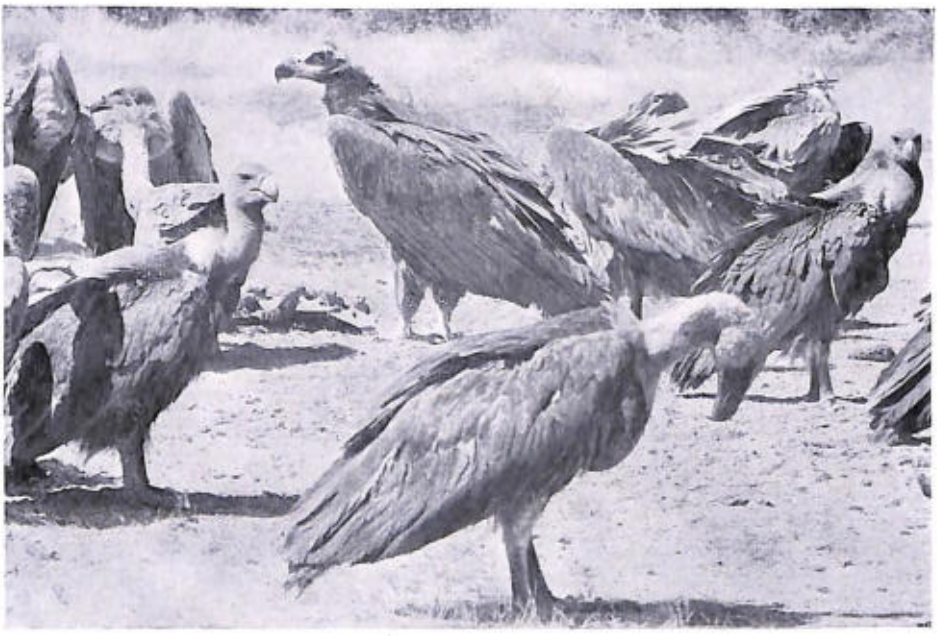
M. K. HIMMATSINHJI

[The specimen was sent to the Society and its identification as *M. bimaculata* has been confirmed. The condition was not good enough for racial discrimination, but it presumably belonged to *torquata* Blyth, the breeding population of Baluchistan.—EDS.]

6. THE CINEREOUS VULTURE [*AEGYPIUS MONACHUS* (LINNAEUS)]—AN ADDITION TO THE BIRDS OF KUTCH

(With a plate)

On 9 March 1960, while motoring through the Banni, I observed a solitary Cinereous Vulture (*Aegypius monachus*) among a gathering of other vultures.



A Cinereous Vulture (*Aegypius monachus*) among Indian Griffon(?) and Whitebacked Vultures

Another rare visitor to Kutch. A raven (*Corvus corax laurencei*) among vultures at a carcase

Photos : Charles Ho

Subsequently, on 19 March 1960 while photographing vultures at an animal carcase on Kuar Bet off Pachham, Mr. Charles Ho obtained an excellent picture of a solitary Cinereous Vulture amongst a gathering of Whitebacked and Longbilled (possibly also some Fulvous) Vultures and a pair of ravens (*Corvus corax*). Mr. Ho remarked on the enormous size and dark coloration of this bird, and on the deference shown to it by the other feasters. The raven in the bottom picture, according to Mr. Ho, was definitely not the brown-necked species, therefore doubtless *C. c. laurencei* which has been collected in Kutch before.

33, PALI HILL,
BANDRA,
BOMBAY 50,
April 25, 1960.

SÁLIM ALI

[This large vulture is found in south Europe, northern Africa, and eastwards through south-west and south-central Asia to India and China. It breeds in Baluchistan and possibly along the Himalayas to Cachar in Assam. In winter it descends into the Punjab, Sind, and other parts of northern India, the southernmost record being from Mitli in Kaira District, about 40 miles south of Ahmedabad (*J. Bombay nat. Hist. Soc.* **50**: 945-6).—EDS.]

7. ON THE OCCURRENCE OF THE REDHEADED MERLIN (*FALCO CHIQUERA*) IN KERALA

Though in popular bird books there are vague general remarks implying that the Redheaded Merlin (*Falco chiquera*) might be met with all over south India, Whistler (1936) questions the occurrence of the species in the then Presidency of Madras. He states: 'Dewar includes the Redheaded Merlin in his Madras list, but as he makes no comment on the fact and there is no other record for the Presidency, I think it wiser not to admit the species to the Presidency list until further evidence is forthcoming.'

Koelz (1947) records a male taken at Cudappah on March 20. This appears to be the only definite record for the south.

The facts given below show that the bird not only occurs in Kerala State, but might even be found breeding here.

I saw the Redheaded Merlin first at Kavasseri (Palghat Dist.). On 4 June 1950, late in the evening two Merlins came flying from the jungle across a river, and alighted on a palmyra tree. Their

incessant bickering and the fact that finally one was chased away by the other suggested that they were not a mated pair. I made no attempt to judge their sexes, but noted that (i) only one of them had a prominent moustachial streak, (ii) it had also a more reddish head than the other, and (iii) only one of the birds uttered call-notes: a continual *tiriririri-tiriririri*. In the light of later experience, I guess that the one which uttered the call-notes was a fully-fledged young bird which the other, presumably a parent, was trying to shake off.

A single, silent Redheaded Merlin was found at the same spot on 18 May 1951, again in the evening.

On 30 April 1958, I took up residence at Chittur-Cochin, 15 miles ENE. of Kavasseri. On 22 May 1958, I found three Redheaded Merlins on a palmyra tree beside the river in terrain almost identical with that where the birds were seen at Kavasseri. Time 18.30 hrs.

At 11.00 hrs. on the next day they were not found at the place, but at 13.30 hrs. all three were there. Judging by the absence of barring on the breast and the middle of the underparts as well as by their constant calling and wing-quivering when perched, I decided that two were young ones. The other bird of the party had breast and the rest of the underparts closely barred in grey, and was constantly chivvying kites and Serpent Eagles which passed that way. It was undoubtedly a parent bird.

That evening I watched them again from 17.00 hrs. for half an hour. One of the juveniles had disappeared. The two that were there repeatedly swooped at Common Mynas feeding on the meadow between the trees and the river, but the mynas just scattered and none was caught.

Once the two falcons pursued a Whitebreasted Kingfisher. The kingfisher fell flop into the shallow stream in the river. Every time it attempted to escape, the falcons swooped forcing the kingfisher back into the water. After half-a-dozen tries at the victim, the falcons moved off and the kingfisher escaped.

On the 24th at 18.15 hrs. there were only two falcons at the place. None was found at 18.30 hrs. on the 25th. On the 28th at 17.00 hrs. there were two. On the 30th only one at 17.30 hrs. On the 4th of June at 18.30 hrs. one was present.

Having decided to obtain a skin for confirmation of my identification, I went to their haunts on 8 June with a friend who had agreed to shoot one of the birds for me. At 18.00 hrs. a single falcon came flying with a small bird in its talons and, alighting on a palmyra frond, began feeding. My friend shot the bird just as it had finished eating. The skin was sent to the Bombay Natural History Society,

and Dr. Sálim Ali confirmed my identification. Sri Humayun Abdulali wrote: 'From the size and colour the specimen appears to be a female in immature plumage'.

The Redheaded Merlin was seen again in the same area later on. Details are given below:

11th June 1958—One seen flying over at 11·00 hrs.
13th ,, ,, — ,, ,, ,, ,, ,, 18·40 hrs.
12th April 1959—Two harrying a Brahminy Kite at 18·30 hrs.
13th ,, ,, —One ,, ,, ,, ,, 18·15 hrs.
14th ,, ,, —One eating a small bird on palmyra tree, 18·00 hrs.

My thanks are due to Sri M. Srinathan Nair, Cochin Nair Bank, Chittur, for having shot one of the falcons for me, and to Sri M. K. Prasad, then Lecturer in Botany, Govt. College, Chittur, for having prepared the skin.

GOVERNMENT COLLEGE,
CHITTUR-COCHIN,
April 15, 1960.

K. K. NEELAKANTAN

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[The Virus Research Centre at Poona have in their collection a male and a female *Falco chiquera* obtained by B. S. Lamba at Palivada in Krishna District, Andhra State on 17th November 1956.—EDS.]

8. THE BUFFBREASTED SANDPIPER, *TRYNGITES SUBRUFICOLLIS* (VIEILLOT): AN ADDITION TO THE AVIFAUNA OF INDIA AND CEYLON

A specimen collected by Dr. T. S. U. De Zylva on 5 March 1960 at Kalametiya Lagoon was forwarded to me for identification. My identification has been confirmed by the Senior Scientific Officer in the Bird Room at the British Museum (Natural History), London. Sex, unfortunately, unknown.

Kalametiya Lagoon, situated on the southern coast of Ceylon, is bordered by a grass plain on the eastern side which is cropped low by cattle and buffalo. Dr. De Zylva states the bird was seen by itself on this grass plain, reminding him of a Golden Plover; on making a closer inspection through binoculars he realised it to be something

new and out of the ordinary. This is the first record of this species from Ceylon, which adds a new bird to the list of our avifauna.

The HANDBOOK OF BRITISH BIRDS gives its distribution as:

'N.W. Nearctic region—breeds on arctic coasts of N. America from N. Alaska to N. Mackenzie. (No proof of breeding in E. Asia) Migrates through N. and Central America to S. America (Argentina and Uruguay; noted on migration N. E. Siberia). Casual in Japan, W. Indies, Bermuda, and accidental in France, Switzerland, Heligoland, Red Sea, and possibly Turkey.

Nineteen specimens have been recorded from the British Isles, mostly in September, but one in May, one July, one August, one October.'

It has no subspecies. It can be distinguished by pink-buff under parts and by the inner webs of the primaries and secondaries being freckled with black, and short, slender, black bill; the head is noticeably rounded.

Dr. De Zylva is to be congratulated on his keen observation thus making this most interesting find possible.

PINGARAWA,
NAMUNUKULA,
CEYLON,
April 14, 1960.

C. E. NORRIS,
F.Z.S., M.B.O.U.

9. 'FLAMINGO CITY' RE-VISITED: NESTING OF THE ROSY PELICAN (*PELECANUS ONOCROTALUS* LINNAEUS) IN THE RANN OF KUTCH[1]

(*With a plate*)

Owing to the abnormally heavy rainfall in Kutch during the SW. monsoon of 1959 (in some areas over 60" against the annual average of about 15") the Great Rann was inordinately flooded in March 1960. The marginal area along the base of the rocky range of hills running E.-W., known as Kala Dongar, over which it is possible in normal years to go by jeep from Kotda to Nir was still partially submerged by 20 March, or too wet and treacherous even for jeep traffic. Therefore, in order to reach Nir, the base for Flamingo City, it was necessary to travel camelback from Kakrao Police Outpost near Kuran village—a distance of about 14 miles (3 hours)—over rough stony ground cross-country along the lower contours of Kala Dongar. During more or less the entire camel journey the edge of the Rann

Rosy Pelican (*Pelecanus onocrotalus*), adults and chicks, in pelicanry in the Rann of Kutch

Rosy Pelican (*Pelecanus onocrotalus*) chicks in pelicanry in the Rann of Kutch with flamingos in the background

Photos : Sálim Ali

remained in sight, and from time to time there could be seen in the shallow brine jostling masses, looking like flat mud islets, of thousands of mixed waders—Common and Dusky Redshanks (*Tringa totanus* and *T. fuscus*), Ruff & Reeve (*Philomachus pugnax*), Dunlins (*Calidris alpinus*), stints (*Calidris temminckii* and *C. minutus*), sandpipers (*Tringa nebularia, T. stagnatilis, T. ochropus, T. glareola, T. hypoleucos*), Stilts (*Himantopus himantopus*), Little Ring Plovers (*Charadrius dubius*), and perhaps also others too far off to identify, but certainly with a sprinkling of Turnstones (*Arenaria interpres*) amongst them. At Nir there was also a considerable concourse of White Storks (*Ciconia ciconia*)—one flock of 300-400—a species I had not met with in such large numbers in Kutch before, and about 50 spoonbills (*Platalea leucorodia*). There were also present large numbers of a species of gull which, owing to the distance, could not be satisfactorily identified. In size they were between the Blackheaded and the Herring Gull—silvery grey above, white below with darkish shading to underside of the wing near the tip (primaries) rather as in the blackheaded species. There was no black visible in the head while the bill and legs appeared to be black without any glint of red even in good light. With them there were the similarly coloured but unmistakable Gullbilled Terns (*Gelochelidon nilotica*).

On the morning of 21 March accompanied by Charles Ho, we started on camels for Flamingo City about 8 miles NE. of Nir under the guidance of the erstwhile Flamingo Warden, Jamal Nathoo. The entire intervening distance was now one vast expanse of water from ankle to knee deep, stretching on three sides to the featureless horizon. With the perilous swaying and slithering of the camels on the treacherous bottom mud, the ride was scarcely conducive to physical comfort or mental relaxation, and one had the curious feeling of suddenly being transported from the ship of the desert to a ship on the ocean! A heavy cross-wind whipped up the surface into angry little wavelets and, in the absence of any landmarks to steer by, all this gave the disturbing illusion of our animals being constantly drifted away from a straight course. Under these conditions it took us a full 4 hours to reach Flamingo City.

The 'City' itself was situated in its traditional site, now an extensive pancake-flat sun-baked mud island only a few inches above the level of the surrounding water. The area actually occupied by the nest mounds has expanded considerably since my last visit in 1957, and its broadest and most thickly populated part now stretches for quite half or three-quarters of a mile. The number of flamingos here was greater than I have ever known before. The impression,

which I noted down on the spot, was that there were at least twice as many birds as estimated by me in April 1945, therefore (including adults and juveniles) something of the order of a million individuals. However, owing to pressure of time no sample counts were possible as on the previous occasion, and this guess possibly means little more than that there was indeed a truly fantastic concentration of birds. The nesting was now at its peak and in all stages, from birds sitting on more or less fresh eggs, through new hatchlings, grey downy runners of two or three progressive age groups, to even a few lanky flying youngsters in the brown juvenile plumage.

A new and unprecedented feature was the presence within and for several miles around Flamingo City of vast numbers of Eastern White or Rosy Pelicans (*Pelecanus onocrotalus*)—Kutchchi *Pēn*—dotted about in herds or rafts of varying sizes, estimated as aggregating 3000-4000 birds. Several hundred pairs of these were nesting in certain sections along the periphery of the occupied flamingo colony, in what may be called its deserted suburbs, among the bases of old worn-down stumps of the nest mounds. The nests consisted of from a skimpy to a fairly substantial bed of large white feathers (the birds' own and flamingos'). They were close together, roughly one to a square yard, and contained mostly 2 eggs or young each, but in some cases 3 and occasionally 4. The eggs were ivory white with a smooth gloss and not chalky-textured like flamingo eggs, though of about the same size, only broader. Twenty-five eggs averaged 95.56×61.65 mm. Maximum 103×63 and 102×66.5 mm.; minimum 87×60 mm. and 95×57 mm.

14 eggs from the Persian Gulf (F.B.I., ii ed. **6**: 273, averaged 88.3×57.5 mm. Maximum 94.1×60.0 mm.; minimum 83.1×58.0 mm. and 89.0×55.0 mm.

Unlike the tree-nesting Spottedbilled Pelican whose nestlings are covered with snow-white down, the nestlings of the Rann pelicans wore a funereal livery of dull sooty black. When newly hatched the young is naked, rather glossy skinned dark flesh-coloured. In the slightly older chicks (at 3 or 4 days?) the skin turns blackish, and the chick becomes blacker when the feather papillae begin to show and the down and quills sprout. The bill, bill-pouch, and legs are all funereal black. The larger squabs are enormously fat and ugly; when approached they tend to herd together and waddle away with an unsteady, ungainly gait. Little dumps of cast-up fish, each of astonishing quantity, soon lay dotted about the nests as the young disgorged them in fright on our approach. Some of these fish were fully 10" long and must have easily weighed ½ lb.

This is the first record of the Rosy Pelican breeding within Indian limits where it has hitherto been considered a winter visitor only. As far as I am aware its nearest known breeding place is, or was, Bubyan Island at the head of the Persian Gulf where La Personne, collecting for Sir Percy Cox, found a colony in 1922 (*J. Bombay nat. Hist. Soc.* **31**: 109). But it is curious that although this colony contained downy chicks at the time no mention of their colour is made. Likewise there is no description of the downy young in any of the better known literature I have consulted in spite of the fact that it is so startlingly different from its parents and from similar chicks of the Spottedbilled species.

The discovery of the Rosy Pelican breeding in the Great Rann of Kutch again points up to the many surprises that await a proper biological exploration of this unique and truly fantastic salt desert. It will be remembered that my visit to Flamingo City in 1945 produced the first record of an avocet breeding colony on Indian soil. Although agitated avocets were present in small numbers in March this year also, and probably breeding, no definite evidence of this was procured.

33, PALI HILL,
BANDRA,
BOMBAY 50,
April 15, 1960.

SÁLIM ALI

10. IN SEARCH OF THE PINKHEADED DUCK [*RHODONESSA CARYOPHYLLACEA* (LATHAM)]

I have just returned from a tour of north Bihar where I had gone in search of the Pinkheaded Duck. Having failed to locate the 'Patraha Katla'[1] anywhere in the Bhagalpur district in spite of extensive enquiries, and finding a place called Pathraha shown on the 1" topographical map of Purnea district, I made my way to Forbesganj in the extreme north of the district. Pathraha, which lies some seven miles west of Forbesganj and is approachable only by bullock cart, proved disappointing. All the chaurs and jheels have been reclaimed for cultivation, and I could not find a single habitat which even remotely resembled that of the Pinkheaded Duck.

Mr. Frank B. Simson mentions in *Ibis*, 1884, p. 271 the area in the south of the Purnea district lying between the Kosi and Ganga rivers

[1] Where an anonymous writer in the defunct *Asian Sporting Newspaper* had found it breeding in July 1880.

as a favoured locality for this bird. He particularly mentions the Purnea Trunk Road, and a travellers' bungalow on it. The map showed the area lying between Karhagola Road railway station and the Ganga River as full of jheels and chaurs. Karhagola Road lies on the Purnea Trunk Road, and there is a travellers' bungalow there. Unfortunately the bulk of this area too has been reclaimed for cultivation, and Mr. Simson's description of 'pools of deep water abounding in wild fowl and crocodiles' reads like an after-dinner story. I found only two chaurs, the Chapri and the Drona, each nearly 10-12 acres in extent, lying past Uchla village, some 1½ miles south of Karhagola Road railway station. The Drona chaur was practically devoid of vegetation, but the Chapri chaur had water hyacinth, lotuses, and dry grass. Both are located in the midst of cultivated fields, and neither looked in the least suitable as a place for the Pinkheaded Duck. Though I could not find the duck, I found some interesting water birds. Of particular interest was a colony of River Terns breeding, and there were 9 young ones playing or flying on the banks of the Drona chaur. They appeared to be in almost exclusive occupation of the chaur. I have not seen such a big colony even on the river Ganga. The other interesting bird was the Spurwinged Plover, which probably breeds there.

I showed the pictures given in the *Illustrated Weekly of India* (28th July 1957) with Mr. Sálim Ali's article to a number of villagers, and they all unhesitatingly pointed out the Redcrested Pochard or *lal sir* as visiting the chaurs in large numbers with other ducks during the cold weather. They also told me that both these chaurs were extensively shot over during the winter, and only some 15 days before my visit a party had bagged about 20. They proved more accurate observers than a 'sportsman', who told me that 'these migratory birds go back to their nesting places by the end of March' on being questioned about the Pinkheaded Duck, and was obviously referring to the Redcrested Pochard. Nawab Chaudhri Nazirul Hassan, a great shikari of north Bihar, however, mentioned that he had shot a pair of Pinkheaded ducks with Mr. Atkins many, many years ago, but had not seen any since then. One more locality in Darbhanga will be investigated by me next cold weather, since the last record of this duck is from this area in June, 1935.

4, European Bachelors' Quarters,
Doranda, P.O. Hinoo,
Ranchi,
April 29, 1960.

JAMAL ARA

[We are informed by Mr. D. E. Reuben, I.C.S. (Retd.) that a pair shot by Nawab Chaudhri Nazirul Hassan and T. Atkins at Bakhtiarpur (Monghyr Dist.) on 11 March 1924 are exhibited in the Patna Museum.—EDS.]

11. A PINKHEADED DUCK [*RHODONESSA CARYOPHYLLACEA* (LATHAM)] AT LAST?

This is to inform you that, on 28 and 29 February 1960, I along with a friend Shri Grehawal, an Engineer in the Western Command, Simla, saw a solitary Pinkheaded Duck in a local tank in 'Kunihar State' situated about 40 miles south of Simla.

We tried to take a coloured photograph but, owing to the abundance of reeds and lack of a proper hide, we were unsuccessful in taking the picture. My Wildlife Guard told us that this drake was in the tank for the last two months or so along with Mallard and Common Teal.

SIMLA 4, K. L. MEHTA.
March 23, 1960. *Deputy Game Warden, Himachal Pradesh*

[It will be recalled that the last *definite* record of this species in a wild state goes back to 1935 when a trapped bird was brought to the late Mr. C. M. Inglis, in the Darbhanga Dist., Bihar.—EDS.]

12. BIRD NETTING AND THE WEATHER: SOME EXPERIENCES IN KUTCH, MARCH 1960

Clouds loomed ominously in the Kuar Bet sky as the first net was being installed. This was only a foretaste of the unpredictable spell of weather that confronted the Migration Study Team during the three weeks of the project. There were three dust-storms, one rainfall, and on three successive nights the thermometer recorded 40°, 42°, and 52° F. respectively.

How and to what extent did this abnormal weather affect the flow of migration? The answer is difficult, but a look at the collection statistics vis-á-vis the weather-chart is suggestive.

Below, the daily collection of three migratory species, namely Lesser Whitethroat (*Sylvia curruca blythi*), Orphean Warbler (*Sylvia hortensis*), and Rosy Pastor (*Pastor roseus*) are plotted on a graph with dates on the other axis. Readings of temperature (maximum and minimum) and relative humidity are also plotted likewise.

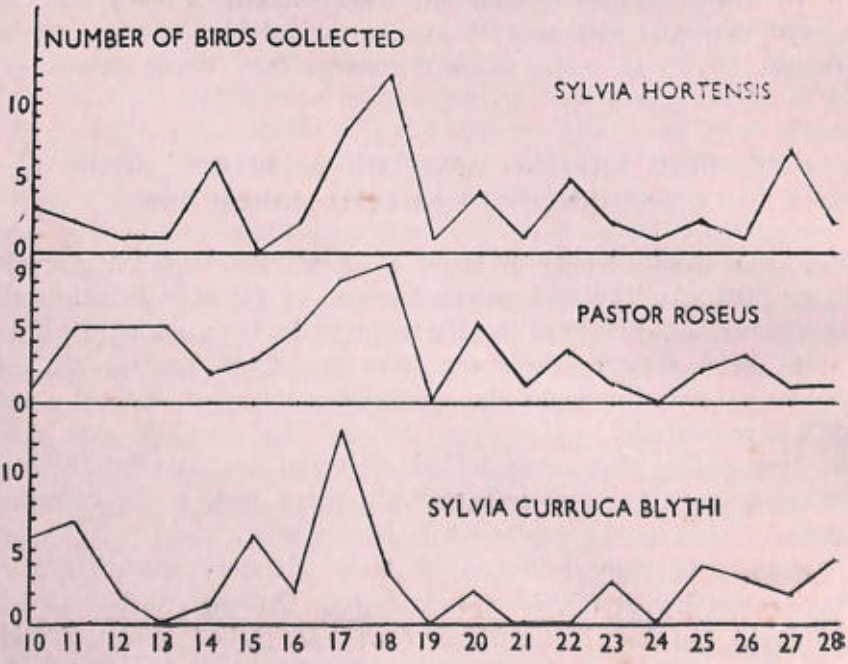
The collection period can be divided into two parts based on weather conditions:

1. *From the 10th to the 18th of March.* During this period the bird curves are on the ascendant. The Whitethroat curve reaches a peak on the 17th (13 birds). A day later the maximum numbers of Rosy Pastors and Orphean Warblers are trapped (9 and 12 respectively). The average temperature readings for this period are maximum 88.8 and minimum 66.6 Fahrenheit. The average relative humidity reads 64.5%. The minimum temperature is never below 60° F.

Two days stand out for record collection. They are: (1) 17-3-60 Max. 80°, Min. 68°, R.H. 64.5%. Number of birds collected 109. (2) 18-3-60 Max. 87°, Min. 66°, R.H. 49%. Number of birds 106.

During these 9 days 42 Whitethroats (70% of total collection of this species), 35 Orphean Warblers (57.3%) and 43 Rosy Pastors (71.4%) are recorded. This period also accounts for 69% of the total collection made during the entire project.

2. *From the 19th to the 28th of March.* The first day shows a marked fall in collection (21 birds) due to high winds that had sprung up in the night. There are temporary revivals on 20th and 22nd, after which the bird curves decline again following freakish weather.



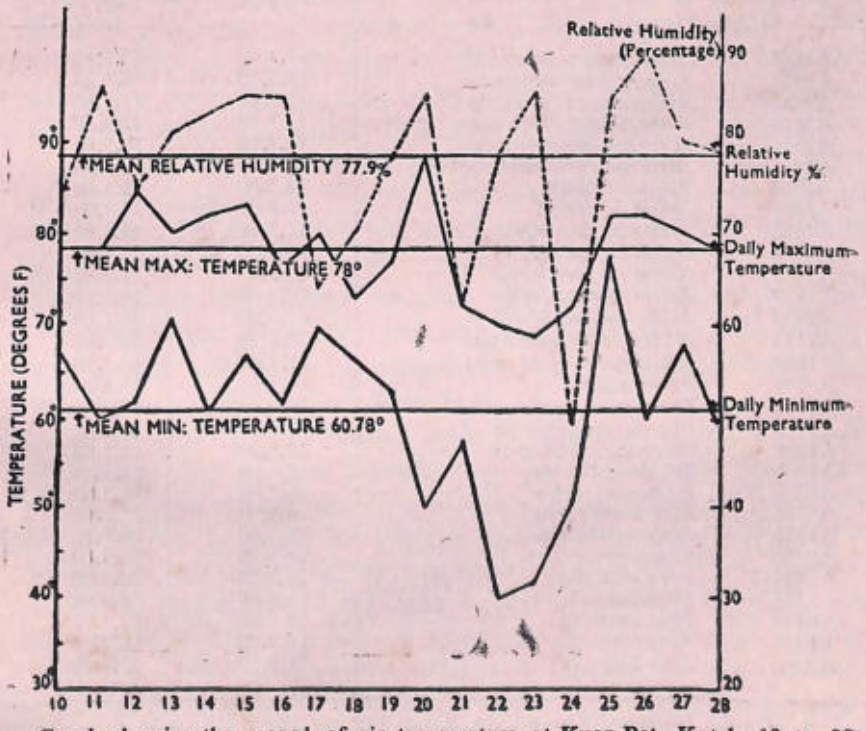
Graph showing the collection of three migratory species, Orphean Warbler, Rosy Pastor, and Lesser Whitethroat, at Kuar Bet, Kutch, 10-28 March 1960.

The weather chart shows big fluctuations from average readings during this period. The record shows:

Date	Max. Temp.	Min. Temp.	R.H.%	No. of birds collected
19.3.1960	77	63	79	21
20.3.1960	88	50	86	55
21.3.1960	72	58	63	18
22.3.1960	70	40	79	60
23.3.1960	69	42	86	39

The only exception is the capture of 7 Orphean Warblers on the 27th. In the course of these 10 days 18 Whitethroats, 26 Orphean Warblers, and 17 Rosy Pastors are recorded.

Another significant factor in the capture of birds was the flowering of *Capparis aphylla*. In the first half of the spring migration project these richly coloured and nectar-laden flowers were in full bloom, presenting a sure attraction for migrant species like Rosy Pastor and many of the warblers. Nets were erected between adjacent bushes—very often two nets were placed at an angle—so that the birds got entangled while crossing from one bush to another. This plan



Graph showing the record of air temperature at Kuar Bet, Kutch, 10 to 28 March 1960.

fetched handsome results when the flowers were in full bloom (10th to 19th of March). But once they started withering (from the 19th onward) the number of birds caught in these nets began to fall steeply.

Recapture of Banded Birds

Out of a total of three hundred and twenty migrant birds ringed in the course of the present migration study 31 were recaptured on Kuar Bet between 10-3-60 and 28-3-60.

A Bluethroat (*Erithacus svecica*), banded on the 15th of March, was recaptured on the 28th. This is the longest period of stay of a migrant bird on the present record and suggests that the bird had probably overwintered here and was not on the move. Similarly, a Thickbilled Warbler (*Phragamaticola aëdon*), banded on 10-3-60, and the only one of its kind to be ringed, was caught again on the 22nd.

The following are particulars of some of the other migrants recaptured:

Ring No.	Name of Bird	Date of ringing	Date of recapture
A1652	*Acrocephalus stentoreus*	11.3.60	23.3.60
A1826	*Acrocephalus stentoreus*	15.3.60	18.3.60
A1838	*Acrocephalus stentoreus*	15.3.60	18.3.60
A1810	*Acrocephalus dumetorum*	15.3.60	22.3.60
A1808	*Acrocephalus dumetorum*	15.3.60	20.3.60
A1815	*Acrocephalus dumetorum*	15.3.60	16.3.60
A1763	*Sylvia hortensis*	13.3.60	23.3.60
A1981	*Sylvia hortensis*	17.3.60	25.3.60
A1657	*Sylvia curruca blythi*	11.3.60	19.3.60
A1901	*Sylvia curruca blythi*	16.3.60	25.3.60
A1619	*Sylvia curruca blythi*	10.3.60	15.3.60
A1929	*Sylvia curruca blythi*	17.3.60	18.3.60
A1934	*Sylvia curruca blythi*	17.3.60	18.3.60
A2153	*Hippolais caligata rama*	22.3.60	28.3.60
A1664	*Hippolais caligata rama*	11.3.60	12.3.60
B 599	*Pastor roseus*	13.3.60	15.3.60
A1902	*Phoenicurus ochruros*	16.3.60	27.3.60
A1977	*Phoenicurus ochruros*	17.3.60	20.3.60
A1958	*Phoenicurus ochruros*	17.3.60	18.3.60
A1841	*Erithacus svecica*	15.3.60	28.3.60
A1706	*Erithacus svecica*	12.3.60	15.3.60
A1770	*Muscicapa parva*	14.3.60	23.3.60
A1833	*Muscicapa parva*	15.3.60	18.3.60
AB190	*Upupa epops*	18.3.60	26.3.60
A1724	*Jynx torquilla*	13.3.60	20.3.60
A1753	*Jynx torquilla*	13.3.60	19.3.60
AB194	*Jynx torquilla*	18.3.60	22.3.60
A1799	*Jynx torquilla*	14.3.60	16.3.60
AB044	*Jynx torquilla*	11.3.60	12.3.60

A House Sparrow, ringed on Kuar Bet on the 18th, was recaptured on the 25th at Vad vāli vai near Kotda. This involved a straight line

distance of about four miles across a bare arm of the Rann, suggesting that the birds fly such long distances to forage.

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, DANIEL MATHEW
BOMBAY 6,
April 15, 1960.

13. NOTES ON THE SPINYTAILED LIZARD, *UROMASTIX HARDWICKI* GRAY

In the latter half of February 1959 I had the opportunity of visiting the Banni on the borders of the Rann of Kutch. The 'Sanda' or Spinytailed Lizard (*Uromastix hardwicki* Gray) was common and there were large colonies on the outskirts of villages. The Banni is flooded during the rains and the villagers and the lizards form colonies on islands where alone they can survive.

They appeared to be very watchful and as our jeep approached would scuttle away into their holes, often 20 to 30 yards away. Their movements were too fast even to make an attempt at catching them by placing one's feet on their holes as is said to be done by boys in the Salt Ranges (Hora, *Rec. Ind. Mus.* **25**: 369-376).

At Dhorda we stopped for lunch and met a local inhabitant who offered to secure some. We went out to shoot spotted sandgrouse and when we came back after two hours, he had a bag full of lizards. When placed on the ground, however, they refused to run and a closer examination showed that they all had their backbones broken just behind the neck; we were informed that they would live for over a week and require no attention! These were put into spirit and we went out again to catch some more.

In the heat of the afternoon most of them had entered their holes but the method of their capture was very simple. The hunter was armed with two hard sticks, one about three-quarters inch diameter and four feet long and the other a little thicker, half its length, and pointed at one end. Having examined the entrance from which he could tell if the animal was within or not, he would quickly push in the longer stick as far as it would go, wedging the lizard against the wall. Then squatting near the hole and holding the big stick down with his toes, he used the shorter stick, as a pick-axe holding it between both his hands. Between 12 inches and 18 inches he would reach the tunnel and then grab the animal with his bare hands. It

was quite harmless and never made the slightest attempt at biting, though it would thrash sideways with its tail, the spines on which were quite formidable.

Differences in colour were noticed in the field and the villager said that it was possible to tell the males by their longer tails. Though I could not then check upon the difference, I have subsequently sexed and measured the specimens with the assistance of Mr. V. K. Chari of the Prince of Wales Museum with the following results:

Sex	*Total length*	*Head & body*	*Tail*	*Percentage of tail to head & body*
♀	392 mm.	224 mm.	168 mm.	75
♀	396 mm.	226 mm.	170 mm.	75.3
♀	370 mm.	220 mm.	150 mm.	68
♂	403 mm.	225 mm.	178 mm.	79
♂	..	248 mm.	125 mm. (damaged)	..
♂	369 mm.	196 mm.	173 mm.	88
♂	489 mm.	269 mm.	220 mm.	81.7
♂	415 mm.	223 mm.	192 mm.	86
? (alive)	340 mm.	200 mm.	140 mm.	70 (♀?)
? (alive)	441 mm.	240 mm.	201 mm.	83 (♂?)

It will be noticed that in the females the tails range from 68-75% of the length of the head and body while in the males they are 79-88%, i.e. appreciably longer. After preservation in formalin the males were darker in colour than the females, which also appeared to have paler spots on the chin. These differences were, however, not visible on the two live specimens which from the proportions of their tails (83% and 70%) appeared to be of different sexes.

The tails of 1 male (79%) and 2 females (69 & 70%) from Thar & Parkar and Lahore in the Society's collections are within these limits.

What the villager told me and the conclusion pointed at by the above-mentioned measurements are confirmed by E. Home Purves (*J. Bombay nat. Hist. Soc.* **23**: 780-784) in his notes on this species in the Punjab. He refers to 'certain low class Indians who eat this lizard and hunt it systematically', and observes that they can distinguish beween the male and female by the length, shape, and size of the tail and in no case were they found to err. No details however are mentioned of these differences.

The proportionate shortness of the tails of female lizards and snakes does not appear to have been often referred to in Indian literature, but is apparently in agreement with facts observed elsewhere and it may be worthwhile checking for our many and varied forms. Oliver, in THE NATURAL HISTORY OF NORTH AMERICAN AMPHIBIANS AND REPTILES: 277, says: 'In reptiles, males frequently have relatively longer tails than females, but this is usually not under hormonal

control, for at birth males already have proportionately longer tails'.

The two live specimens had the iris reddish orange. The females all had 12-20 eggs in each ovary, the largest about 5 mm. in diameter. The males showed enlarged testes varying between 17×12 mm. and 24×14 mm., all after shrinkage in formalin. Yellow fat bodies were present near the gonads in all of both sexes. The species is diurnal and herbivorous and the stomachs held remains of vegetation, mostly grasses.

Smith (FAUNA, p. 245) indicates an average size of 305 mm. for this species and refers to their attaining a total length of 350 mm. He also refers to a 450 mm. individual from Karachi as unusually large. The male from Thar & Parkar which had enlarged testes measured 388 mm. and the two females 296 and 238 mm. In the present series, the males averaged 415 mm. (369-489 mm.) and the females 375 mm. (340-396 mm.).

All the specimens captured were measured and it is significant that no small ones were obtained. Is the Kutch population larger in size?

BOMBAY NATURAL HISTORY SOCIETY,
91, WALKESHWAR ROAD, HUMAYUN ABDULALI
BOMBAY 6,
October 16, 1959.

[The Society's bird migration camp on Kuar Bet on the borders of the Rann in March 1960 was partly under a large Acacia tree which held a nest of a Tawny Eagle, *Aquila rapax*, containing an almost fully fledged young one. The nest was littered with the remains of tails and backbones of the Spiny-tailed Lizard, *Uromastix hardwicki*, which appeared to be the staple food at least of the young. A pair brought in by P. W. Soman, Junior Research Assistant, were cast as exhibits for the Natural History Section of the Prince of Wales Museum, Bombay. The male with a total length of 333 mm. had his tail 80% of the head and the body and the female (292 mm.) 70%.—EDS.]

14. THE BULL FROG (*RANA TIGRINA*) AS A PREDATOR OF POULTRY

During our annual family gathering for Christmas in Pithapuram (East Godavary District, Andhra Pradesh) this year, we were not served with fowl as frequently as in previous years. On enquiry my mother explained that most of the chicks reared during the year were lost and it must be the work of kites or thieves.

My two daughters and I decided that the thief must be caught. Our prize Rhode Island Red hen, with her brood of 15 chicks hardly 10 days old, was going about briskly with the chicks running hither and thither. We hid near a small bush in our compound and waited for the thief. An hour passed by but there was no sign either of kite or thief. The chicks were evidently thirsty and so was their mother. They proceeded towards a small forsaken pool in the compound. While we watched from the bush, presto, a chick disappeared and then, equally suddenly, another. We ran towards the pool and the sight was really ghastly. Two bull frogs (*Rana tigrina*) had each a chick in its mouth firmly grasped with their forelegs. Within the twinkling of an eye the victims were swallowed. At last the thief had been caught.

RESEARCH DIVISION OF ENTOMOLOGY,
AGRICULTURAL COLLEGE, EDWIN DHARMARAJU
BAPATLA,
May 2, 1960.

15. FOUR NEW BUTTERFLIES FROM ASSAM

(*With five text-figures*)

LYCAENIDAE

1. **Spalgis baiongus** sp. nov. This species is described from a male and a female taken by Norman in thick forest in the plains of Sibsagar District. The ♀ was taken on 4 July 1954 in the Nambar Reserve and the ♂ on 5 April 1956 near the old Mokukchang road. Mr. G. E. Tite of the Tring staff of the British Museum (Natural History) has recently found a further two specimens in the Museum collection, a ♂ collected by Tytler at Ghaspani in the Naga Hills and a ♂ collected by Ferrar on Great Nicobar. Unfortunately the identity of the latter specimen cannot be determined with certainty since it lacks an abdomen.

DESCRIPTION

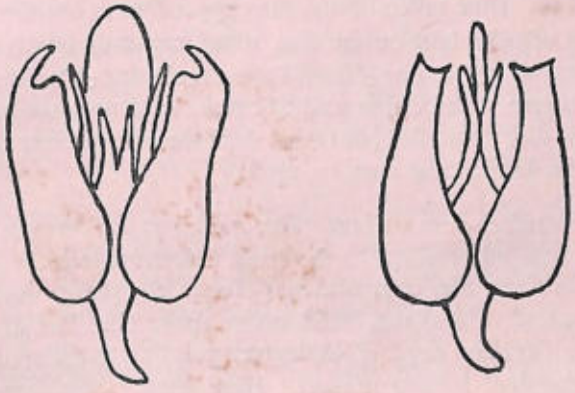
♂ and ♀. Antennae and palpi resemble those of *Spalgis epeus* Westwood.

Upper side : Both wings uniform brown with no trace of white at the end of the cell.

Under side : Both wings have rows of slender curved brown strigae similar to but much more irregular than those of *epeus*.

The strigae are outwardly lined with whitish ; inwardly each shades into a brown area, thus giving the effect of a spot and making the wing look blotched and glazed. The submarginal area of both wings is diffusely whitish (particularly the upper half of the termen of the fore wing), and as the basal area is also pale the central darker area stands out in contrast. Both in detail and in general appearance the under side is quite distinct from that of *epeus epeus* Westwood, *epeus nubilus* Moore, and *epeus titius* Frühstorfer, whose ground colour is either clear grey or clear brown. Length of fore wing from base to apex : ♂ 7 mm., ♀ 9 mm. The apex of the fore wing is much less pointed than that of *epeus*.

Genitalia : Norman dissected his ♂ in Assam, showing that the clasp differed in important respects from that of *epeus*. Unfortunately this dissection was subsequently lost, but two drawings made by Norman in 1956 correspond exactly with the genitalia



1. 2.

1. *S. baiongus:* aedeagus and clasps ; 2. *S. epeus:* aedeagus and clasps.

of Tytler's Ghaspani specimen, which Tite very kindly dissected. The figure shows the aedeagus (but not the uncus) and the clasps of *baiongus* and *epeus*. Considerable difficulty was experienced with the morphology of the various processes until Mr. J. V. Pearman, a colleague of Tite, succeeded in the difficult task of separating the central process of *epeus* into two halves, thus proving that it is two styles and is not an annellus, although wrapped round the aedeagus. *Baiongus* has, therefore, styles as well as an annellus, while *epeus* has styles but no annellus. The aedeagus and the shape of the distal portion of the clasp also differ in the two species.

Of the specimens taken by Norman the ♀ has been presented to the

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May 2, 1960.

EDWIN DHARMARAJU

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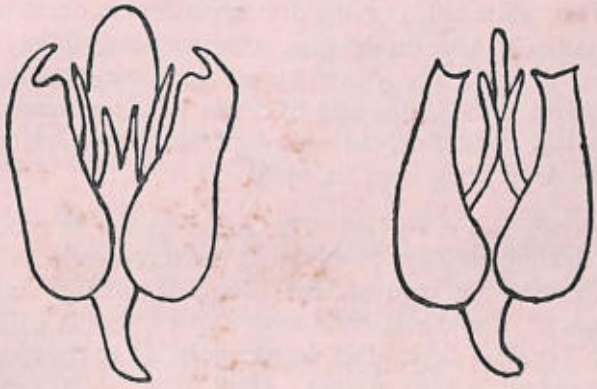

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Of the specimens taken by Norman the ♀ has been presented to the

British Museum (Natural History) and the ♂ will be presented to the Zoological Survey of India.

2. **Celastrina vipia** sp. nov. This species is described from a single male taken by Norman at Jhakama (5400 feet) in the Naga Hills on 2 May 1950. There is reason to think that it also occurs in north Burma.

DESCRIPTION.

♂. *Upper side :* Fore wing. Pale blue of a shade like *dilectus* Moore from Burma, slightly darker than Assam specimens of *dilectus*. On the disc there is no trace of white nor of paler blue. The black border a thread, expanding to 1½ mm. at the apex. Hind wing. Pale blue, with white streaks in spaces 4, 5, and 6 and sparse white powdering in spaces 2 and 3. A bar is visible at the end of the cell. This facies differs from *dilectus*. In *dilectus*, when the white patch on the disc upper fore is obsolete, there is a patch of paler blue on the disc, sometimes only faintly discernible. Exceptions exist ; one ♂ from Burma and some ♂♂ of the subspecies of *dilectus* from China and SE. Asia have no trace of paler blue on the disc upper fore, but these lack the conspicuous white streaks on the hind wing seen in *vipia*.

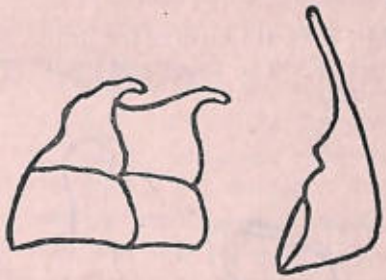
Under side : Fore wing. The markings are brown, faint, and delicate, and conform to the usual *Celastrina* (e.g. *cardia*) pattern. The strigae are comparatively long, stretching across the interspaces. The discal band enters space 1 b. The discal spot in space 4 is at an angle of 45 degrees pointing to the spot in space 6. Submarginal lunules present. Hind wing. Markings similar in type to those on the fore wing except that the three basal spots are black. No spot at base of 1 b. Discal spots in 5, 6, and 7 are not in line, that in 6 being shifted in. Submarginal lunules present.

Size and venation : Fore wing. 12 mm. from base to apex. Veins 11 and 12 straight and separate.

Cilia : Chequered at the ends of veins.

Genitalia : Mr. N. Bennett of the British Museum staff very kindly dissected the genitalia in 1952 and prepared the slide from which the figure has been drawn. The figure illustrates the uncus and inside of the left clasp. The general pattern resembles *argiolus jynteana* De N. but the lower broad portion of the clasp differs, lacking the sharp triangular projection so noticeable in *jynteana*. The sharp projection on each side of the uncus ends in

a straight point whereas the somewhat similar projection of *jynteana* curves inward like the beak of a bird of prey. The genitalia of *dilectus* are quite different. No genitalia matching this dissection are discernible amongst Chapman's (1909) or Toxopeus's



3. *C. vipia:* uncus ; 4. *C. vipia:* medial aspect of left clasp.

(1927-28) figures, nor among those shown or referred to by Corbet & Pendlebury (1956), nor on the British Museum slides or in the authors' own dissections.

In appearance and small size *vipia* is nearest to *ceyx clothales* Frühstorfer from Sumatra, but the genitalia are very different.

The specimen has been presented to the British Museum (Natural History), where it has been lodged since 1951.

3. **Celastrina howarthi** sp. nov. This species is described from a single male taken by Norman on 23 March 1958 at the edge of thick forest in the plains of Sibsagar District, near Amgoorie Tea Estate.

Description

♂ *Upper side :* Violaceous blue, iridescent in certain lights, with a white discal patch on both fore and hind wings. The black terminal border of the fore wing expands gradually and evenly from the tornus to 2 mm. at the apex. There is no black border to the costa of the fore wing. In this respect it differs from *puspa gisca* Früh. which otherwise it resembles above though it is very different below.

Under side : Fore wing. The strigae of the discal band are small, delicate and faint, and do not enter space 1 b. The strigae in 3 and 4 both point to that in space 6. The subterminal markings

are a row of faint lunules and an outward row of five strongly marked linear strigae from space 2. Hind wing. No basal spot in spaces 1 b and 7.

Size and venation : Fore wing. 16 mm. Veins 11 and 12 straight and separate.

Genitalia : Mr. T. G. Howarth of the British Museum very kindly made the dissection. The uncus and inside of the right clasp are

5.

5. *C. howarthi:* uncus and medial aspect of right clasp. The triangular process at the distal end, dorsal side, of the clasp actually projects at right angles to the clasp.

shown in our figure ; the small triangle at the apex of the clasp, on the edge towards the uncus, is an attempt to show a triangular tip curled in at right angles to the clasp, seen clearly in alcohol. Though clasps of this general shape with serrations and projections from the tip towards the uncus are found in the figures of Chapman, Corbet, and Toxopeus, we have not seen any exactly like it.

Generally speaking, one may say that *howarthi* resembles *puspa* or *albisdisca* on the upper side although below it is very different, while the under side (but not the upper side) resembles *corythus corythus* from Sumatra and *catreus* from Java. It may also be distinguished from these four species by the genitalia.

HESPERIIDAE

4. **Plastingia tavoyana titei** ssp. nov. The new subspecies is described from a single male taken by Norman on 27 April 1954 at Moreh, at plains level in the Kabaw Valley of SE. Manipur. One other specimen, presumed to have been of this species, was seen on the same day.

The clasps of this specimen and the ring spots on the under side of the hind wing show it to be a *tavoyana,* but there are certain differences

from the typical form. On the *upper side* of the fore wing the yellow is bright instead of the dark ochreous of typical *tavoyana*, and the yellow streaks along the costa and dorsum are somewhat wider ; on the hind wing the yellow discal area extends further distally, the yellow scales are thicker over the lower part of the cell to the base and the hyaline spot is more elongated. On the *under side* the ground colour is the bright yellow of *noemi* instead of the much darker shade of typical *tavoyana*. The spots in the cell and in spaces 6 and 7 are ring spots. The irregular linear spots in spaces 2 and 3 are on the distal edge of large faint ovoid rings, just as in *tavoyana*, but in this Assam specimen the ovoid rings are obsolescent and discernible only with difficulty.

No example of *tavoyana* has previously been taken north or west of the Karen Hills. The differences are sufficient to give subspecific rank to this specimen. *Tavoyana* Evans will now become *tavoyana tavoyana* Evans. [Both *tavoyana* Evans and *noemi* De N. are dealt with by Evans (1949).]

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge our gratitude to the authorities of the British Museum (Natural History) who have allowed us to examine the specimens in their care ; and particularly to Mr. T. G. Howarth, Mr. G. E. Tite, Mr. N. Bennett, and Mr. J. V. Pearman, who have made the dissections and who have made their time and advice so freely available to us. Two of the names we have used will, we hope, reflect our gratitude in a more permanent form. *Celastrina vipia* has been named after Mr. Vipikhieya Angami, who has captured such a wealth of material for us. The name *baiongus* is derived from the Khasi word meaning ' dark-coloured '.

SELENG T. E.,
SELENG HAT P.O.,
UPPER ASSAM,
April 16, 1960.

KEITH CANTLIE,
C.I.E., I.C.S. (RETD.)
T. NORMAN

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16. ON THE MIGRATION OF THE SWALLOWTAIL, *POLYDORUS HECTOR* (LINNAEUS) [LEPIDOPTERA: INSECTA], OVER SEA[1]

(With two text-figures)

Reviewing our existing knowledge of butterfly migrations, Williams (1950) has drawn attention to the need for more precise information from different parts of the world regarding this aspect of insect life. Since the preponderance of existing records pertain to overland migrations, instances of migratory movements over the sea are of special interest.

Williams (1927) cited the few instances on record of the swallowtail, *Polydorus hector* (Linnaeus), one of the commonest butterflies of our plains, undertaking migratory flights overland, and also crossing over the sea between India and Ceylon. Instances of the latter type pertain to sight records or captures made very near the coast with one exception, namely von Frauenfeld's (1867) capture of six individuals aboard S. S. Novara, about 200 miles off Ceylon, on the way to St. Paul. Unfortunately most records are lacking in detail regarding the direction of flight, the prevailing weather conditions, etc. However, on the data available, Williams (1930: 46) concluded that *Polydorus hector* 'passes from India to Ceylon, or vice versa with some regularity in February, March, and April'.

From about the beginning of October, *P. hector* abounds around Mandapam and at any one time of the day several may be seen flitting about the Drumstick Tree (*Moringa pterygosperma* Linnaeus) for which plant, so common on the campus of this Research Station, it shows particular preference, and on one of which I have seen several hundreds roosting on successive nights. To a certain extent, the occurrence of this butterfly also coincides with the commencement of the NE. monsoon. On several occasions in October 1959 I observed regular flights of *P. hector* from the mainland in the direction of the chain of coral islands lying off the Ramnad coast in the Gulf of Mannar (Text-fig. 1). Subsequently I was able to make more detailed observations on five days while out at sea in this area and these are summarised below:

5 *November* 1959. Time: 09.00 to 11.30 hours. Place: half-a-mile out at sea between CMFRS[2] and Vedalai. Several *P. hector*

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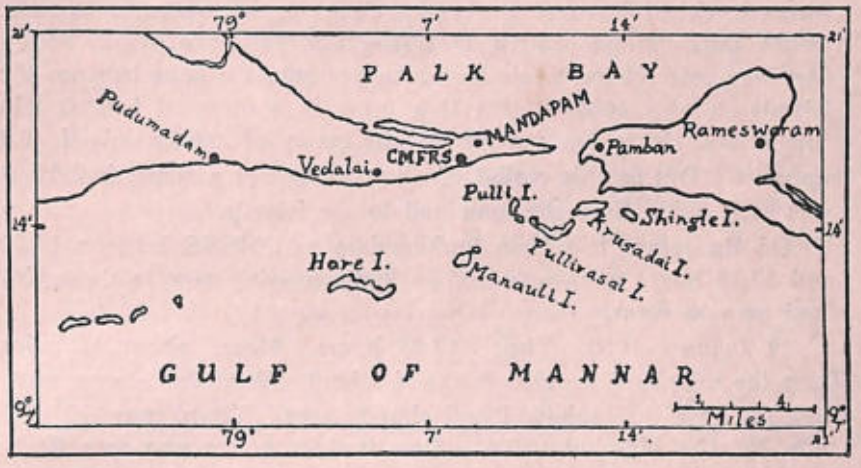
[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

[2] Central Marine Fisheries Research Station.

were seen migrating from the mainland towards Manauli and adjacent islands; flight thin and diffuse (4 to 6 noticeable at a time); course steady without any deviations; flight 3 to 6 metres above sea-level. None seen approaching mainland. Weather: sky



Text-fig. 1. Map showing part of the Ramnad Coast and the adjacent islands in the Gulf of Mannar.

overcast, calm, with hardly any breeze. Temp.: max. 29° C.; min. 26° C. Humidity 90%[3].

6 *December* 1959. Time: 09.15 to 11.30 hours. Place: same as on 5-11-'59. Migration of *P. hector* from mainland to islands, numerically more than on previous occasion, 36 being counted within 3 minutes. Flight steady, low, not more than 2 to 3 metres above water level. Weather: sky slightly overcast; steady breeze from mainland. Temp. max. 29° C.

21 *January* 1960. Time: 09.30 to 11.30 and 14.30 to 17.15 hours. Place: to and fro between CMFRS and Pudumadam about 12 miles SW. along Ramnad Coast. Weather: Sky slightly overcast in the morning, clear in the afternoon. Temp.: max. 29° C., min. 24° C. Humidity 90%.

Numerous *P. hector* were seen migrating from Manauli and Hare Islands towards the mainland between 09.30 and 11.30 hours. From the boat travelling at a speed of 6 knots, 67 butterflies were counted in a period of five minutes. One apparently completely exhausted

[3] Data regarding temperature and humidity pertain to Pamban as given in the Regional Daily Weather Reports of the Regional Meteorological Centre, Madras.

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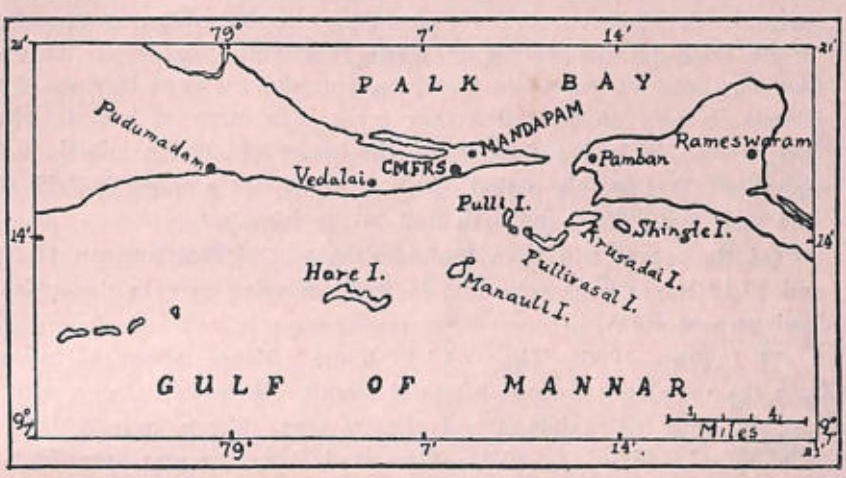


Text-fig. 1. Map showing part of the Ramnad Coast and the adjacent islands in the Gulf of Mannar.

overcast, calm, with hardly any breeze. Temp.: max. 29° C.; min. 26° C. Humidity 90%[3].

6 *December* 1959. Time: 09.15 to 11.30 hours. Place: same as on 5-11-'59. Migration of *P. hector* from mainland to islands, numerically more than on previous occasion, 36 being counted within 3 minutes. Flight steady, low, not more than 2 to 3 metres above water level. Weather: sky slightly overcast; steady breeze from mainland. Temp. max. 29° C.

21 *January* 1960. Time: 09.30 to 11.30 and 14.30 to 17.15 hours. Place: to and fro between CMFRS and Pudumadam about 12 miles SW. along Ramnad Coast. Weather: Sky slightly overcast in the morning, clear in the afternoon, Temp.: max. 29° C., min. 24° C. Humidity 90%.

Numerous *P. hector* were seen migrating from Manauli and Hare Islands towards the mainland between 09.30 and 11.30 hours. From the boat travelling at a speed of 6 knots, 67 butterflies were counted in a period of five minutes. One apparently completely exhausted

[3] Data regarding temperature and humidity pertain to Pamban as given in the Regional Daily Weather Reports of the Regional Meteorological Centre, Madras.

alighted on the water with wings spread out within five metres of the boat, but was seen in a few seconds to take off, its flight at first being a bit erratic, but when last seen it was flying vigorously towards the mainland which was about a mile away from the place of observation. None seen flying more than three metres above water level, while most kept very close to the water on account of the fairly strong head wind. The fact that none of the butterflies was encountered while travelling opposite the gaps between the islands strongly suggests that they cross in a more or less straight line course from the islands to the parts of the mainland just opposite. During this period of observation, not a single individual was seen flying from the mainland to the islands.

On the return trip from Pudumadam to CMFRS between 14.30 and 17.15 hours none was seen in flight crossing over to the mainland or vice versa.

29 *January* 1960. Time: 17.45 hours. Place: about 3½ miles from the mainland towards Manauli Island. Weather: strong wind blowing from the mainland and choppy seas. Temp. max. 29° C., min. 25° C. Humidity 80%. One dead *P. hector* was seen floating. None seen in flight between mainland and Manauli Island between 16.45 and 18.00 hours.

31 *January* 1960. Time: 12.00 hours. Place: 2 miles from Manauli Island towards mainland. Weather: Sea relatively calm; steady breeze blowing from the mainland. Temp. max. 29° C., min. 25° C. Humidity 85%. Three *P. hector* were seen almost at the same time, all flying about 2 metres above water and heading towards Manauli Island. None seen crossing in the opposite direction.

From about the last week of January these butterflies appeared to be much fewer in numbers in the campus area and on two trips made to Pudumadam on 6 and 11 February none was seen in flight over the sea. After a few weeks' absence, on my return to Mandapam in the last week of March, I found that they had almost completely disappeared from the scene

The above observations and the many reports I have received from my co-workers going out on regular fish and plankton collections point definitely to a migratory movement of the swallowtail north to south, from the mainland to the chain of islands mentioned above, and at certain periods vice versa. A few noteworthy features are:

1. The migration is thin and diffuse with generally 5 or 6 individuals visible to the observer at a time.

2. The steady and non-deviating pattern of flight.

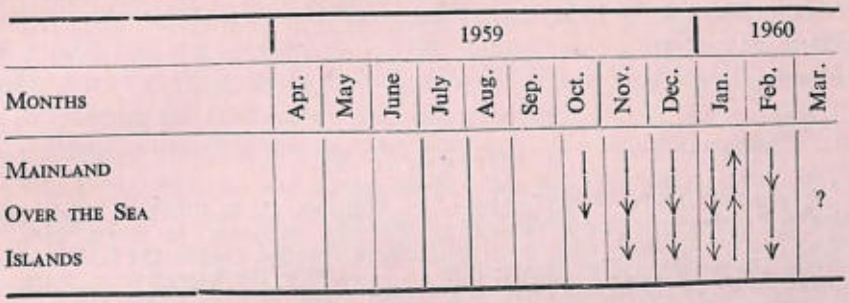
3. When there is a strong head or tail wind, the butterflies keep as close to the water as possible.

4. When on sea, the direction of flight of a single individual is typical of the direction of the whole flight at a particular time.

5. The to and fro flights between the mainland and the islands may be indicative of 'return' flights.

6. It appears likely that, when exhausted in flight, they alight on the water for shorter or longer periods as seen in one instance on 21-1-'60.

7. The peak activity appears to be from November to about the middle of January. However, it is not known whether this would change from year to year, for Williams (1930) records February, March, and April as the months during which migratory flights of this species between India and Ceylon and vice versa take place.



Text-fig. 2.

(Arrows indicate direction of flights in the different months)

8. Not once did I see *P. hector* being preyed upon when in flight over the sea. This is quite unlike what Evershed (1912) found for this species on its overland migrations especially when migrating across Palni Hills, south India, when it is specially liable to attack by birds.

9. All migratory flights over the sea were observed during the earlier half of the day and hardly any after 14.00 hours.

The voluntary nature of these flights and the purposeful manner in which they are carried out would amaze any observer. We do not know why this or for that matter many other species voluntarily migrate over sea and our knowledge about migratory movements is incomplete on several scores, such as the periods when these migratory flights are undertaken, the size of migratory movements, whether in this case the chain of islands act as only a stepping stone for the colonisation of areas beyond and vice versa, whether those that undertake the flights are surplus populations from overpopulated areas, the

relationship between migration and breeding area, whether the return flights are undertaken by the same individuals, whether there is any difference between the migrants and non-migrants in this species, the size, age, and maturity of migrants, the sex ratio of the migrants, their survival rate, whether at any time more than one species is involved in these migratory flights, whether they resort to nocturnal migratory flights, the influence of weather conditions on the pattern of migration, etc. I hope that this note will create an urge in some of our readers to observe and try to unravel the mysteries of this aspect of butterfly life, which is as fascinating as the study of other animal migrations.

CENTRAL MARINE FISHERIES RESEARCH STATION, E. G. SILAS
MARINE FISHERIES P.O.,
MANDAPAM CAMP,
March 31, 1960.

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[Dr. C. B. Williams asked for information about insect migration in a paper published in this journal in 1938 (*J. Bombay nat. Hist. Soc.* **40**: 439-457. The migration of butterflies in India,) and the request is repeated in his book on insect migration, a review of which appears elsewhere in this issue. The particulars required are briefly indicated by the headings of the standard form in which he files details of the records received: year, month, date and time of day, locality, direction of flight, direction and strength of wind, numbers seen, number captured and where they are kept, sex, condition (fresh, worn), notes (extent of flight, speed, pairing, egg-laying, etc.), present and past weather conditions (temperature, rain, sun, cloud, thunder, barometer, etc.), height above the ground/sea, name and address of observer, name of species, other species in the flight (name and number), identified by. All information should be put down at the time of the observation or as soon thereafter as possible. Specimens should be captured and sent in; as many as fifty is not too much and some of them should be preserved in spirit for examination for

fat reserve and state of development of the eggs. Specimens are of value even if they are not in perfect condition. If the flight lasts over several days observations should be made as to the earliest and latest hours of activity and attempts should be made to discover what the insects do at night.—EDS.]

17. INSECT-BIRD ASSOCIATIONS WITH NESTS OF LARGE RED ANTS [*OECOPHYLLA SMARAGDINA* (FABRICIUS)]

Charles Barrett & A. N. Burns (1951) in BUTTERFLIES OF AUSTRALIA AND NEW GUINEA (N. H. Seward Pty. Ltd., 457 Bourke Street, Melbourne) refer to the moth butterfly (*Liphyra brassolis major*) laying eggs singly on twigs and leaves of trees bearing nests of the green tree-ant (*Oecophylla smaragdina*)—they refer, presumably, to *O. smaragdina* var. *virescens*, which occurs in Australia. When freshly emerged the butterfly has numbers of special dehiscible scales, which prevent the true scales from being injured by the ants whilst the butterfly is crawling through and out of the nest when emerging.

The larvae feed on the larvae of the tree ant, the body juices of which are sucked up; they are enemies of the ants, whereas all other Lycaenid larvae which live in association with ants are their friends, because they supply them with a sweet exudation from glands on the posterior portion of their bodies. A more detailed report of this is said to be contained in an article, 'The Green Tree-ants' by Frederick P. Dodd, published in the *Victorian Naturalist* (September 1928).

In addition to the Rufous Woodpecker (*Micropternus*) which lays its eggs within the nest of the red *Crematogaster* ants, I have seen nests of different species of sunbirds (*Leptocoma* spp.) hanging very close to the green leaf-nests of the large red ant (*Oecophylla smaragdina*). Unfortunately, the actual distances were not recorded nor any of them kept under observation, but my impression that they were too close to be due to accidental circumstances is shared by my brother Shumoon who has done a fair amount of bird-nesting around Bombay.

It is also true that few of the mango trees around Bombay are free from these red ants and bird-nesters have all been well bitten while climbing to examine nests of drongos, doves, tree-pies, etc., etc. Surely, some form of armistice must prevail; otherwise, it appears impossible that any of such nests would survive.

It is well known that doves, munias, and such other 'harmless' birds often build their nests touching those of kites, eagles, and other birds

of prey. I do not remember having read of the eggs or young being taken, and such nesting is definitely under armistic terms.

c/o Faiz & Co.,
Abdul Rehman Street,
Bombay 3,
February 27, 1960.

HUMAYUN ABDULALI

18. TWO SOCIAL WASPS: *ICARIA VARIEGATA* (SMITH) AND *POLISTES STIGMA* (FABRICIUS)

Icaria variegata (Smith) is a small reddish brown wasp about 7 mm. long with yellow markings, warning colours adopted by most of its relatives. It has the usual 'wasp waist', a long stalk with a smaller, then a larger bulge. The yellow is in two spots at the base and a band at the end of the large bulge, with marks on the thorax. It has the habit of drawing in the end segments of the abdomen into the large bell-shaped second segment.

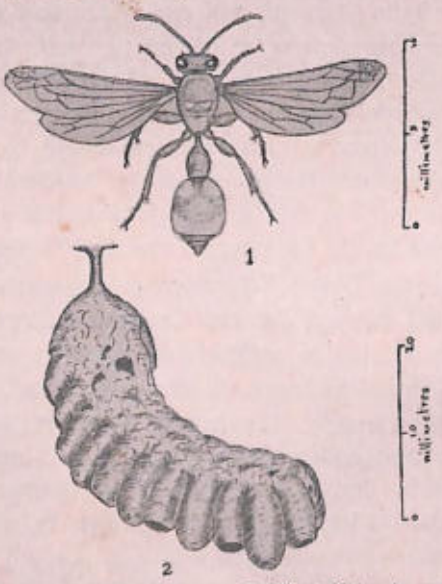


Fig. 1. *Icaria variegata* ♀; Fig. 2. Nest of *Icaria variegata*.

The nest is placed in the open, without any attempt at concealment, hanging from the underside of a leaf, or in some sheltered position. It is made of a papery substance, formed by the wasp itself by chewing up wood and mixing it with saliva. It consists simply of three or four irregular lines of cells, upside down, hanging

from one end. More are added on at the far end as the colony grows.

As is well known in the case of honey bees, the colony cannot be moved short distances. I have tried on several occasions moving a nest about 100 yards, but without success. The wasps on leaving the nest in its new position, find themselves in familiar surroundings. They know well the way 'home', i.e. to the original site, and there they return looking in vain for the departed nest. If, however, the nest is moved far enough, the wasps find themselves in a strange country. They hover round the nest learning its new position, to which they will return as they see no familiar landmarks to lead them to their original 'home'.

I moved a colony successfully from a distance of about two miles on 25 March 1957. There were at that date about 23 cells, 5 being capped over and containing pupae, 6 or 7 deep uncapped, some of which contained larvae or eggs, and another 10 or 11 begun or damaged. There were 7 wasps on the nest.

On watching carefully it seemed that two kept constantly on the nest, and that one kept chasing the other, as if to drive it away. To make observation easier, I marked these two on the thorax with a dab of blue and green paint respectively. I have read of a queen wasp (*Polistes*) taking possession of another colony (Yoshikawa, K: Insects sociaux **2**: 255) and I wondered whether this is what may have been taking place here. It is difficult to distinguish the queen, as there is no difference in the markings and only 2 or 3 mm. difference in length. The blue queen was seen to go for a short flight of a minute or two on two occasions. Eventually on 13 April she drove off the green queen and was left in possession.

The workers are often off the nest. On their return the queens get very excited. As the worker arrives, a queen makes a fierce rush at it, climbs on its head, often standing on the eyes (a proceeding which seems to cause no inconvenience to the worker) and curls round so as to put her mouth to the worker's mouth. A drop of transparent fluid then passes from the worker to the queen and her hunger is appeased for the moment. On one occasion I saw a worker feed both queens in succession.

If possible the worker will avoid the queen and go to one of the larvae. A caressing movement of the antennae causes the larva to put its head to the mouth of the cell, and the worker then feeds it, in the same way as it feeds the queen, with a drop of fluid. I could see no difference, using a lens, between the feeding of the larva and the queen. On some occasions it seemed as if a queen would get a drop of fluid from one of the larvae.

When about to pupate, the larva caps over its cell by itself. In the instance I watched, the green queen stood over it for a long time apparently watching, but not helping at all. At 11 a.m. the larva was weaving a loose mesh of silk which it seemed to press together later. At 12.15 it was still working, the silk fairly thick, but with a hole remaining in the centre. By 1.30 the entire cell was capped. The eggs are white and oblong, and are attached to the base of the cell. The larvae look pinkish at one stage, but white when full grown with a dark head.

In a colony which I was keeping in March 1960, I noted that the newly-emerged wasps seemed to have black eyes, which gradually became light and mottled in appearance as in the older wasps. While the eyes are black, they do not seem to leave the nest. I also noticed one morning two or three very small insects emerging from a hole in the top of the nest. They seemed to have torn the hole from inside one of the cells. The wasps were much excited; one had caught an insect and was chewing it up with the mandibles. The insects were black, about 2 mm. long, and may have been parasitic wasps or flies.

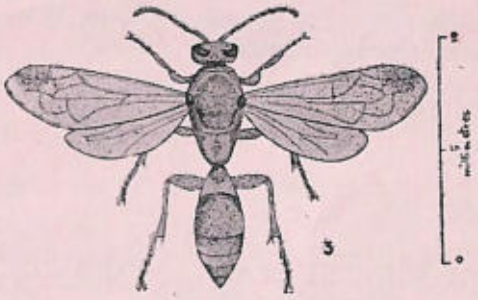
In contrast to *Icaria*, *Polistes stigma* (Fabricius) has no 'stalk', the abdomen being close to the thorax, though of course with the 'wasp waist'. It is also reddish with yellow markings on the thorax and a broad band of yellow on the abdomen. The worker measures about 10 mm.

It builds a circular nest, consisting of a bunch of cells, mouth downwards, attached by a stalk to the underside of a roof or arch in a sheltered position. When the cell is capped the silk continues the wall of the cell, making it almost twice as long as when uncapped. The white silk of the cap contrasts with the greyish paper of which the cell is made.

On 2 February 1960 I picked up a nest which had been broken off from its position and was lying on the ground. The wasps, of course, had flown away. However, the nest contained capped cells, larvae, and eggs, so I hung it up by wire in an observation box. The next day 3 pupae hatched out. As there were no workers or queen, I wondered how to feed these wasps. I tried with a drop of sugar water on a needle, and I thought once or twice some was taken, but could not be sure. The following day, one of them solved the problem by pulling out a well-grown larva from a cell and proceeding to eat it, holding it in its forelegs. It was soon joined by another, and the two soon finished off their meal.

On 6 February 1960 several more wasps emerged, together with

two flies like large house flies, evidently parasitic on this wasp. They did not rest on the nest, but remained on twigs near by, drying their wings before flying off. By 19 February there were 19 wasps on the nest, of which at least 5 were males. I could see 8 eggs and



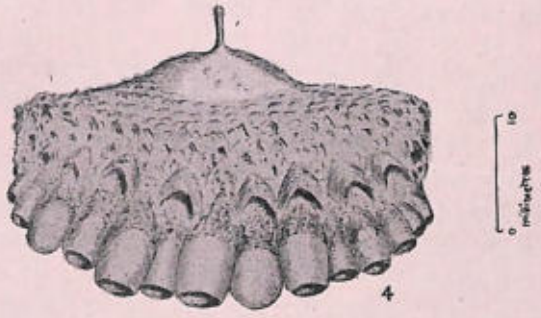


Fig. 3. *Polistes stigma* ♀ ; Fig. 4. Nest of *Polistes stigma*

3 larvae. The feeding process was much the same as in *Icaria*. These wasps seem often to preen each other, gently scraping with the mandibles on the clypeus especially, the eyes, and the thorax. Curious behaviour noted on several occasions was when one of the workers seized a male by the base of the antenna and held it for a considerable time, the male now and then making feeble attempts to escape.

The workers, which are imperfectly formed females, are not capable of being fertilised. Nevertheless on occasion they will lay eggs. As is well known in the case of honey bees these unfertilised eggs develop into males. In the *Polistes* nest there was no queen, but the workers laid a considerable number of eggs, white ovals, glued to the side, not the base of the cells. The experiment did not last long enough to know if or into what these eggs would develop. The colony seemed lethargic, and not many individuals were out

foraging. I noticed several wasps devouring one of the larvae. The numbers dwindled until on 29 February only 11 remained, and that afternoon they all left the nest, none remaining in the evening. On that date there were 34 eggs and 9 larvae in very early stages. The two following days two wasps were seen to return to the nest for a time, one even feeding the other on one occasion, but after 2 March the nest remained completely deserted.

ST. JOHN'S MISSION HOUSE,
POONA,
March 29, 1960.

F. L. WAIN, S.S.J.E.

19. *RHYNCHOSIA SERICEA* SPAN.: A NEW RECORD FOR BOMBAY STATE

Rhynchosia sericea Span. in Linnaea **15**: 195, 1841; FBI. **2**: 225; Duthie, Fl. Upper Gang. Plain **1**: 222, 1903. *Dolichos tomentosus* Roth, Nov. Pl. Sp. 345, 1821; DC. Prodr. **2**: 401, 1825; Wt. & Arn. Prodr. **1**: 248, 1834. *Rhynchosia tomentosa* Kurz in JASB **43**: 186, 1874 (non Hook. & Arn. 1835).

A large woody twiner, reaching 3-6 m. high; stems much branched, younger parts clothed with soft, short, greyish brown, glandular hairs, older ones nearly glabrous; internodes 4.5-15 (12.5) cm. long, often twisted. Leaves alternate, trifoliate; rachis 4-11 (8) cm. long, densely hairy; leaflets 4-17×1.7-6-13 (10×7.3) cm., softly pubescent on both surfaces, densely beneath; terminal leaflet largest, ovate or ovate-rhomboid, equal-sided, lateral ones obliquely ovate; apex acute or slightly acuminate; base rounded, truncate or subcordate; stipules 0.5-1.5 (1) cm. long, persistent, broadly ovate or lanceolate, acuminate, hairy on the margins; stipels 0.2-0.4 cm. long, filiform, persistent. Racemes 4-20 (13) cm. long, compact, simple or branched, axillary; floral-axis villous, terete. Flowers 10-25, subpedicellate, bracteate; pedicels about 0.2 cm. long, pubescent, reflexed in fruit; bracts about 0.5 cm. long, ciliate, caducous. Calyx 0.6-0.8 cm. long, persistent, rufous-pubescent, campanulate, of five unequal teeth; tube about 0.4 cm. long. Corolla yellowish brown, purple tinged; standard about 1.4×1.1 cm., wedge-shaped, with two distinct callosities before tapering at the base into a short claw; wings 1×0.3 cm., ovate-linear, spurred; keel 1.3×0.3 cm. Stamens about 1.3 cm. long, monadelphous. Ovary densely whitish-tomentose with a filiform style. Pods 2-3-seeded, 2-3×0.5-0.8 (2.5×0.6) cm., straight or falcate, compressed, with a long apiculation, densely-pubescent, villous on the

margins with spreading white or pale brown hairs; seeds 2, estrophiolate, about 0.4 cm. across, nearly orbicular, dark brown.

This plant is not recorded in our floras. From the available data, it occurs in Poona, Bombay, Salsette, and southern Gujarat. The plant is neither common nor abundant.

Flowers: September-November. *Fruits:* September-December.

Herbarium specimens examined: Santapau 12048 (Poona) and 19427, 20019-23, 20274-20275 (Dangs Forest); *Panthaki* 2235-37 & 2408 (Dangs Forest); *Shah* 7510-11 (Malad); *Shenoy* 4759-61 (Mumbra).

World distribution: India and Malaya.

Critical notes: In general appearance and habit this plant resembles *Rhynchosia bracteata* Bth.; the latter, according to Cooke, is very rare. The following are the differences between the two:

R. sericea: Stems clothed with glandular, greyish brown hairs; stipules persistent, broadly ovate or lanceolate; leaflets 4-17×1.6-13 cm.; corolla about 1.4 cm. long.

R. bracteata: Stems not glandular-pubescent; stipules minute, caducous; leaflets 5.8-11.6 cm. long and broad; corolla about 1.2 cm. long.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
April 15, 1960.

G. L. SHAH, M.SC.
D. P. PANTHAKI, M.SC.

20. A NOTE ON THE OCCURRENCE OF *ACANTHOSPERMUM HISPIDUM* DC. IN RAJASTHAN

(*With a plate*)

Acanthospermum hispidum (Compositae) a native of S. America made its appearance recently and established itself very well in several parts of India. The plant has been observed by us for the first time in Pilani in the vicinity of Birla College, in September 1955. Now this plant is very well established in several localities in Pilani and its neighbouring places. No reference to this plant is made in any of the standard works, which we have consulted, on the plants of the Indo-Gangetic plain and Rajasthan, and a complete description of the species is not available in any of the Indian floras. Therefore, the present note is called for.

A. hispidum: Annual herbaceous weed; *stem* 30-45 cm. long, dichotomously branched, terete, hairy, hairs slightly stiff; *leaves*

simple, opposite, sessile, lamina with three prominent veins, obovate or nearly so, gradually narrowing towards the base, 3.2-4.7×2-3 cm., hairy on both surfaces, margins, serrate; *heads* in the forks of stem, solitary, radiating, about 5-6 mm. across, heterogamous, involucre 5-7 in number; *flowers* yellow, peripheral female flowers 7, very rarely 5, corolla strap-shaped, sometimes persistent disc florets minute 10-15, functionally male with abortive ovaries, corolla tubular, five-toothed; stigma papillose; cypsela 5 mm., compressed, bristly with two horn-like spines at the top, pappus absent.

Flowers and Fruits: August-November.

Ecological notes. The plant is not abundant nor common. It is generally found in waste places, roadsides, and open plain ground, often in association with *Tephrosia purpurea* Pers. Pure stands are rarely met with. Not eaten by livestock. Fruits distributed by sheep and cattle.

DEPARTMENT OF BOTANY,
BIRLA COLLEGE,
PILANI,
November 4, 1959.

N. C. NAIR
M. B. DESHPANDE

21. ON THE NOMENCLATURE OF *JASMINUM VIRGATUM* KERR.

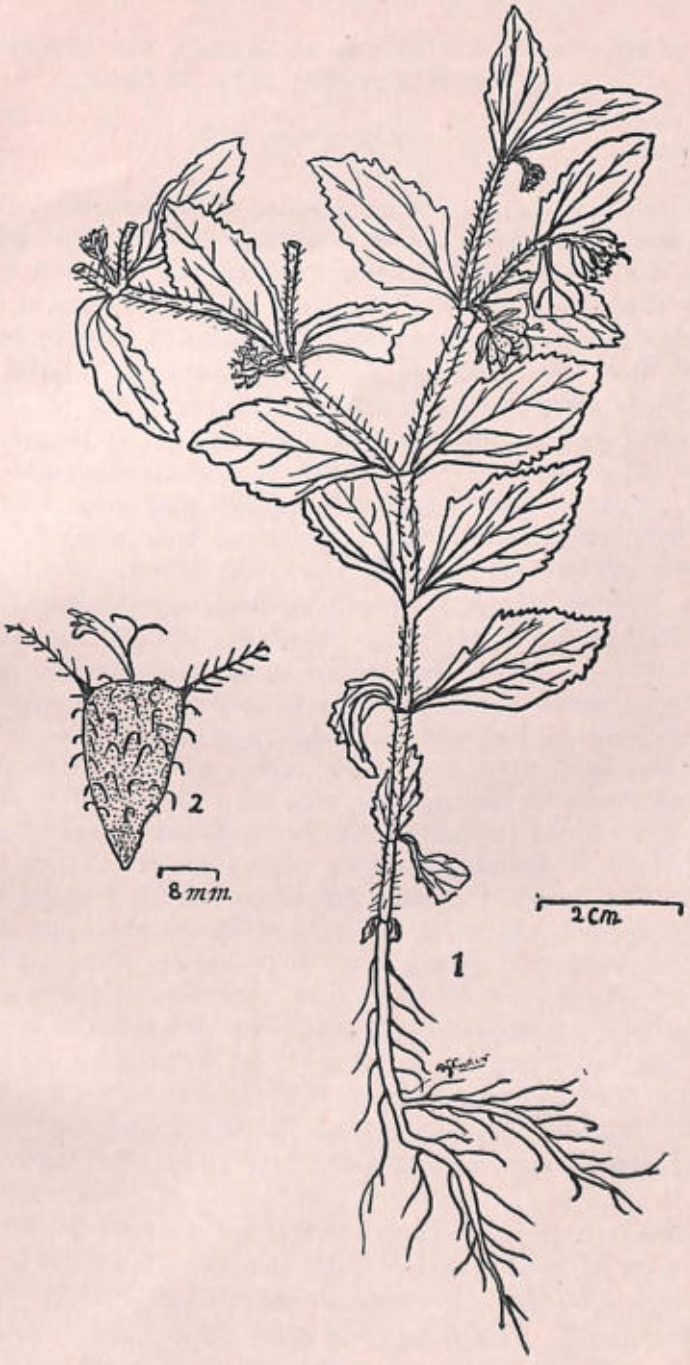
INDEX KEWENSIS (1947) lists *Jasminum virgatum* Kerr. (1938) from Siam (now Thailand) and *J. virgatum* Knobl. (1936) from Tanganyika. Evidently the same name has been used for two plants from widely separated localities which, from their respective descriptions, appear quite different from each other.

According to Art. 64 (2) of the *International Code of Botanical Nomenclature* (ed. 1956) *J. virgatum* Kerr. must be rejected, it being a later homonym of *J. virgatum* Knobl. In 1952 Turrill & Milne-Redhead reduced *J. virgatum* Knobl. to the synonymy of *J. stolzeanum* Knobl.; even so the later homonym must be rejected in accordance with the second paragraph of Art. 64 (2).

As far as I am aware, *J. virgatum* Kerr. has neither been renamed nor been merged in the synonymy of any other species. I, therefore, rename *Jasminum virgatum* Kerr. (in Kew Bull. 1938: 31-32) as *Jasminum kerrii* nom. nov. The type of the species is *Kerr* 8580 in Kew Herbarium.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
June 22, 1959.

G. S. BHATNAGAR



Acanthospermum hispidum DC.
1. Entire plant; 2. Fruit.

22. *MERREMIA TUBEROSA* (L.) RENDLE: AN IDEAL CREEPER FOR THE PLANT-HOUSE

(With a photograph)

Many of our ornamental palms, crotons, begonias, gesnerias, and other plants suffer heavy casualties in India during the hot and dry months of summer. The practice commonly followed for their protection is to construct a plant house with wooden or iron poles with wire-netted covering all round and to allow some kind of creeper to grow on them. The ornamental plants are kept inside such plant houses. If the heat is too much and the plants still suffer, additional shade is created by putting a thin layer of straw or *Kans* grass on the roof and these are kept in position by tying them on the wire netting and keeping them flat with the help of split bamboos. The creepers commonly used for shade on these plant houses are the Sandwich Island Creeper (*Antigonon leptopus*), the Golden Shower (*Pyrostegia venusta*), the Railway Creeper (*Ipomoea palmata*), the Bridal Creeper (*Porana paniculata*) and the Rangoon Creeper (*Quisqualis indica*). Some other creepers and twiners are also used for the same purpose, such as *Bignonia unguis-cati*, *Derris scandens*, *Ipomoea hederacea*, *Jasminum pubescens*, *Passiflora coerulea*, etc.

All these creepers, when fully grown, have their good and bad points. Some are found to be slow growing, others do not spread rapidly and remain somewhat thin. Others are not hardy enough to withstand the strong sun, while some are considered too leafy. Therefore garden lovers and particularly those in charge of such plant-houses are constantly on the look-out for better and more desirable creepers. One such creeper which is considered very good from a number of points of view appears to be the plant commonly known as *Ipomoea tuberosa* of the family Convolvulaceae. The plant was originally a native of the West Indies and South America and is now found naturalised in many tropical countries like tropical Africa, the Mascarene Islands, India, Ceylon, and Malaysia. Many years ago it was introduced into India but its great value was apparently not fully appreciated.

Although the plant was not expected to occur in cold countries like England, it is interesting to note that for a long time its seeds and fruits were regularly found on the shores of the Orkney Islands and the Hebrides situated on the north of Great Britain. The occurrence of these seeds so many hundred miles away from the West Indies remained a mystery for a long time and towards the end of the last century it was Sloane who established that the seeds and fruits must

have reached these islands by the effective floating device of the fruits and by the action of the Gulf Stream. In 1872, Hemsley identified the seeds and fruits as those of *Ipomoea tuberosa*. An admirable account of the distribution of these seeds has been given by Guppy (1917).

The plant appears to have been introduced in India by the Botanic Garden at Calcutta about the year 1840 and has been mentioned in the list of plants found growing in the Garden in 1843. It is a vigorous climber and is grown from seeds which are hard and black. It is a perennial and develops a large underground tuber. The leaves are deep green in colour and almost palmate and the flowers are slightly fragrant and golden yellow. They are usually borne singly or in twos on axillary flower stalks (see photo).

Merremia tuberosa (L.) Rendle : an ideal creeper for the plant-house

The plant has been mentioned by Cooke as a cultivated plant in Bombay and was also described by Woodrow in his book on gardening in India in 1899. Apparently the species lost favour in the years that followed, as it has not been mentioned in Bor & Raizada's admirable book on Indian climbers and shrubs. Being an exotic climber, it was also not expected to occur in the

interior of Bombay State and therefore was not listed by Santapau in his work on the Khandala flora. Santapau (1947) has however discussed the nomenclature of this plant in his paper dealing with the Convolvulaceae of Bombay. In Calcutta, the plant also lost its popularity for many years as it was not noticed in private and other gardens and the plant or plants which once existed at the Botanic Garden were destroyed. It was therefore necessary to reintroduce the plant in the Indian Botanic Garden, Calcutta, and this has been done recently with seeds secured through the courtesy of Shri M. S. Sivaraman, I.C.S., Adviser to the Planning Commission, New Delhi. At present two such plants are growing vigorously inside the garden and producing flowers and seeds. The creeper is found to be almost ideal for the plant house and it helps in reducing the inside temperature of the plant house by 5 to 10 degrees. Small quantities of seeds are available for distribution. The correct name and synonymy of the plant is given below:

Merremia tuberosa (L.) Rendle in This.-Dyer, *Fl. Trop. Afr.* **4 (2)**: 104 (1905); Van Oostroom in *Blumea* **3**: 325 (1939); Santapau in *J. Bombay nat. Hist. Soc.* **47**: 345 (1947).

Ipomoea tuberosa Linn. in Sp. Pl.: 160 (1753); Cooke in *Fl. Bomb.* **2**: 251 (1905).

Convolvulus tuberosus Spreng. Syst. **1**: 591 (1825).

Operculina tuberosa Meissn. in Mart. *Fl. Bras.* **7**: 212 (1869).

INDIAN BOTANIC GARDEN,
BOTANIC GARDEN P.O.,
CALCUTTA,
April 19, 1960.

D. CHATTERJEE,
Superintendent

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23. NEW PLANT RECORDS FROM GUJARAT

1. *Nicotiana plumbaginifolia* Viv. (Solanaceae).

During one of our local botanical excursions, we came across a few plants of *N. plumbaginifolia* Viv., which were found occupying the banks of a water stream in the most shaded and undisturbed portions of the Navlakhi area in the L.V. Palace compound. The plant was first thought to be an escape of some cultivated species of *Nicotiana*. Later on the same plants were also collected from a few places on the banks of the River Vishwamitri. This plant has a restricted area of distribution.

The genus *Nicotiana* is represented by three species in India, out of which *N. tabacum* Linn. and *N. rustica* Linn. are cultivated forms exhibiting very little tendency to spread as weeds. According to Hooker (in F.B.I.), the third species, viz. *N. plumbaginifolia* Viv. is 'an introduced weed commonly found in Bengal and is the only species of *Nicotiana* which has established itself in India'. Kashyap (1924) remarks that the plant is quite common near Lahore. Raizada (1931) reports that it is 'completely established as a weed of waste places round about Dehra'. Pattnaik (1956) has included it in his list of the useful weeds in and around Cuttack, which means that the plant is fairly common there. Cooke (1908) does not mention it in THE FLORA OF THE BOMBAY PRESIDENCY. Santapau (1948) does not record any wild species of *Nicotiana* in his notes on the Solanaceae of Bombay. The plant, a native of Mexico and West Indies, is a medium-sized erect herb with narrow, linear, pinkish white flowers in lax racemes. The leaves are either oblong or elliptic with a narrow base.

No wild species of *Nicotiana* has been recorded by any of the previous workers on the flora of Gujarat and, as far as the authors are aware, the plant mentioned above is a new record for Gujarat or possibly for the whole of Bombay State.

2. *Eleocharis fistulosa* Link. (Cyperaceae).

The plant was first collected from a pond on the outskirts of Baroda city and was growing as an amphibious hydrophyte in association with *Cyperus esculentus* and *Eleocharis plantaginea*, from which it could not be easily distinguished. It has been observed that the plant has not yet spread much and has a localized area of distribution.

Out of the eight species of the genus *Eleocharis* reported from the Bombay Presidency, only three species, viz. *E. plantaginea* R. Br., *E.*

atropurpurea Kunth., and *E. capitata* R. Br., are reported to occur in Gujarat. *E. fistulosa* Link., which is hitherto recorded from a few places in W. Ghats, Southern Mahratta Country, and North Kanara, is for the first time recorded from Gujarat.

E. fistulosa Link. is a stout, stoloniferous sedge with a solitary, terminal spikelet as in most of the species of the genus *Eleocharis*. The stem is triquetrous (unlike *E. plantaginea*) and is of a pale green colour. The plant was found profusely flowering in the months of August and September.

Thanks are due to the Director, Sibpur Botanic Gardens, Calcutta, and Shri M. B. Raizada, Officer-in-charge, Botany Section, Forest Research Institute, Dehra Dun, for the confirmation of the identification of the plants.

DEPARTMENT OF BOTANY,
M.S. UNIVERSITY OF BARODA, A. R. CHAVAN
BARODA, S. D. SABNIS
November 12, 1959.

[*Nicotiana plumbaginifolia* Viv. is a garden plant commonly cultivated in gardens in most parts of India; from such gardens it has escaped and become naturalized particularly in the eastern parts of the country. This is the first time the plant has been mentioned as growing wild in Bombay; it has been known as a garden plant for a long time.—EDS.]

24. *ARTOCARPUS HETEROPHYLLUS* LAMK.

(*With a plate*)

This tree is often listed in our popular floras under the names of *A. integrifolius* or *A. integra*. Miss F. M. Jarrett of Arnold Arboretum and Kew Herbarium has recently published a revision of *Artocarpus*, from which I extract the following data on the nomenclature of our plants:

(*a*) **Artocarpus heterophyllus** Lamk. Encycl. **3**: 210, 1789; Jarrett in Journ. Arn. Arbor. **40**: 334, 1959. *A. integrifolia* Linn. f. var. b. *heterophylla* Pers. Syn. Pl. **2**: 531, 1807. *A. integrifolia* auct. mult. non Linn. f. *A. integer* mult. auct. non Merrill, sensu Merrill, Interpr. Rumph. Herb. Amb. 190, 1917.

This is the commoner species of the genus in western India; it is quite different from the following.

(*b*) **Artocarpus integer** (Thunb.) Merrill, Interpr. Rumph. Herb. Amb. 190, 1917; Jarrett, loc. cit. 329. *Rademachia integra* Thunb. in Vet. Akad. Handl. Stockholm **37**: 254, 1776. *Artocarpus integrifolia* Linn. f. Suppl. 411, 1781, nomen illegit.

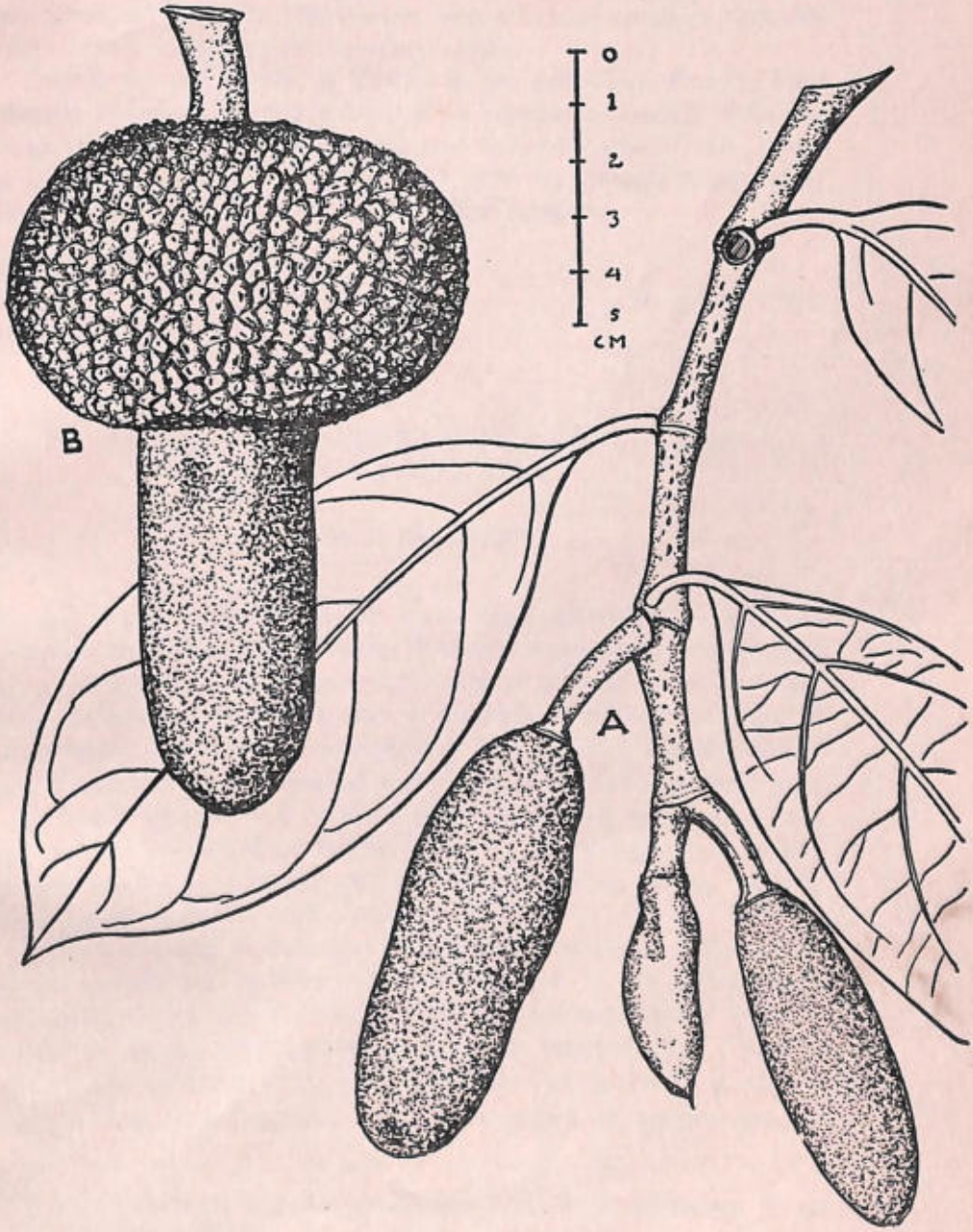
These two plants have often been confused in the literature; the differences between the two species are given by Jarrett in her key, pp. 135-136, as follows:

'Twigs and peduncles usually pilose from patent, rufous hairs, c. 3 mm. long; base of leaf abrupt, intercostals to c. 10, inflorescence without a basal annulus ... *A. integer*

'Twigs and peduncles glabrous, base of leaf decurrent, intercostals c. 10-14; inflorescence with a basal annulus formed by the enlargement of the top of the peduncle into a narrow flange ... *A. heterophyllus*'

The geographical distribution of these two trees is the following: *A. integer* is apparently indigenous in evergreen forests 1500 to 4000 ft. in Sumatra, Borneo, Celebes, Mollucas, and New Guinea; it is cultivated throughout Malaysia and the Philippines. *A. heterophyllus* is 'possibly indigenous in evergreen forests from 1500 to 4000 ft. on Western Ghats of India; becoming naturalized sparingly in evergreen and semi-evergreen forest and tolerant of the dry season; cultivated throughout the tropics.' (Jarrett, op. cit. p. 336.)

According to the information available to me, these trees are monoecious, i.e. male and female flowers are found on the same tree, but the sexes are separate on different receptacles or inflorescences. Recently I have had occasion to examine several trees of *A. heterophyllus* cultivated in St. Xavier's Villa, Khandala, on the Western Ghats of India. One tree called my attention strongly; it was loaded with small 'fruits', some of which were collected and examined in detail. The results of this examination showed a peculiarity that has apparently been missed in our floras; the results are embodied in the plate that accompanies this short note. Some of the 'fruits' were in fact male inflorescences (fig. A in plate), consisting of very numerous male flowers, the anthers of the stamens being clearly visible to the naked eye. Other 'fruits' consisted of female flowers, the styles and stigmas being quite clear. But a third group of such 'fruits' consisted of female flowers below near the base, and male flowers above (see fig. B in plate), the part of the female flowers bulged considerably, as may be seen in the illustration. The tree under examination had about 20 female inflorescences or developing



Artocarpus heterophyllus

'fruits', some of which were already 20×12 cm. in size; at or near the ends of the branches all the inflorescences were male; scattered on the trunk and branches were 6 mixed inflorescences of the type shown in the fig. B in the diagram. Material was collected and is now preserved in Blatter Herbarium with reference numbers *Santapau* 23356-23357, Khandala 20 February, 1960.

This is the tree known in English as the *Jack Fruit Tree*, in local Marathi *Phanas*. It is the species of *Artocarpus* commonly cultivated along some of the Bombay streets and in local gardens. The 'fruit' is edible and attains sizes of up to 45×30 cm., though much larger sizes are occasionally seen in the local markets.

ST. XAVIER'S COLLEGE,
BOMBAY, H. SANTAPAU
March 2, 1960.

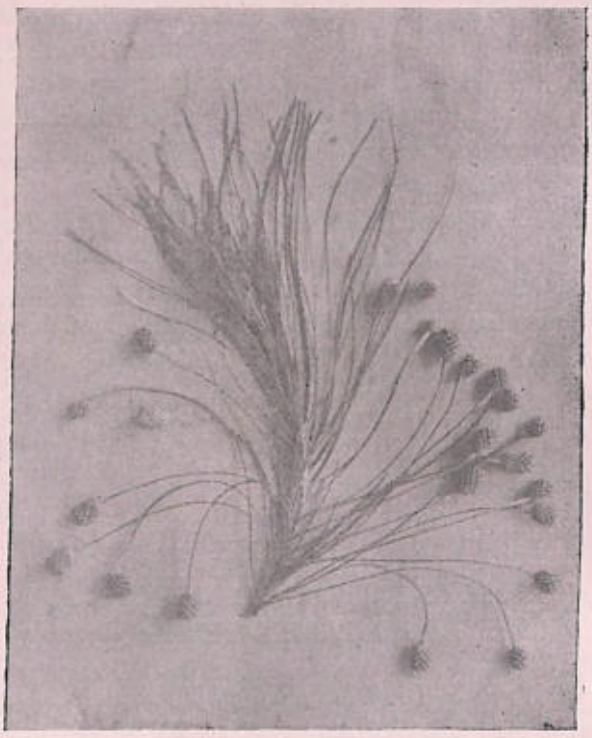
25. AN UNUSUAL INFLORESCENCE OF *CASUARINA EQUISETIFOLIA* LINN.[1]

(*With a photograph*)

An unusal inflorescence of *Casuarina equisetifolia* Linn. was collected from the Central Marine Fisheries Research Station campus on 12 November 1958. The inflorescence is striking in the fact that, here, the female flowers were seen at the ends of branchlets instead of short lateral branches (see photograph). On a closer examination, it was found that these abnormal inflorescences consisted of both male and female flowers in a 'catkin', the male flowers were lower and the 'catkin' terminated in female flowers. The groups of male and female flowers were normal and the female flowers in the 'catkins' were mostly fertilised with mature seeds.

It is interesting to note that such a condition of the inflorescence would suggest the possibility that in the case of the Casuarinales, one could expect shoots with staminate and pistillate 'catkin' inflorescences or shoots with androgynous 'catkin' inflorescences. Such a condition is indicated in the case of *Myrica gale* by Davey & Gibson (1917). Thus it is possible, from the structure of inflorescence, to

[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station.



consider the Casuarinales as taking an early off-shoot in phylogeny from the Juglandales, rather than a separate line of evolution as indicated by Rendle (1956).

CENTRAL MARINE FISHERIES
RESEARCH STATION,
MARINE FISHERIES P.O.,
MANDAPAM CAMP, S. INDIA,
February 6, 1960.

P. PRASANNA VARMA

REFERENCES

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26. BAMBOO FRUITS

(With two plates)

A considerable amount of public interest was caused recently by the publication of a newspaper report that a large number of bamboo clumps in the Mizo Hills (formerly known as the Lushai Hills) of Assam are producing large numbers of peculiar fruit. The clumps later dried up and the whole area was infested by rats, which evidently came to consume the kernels of the fruit. Exaggerated reports also appeared in the press stating that rats had multiplied in large number and that many of the fruit were being sold in the market at a high price. The fruiting of bamboo being of very rare occurrence, it was considered by old villagers as an ill-omen, and as a fore-runner of famine in the country.

Similar reports of flowering of a bamboo, commonly called the *mooli* bamboo, came from North Bengal. Mr. R. I. Macalpine of the India Tea Association, Nagrakata, informed the author that a large plantation of bamboo in Ranicherra Tea Estate on the main road from Siliguri to Mal had flowered and fruited. In forest areas of Moraghat Range under the Jalpaiguri Forest Division, the *mooli* bamboo plantation at Rehti had also been reported to have flowered. It was further verbally reported by some forest officers that a few clumps of *mooli* bamboo near Bamanpokhri Reserve Forest, about twelve miles north-west of Siliguri, had also flowered.

It is, however, known that many species of bamboos are monocarpic, i.e. they produce flowers and fruit only once in their lifetime, and that the plants die after the production of flowers and fruit. The flowering is simultaneous and takes place in almost all the clumps over a wide area. The *mooli* bamboo is botanically known as *Melocanna bambusoides* Trin., and is distributed over north Bengal, Assam, East Pakistan, and Burma. The bamboo is thin-walled but, in view of certain desirable qualities, it is considered an important bamboo for building purposes. According to Gamble (1896) about 16 million pieces of this bamboo used to be exported annually from East Pakistan to the Gangetic delta area for building purposes. The usual flowering cycle is 30 to 35 years but this requires further study and confirmation. The years of flowering as given by Gamble (1896), Brandis (1907), (1960) and C.C.F. (W.B.) are as follows:

(i) 1863-1866; (ii) 1892-1893; (iii) 1900-1902; (iv) 1933; (v) 1960 (the present flowering).

According to Pearson (1920), the *mooli* bamboo flowered over a large area in Cachar district of Assam during 1910-1912.

The flowering and fruiting of *mooli* bamboo is an interesting phenomenon as this bamboo is known to produce the largest size of fruit among bamboos. The only other genus of bamboo which produces conspicuous but smaller fruit is *Ochlandra*, which is commonly found in south India and Ceylon. In view of the rare phenomenon of flowering and fruiting of the *mooli* bamboo at intervals of 30 to 35 years, it was decided to visit the clumps at Bamanpokhri Forest. One visit was made by the author on 30th May 1960, in company with Mr. T. K. Mitra of West Bengal Forest Service and Mr. S. N. Singh Deo, M.L.A. Some fruit collected from the first visit were shown to Dr. M. M. Das, Deputy Minister, Government of India (Ministry of Scientific Research & Cultural Affairs), who happened to be in Darjeeling at that time. As Dr. Das took keen interest and expressed a desire to examine the fruiting clumps personally, a second visit to the spot was arranged on the 4th June 1960, and the author accompanied Dr. Das again to the spot in the forest.

It was indeed a wonderful sight for a botanist to see the bamboo clumps with large numbers of drooping fruit. As many botanists are not familiar with bamboos in fruit, the first impression was that the fruit belonged to some creepers which might have twined round the bamboos. On closer examination, however, this illusion vanished. The fruits are green or greenish yellow and apple- or pear-like in general appearance with a tapering and pointed end. Unlike the normal fruit of the grass family, the young fruit of this bamboo contain a liquid endosperm, while the endosperm in the mature fruit is fleshy with a cavity in the middle. Both the liquid and the fleshy endosperm are comparable with the liquid and the fleshy endosperm of green and ripe coconuts. The kernel in mature fruits is creamy-white, oval, and edible. A study of the development of the embryo of this bamboo and its nature and differences if any, from the normal embryo of other members of the grass family would be interesting.

It is rather unfortunate that these monocarpic bamboos die after the production of flowers and fruit. No detailed study regarding the causes (climatic, edaphic, florigenic, or genetic) of this flowering has been done, and it appears that such studies would be of great value. In our present state of knowledge the information, that the bamboo would flower at the end of its 30th or 35th year of life appears to be of some advantage. This bamboo is cultivated on plantation scale as it is an important source of paper pulp. In the first place, the extraction of the bamboo from the plantation may be so planned that the major part is extracted much ahead of the anticipated time

Fig. 1. Photo shows the general habit of *mooli* bamboo (*Melocanna bambusoides*). Standing in the foreground are Mr. S. N. Singh Deo, M.L.A. and Mr. T. K Mitra.

Fig. 2. Shows a cluster of fruits hanging from the bamboo culm

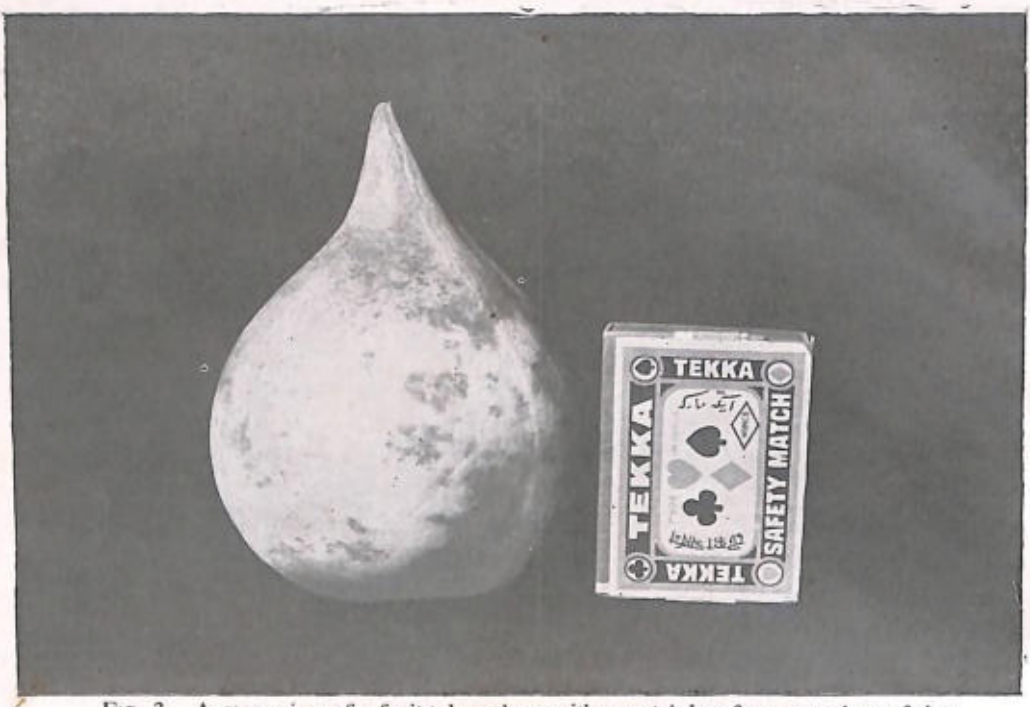

Fig. 3. A close view of a fruit taken along with a match box for comparison of size

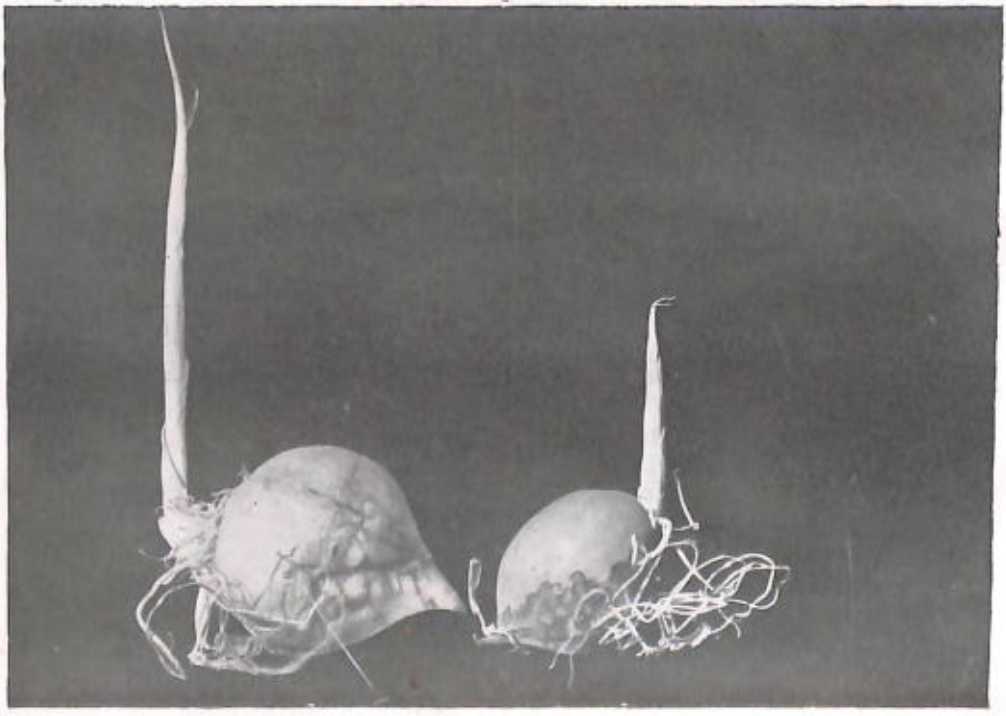

Fig. 4. Fruits showing germination of the young plant

of flowering and fruiting. In the second place, uniform growth would be assured when new plantations are planted by using the fruits as propagating material. Thirdly, due to the advantage of easy transport of these fruits, new plantations could be raised in distant places and even outside the country by transporting the fruits by air, if necessary.

On examination of the fruiting culms, it was found that the fruits hang with their pointed ends downwards and, with slight breeze or wind, the fruits drop and the pointed ends strike the soft and moist soil first and thus fix the fruits to the ground. The atmosphere at the time of fruit drop being highly humid, it was noticed that all the fruits germinated simultaneously. The germination was so quick that it was even suspected that some fruits must have germinated while still on the tree. On careful examination, however, no viviparous fruits were noticed but the occurrence of this phenomenon cannot be altogether ruled out as stated by Gamble.

I have not been able to locate any good published photograph of this bamboo in fruit. The drawings given by Gamble (1896) and Brandis (1907) do not convey a clear idea of the manner in which the fruits are held on the culm. Only one photograph of the sterile bamboo clumps has been published earlier by Pearson (1920). A number of photographs of the fruiting culms, fruits, and germinating fruits were taken on the spot by the author. Some of these photographs, probably the first few, showing clearly the fruits hanging on actual growing plants, are published along with this note.

INDIAN BOTANIC GARDEN,
BOTANIC GARDEN P. O.,
CALCUTTA,
July 6, 1960.

D. CHATTERJEE

REFERENCES

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3. Brandis, D. (1907) : Indian Trees: 632. Archibald Constable & Co. Ltd. London, W. C.
4. Pearson, R. S. (1920) : *Indian Forester* **46** : 613 et tab. 25.

27. NEW SPECIES OF CYANOPHYCEAE FROM MYSORE STATE—I

(*With two plates*)

In this paper three new species of the Cyanophyceae, one of *Calothrix* and two of *Cylindrospermum*, are described. These have been collected from areas which, prior to the reorganization of the States, were included in Bombay State, and now come within Mysore State.

1. **Calothrix santapaui**[1] sp. nov. (Plate 1, Figs. 1 and 2)

Filaments single, straight or curved, sometimes branched. Sheath firm, hyaline to yellow-brown, distinctly stratified; in the basal region 20-25 μ broad; in the middle of the filament tumid and 30-40 μ broad; basal part of the filament surrounded by a thick layer of refractive mucilage. Trichomes without constrictions at joints and tapering into a long hair which comes out of the sheath at right angles to it in the upper part of the filament. Cells shorter than broad or as long as broad; in the basal portion, 5.1-6.4 μ broad, 3.2-6.4 μ long; long cylindrical in the region of the hair and 2 μ broad. Heterocysts basal, single, spherical to ellipsoidal, 5.8-6.4 μ broad, 5.8-7.2 μ long. Akinetes one to three in a row, separated by disintegrated cells, cylindrical, 6.4-9.7 μ broad, 12-24 μ long; outer wall of the akinetes smooth and hyaline.

In a mucilaginous mass with other algae at Castle Rock on 2nd November 1951. Collected by N. D. Kamat and kept in the personal collection of the senior author. No. M 15.

Filamenta singula, recta vel curvata, nonnumquam ramosa vel furcata. Vagina firma, hyalina vel luteo-brunnea, distincte stratis diversis notata, in regione basali 20-25 μ lata, ad medium tumescens 30-40 μ; filamenti basis circumdata corio denso mucilaginoso refractivo. Trichomata non constricta ad septa, fastigata in appendicem longam, quae ad partes superiores filamenti emergit e vagina efformans angulum rectum. Cellulae longitudine minores quam latitudine vel aeque longae ac latae; cellulae basales 5.1-6.4 μ latae, 3.2-6.4 μ longae, in regione appendicis elongato-cylindricae, 2 μ latae. Heterocysta basalia, singula, sphaerica vel ellipsoidea, 5.8-6.4 μ lata, 5.8-7.2 μ longa. Akinetes 1-3 in serie, separati inter se cellulis corruptis, cylindrici, 6.4-9.7 μ lati, 12-24 μ longi, parietibus exterioribus levibus et hyalinis.

Typus lectus in massa mucilaginosa algarum ad Castle Rock a N. D. Kamat die 2 novembris anni 1951 et positus in herbario auctoris senioris sub numero M. 15.

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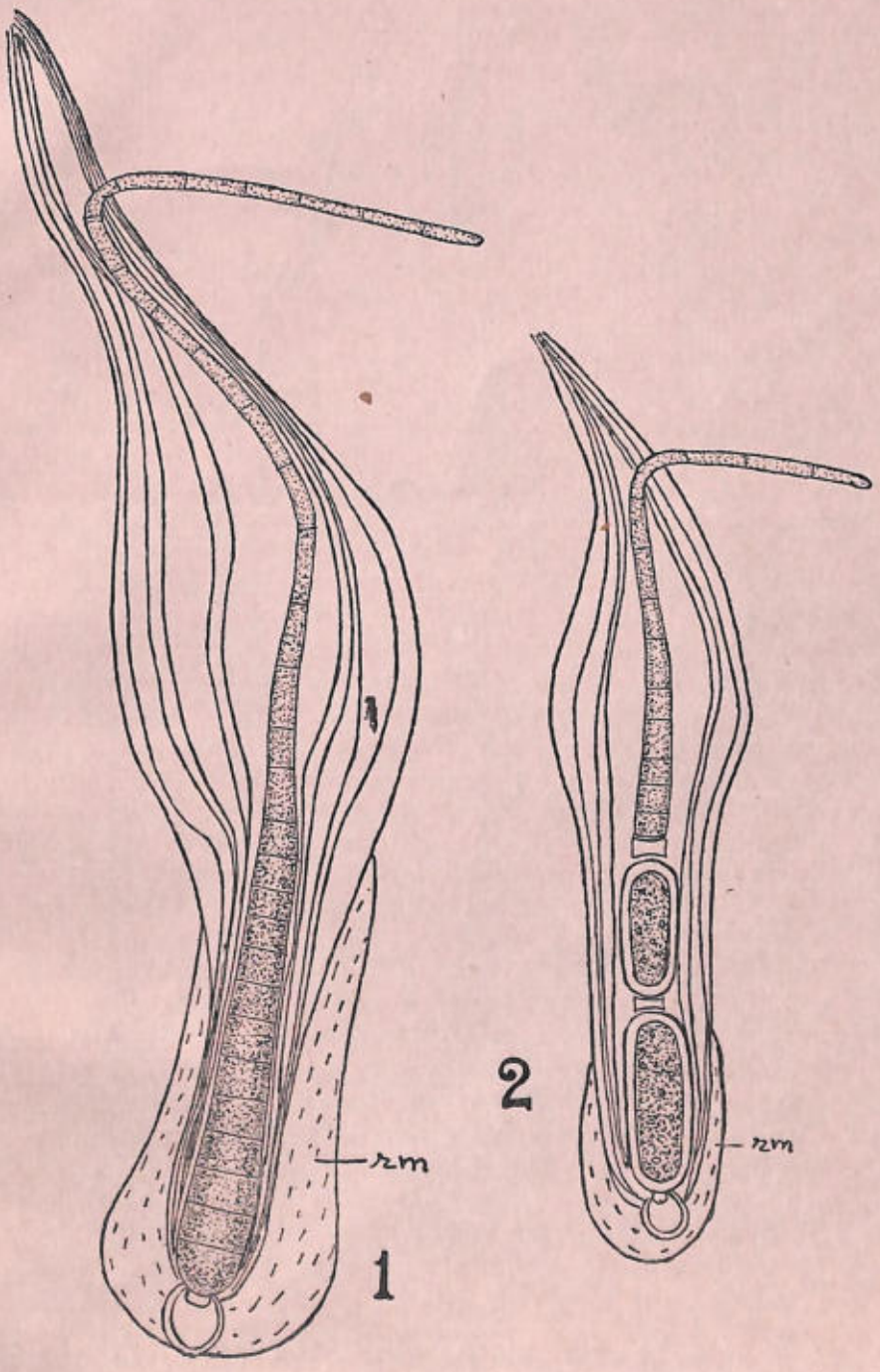
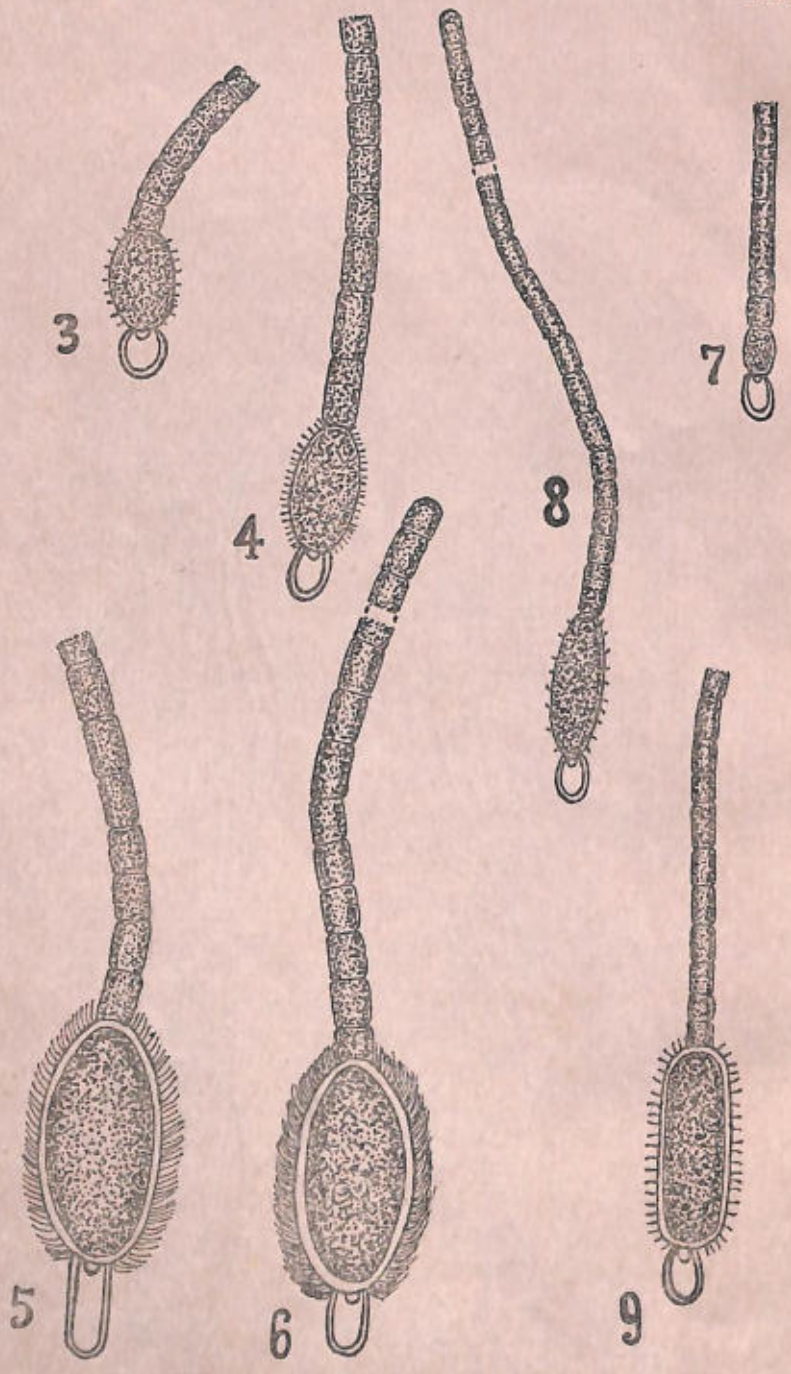
[1] Named after Rev. Fr. H. Santapau, the well-known botanist of India.



Figs. 1 and 2. *Calothrix santapaui* sp. nov.
rm—refractive mucilage
Figs. 1 and 2. ×1280



Figs. 3-6. *Cylindrospermum gracile* sp. nov.
Figs. 7-9. *Cylindrospermum echinulatum* sp. nov.
All figs. × 1280

The only species with which this species agrees in respect of the stratified sheath, cylindrical akinetes, and unconstricted cells is *C. sandwicensis* (Nordst.) Schmidle (Geitler, 1932); but its cells and akinetes are much longer than those of *C. sandwicensis*, while the tumid sheath in the middle of the filament makes it distinctive. The akinetes in this alga may be one to three. When more than one, they occur in a series alternating with dead cells.

2. **Cylindrospermum gracile** sp. nov. (Plate 2, Figs. 3-6)

Plant-mass mucilaginous, blue-green. Trichomes loosely entangled, with constrictions at the joints. Cells cylindrical, rarely quadrate, 3.2-3.8 μ in diameter, 3.8-6.4 μ long. Heterocysts ellipsoidal, rarely cylindrical, 3.8-5 μ in diameter, 5-12.3 μ long. Akinetes single, ellipsoidal, 12.5-15 μ in diameter, 20-30 μ long, with fine, hair-like processes, 3.2-4.5 μ long.

Attached to blades of grass in a small pond at Devarayi on 15th October 1951. Collected by N. D. Kamat and kept in the personal collection of the senior author. No. M 16.

Plantae massa mucilaginosa, caeruleo-viridis. Trichomata laxe intertexta, constricta ad septa. Cellulae cylindricae, raro quadratae, 3.2-3.8 μ diam., 3.8-6.4 μ longae. Heterocysta ellipsoidea, raro cylindrica, 3.8-5 μ diam., 5-12.3 μ longa. Akinetes singuli, ellipsoidei, 12.5-15 μ diam., 20-30 μ longi, ornati processibus tenuibus capilli similibus 3.2-4.5 μ longis.

Typus lectus affixus foliorum laminis graminum in lacuna parva ad Devarayi die 15 octobris anni 1951 a N. D. Kamat, et positus in herbario auctoris senioris sub numero M. 16.

This species is distinguished from all the known species of *Cylindrospermum* by the hair-like processes on its akinetes.

3. **Cylindrospermum echinulatum** sp. nov. (Plate 2, Figs. 7-9)

Plant-mass mucilaginous, light blue-green. Trichomes loosely entangled, with constrictions at the joints. Cells quadrate to cylindrical, 2.5-2.8 (-3.2) μ in diameter, 3.2-5.2 μ long. Heterocysts ellipsoidal, rarely quadrate, 3.2-4.5 μ in diameter, 5-7.7 μ long, mostly present at both ends of the trichomes. Akinetes single, cylindrical, 9-11 μ in diameter, 16-22 μ long, outer wall yellow-brown, ornamented with fine slightly curved spines, 1.5-2.5 μ long.

Free-floating in a puddle at Londa on 14th March 1952. Collected by N. D. Kamat and kept in the personal collection of the senior author. No. M 17.

Plantae massa mucilaginosa, pallide caeruleo-viridis. Trichomata laxe intertexta, constricta ad septa. Cellulae quadratae vel cylindricae, diametientes 2.5-2.8 (-3.2) μ, 3.2-5.2 μ longae. Heterocysta ellipsoidea,

raro quadrata, 3.2-4.5 μ diam., 5-7.7 μ longa, ut plurimum insidentia utrique apici trichomatum. Akinetes singuli, cylindrici, diametientes 9-11 μ, 16-22 μ longi, parietibus exterioribus luteo-brunneis, ornati spinis sparse curvatis 1.5-2.5 μ longis.

Typus lectus libere natans in lacuna ad Londa die 14 martii anni 1952, a N. D. Kamat et positus in herbario auctoris senioris sub numero M 17.

This alga resembles *Cylindrospermum trichotospermum* Fremy (Geitler, 1932) and *Cylindrospermum gorakhporense* Singh (Singh, 1939) in possessing delicate needle-shaped projections, but the akinetes here are cylindrical and not ellipsoidal as in *Cylindrospermum trichotospermum* and *Cylindrospermum gorakhporense*. Moreover this is a much smaller form.

ACKNOWLEDGEMENT

The authors sincerely thank Rev. Fr. H. Santapau for rendering into Latin the diagnoses of the new types.

INSTITUTE OF SCIENCE,
BOMBAY, 1,
February 12, 1960.

ELLA A. GONSALVES,
N. D. KAMAT.

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28. *CORYNOMORPHA PRISMATICA* J. AG. FROM OKHA: A NEW LOCALITY RECORD FOR INDIA

(With two plates)

The genus *Corynomorpha*, till recently recognised under the family Grateloupiaceae in Cryptonemiales, consisted of but two species of little known red algae, viz. *Corynomorpha prismatica* J. Ag. and *C. clavata* Harvey. Balakrishnan (1958, 1959), however, created a new family Corynomorphaceae with a single genus, *Corynomorpha*, and with type species *C. prismatica*, based on the nature of the reproductive structures in the alga which were found by him to be variant from those met generally in Cryptonemiales.

The species *C. prismatica* (*Acrotylus prismaticus* J. Ag.) was earlier known from the coast of Hindustan, S. India (Agardh, 1851, p. 193). It was also reported by Boergesen (1937) from Cape

Fig. 1. General aspect of the Rocky Coast at Cape Comorin, S. India

Fig. 2. Huge rocks far out at sea where *Corynomorpha* grows luxuriantly

Fig. 3. General aspect of the coast at Okha

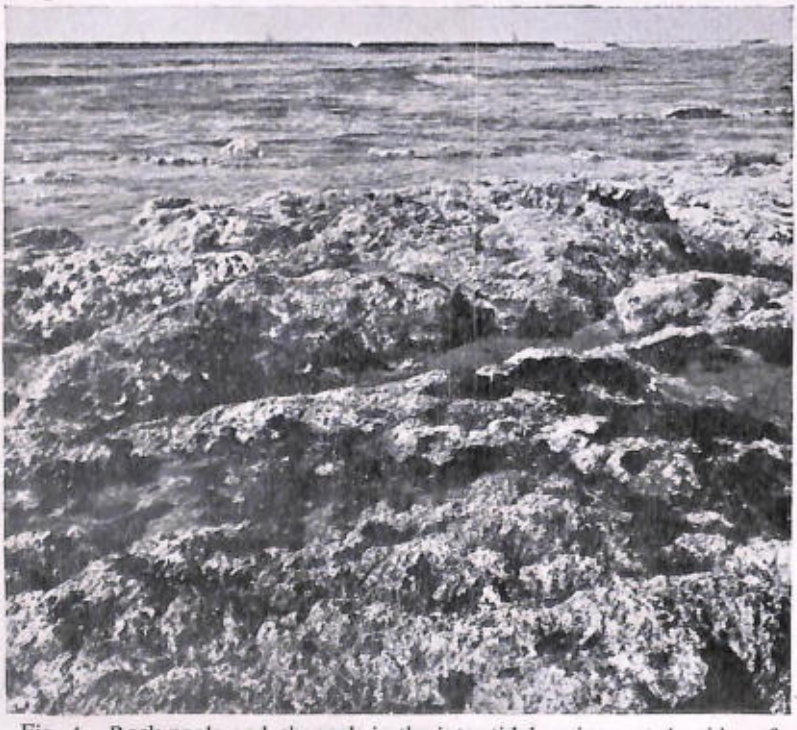

Fig. 4. Rock-pools and channels in the inter-tidal regions, at the sides of some of which *Corynomorpha* flourishes

Comorin in south India, on materials collected by Prof. Iyengar from that area. The author has collected this alga quite frequently from Cape Comorin with Prof. Iyengar or independently. At Cape Comorin, it grows attached to some of the huge Archean-gneiss rocks in the open sea which are exposed to direct and violent surf-action (Figs. 1, 2). The alga is generally at the sides of submerged portions of rocks well below the surface level of the water. In these areas, a sort of a vertical zonation of algal growth can be noticed. At comparatively higher levels *Caulerpa racemosa* (Forsk.) W.v.B. and *C. peltata* Lamour are seen. Below this, *Botryocladia leptopoda* (J. Ag.) Kylin comes up; further below *Corynomorpha prismatica* is found marking perhaps the lowest limit of algal growth in these vertical series. Below the *C. prismatica* level usually it is either barren or colonised by a few animal communities.

At Cape Comorin *C. prismatica* is at its best and most luxuriant growth at the sides of a huge rock seen far out at sea (Fig. 2). This rock can be reached by means of country catamarans, though with some difficulty and with a certain amount of risk. From the writer's personal experiences and observations, this rock shows extensive growths of *C. prismatica*; the plants themselves are more tough, sturdy, and deeper in colour and larger than those found elsewhere nearer shore. The alga is invariably found heavily loaded with the epiphytic red-alga *Leveillea jungermannioides* (Mert et Hering) Harv.

Apart from the locality mentioned above, the writer has collected *C. prismatica* from Okha Port in Saurashtra, in the northern part of the Arabian Sea. From this area, it is reported here for the first time. In this locality, the alga was, however, found in quite a different situation from that met with at Cape Comorin. The alga grew luxuriantly at the inter-tidal belt, and well above the low-water mark. Here the coast is gently sloping towards the sea and more or less flat with undulations of the hard rocky substrata composed of Deccan Traps and Tertiary formations (Figs. 3, 4). This area is further characterised by long and narrow crevices with very shallow channels and rock-pools, which are heavily silted by very fine smooth white sand and mud. At low tide, the entire area becomes exposed, with absolutely calm rock-pools and narrow channels with about a foot or a little more of clear water in them. At the sides and on the vertical faces of such pools and narrow channels, *Corynomorpha prismatica* was found well above the water level, but sufficiently protected from direct insolation; it was associated with *Caulerpa scalpelliformis* (R. Br.) W.v.B. and *C. peltata*. Compared to the Cape Comorin alga,

the Okha form was less robust and lighter in colour, being purple-red with a tinge of yellowish brown.

INDUSTRIAL SECTION,
INDIAN MUSEUM,
CALCUTTA,
February 23, 1960.

K. S. SRINIVASAN,
Curator.

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29. OBSERVATIONS ON SOME DRIFT ALGAE AT MAHABALIPURAM COAST

(With three plates)

The present account is based on observations and collections made in the field by the author at Mahabalipuram coast, about 56 km. south of Madras, during a study of the ecology and seasonal succession of the marine algae of the locality covering a period from October 1944 to September 1945.

Reports on algal drifts on Indian coasts are extremely few, although some records are seen wherein a particular species of alga is mentioned as having been collected from a locality to which it would appear to be alien. Edgar Thurston collected *Sphacelaria tribuloides* Menegh. growing on an old battered and indeterminable stem of a fucaceous plant cast ashore on the beach at Madras (Boergesen 1938: 209). From the same locality he collected *Halymenia dilatata* Zan. (Boergesen 1938: 214) and *Avrainvillea erecta* (Berkeley) A. & E. S. Gepp (Gepp 1911: 29). Rangachary collected from the same beach *Scinaia bengalica* Boergs. (Boergesen 1938: 209). Grunow (1915, 1916) has referred to some species of *Sargassum* from Tranquebar in south India, based on the collections made by Koenig and Klein and on the materials present in the herbaria of Rottler and Rudolph. Krishnamurthy (1954: 176) has, however,

Fig. 1. Photograph showing naturally occurring rocks in the sea, opposite the Shore-Temple

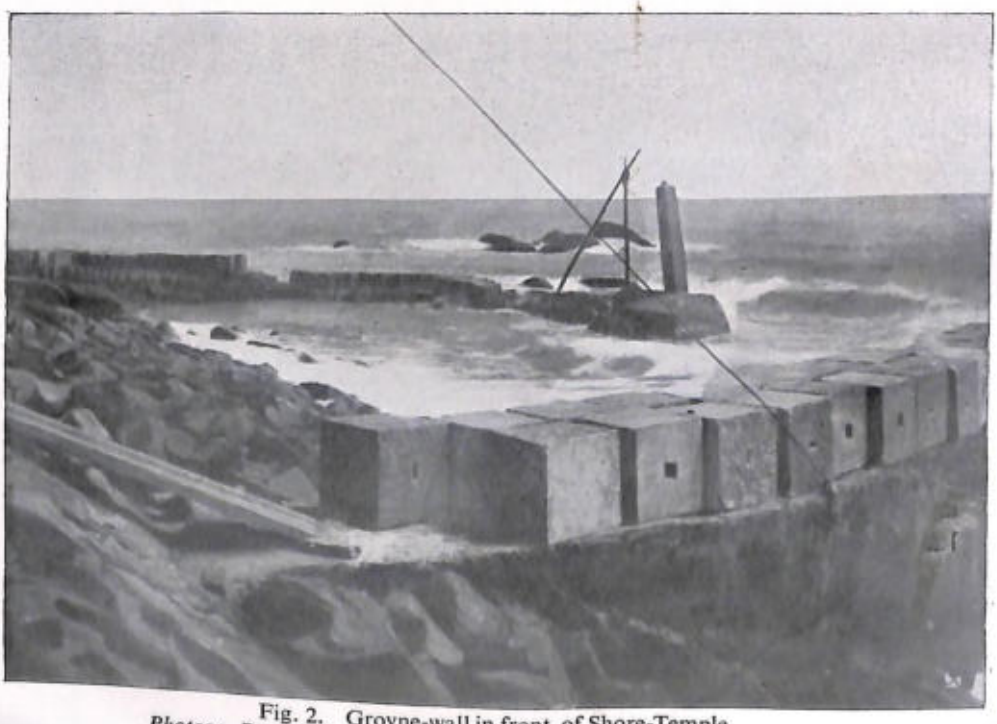

Fig. 2. Groyne-wall in front of Shore-Temple

Photos: By courtesy of the Archaeological Survey of India, S. Circle

referred to some marine algae as *Sargassum*, *Turbinaria*, *Hormophysa* and *Ulva reticulata* from Pamban and Tuticorin, being stranded at the Madras beach in the salt marshes at the mouth of River Adyar. A careful examination of the coasts from where the algae mentioned above have been collected would readily show that the particular habitat associated with these algae is not present at these coasts. In fact, these algae do not grow in the localities referred to.

The greater part of the coast at Mahabalipuram is sandy. In the immediate vicinity of the Shore-Temple and opposite to it, a few rocks are seen, some of which are quite large and project a little into the sea (Fig. 1). To protect the Shore-Temple from sea erosion, huge boulders are piled up to some distance from and on either side of the Shore-Temple. In front, a sea-groyne is also constructed (Fig. 2) to ensure additional protection. The natural rocks, the artificial groyne-wall, and the embankments of large boulders afford very good substrata for a variety of algae to grow and flourish on this coast and at various seasons of the year.

Even though the coast harbours a number of marine algae, the forms which are cast ashore at different seasons are very few and practically insignificant. Among the plants of the coast that may be seen stranded at different times may be mentioned species of *Ulva*, *Enteromorpha*, *Cladophora*, *Chaetomorpha antennina* (Bory) Kutz. [=*Chaetomorpha media* (Ag.) Kutz.] and *Grateloupia filicina* (Wulf.) Ag.

Apart from the species mentioned above, during the early part of October 1944, the author made a good collection of various other species from the beach at Mahabalipuram, Edayur, (another sea-shore village south of Mahabalipuram), and beyond, the stretch of coast thus extending a little over 8 km. (5 miles). For the most part, the coast along this beach is practically sandy. At Edayur a few rocks are seen, but the algal vegetation on them was extremely poor, with only a few forms of Chlorophyceae as *Ulva*, *Enteromorpha*, and *Chaetomorpha*.

The collection of algae stranded at the Mahabalipuram coast comprised several bits of brown sea-weeds as *Sargassum* (at least about three species), *Turbinaria*, *Cystophyllum muricatum* (Turn.) J. Ag., *Hormophysa triquetra* (L.) Kutz., a single specimen of this very rare alga attached to a coralline fragment, and *Hypnea musiformis* (Wulf.) ; amour attached to *Turbinaria*. Besides these sea-weeds, and entwined by *Sargassum* clumps, a few specimens of the hypocotyl of *Rhizophora mucronata* Lam. and *Ceriops candolleana* Arn. were also collected from the beach. In some places the algae were found thrown up high on the shore to a distance of 9 to 12

metres from the water's edge at low tide. In some cases, the specimens were found lying on the beach completely exposed and, in other cases, partially or completely buried under tiny sand mounds formed through wind action. Most of the specimens were found in quite fresh condition.

It was, however, in the month of October 1944 that comparatively more numerous specimens were found stranded on the shore. In November, the number was much less and only stray bits of two or three species of *Sargassum* and a few bits of *Cystophyllum muricatum* and *Turbinaria* were found, this time all the stranded specimens occurring on the beach north of Shore-Temple. In December, however, the number was at its lowest, with only two or three bits of *Sargassum* and a single bit of *Turbinaria*, even though the sea was very rough, and there was heavy rain for a number of days continuously, conditions which can be regarded as favourable for many algae to get stranded. In the months following December, none of the species mentioned above was found stranded on the beach.

It is significant to mention here that species of *Sargassum*, *Turbinaria*, *Cystophyllum*, *Hormophysa*, *Rhizophora*, and *Ceriops* do not at all grow at Mahabalipuram or in the neighbouring areas. These specimens, therefore, must possibly have come from a distant shore. The nearest possible source would appear to be Krusadai and the neighbouring islands in the Gulf of Manaar, which islands lie, as the crow flies, about 400 km. (250 miles) south of Mahabalipuram (Fig. 3). The following evidence would seem to lend much support to this view:

1. The species of *Sargassum*, *Cystophyllum*, *Turbinaria*, and *Hormophysa* collected at Mahabalipuram coast have their representatives flourishing well at Krusadai and the neighbouring islands at the reef and in the lagoons.

2. The coral bit to which *Hormophysa* was found attached would lend support to the origin of these algae from a coralline region which is met with at Krusadai and other islands in the Gulf of Manaar.

3. *Hormophysa triquetra*, which is an extremely rare alga of our country, is seen only at the Krusadai Island along the Bay of Bengal coast, even though coralline substrata and lagoons, which form the characteristic habitat of this alga, are found in other neighbouring places and islands in the Gulf of Manaar, off Tuticorin coast.

4. The hypocotyl specimens of *Rhizophora* and *Ceriops* would further confirm that all these specimens must have come from

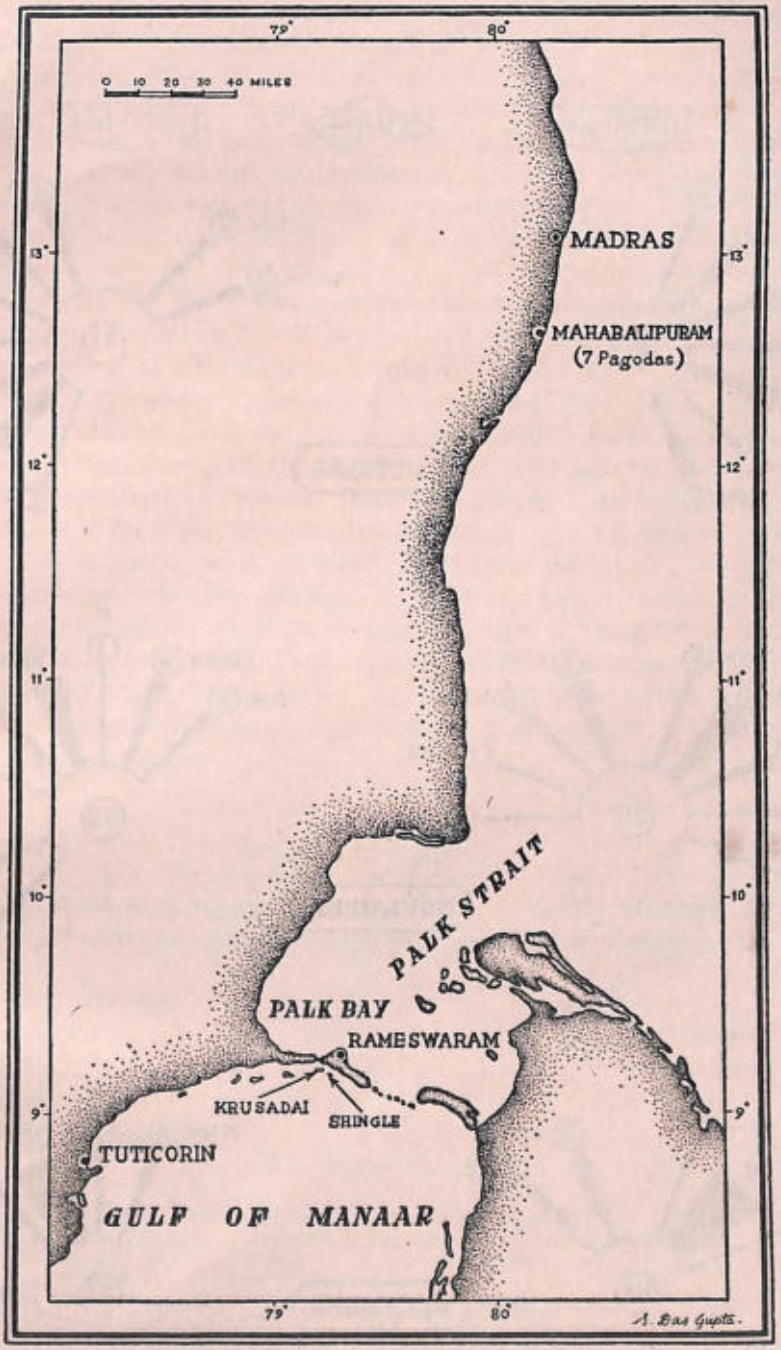

Fig. 3. Map showing Krusadai and other islands and Mahabalipuram

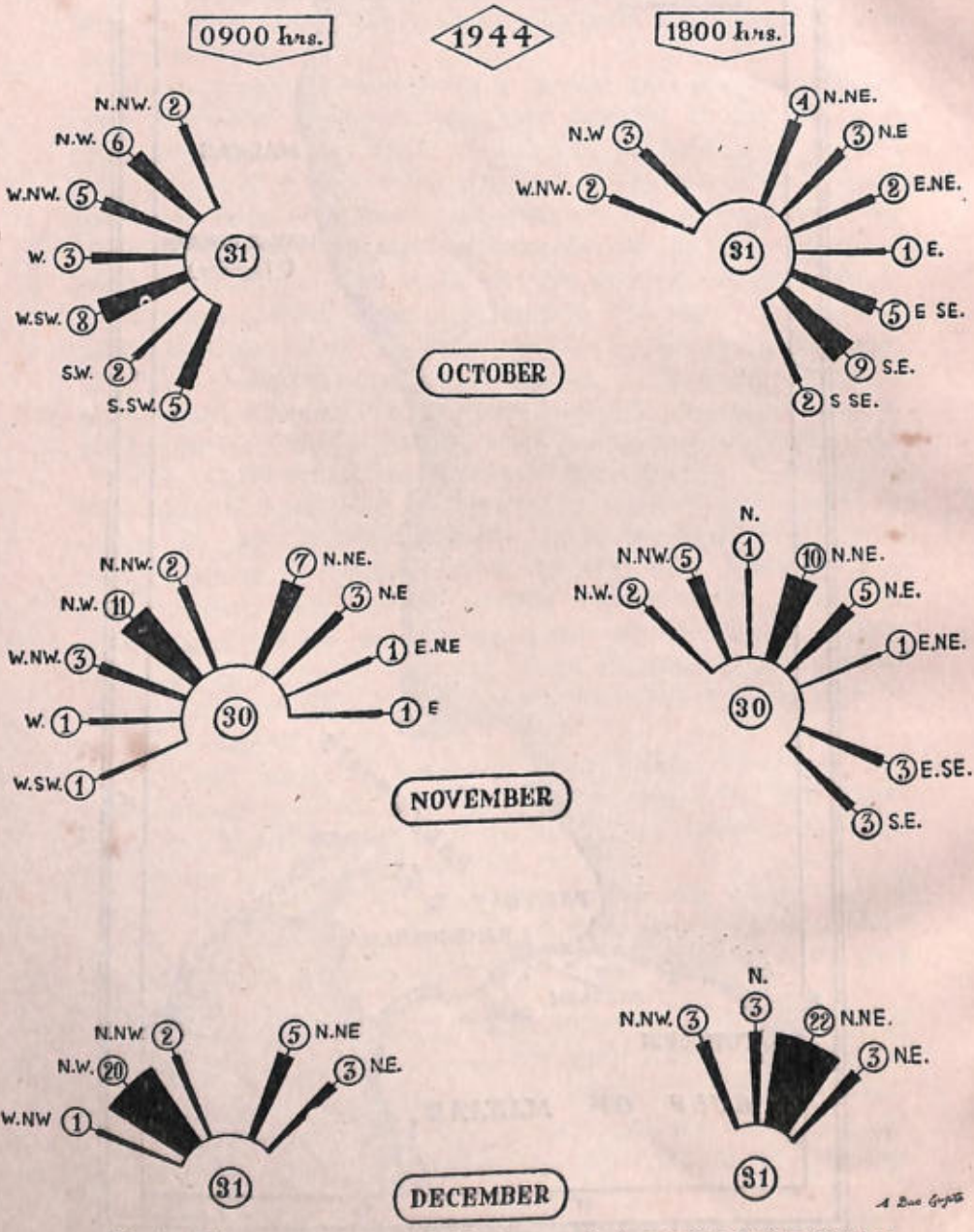

Fig. 4. Diagram showing wind directions and frequencies during October-December 1944

Krusadai Island, where in the region of coral islands in the Gulf of Manaar these mangroves are found.

The ocean currents and the direction of wind (Fig. 4) would seem to have contributed much towards the drift of these algae and other specimens from Krusadai in the Gulf of Manaar, ultimately casting a portion of them on the Mahabalipuram coast. It would be very interesting to know the extent of such drifts along our coasts and to what distant shores the plant materials are carried by Nature's processes.

In the light of the evidence now before us, the collections made by Thurston, Rangachary, and others from Madras (Boergesen 1938; Gepp 1911) and Tranquebar (Grunow 1915, 1916) would be intelligible. The genus *Avrainvillea*, a rare green-alga of our coasts, inhabits shallow lagoons and intertidal belts with coralline and mud substrata. It is found at the coralline beds at Krusadai and Hare Islands in the Gulf of Manaar. Similarly *Scinaia bengalica* is found growing on coral rocks at the reefs at Krusadai and the neighbouring areas. These species must, therefore, have come from these localities and been cast on the Madras beach. As regards the several species of *Sargassum* reported by Grunow from Tranquebar, it may be stated that Tranquebar with a purely sandy coast does not show any situation at all favourable for the growth of these forms. They, also, must have come from some distant shore and been stranded at Tranquebar beach.

ACKNOWLEDGEMENTS

Grateful acknowledgements are due to Rev. Fr. H. Santapau, S.J., for his kind criticism and help in the preparation of this paper.

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INDIAN MUSEUM,
CALCUTTA,
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Gleanings

A Female Mowgli?

The following extract from TIGER LADY: Adventures in the Indian Jungle, by Olive Smythies, published by William Heinemann Ltd., London (1953), is reproduced with the permission of the author and publishers:

Page 21: 'One day my husband came into the bungalow looking very excited. It appeared that a Forest guard had brought in a girl, about eleven years old, who had been found in a not very distant forest where she had been actually brought up by a bear—a sort of female Mowgli, who had lived as an animal all her life! The bear had been killed by villagers, who had seen this strange being wandering about near by. They had promptly captured and found to their astonishment that it was a human being, a girl. She walked on all fours and grunted like a bear. She was very savage, too, snapping and snarling at anyone who came near her. "She's been taken to the hospital, where she'll be fed on fruits and roots and carefully looked after", Evelyn told me. "I doubt if it will do any good, though."

'He was right. We often went too see her, and tried to make friends, but it was no use. She never became any tamer, and after a few months she pined away and died. This was the only authentic case of a jungle child I ever heard of in all my years in India.'

[The author informs us that this was some time between 1913-1916 and the child was kept at the Ramsay Hospital, Naini Tal.—EDS.]

Notes and News

Seventh Commonwealth Entomological Conference

The Seventh Commonwealth Entomological Conference was held in London from 6 to 15 July 1960. Nearly 50 delegates from most of the countries of the Commonwealth attended. India was represented by Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, who also presided over one of the sessions, on 'Recent investigations on timber boring beetles'.

The subjects discussed at the Conference were as follows: (i) Recent developments in insecticides for crop protection, (ii) Problems in the use of insecticides, (iii) Hazards and precautions associated with the use of pesticides, (iv) Research on stored products pests and their control, (v) Biological control of insects and weeds, (vi) Insect attack in relation to the physical characters and physiological state of the plant, (vii) Recent investigations on timber-boring beetles, (viii) Termite control in afforestation projects and constructional timbers, (ix) The utilization of pathogenic organisms in the control of insect pests, (x) Recent advances and current trends in the study and control of tsetse flies and trypanosomiasis, (xi) Developments in the study and dispersal of insecticides, (xii) Recent research on locusts and their control, (xiii) Developments in the study of plant viruses and their vectors and their bearing on control measures, and (xiv) The link between research work and its application in the field of plant protection.

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