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Wild Elephant (*makhna*), Kaziranga, Assam



Barasingha or Indian Swamp Deer in Kanha, Madhya Pradesh

(*Photos: E. P. Gee*)

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THE MANAGEMENT OF INDIA'S WILD LIFE SANCTUARIES AND NATIONAL PARKS

BY

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

PART III

(With one coloured and 5 black and white plates)

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INTRODUCTION

This paper forms the third of the series, Part I having appeared in the Society's *Journal*, Vol. 51, No. 1 (December 1952), and Part II in Vol. 52, No. 4 (April 1955). With the slow but gradual evolution of properly organised wild life conservation in India, with successive meetings of the Indian Board for Wild Life and its Executive Committee, and with more travels on my part around India's wild

life centres, it is inevitable that there should be a succession of these papers at two- or three-year intervals.

Since writing the last paper, a few places in Assam, Madras, and Mysore have been re-visited; but in particular the famous Gir Forest of Saurashtra was visited for the first time in January 1956, and the present paper naturally deals mainly with this most interesting place and its peculiar problems.

Recent Work of the Indian Board for Wild Life

Since Part II of this series was written, the activities of the Indian Board for Wild Life in connection with national parks and sanctuaries may be summarised as follows:

The Executive Committee and the Board itself met in Calcutta in January/February 1955 and discussed the need for clarifying the general principles that should govern the creation of national parks, wild life sanctuaries, and protected areas. The Board called attention to the following points:

(*a*) National Parks.

(i) National Parks are areas set apart by an Act of the competent Legislature for permanent preservation. Such areas may have for their objective the preservation of one or more of the following features: geological, pre-historical, historical, archaeological, scenic, faunal, and floral.

(ii) It is not an essential condition of National Parks that there should be no human intervention. Where it is desired to exclude human intervention altogether, it may be possible to set apart a suitable part within the National Park, a *sanctum sanctorum* which may receive absolute protection.

(iii) Such parks are not to be created lightly.

(iv) In framing proposals for the constitution of National Parks, the Board considers it desirable that State Governments should consult it and avail themselves of the technical knowledge and experience at its disposal.

(v) The Board recommends further that legislation to be enacted in various States for the creation and management of National Parks should follow a common pattern. In order to facilitate this, the Board will prepare and circulate a model draft bill.

(*b*) Wild Life Sanctuaries.

Wild Life Sanctuaries are areas ordinarily set apart by an Order of the State Government for the purpose of preserving wild life. The management of such sanctuaries is adequately dealt with under Resolution 6 'Protection of Nature and Wild Life' of the Mysore Session of the Board held in 1952. The Board recommends that sanctuaries conforming to the standard laid down under Resolution 6 (b) of the Mysore Conference may be constituted as such.

(*c*) Protected Areas.

In many States there may be areas where it may be considered expedient:

(i) to afford special protection to wild life, in order to enable

species of wild life which are on the verge of extinction to re-establish themselves;

(ii) to afford protection to wild life attracted to water impounded in River Valley Projects and to other irrigation works;

(iii) to afford protection to wild life in and around large towns and sacred places.

Such areas may be constituted by an order of the Government, which may also lay down the degree of protection.

The Executive Committee of the Board met at Ootacamund in May 1955, and among other resolutions resolved to advise the State Governments that, pending the constitution of any sanctuaries into national parks, any attempt that might be made to change their existing character or whittle away their resources in any way should be guarded against. It also examined the Draft National Parks Bill clause by clause, and made a number of suggestions to be incorporated.

The Executive Committee again met at Sasan Gir in January 1956 and considered a great number of items dealing with wild life conservation in general. As regards wild life sanctuaries and national parks in particular, it was decided to collect information from all sources regarding the methods of preventing diseases contracted by wild life from domestic animals grazing in or near sanctuaries. The Draft Model Bill for National Parks, as finalised by the Law Ministry, was again considered before being sent to the State Governments.

In 1955 national parks were created in the following States: Kanha in Madhya Pradesh, and Shivpuri in Madhya Bharat.

Proper Land Use Essential for Wild Life Preservation

In most parts of the world nowadays the rapidly increasing human population, with consequent increasing demand for land for settlement, cultivation, and grazing, presents grave problems. When such a demand for land occurs near reserved forests or wild life sanctuaries, forest officers and wild life conservationists often find it difficult to convince land-hungry people that it is in the public interest to continue maintaining these forests and sanctuaries.

Moreover, there is a commonly held idea that wild life is something intangible and abstract, something to be appreciated by the select few who are able to comprehend the aesthetic, recreational, and biological value of flora and fauna. Even some educated persons in high positions in India have been known to exclaim 'We cannot afford to keep Kaziranga/Kanha/Gir Forest. Human beings are more important than wild animals. These places must be given up to settlement and cultivation.'

In such matters one must be realistic: the land-hungry people and their political leaders can produce facts and figures to support their case, and so we must be in a position to prove that a good wild life sanctuary has a greater value to the country as such, rather than just as an area of land to be opened up for settlement or grazing. Otherwise, if we cannot show good reason why Kaziranga/Kanha/Gir Forest should continue to be maintained as wild life sanctuaries or national parks, then we will sooner or later lose them.

It is really all a matter of proper and effective land use. Land must, in all places, be put to the best possible use after taking into consideration each particular case; and it must be carefully considered whether a sanctuary or national park is more valuable to the country as a whole if it is maintained as such, or if it is opened up for settlement, cultivation, and grazing.

As wild life has dwindled and is still dwindling very rapidly, and as wild life and beautiful unspoilt scenery are a priceless irreplaceable heritage and a most valuable national asset, it is obvious that sanctuaries must be safeguarded, even if it may bring some temporary unpopularity on those who have to enforce such measures.

To get down to rock-bottom facts and figures, I will state the general position at one of India's foremost sanctuaries, Kaziranga in Assam. In recent years several square miles of valuable sanctuary land within the southern boundary, favourite haunt of rhino, wild buffalo, and deer, and accessible to visitors even in the rainy reason, have been opened up to villagers for grazing their tame buffaloes and cows. This pressure on the sanctuary is increasing, as the following figures of domestic buffaloes allowed to graze inside the sanctuary show:

Year	*Number of domestic animals allowed to graze inside the sanctuary*
1950	100
1954	500
1956	1000

If this rate of encroachment is allowed to continue and if similar encroachments are allowed in other parts of the sanctuary, with accompanying cattle-borne diseases spread among the wild animals, there will be very little left of Kaziranga and its unique fauna in fifty years' time.

Now the following figures show the tourist or economic value of Kaziranga, with consequent revenue for Assam in particular and for India as a whole:

Year	*Visitors from abroad*	*Visitors from India*	*Total*
1950–51	25	21	46
1951–52	78	42	120
1952–53	167	106	273
1953–54	172	134	306
1954–55	188	306	494
1955–56	287	616	903

As revenue from the tourist trade is an indirect one, not confined to one place but spread over the whole country visited, it follows that for every Re. 1 spent by foreign visitors at Kaziranga about Rs. 30 or 40 are spent in the rest of India. Therefore for every Rs. 6,000 (the amount paid by foreign tourists at Kaziranga in 1954-55) spent here, about Rs. 2,10,000 are spent in the rest of India. And if the increase of popularity of Kaziranga continues at the





Hog Deer in Kaziranga, Assam.



Mother and baby Great Indian One-horned Rhinoceros in Kaziranga, Assam.

(*Photos : E. P. Gee*)

above rate, the revenue to Assam and India will be very great indeed in fifty years' time.

It is clear, therefore that the economic value of Kaziranga as a wild life sanctuary is so important to Assam and to India that this piece of land (166 square miles) should be preserved inviolate with sacrosanct boundaries as a national park. All possible steps should be taken so that the local surplus village population with their increasing cattle should be given land and grazing facilities elsewhere, or else the numbers of their cattle reduced.

So far, then, from not being able to afford to keep Kaziranga/Kanha/Gir Forest, we cannot afford to lose such places.

This very same problem occurs all over India, and the case of Kaziranga is duplicated in most other States. In fact it is found all over the world; and as George Petrides (1955) has pointed out in his admirable 'Report on Kenya's Wild Life Resources and the National Parks', Kenya's wild life and the tourist trade brought by it are of the utmost value to the country as a source of considerable national income. He has established that improper land use is chiefly responsible for the diminution of Kenya's wild life, and that complete wild life habitats should be carefully preserved.

It is perhaps not fully realised in India that the potential value of her wild life as a source of revenue from tourists is very great indeed. Wild life is an important industry, even in the U.S.A. In Kenya wild life ranks as the third most important industry after coffee and sisal. Tourists who go to see, and occasionally shoot, wild life in Kenya spend about four crores of rupees annually there. Each year there are about 1,00,000 visitors to the Nairobi National Park alone to see its wild life.

Wild life is an industry as tangible as tea, oil, jute and coal, for which land is required to be set aside in select areas for the benefit of the whole country for all time.

Some Potential National Parks

The following places, all potential national parks of India, were visited by the writer since the previous paper was written, and observations were made as under:

1. Assam. In December 1954 the new Tourist Lodge at Kaziranga was opened to visitors. Specially constructed for visitors to the sanctuary, this five-roomed ten-bedded rest house has modern sanitation and electric light. It is fully equipped in every respect for visitors, who need now bring nothing with them in the way of bedding, food, servants etc. A new tree-top house has recently been constructed north of Hulalpat Camp, but I have not yet had the opportunity of visiting this place. A set of eight picture postcards depicting wild life in Assam has been printed, 1000 of each, for sale to visitors. This is an encouraging step in the right direction.

A rest house has also been built at the foot of the hills near the Manas River in the North Kamrup (Manas) Sanctuary. When the new access road, aligned to avoid erosion by the river, becomes consolidated and when the rest house is fully equipped, this sanctuary

should be a most attractive place for visitors. No more has been heard of the proposal for requesting the Bhutan Government to create a sanctuary on their side of the border, adjacent to the Assam sanctuary. It is to be hoped that a move in this direction can be made before it is too late.

Unfortunately no progress has been made with the draft Assam National Parks Bill, by which it was hoped that by now these two fine wild life sanctuaries of Assam would have gained the status of national parks.

A small one-and-a-half-square-mile wild life sanctuary was created at Garampani in 1952; and since poaching has been reduced at these seven salt-licks and hot-springs the number of wild animals and birds to be seen there has increased considerably. Considering that this area is famous for butterflies and plant life as well as for wild life, Garampani Wild Life Sanctuary deserves full attention for strict protection and development.

2. Madras. I re-visited Mudumalai Sanctuary on the afternoon of May 10th and morning of 11th 1955, staying the night at the Kargudi Rest House. I must congratulate the Madras Government on a considerable all-round improvement in the administration of this place since my first visit made in 1950. The Rest House had been improved and was cleanly kept. A separate 'game staff' had been provided purely for wild life preservation in the sanctuary, and consists of one game warden, one assistant game warden, two forest guards and two watchers. This staff works within the Forest Department, with no forestry duties to perform, and thus is able to concentrate on the elimination of poaching and the observation and protection of wild life. This is just the kind of administration required for sanctuaries in India under the present policy of not having a separate wild life department.

There was no fee for cameras, and this is a wise policy, especially as the forest and undergrowth are very thick and photography correspondingly difficult. I obtained no photographs during my two visits, although my three cameras were held ready all the time.

The extensions to the sanctuary, I understand, are still in the proposal stage, and shooting in these blocks has not yet been stopped. As I was unable to visit these parts I am unable to comment on the desirability or otherwise of these extensions; but in general it is considered that a larger wild life sanctuary is preferable to a smaller one, provided it can be effectively administered.

I make the following suggestions, not in a critical sense but as ideas for the further improvement of the sanctuary:

1. As the forest is very thick with an annual average rainfall of 65" compared with 38" at Bandipur, and as the viewing of wild life is difficult with photography still more difficult, I think the possibility might be considered of creating a few grassy areas or *maidans* of, say, 200 or 300 yards in width, in suitable areas accessible to visitors, where wild life could be viewed in the open, as at Kanha in Madhya Pradesh.

2. Salt-licks and water-holes could be made at these open places, so that wild life can be easily located, seen, and photographed.

3. More motorable link roads would be a great advantage, with Bandipur as the ideal.

4. Exploitation of timber and plantations of young trees might be eliminated in the vicinity of the Rest House and the parts chiefly visited by visitors, so that the conditions of an 'inner sanctuary' might be fulfilled.

5. At least 75% of the wild dogs should be destroyed. I saw wild dogs on three occasions in only two visits, and on one of these occasions a chital was being chased.

6. The charge for a night at the bungalow could be increased from Re. 0-8-0 to about Rs. 2 or Rs. 3, and more amenities provided such as a filter and drinking water.

7. The compound of the bungalow could be improved with flowering trees, shrubs and plants (preferably local indigenous flora, rather than the ordinary flowers found in gardens in towns).

8. A pamphlet describing the sanctuary and its wild life, with map and illustrations, would be very advantageous.

9. I noticed new signboards, with 'Mudumalai Game Sanctuary' and the title 'Game Warden', were being used. The word 'game' could in all cases well be replaced by the words 'wild life', in accordance with the general policy adopted in India.

3. Mysore. I re-visited Bandipur Sanctuary on the afternoon of 12th and morning of 13th May 1955. Coming here immediately after Mudumalai, I was struck by the difference in vegetation etc. With an annual average rainfall of about 38", instead of 65" at Mudumalai, the forest was sparse, stunted and without much undergrowth at this time of the year, making conditions ideal for viewing and photographing wild life, in most photogenic surroundings.

My visit on 12th was unfortunately marred by the continuous breaking down of the Forest Department lorry which was taking me round. A herd of about 30 'bison' was observed, but they may have been frightened by the misfiring of the lorry engine and were very wary. No photographs were obtained.

The morning visit on elephant-back was better, and in addition to chital and peafowl I saw and photographed a fine tusker elephant.

Some suggestions for the even further improvement of the sanctuary were made by me in December 1952, and to these I would add the following:

1. The right vehicle for visitors to see the sanctuary from, I think, is not a lorry but a Land-Rover with a station-wagon or truck-like body, with a trapdoor in the roof for photography. In East Africa I tried out every kind of vehicle, including a Bedford Hunting Truck and Land-Rovers with truck-like bodies and trapdoor ('sunshine') roofs. The latter were the best, and could seat 6 people comfortably, and are cheap on petrol. I used this kind of vehicle in tours in Kenya, Uganda, and Tanganyika, leaving the road and going right across country at times.

2. I saw a 'tiger block' with a sandy path being prepared all round it, presumably for tracking down a tiger, adjacent to the sanctuary boundary. I hope that tigers are not being shot in the adjacent forests.

3. The tiger, which is the most spectacular of beasts in India, and possibly the world, is the very animal most sought after by visitors to see and photograph. If any sanctuary in India can 'lay on' a tiger for visitors to see, this will be the sanctuary or national park *par excellence*. Possibly some artificial means would have to be employed, viz. keeping a tame or semi-tame tiger in an enclosed area, or feeding wild ones regularly (with 'doped' meat?), or even making a natural-looking enclosure with a moat all round as in the Mysore and Travancore Zoos, only larger in extent.

There might be an objection that such a tame or semi-tame tiger would appear unnatural, while the 'purists' might object simply on principle. But how otherwise can we show our tiger to visitors? The vast majority of the public, who have few chances of visiting sanctuaries, would welcome such a step. And after all, many of the lions of the national parks of Africa have for various reasons (among which man-given meat can sometimes be included) become semi-tame and display themselves openly to the many thousands of visitors who come from all parts of the world to see them, thus bringing in a substantial revenue to the country and giving a fillip to the cause of wild life preservation.

In this connection it is interesting to note that Champion (1939) expressed the conviction that the tigers of the Hailey National Park would in due course 'carry on their daily life regardless of the presence of human beings in the way that lions are now to be seen doing in the national parks of Africa'. As they have not done so, then other means should now be tried so that these fine creatures can be seen and enjoyed by visitors.

4. Saurashtra. A meeting of the Executive Committee of the Indian Board for Wild Life at Sasan Gir from January 18th to 20th 1956 gave me the long awaited opportunity of seeing the famous Gir Forest and its lions. Two extra days were very kindly allowed by the hospitable Government of Saurashtra, making a total of five days altogether. Under the personal and knowledgeable guidance of the Jam Sahib of Nawanagar we were shown lions; and all the available information was given to us. Thus by studying the material that has been written about the Gir and its lions, by listening to all that was told us by our hosts the Rajpramukh, the Minister, the Conservator, and others, and supplemented by personal observation, it was possible even in the short space of five days to come to a few general conclusions about what must be one of the most complex and interesting wild life centres of India.

It was particularly interesting for me to see the Indian lion in its habitat, after my visit to East Africa where the African lion is one of the main attractions.

I will confine myself to only a few broad generalisations about the Gir, and will avoid touching on such aspects as description, history, census, forest operations, etc., which have been so ably dealt with by others. In fact most of my observations will purposely be of such a general nature, as rather to be the basis of future and more detailed investigations than attempts at passing final verdicts, which

can only be arrived at after very much more thorough and prolonged field work.

The first thing that struck me was that here was a first-class potential national park, which did not enjoy the status even of a wild life sanctuary! At the time of writing this paper the Gir is a region consisting partly of Reserved Forest and partly of village settlements, cultivation, and grazing areas, through the whole of which runs a railway and some roads. It was explained to me that as there were villages, cultivation, and grazing of domestic livestock in the lion areas, therefore they had not been created a national park.

If this is so, then this must surely be the result of a misunderstanding. For while it is true that the generally accepted definition of an ideal faunal national park is an area free from human settlements etc., it should not follow that because there happen to be some human settlements in an area therefore that area cannot become a national park! Many of the world's finest faunal national parks have villages and grazing of livestock inside them, such as the Nairobi National Park in Kenya, the Serengeti National Park in Tanganyika, the Queen Elizabeth National Park in Uganda, and the Kafue National Park in N. Rhodesia.

For more detailed examples, there are 198 Somalis living in the 40-square-mile Nairobi Park, with 200 head of cattle. In the 5,500-square-mile Serengeti Park there are approximately 2,000 Masai and others living in the park, with their 3,00,000 head of cattle, sheep, and goats. In the 756-square-mile Queen Elizabeth Park there are villages containing about 2,000 inhabitants, though their livestock is few in numbers due to tsetse fly.

It is obvious that where there is good grazing for wild herbivorous animals, there is also good grazing for domestic animals, with accompanying human settlements. This is the big problem in East and Central Africa: how to reconcile the two diverse objectives of wild life preservation and safeguarding the interests of the indigenous and sometimes nomadic human populations.

If such villagers can be moved by rehabilitation, or if their villages can be excised from the proposed national park, then so much the better. But if they must be included, and if for political and other reasons the grazing by their livestock cannot be prevented, then at least this can be restricted, controlled, and regulated after a careful study of the conditions and in conformity with a wise policy of effective land use.

In this respect we can learn an interesting lesson from East Africa. When, for example, the Serengeti National Park of Tanganyika was created, it was laid down that the rights of the indigenous local inhabitants would be safeguarded. But these 'rights' were never defined. Consequently these indigenous inhabitants can now at any time hold a meeting and demand something as a right, which it is very difficult for Government to oppose. Moreover, more people may come into a park from outside and cattle may increase enormously in numbers, making subsequent control extremely difficult. Further, the habits of the villagers may change: for example the Masai in East Africa never used to hunt wild animals, but since intermarrying with other tribes has taken place some of them have now taken to

hunting, with consequent detriment to the wild life of the national parks.

When the Queen Elizabeth Park of Uganda was being created in 1952-54 there was some opposition, and the 2,000 villagers resident within the boundaries of the proposed park were allowed to remain. But regulations ensure that no cash crops are allowed to be grown by them, and only sufficient cultivation is allowed to be done for the production of their own food. No hunting is allowed. A fishing village area was excised entirely from the park.

From all the foregoing facts, then, it follows that the Gir Forest could be created a national park with some, if not all, of the *maldharis* and others remaining there with their livestock, provided that suitable legislation is enacted clearly defining their rights, demarcating the boundaries of their land for cultivation and grazing, regulating the numbers and types of their livestock, ensuring that precautions are taken against cattle-borne diseases, prohibiting further inroads of men and livestock from outside, and so on.

In fact the villages in the Gir, the *maldharis*, and their beasts can even be regarded as a picturesque attraction of a future national park, providing interesting subjects for sightseeing and photographing by visitors.

There is not a shadow of a doubt that the Gir Forest and its lions, as well as its other wild animal and bird life, would rank as one of the best national parks of India. Its close proximity to Bombay, the threshold of India's tourism, is an additional attraction. It is only one-and-a-half hour's flying from Bombay to Keshod and one-and-a-half hour's motoring time from Keshod to Sasan Gir, where a palatial Guest House with numerous well-equipped rooms awaits a regular stream of tourists and visitors. These potential tourists and visitors do not come only because there is no publicity, no provision for their reception, and no open-for-all arrangements to show them the lions.

A further attraction to the Gir as a national park should be the new one-and-a-half square mile lake due to be formed by the dam over the Hiran River. In fact a veritable 'Periyar' in the heart of the lion country is about to come into existence, with the two-fold advantage of perennial drinking water for wild life and scenic beauty for human visitors.

Some Additional Notes on the Lions of the Gir Forest

1. Indian Lion and African Lion. A careful comparison of lions as seen in my cine films of East Africa and of the Gir reveals that the Indian lion is perhaps a little stockier, a little shaggier, less whitish in the underparts, less dark in the head and neck, has a bigger tuft on its tail and has a mane not quite as big. The common notion that the Indian lion is a maneless or mangy beast is quite erroneous. I was very impressed with the lions which I saw in the Gir, which numbered seventeen in four days of looking for them. Four lions with reasonably good manes were seen, and the lionesses were fine animals.



Typical thorny scrub on the fringe of the Gir Forest. Two of a pride of five Lions can be seen on a 'kill', while a kite circles overhead in anticipation.

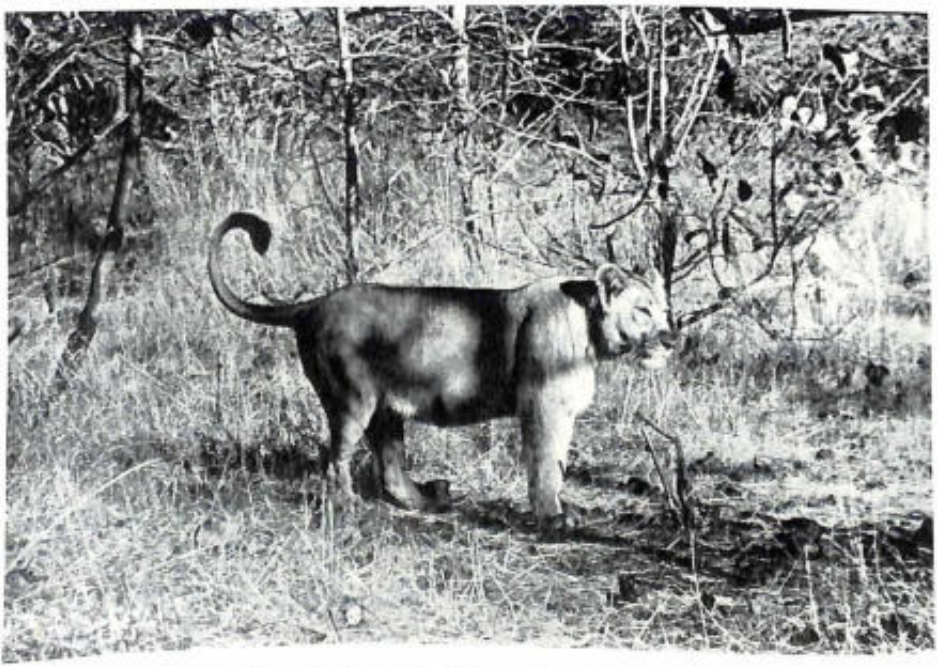


A young male Lion, with mane starting to grow, comes out to a 'kill'.

(*Photos : E. P. Gee*)



A hurriedly constructed 'hide' for photographing lions. (This is the lions' view of the 'hide'.)



A young adult male Lion photographed from the above 'hide'. Its mane has not yet developed.

(*Photos : E. P. Gee*)

Regarding size of manes of maned lions, it has often been pointed out that the presence of thick undergrowth, thorny scrub, etc. in India is a deterrent to the growing of big manes. It is claimed that the manes of Indian lions get too much 'combing' and are consequently smaller than those of their African cousins. R. I. Pocock, (1939), however, does not agree with this. He says: 'This notion that the combing action of thorns accounts for the scantiness of manes in many lions has often been thoughtlessly quoted with approval as supplying a satisfactory explanation of the fact. There is not a word of truth in it. The most that thorns could achieve would be keeping the mane tidy by the removal of dead, moulted hair, which might for a time adhere to the growing mane before being shed. They could no more affect its potential luxuriance than the daily use of a comb can reduce the quantity of living hair on a woman's head'.

I feel myself that further field investigations and zoological garden study are needed to decide this matter. A possible explanation of the slightly smaller manes found on Indian lions could be found in the fact that their Gir Forest habitat, which is only about 200 to 400 ft. above sea level, has a much hotter climate; whereas in Africa the lions range over comparatively cool uplands of 3,500 to 6,000 ft.

Another reason for the lack of lions with really good manes in the Gir may be found in the custom in the past for V.I.Ps. to come and shoot. Up till quite recently, a quota of about four lions were officially allowed to be shot annually, and as a maneless or poorly-maned lion is no trophy, only the lions with the largest manes got shot, inevitably resulting in a stock of lions with smaller manes. Fortunately this custom has now ended, and Indian lions are fully protected by the Government of Saurashtra. It is to be hoped that if any reduction in numbers is ever contemplated in the future, then only the aged and sickly lions and lionesses will be destroyed by persons specially deputed for the job by the authorities in charge of administering the area.

Wynter-Blyth (1956) considers that the number of lions has already increased sufficiently to necessitate a reduction in their numbers, in order to prevent overstocking within the limits of the Gir Forest and to counter inevitable complaints from the *maldharis*. With his great experience of the area he is most probably right in this. But his suggestion that five or six permits per annum to shoot lions might be given as an experimental measure is fraught with the very danger referred to above, unless such permits are given only for lions outside the Gir Forest and only for lions without good manes.

2. Different Varieties of Indian Lion. The Jam Sahib of Nawanagar, whose knowledge of the Gir lions is only equalled by his intense interest in them, has informed me that there are two distinct varieties of lions in the Gir. These are described as (i) the 'donkey' variety, more vertical-shaped, bigger, fiercer, and which go in prides of up to six in number, and (ii) the 'waler' variety, more horizontal-shaped, smaller, better natured, and which go in prides of up to fourteen in number.

The Conservator of Forests, Saurashtra, has also informed me that there are 'two distinct sizes of lions in Gir Forests'. But I cannot find this theory substantiated in any journals or books, and consider that this would be a most interesting subject for study in the field. Any evidence to prove or disprove this theory would have to be supported by measurements or photographs of living animals.

3. Introduction of African Lions into India. It is known that three pairs of African lions were imported from Africa into India (in about 1916) by the Maharaja of Gwalior,[1] but these were quickly shot out owing to their lack of fear of human beings after a short spell of captivity. As Gwalior, which is SSE. of Delhi, is a very considerable distance from the Gir Forest, it is presumed that there can have been no mixture of African blood as far as the Gir lions are concerned. I am personally against the introduction of African lions into any part of India, and would prefer the Indian lions to remain as 'pure' as possible.

I do not think that any African lions have ever been brought into the Gir, but am indebted to R. W. Burton and E. C. Apcar for drawing my attention to the following newspaper report which alleges that this was in fact done about the year 1890.

According to an article by Lovat Fraser published in a newspaper in India (about 1924?), some African lions were alleged to have been introduced into the Gir prior to the shoot arranged (about the year 1890?) for H.R.H. the Duke of Clarence, elder brother of (later) King George V.

This newspaper article reads: 'When the Duke of Clarence's visit was announced the Junagadh authorities, fearing that he might not get good sport, secretly obtained a number of African lions which were brought across the Indian Ocean in native sailing vessels and turned loose in the Gir. They multiplied amazingly, they were far more formidable than the Indian lions, and they had big manes'.

According to the article, it was not until about 1908 or 1909 that the news of the reported introduction of these lions from Africa leaked out. In 1906, the article continues: 'Lord Lamington, then Governor of Bombay, and several others went to the Gir to shoot . . . At the first day's shoot three lions and a lioness were killed. Lord Lamington, Colonel Kennedy and Sir James du Boulay each got a lion. Major Carnegy, the local Political Agent, was attacked by a wounded lioness and instantly killed, whereupon the camp was broken up . . . The lions all had large manes and were much larger than Indian lions. Sir James du Boulay's lion measured 11 ft., and Colonel Kennedy's was 10 ft. 10 in. I was present at the shoot and noted the measurements myself. The manes and measurements produced much mystification. It was not until two or three years later that the mystery was privately explained.' (Then follows the passage quoted in the previous paragraph.)

The belief that 'they multiplied amazingly' is easily explained: the Jam Sahib has informed me that in those days the Nawabs

[1] See the note 'Experiments in implanting African lions into Madhya Bharat' by Col. Kesri Singh, *JBNHS*, **53**: 465—Eds.

of Junagadh used purposely to let it be known officially that the number of lions in the Gir was very low, about 12 or 13 only. This was because every British Viceroy, Commander-in-Chief, Governor of Bombay, Indian Princes, and others down to persons of less importance were in the habit of longing to be invited to shoot a lion. Even Lord Curzon at the turn of the century was informed that there were only about 12 lions left, and therefore he refrained from shooting and encouraged the preservation of the lions instead. Actually there must have been about 100 lions in existence in those days, if not more. So naturally anyone actually going there and shooting lions would be surprised at the real number of these beasts in the Gir.

The belief that the 'African' or 'mixed African-Indian' lions were 'far more formidable than the Indian lions' may to a certain extent be discounted by the following historical fact: M. A. Wynter-Blyth and R. S. Dharmakumarsinhji (1950) have pointed out that the years 1899 and 1900 were famine years in the Gir, and that in 1901-1904 'almost all the game in the forest had died off, and the lions . . . were living on the edge of the Gir and preying solely on cattle with occasional human victims.' And that subsequently (about 1904-1911) 'the habits of the lions underwent a profound change, for never again are they heard of as a menace to human life. This was in all probability the result of a return to normal conditions after the famine years.'

The record-breaking measurements given above are even more easily explained in L. L. Fenton's book 'The Rifle in India', where the author says: 'At the time of Lord Lamington's shoot in the Gir, when Captain Carnegy was so unfortunately killed by a wounded lion which three of the party were engaged in following up, it was stated that one or two lions which were then shot measured over 11 ft. in length, but it afterwards transpired that the measurements were taken after the animals had been skinned, and they are, therefore, obviously of no value.' As L. L. Fenton was present at the shoot in question as an organiser, his explanation of these outsize measurements can be taken as the correct one.

Another explanation, if such were needed, of such 'record' measurements is this: I am informed that there used to be a system of measuring lions for V.I.Ps. in the Gir which consisted of pulling out the front legs and measuring from the front claws up to the nose and round all the curves.

I have enquired from the appropriate authorities in Saurashtra as to the possibility of there being any truth in the newspaper report of African lions being brought by *dhows* to the Gir. Not only do there appear to be no records or even legends of it ever having happened, but also the report can be discounted for the following reasons:

(i) There was no real shortage of lions in the Gir at the time. (The official low 'estimate' of 12 or so has been previously explained.)

(ii) The voyage from East Africa to Junagadh by *dhow* takes at least two months, and as no *dhow* would attempt the voyage till the monsoon was over lions could not be brought in time for cold weather shoots.

(iii) A very large meat supply 'on the hoof' would have been necessary, making such a project almost impossible.

(iv) Even if such 'imported' African lions were let loose after being caged during a sea journey of at least two months in a *dhow*, they would have quickly fallen victims to the Gir lions.

A possible clue to the start of such a rumour may lie in the following extract from L. L. Fenton's book concerning the shoot for the Duke of Clarence: 'At daybreak I had a visit from the Dewan, who . . . came over to suggest that, rather than that the Prince should be allowed to leave the Gir without bagging a lion, two lions which had been sent out from Junagadh during the night, confined in cages or carts, should be set free in the jungles, and then be driven out to be shot . . . Of course, neither Colonel Kennedy nor I would entertain the Dewan's suggestion for a moment . . . So the matter was dropped, and the lions were sent back to their home in Junagadh. I have often wondered since how the latter would have acted had they been set free.'

4. Natural Food Supply for the Lion. It was reported to us that many of the wild deer and antelope, which in addition to domestic livestock form the food supply of the lions, had died of foot-and-mouth disease. It was, therefore, suggested that additional *nilgai* might be captured and imported from elsewhere. This would surely be a very costly venture.

Probably the following steps to increase the natural food supply for the lions would be adequate:

(i) Reduce the incidence of cattle-borne diseases by strictly controlled prophylactic measures, and by the prohibition of more domestic animals being brought in from outside.

(ii) Reduce or prevent any possible shooting of deer and antelope by sportsmen and poachers.

(iii) Put an end to the publicising of wild pig (a valuable lion food) as vermin to be destroyed on all possible occasions.

(iv) Reduce the number of panthers which account for a large number of deer, antelope and pig.

5. Compensation for Livestock killed by Lions. A problem in the Gir Forest and its surroundings is the payment of compensation liable to be claimed by *maldharis* and others for domestic animals killed by the protected lions. While it may be argued that people who choose to live and graze their cattle close to the habitat of carnivora in order to get good cheap grazing must face the risk of losing some of their stock without compensation, there are other aspects of the problem which must here be taken into account, e.g., the historical precedent set by the former Ruler, the Nawab of Junagadh.

My own humble suggestion on this point is that as such 'kills' by lions are exactly what are wanted by tourists and visitors to the Gir, a proportion of the revenue obtained from visitors could be allocated as part compensation to the *maldharis* who lose buffaloes and cattle. In other words, when a cow or buffalo is killed by a lion, the owner should immediately report the matter to the appropriate

quarter. Visitors could then be rushed out to the spot (if it is the right time of the year) to observe and photograph the lions from a 'hide', on payment of duly prescribed fees. A substantial revenue would ensue, a portion of which could be earmarked as part compensation to the persons who have suffered loss of livestock.

6. Number of Lions to be Captured for Introduction into a New Locality. It is proposed to catch and move a few Indian lions from their present one and only refuge in the Gir Forest to an additional locality within their former range and with suitable conditions of environment. First of all a small area of Tikamgarh in Vindhya Pradesh was contemplated for this venture. More recently it has been provisionally agreed to catch and transfer a few lions on an experimental basis to the Chakia Forest south-east of Banaras in Uttar Pradesh, where conditions are reported to be favourable for the re-introduction of these animals. If the experiment takes place and succeeds, it may be repeated in one or two other parts of India where lions formerly existed, where local present-day conditions are suitable and where natural food supply is available.

In selecting an area for the re-introduction of lions firstly the supply of natural food (deer, antelope, pig etc.) must be adequate; secondly the area should be free of tigers which would obviously resent and oppose the invasion of their territory by other large carnivorous animals and thirdly the villagers and other members of the public in the vicinity should be prepared by suitable publicity beforehand so that they would welcome and assist the experiment.

A problem now confronting us is this: when the time comes to catch and transport a few lions to, say, Chakia Forest, how many should we transport? At first we thought of a pair of lions, or two pairs. Then it was pointed out by a correspondent that perhaps the ratio should be one lion to two lionesses, and that two lions and four lionesses would be the ideal number to transport.

Again more recently it has been maintained that as lions live in family groups, a complete family should be caught and sent to the new home. But what should be the future breeding prospects of such a family party, except that grown-up male cubs would have to pair with their mother and sisters, if and when the father allowed them to do so? I felt myself that two young adult lions and four young adult lionesses from different family groups in the Gir Forest might be the best answer. And then let them sort themselves out in their new home.

This problem was referred to several authorities on wild life in Africa, and the following replies have been received. Keith Caldwell, late of the Kenya and Uganda Game Departments, writes: 'I am strongly of the opinion that re-stocking should be done, if at all possible, by moving one or more complete families. I don't think there is any danger of damage being done by 'inbreeding' and I fancy that, as they grow more mature, the family will split up. The ideal would I think be two families. If two young males and four females are moved may I advise that they are all taken at the same time and let out together. If this is done they are far more likely to

settle down without fighting than if they are liberated in their new homes at different times in different places. In this latter case serious battles are most likely to take place when the wanderers meet each other!'

C. R. S. Pitman, formerly Game Warden of Uganda, writes to say that he agrees with the suggestion of 'two young adult lions and four young adult lionesses from different family groups'. R. Bigalke, Director of the National Zoological Gardens of South Africa, writes: 'I favour the plan of taking two lions and four lionesses from different groups.'

R. A. Critchley, President of the Game Preservation and Hunting Association of Northern Rhodesia, writes: 'We, ourselves, think 2 young males and 4 females is the best combination.'

M. H. Cowie, Director of the Royal National Parks of Kenya, in an interesting letter on the subject of moving lions into a new locality, considers that it should be done in two distinct phases as follows: *First Phase*. One adult lion, at least two adult lionesses, and as many of their half-grown cubs as possible should be moved. It does not matter if the animals are related. If more than one adult lion is moved, they are likely to fight and disrupt the pride. *Second phase*. When the half-grown cubs have grown up and start hunting and courting, then a second adult lion should be introduced, if possible more virile than the first one, so that it can take over domination of the young pride. The old lionesses are likely to accept the original lion, while the young lionesses are likely to prefer the newly introduced lion. This will give the required new blood.

After carefully analysing the above opinions from experts on lions and conditions in Africa, the following would appear to me to be a safe summarisation of the principles which might govern the moving of lions in India:

(i) Only one adult lion, preferably a good maned specimen, should be moved with the first 'batch'.

(ii) The first 'batch', in addition to the adult lion, should include two lionesses, and if possible some of their half-grown or three-quarter grown cubs (preferably female).

(iii) All the above animals in the first 'batch' should be released at the same time and in the same place, with live food tied up for them.

(iv) At a later stage, when the grown-up cubs (either introduced with the first 'batch' or born subsequently) start to hunt and court, a second adult virile and maned lion should be introduced.

Sport and Wild Life Preservation

It is important that we should recognise the exact status of the sportsman when considering measures for wild life preservation in India. By 'sportsman' I mean, of course, the *bona fide* sportsman who not only scrupulously observes the game laws and shooting rules in respect of close seasons, protected animals, reserved forests, and so on, but who also shoots only a limited number of game birds and animals. The so-called 'sportsman' who is a butcher, or who is in

any way unscrupulous, is a menace to wild life conservation almost as much as the poacher is.

It is universally admitted by all those concerned with conservation of wild life throughout the world that the *bona fide* sportsman is one of the best friends of wild life. For by occasionally tracking and shooting game within the law, he becomes well versed in jungle lore and jungle craft and develops a knowledge and love of wild animals and birds not always obtainable by the man who is purely an observer or naturalist. The *bona fide* sportsman who later in life gives up all shooting for the camera, binoculars, and notebook is usually one of the ablest protagonists of wild life conservation.

It is universally admitted, also, that the presence of a *bona fide* sportsman in a forest is the most effective deterrent against poachers. Obviously no sportsman who has paid for and taken out licenses, permits, and reservations in a Forest Block is going to tolerate any kind of interference from poachers during his shoot. And even if there has been any poaching previous to his shoot he will soon hear about it and 'raise hell'. For this reason poachers usually give sportsmen a very wide berth. And for this reason many experienced sportsmen all over India have been made Honorary Forest Officers in order to assist the Forest Departments of States in the preservation of wild life.

At the meeting of the Executive Committee of the Indian Board for Wild Life held at Ootacamund in May 1955 it was agreed that Game, Shooting, and Fishing Associations play a very important role, and that real sportsmen in any area are an asset in the preservation of wild life. Consequent upon this, the Secretary of the Board in October 1955 addressed a letter to all Heads of State Forest Departments to the effect that Game Associations and Natural History Societies should be encouraged.

And yet, in spite of all the foregoing evidence that *bona fide* sportsmen are an asset to the country in general and to the Forest Department in particular, how often do we hear of sportsmen being rebuffed, of sportsmen receiving no replies to their letters, of sportsmen not being issued with shooting and fishing permits after payment of the usual fees! Worse still, many sportsmen and naturalists have written helpful reports about poaching, bombing of rivers for fish, and other illegalities to the Forest Officers concerned, and have received not only no thanks for their efforts, but not even an acknowledgement!

It is essential to preserve the wild life outside as well as inside our sanctuaries and national parks; and no real progress can be made in India until full encouragement and recognition is given to genuine sport and genuine sportsmen throughout the country.

'Hides' for Wild Life Photographers

Much has been written by eminent bird photographers on their technique and on the types of photographic 'hides' used by them; but very little has been written on 'hides' for animal photographers. Nowadays roughly three out of every four visitors to a wild life sanctuary or national park carry a camera of some kind. They obviously want photos of wild life, and this requirement of visitors

must be satisfactorily met if the wild life tourist trade in India is to be efficiently developed. And yet very few of the staff of our sanctuaries understand even the elementary requirements of an average photographer.

A few generalisations, therefore, on the subject of photographic 'hides' would not be out of place in this paper. Visitors can usually obtain some photographs from a motor car or riding elephant. But if more time is available, most visitors would welcome a quiet pleasant day or half day in a 'hide', especially if the 'hide' overlooks a water-hole or salt-lick. From such 'hides' wild animals can be observed coming out and towards one, instead of running away as they usually do when they see a human being. A glimpse can be obtained of them behaving naturally, feeding, drinking, courting, and so on.

I have seen 'hides' specially made for photographers in Kaziranga, Hailey National Park, Kanha, Bandipur, Gir Forest, and other places. They were all made by the Forest Department with the best of intentions, but from most of them no good photos could possibly have been taken. Some were sited in unsuitable places from where wild life would be far too far away, if seen at all. Some were fixed in trees as high as 25 ft. or 30 ft. from the ground, and from these only a bird's eye view of wild life could have been obtained. Some were admirably set up on the ground, but were too thick, possessed no peep-holes through which the photographer could see, and the branches and vegetation had not been cleared in front.

The first requirement of a photographic 'hide' is that it must be as close as possible to where an animal is likely to appear. Even with a 13.5 cm. telephoto lens and a 35 mm. camera, a *chital* would appear quite small at 60 ft. It would make a better picture at 30 ft.

The next requirement is that a 'hide' must be as low as possible to the ground while still giving a clear view of the subject. Animals photographed from elephant-back, when the camera lens would be about 12 ft. or 15 ft. above the ground level, would have a semi-bird's-eye-view appearance. If the undergrowth and grass permit, a 'hide' constructed on the actual ground would be the best, so that the camera lens would be about 3 ft. or 4 ft. from the ground. If there is too much undergrowth and grass, then the lowest height possible in order to see over the vegetation in front would be the best height to photograph from, say 6 ft. to 10 ft. Above that height one would get a picture in which one is looking too much down on the animal.

On the other hand, where there are dangerous animals about, such as rhinoceros, rogue elephant, man-eating carnivora, and so on, then the 'hide' would have to be either protected by a ditch 7 ft. wide all round it (for rhino and elephant), or placed in a tree just out of reach of the dangerous animals, say 15 ft. up. In this respect however, wild animals in general need not necessarily be regarded with fear by photographers. Wild animals very rarely attack a human unless provoked to do so. Theodore Hubback (1939) wrote of his photographic experiences in ground-level 'hides' in the Malayan jungle: 'I never think of taking a firearm with me into a "hide" and none should be permitted to do so'.



A portable 'hide' of hessian cloth, camouflaged and in position at a salt-lick.



A Barking Deer buck photographed from the above 'hide'.

(Photos : E. P. Gee)

The next requirements of a photographic 'hide' is that no branch, twig, leaf, blade of grass, and so on should be left uncut in the direct line of vision between the camera lens and the subject to be photographed. Although a human being looking with two eyes (set 3" apart) at a deer, say, will see the deer quite clearly in spite of a few intervening twigs or leaves, yet the single lens of a camera will faithfully record every twig and every leaf which happens to be in the line of vision, the nearer the bigger, and the resultant photo will be spoilt. A few twigs, leaves, or grasses near the animal itself are all right, in fact these would make the subject appear more natural; but anything nearer between the subject and the lens of the camera is to be avoided at all costs.

The next requirement of a 'hide' is that it must appear unobtrusive and natural. This can easily be done by camouflaging the 'hide' so as to make it appear part of the surrounding landscape and vegetation.

The size of the 'hide' is a minor detail, depending on how many people with how many cameras will remain inside it, and for how long. Generally speaking, the smaller the 'hide' the better and less conspicuous it will be.

The choice of materials for making a 'hide' also depends on the time available and the place in which it is made. Obviously the materials of the locality should be used, leafy branches in forest, grass in grassland etc. As little disturbance to the place as possible should be caused.

A disadvantage of using vegetation or grass to construct a 'hide' is that it will wither, shrink and change colour. Also the breeze can dislocate a leaf or a twig which would then interfere with the field of vision. To overcome these drawbacks I myself have a portable 'hide' made of hessian cloth dyed a suitable shade of green, with bamboo poles to hold it up, and with rectangular slits through which photographs can be taken. These slits must be horizontally rectangular to allow for lateral movement of the camera and for the view-finder and range-finder as well as the lens of the camera to function properly. This portable 'hide' can be quickly set up in a suitable position behind grass or undergrowth or creepers, and when finally fixed appears almost invisible.

The top must be covered over, not only to keep out the rain and bird droppings, but also to prevent birds and monkeys from observing one inside the 'hide' and then giving the alarm.

The direction of one's approach to the 'hide' must be carefully worked out whenever possible, so that it can be screened to allow one to enter one's 'hide' unobserved by the subject. The path can be swept of dry leaves and twigs to ensure a silent approach. A well-known device is this: if two persons are going to sit up in the 'hide', then about four or five persons can go to it, the two remain when all is ready and the others return. Any wild life watching the proceedings will be led to think that all have returned and that no one is about.

Another great advantage of having a photographic 'hide' on or near the ground is that it cannot be used by poachers for illicit shooting. A *machan* type of 'hide' in a tree would have to be dismantled after use or else carefully watched in case poachers used

it. A possible precaution against the use of such tree-top 'hides' by poachers would be to have it in the form of a 'cage' with a lock-up door and a sharply apexed roof so that poachers could not sit up on top of it.

A type of 'hide' worthy of trial where dangerous carnivora may exist is a portable or transportable cage with detachable sides, large enough to hold two or three persons when placed in position on the ground. If constructed of bars of aluminium or some light alloy, the photographer could transport it to a suitable place and safely remain inside to do his photography. Such a cage, I understand, is now being tried out in Kotah for tiger photography.

The possibility of constructing (in suitably dry terrain, of course) an underground 'hide' near a water-hole or salt-lick should not be ignored. The Warden of Amboseli National Reserve in Kenya was planning to make one near Ol Tukai water-hole for viewing elephants and rhino at close quarters when I was there in 1954.

If no convenient water-hole or salt-lick exists in a sanctuary, there is no objection to constructing an artificial one at a suitable place. The most famous 'hide' in the world was the former Tree-tops House at Nyeri in Kenya, which was built near an artificial salt-lick.

In the siting of 'hides' the following considerations should be taken into account: (i) direction of the prevailing wind, so that wild animals coming out will not get wind of the hidden photographer, (ii) the direction of the sun, so that it will not shine directly into the camera lens and so that animals coming out will be in good light, and (iii) the background and foreground should be as photogenic as possible.

Whenever expert or experienced photographer visitors come to a sanctuary, their methods and technique, and their praise or criticism of the facilities provided for them should be studied, in order that improvements and new developments in this field can be made.

If photographic 'hides' on the above lines could be provided in India's wild life sanctuaries and national parks for photographer visitors, it would add considerably to their attraction and international status.

Conclusion

In this paper much emphasis has been placed on the need for the management and development of India's wild life sanctuaries and national parks for tourists and visitors. This is not due to any desire on my part to commercialise wild life; rather it is the result of recognising some of the land and population problems confronting India and the rest of the world.

Unless we can produce evidence of the economic or tourism value of our wild life sanctuaries, the other values (aesthetic, recreational, scientific, and biological) may not be sufficient to tip the scales in favour of their maintenance and continuance. Our statesmen, politicians, planners, economists, and others may give heed to the unwise ephemeral demands of unenlightened local interests, instead of considering the need for long-term planning and preservation for the benefit of the country as a whole.

Tourists from abroad and visitors from other parts of India coming to our wild life sanctuaries and national parks will bring revenue as well as the general realization of the value of our wild life. This revenue and this realization are both sorely needed to preserve for posterity a valuable but vanishing national asset.

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NOTES ON SOME WASPS AND BEES (HYMENOPTERA) OF POONA AND THE WESTERN GHATS

BY

F. L. WAIN, S.S.J.E.

(With a plate and 21 figures)

The following notes are based on a somewhat desultory collection made during the past five years. The nomenclature is that of Fauna of British India series (Bingham).

Wasps can roughly be distinguished from Bees, as being less hairy and not having the broad dilated joint on the hind legs which bees use for carrying pollen. Wasps are carnivorous in the larval stage, whereas bee grubs feed on honey and pollen. In the adult stage both Wasps and Bees are vegetarian. Both groups contain social and solitary forms.

WASPS

Wasps are divided into two main groups, the Hunting or Digging Wasps (Fossores) and the True Wasps (Diploptera). The latter fold the wings lengthways in two when at rest.

FOSSORES

The females of these wasps hunt for prey of various kinds on which to lay their eggs. The prey is stored up in various ways, usually alive but paralysed by being stung, to ensure the grub shall have fresh meat for its food and not be poisoned by eating decayed food.

Family MUTILLIDAE

The females are without wings, and at first glance look something like ants; but they move much more quickly. They are said to lay their eggs on the larvae of various kinds of bees.

Mutilla argenteomaculata ♀. About three quarters of an inch long, with six silver spots on the black abdomen. (Khandala).

Mutilla pulchiventris ?♀. Less than half an inch, with five silver spots. (Poona).

Mutilla valida ♀. Same size as above with four spots. (Lonavla).

Mutilla nobilis ♀ (Fig. 1). Head and thorax red, abdomen with golden spots. (Lonavla).

Mutilla emeryi ?♂. Orange red abdomen. (Matheran. Lonavla).

Family Scoliidae

These are usually heavily built hairy wasps. They make no ne
but the female burrows in the earth to find beetle larvae, on which

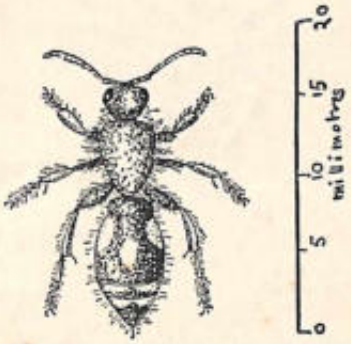


Fig. 1. *Mutilla nobilis* ♀

eggs are laid. They can sometimes be seen entering heaps of decayi
leaves in search of the large fat white beetle grubs. These wasps
often found at flowers.

Scolia bilunata. Black, with four yellow spots on sides of the abdom
The male is slighter with three spines on end segment. (Poona)

Scolia quadripustulata (Fig. 2). Black with red spots or band on
abdomen. A very common species. (Poona, Khandala).



Fig. 2. *Scolia quadripustulata* ♂

Scolia aureipennis. Entirely black, with a coppery sheen on the wir
Tips of the antennae red. (Poona).

Scolia histrionica. Strikingly coloured in red and yellow, with some bl
markings. (Poona).

Elis thoracica (Fig. 3). Black, with thick whitish hair on the thorax
have seen this wasp burrowing in loose earth, but when I dug
the earth only two crickets were found. I could not find any be
larvae. (Poona, Khandala).

Elis annulata ♂. I have only found males. Smallish, black with yellow bands. (Poona. Matheran. Lonavla).



Fig. 3. *Elis thoracica* ♀

Elis asiatica ? A large entirely black wasp. (Poona).

Liacos analis. Black, with most of abdomen bright red. (Matheran).

Family POMPILIDAE

These wasps have very long legs; the abdomen is never on a long thin stalk, as in many of the Sphegids; the eyes are not kidney-shaped. This group contains wasps of very varying size. Most store the prey in holes or crevices in walls or trees, or in the ground, though a few make little mud cells. The prey consists of spiders, crickets or grasshoppers.

Pseudagenia blanda (Fig. 4). This genus makes little earthen cells in which the prey (spiders) is stored. This wasp is about half an inch long, bright metallic blue. (Bombay).

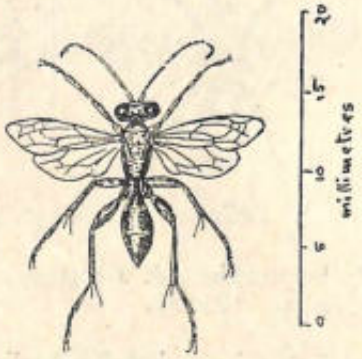


Fig. 4. *Pseudagenia blanda* ♀

Pseudagenia tincta. A small black wasp. (Poona).

Pseudagenia micromegala ? Another smaller black wasp, with two dark bands in the clear wings. (Poona).

Pompilus fenestratus. This genus preys on spiders and stores them in some nearby hole in the earth or crevice, blocking up the entrance afterwards with a small stone or earth. This species is very small, black with red abdomen. (Poona).

Pompilus mitis. Similar to the above, but larger. (Poona).

Salius aureosericeus. *Salius* contains some of the largest species of wasp. They prey on various kinds of Orthoptera. This species is a large insect, with a wing-spread of two and a half inches. It is black, with head and fore part of the thorax covered with golden hairs. The wings are deep yellow. It may have been this wasp (unless it was *Sphex luteipennis*) which I saw flying with a large green grasshopper held in its legs. It dropped the grasshopper and flew off before I could see it properly. (Matheran).

Salius fulvipennis. Similar to the above but smaller. Often seen in light forest. (Lonavla).

Salius flavus (Fig. 5). Rather smaller than *Salius fulvipennis*, with the feet black. (Poona. Khandala).

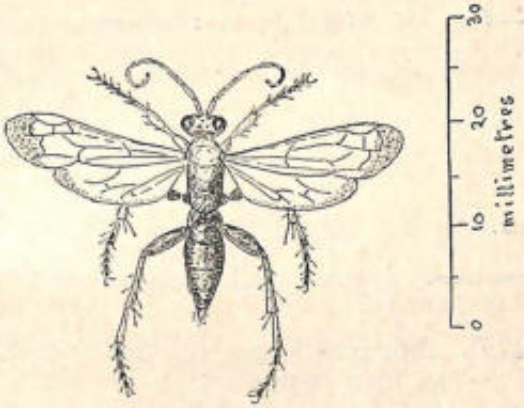


Fig. 5. *Salius flavus* ♀

Salius consanguineus. Black, with orange legs and dark purplish brown wings. (Matheran. Lonavla).

Salius madraspatanus (Fig. 6). A large wasp, velvety black all over, with dark brown wings, having a purple sheen. I saw this wasp as it captured a grasshopper about its own size. The wasp stood over its prey and stung it carefully on the underside of the thorax. The grasshopper was then quite paralysed. After cleaning itself up, the *Salius* took the prey in its mouth and dragged it along between its legs. It flew only occasionally in short flights of a few inches. The grasshopper was pulled up the trunk of a Banyan tree to the wasp's nest in a crevice in the trunk, quite high up. (Lonavla, Matheran).

Family SPHEGIDAE

This is rather a heterogeneous group. They are distinguished by the first thoracic segment, which is short, like a kind of collar round the

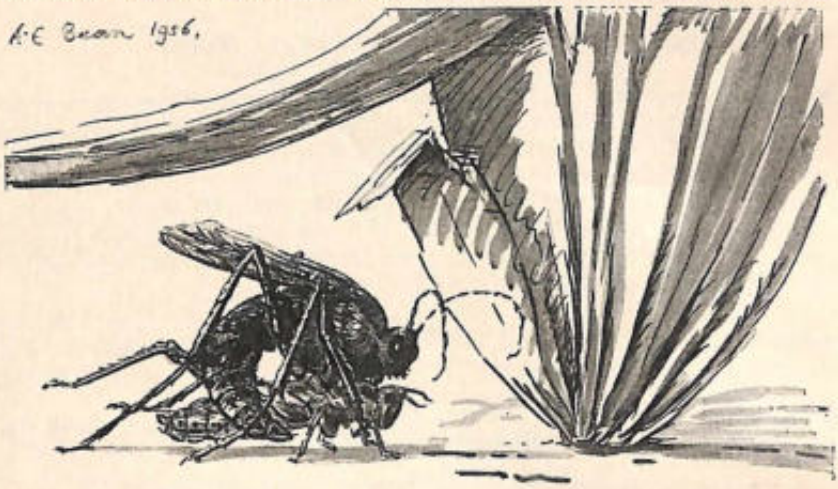


Fig. 6. *Salius madraspatanus* about to sting a grasshopper nymph.

neck, and which does not reach back to the base of the wings as in all other wasps.

Tachytes modesta. Black with lines of silvery pile on the abdomen. The legs reddish. *Tachytes* makes holes in the ground for nests and stores Orthoptera for the grub to feed on. (Poona).

Tachytes nitidula. Similar, but with legs black. (Khandala).

Notogonia subtessellata. A small black wasp, which also nests in the ground and preys on crickets. (Poona).

Liris aurata (Fig. 7). A beautiful little wasp, the golden pile on the head and prothorax being quite conspicuous. I have noted these wasps

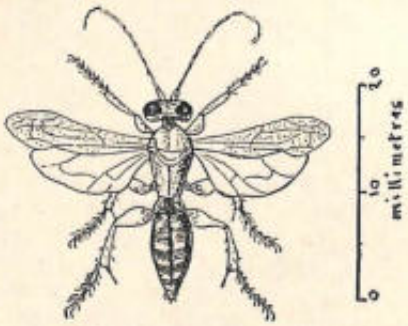


Fig. 7. *Liris aurata* ♀

occupying a hole in a wall at nights for several nights in succession. It preys on crickets and stores them in nests underground. (Poona).

Pison argentatum. A very small black insect, less than half an inch long. I think this is the wasp which builds small elliptical mud nests, many together, often in houses in the corners of ceilings and walls. (Poona).

Trypoxylon intrudens (Fig. 8). This also comes frequently into the house. It has a very long narrow tapering abdomen, reddish with black

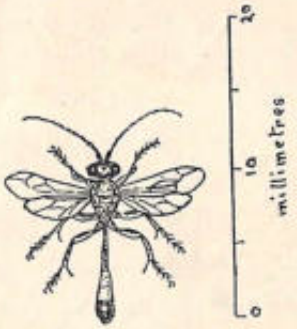


Fig. 8. *Trypoxylon intrudens* ♀

apex, which makes it fairly easy to identify at once. These wasps build mud nests, which I have always found singly, on walls of houses, indoors. They are oblong, and rough outside. They are stored with paralysed spiders for the grub. (Poona).

Trypoxylon bicolor. Similar to the above but larger.

Ammophila laevigata (Fig. 9). Another wasp with a very long petiole to the abdomen. At first glance it resembles *Trypoxylon bicolor*, but can

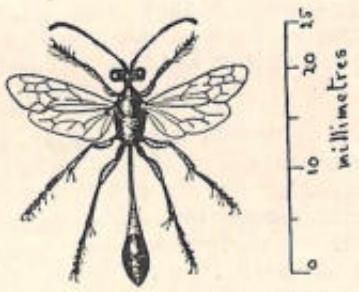


Fig. 9. *Ammophila laevigata* ♀

be distinguished by the two apical spurs on the intermediate tibiae and the more complicated venation of the forewings. *Trypoxylon* has only one tibial spur and a comparatively simple venation. *Ammophila* nests in the ground and stores carterpillars or spiders. A nest of *Ammophila laevigata* I found was dug vertically in level fairly hard ground. I saw the wasp just as it had brought a green caterpillar, which lay rigid and paralysed some three inches from the nest hole. The wasp went down the hole two or three times, and

then, seizing the caterpillar by the head in its jaws, dragged it down the hole, the wasp going backwards. It then came up and proceeded to close up the hole. First a large flat stone was put over the mouth of the nest, then smaller ones, and finally dust swept over. The ground was made quite level and small stones and pieces of grass arranged over the top, so that no sign of the hole remained. (Poona. Lonavla).

Sceliphron madraspatanum (Fig. 10). Another wasp with a very long thin petiole to the abdomen. It is strikingly coloured in black with

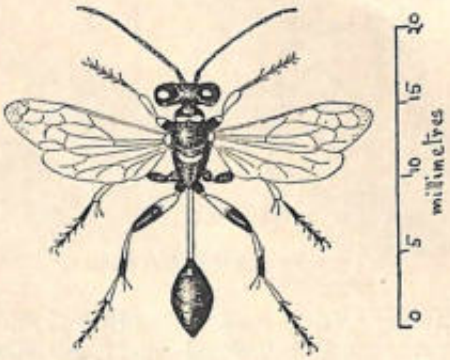


Fig. 10. *Sceliphron madraspatanum* ♂

yellow petiole and legs. *Sceliphron* makes cylindrical mud cells and stores them with spiders. A nest examined contained twenty three spiders. (Poona. Lonavla).

Sceliphron coromandelicum. Distinguished from the above by having the posterior legs yellow, without any black marks on them. I have noticed some of these wasps congregating together in the evenings on some branch or leaf, for several nights in succession. (Poona).

Sceliphron violaceum. Dark shining metallic blue all over. This species seems often to build the mud cell in a hole. I once saw one use the ventilation hole of a sola topi. It first widened the hole, bringing out bits of pith by the front legs. The nest was stored with spiders, carried by the front legs only, except one large one, for which the wasp used the front and intermediate legs. This large spider was carefully stung before being pushed into the nest. Five or six spiders were put in. The nest was then closed with mud, the pellets being carried in the mandibles. At first it was worked smooth, but the finishing coat was put on roughly and allowed to remain so. The whole process took two days, during which the removal of the topi at intervals did not seem to upset the wasp at all. (Poona. Matheran. Lonavla).

Sphex lobatus. All species of *Sphex* make nests in the ground and store them with various kinds of Orthoptera. This species is a large wasp, nearly one and a quarter inches long, brilliant metallic blue-green all

over, with yellowish wings. In hunting for crickets, this wasp digs in loose earth like a dog, using the front and intermediate legs, and sending a spray of earth out behind. Large stones and sticks it removes in its mouth, walking backwards as it removes them. (Poona. Lonavla).

Sphex splendidus. About the same size as the above. The head, thorax and legs are brick red and the abdomen metallic purple. I have not noticed this wasp digging for prey, and it probably attacks grasshoppers. It frequents hard, stony, dry ground. (Lonavla. Sinhagad).

Sphex luteipennis. A very large black wasp with yellow wings. This may have been the insect I saw flying with the large green grasshopper, if it was not *Salius*. But I have seen it stated that *Sphex* always drags its prey along the ground. (Matheran).

Sphex umbrosus. Smaller: black with whitish pubescence on thorax. Wings transparent and colourless. (Poona).

Sphex aurulentus (Fig. 11). Reddish, with apex of abdomen black. A common species. (Poona. Matheran. Lonavla).

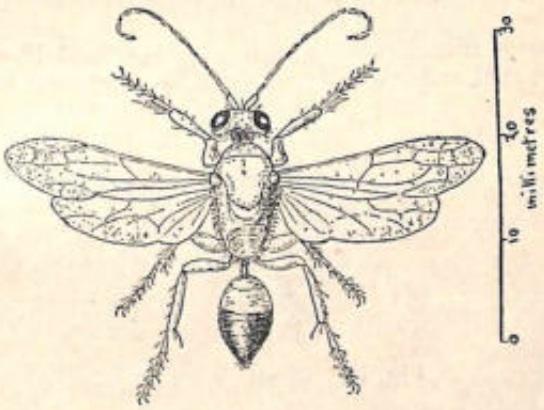


Fig. 11. *Sphex aurulentus* ♀

Sphex vicinus ? Smaller: black variegated with dull red. Also very common. (Matheran. Lonavla. Poona).

Ampulex compressa (Fig. 12). Shining metallic blue-green, with posterior legs red. It is characterised by a very long narrow pro-thorax. It preys on cockroaches and often enters houses in search of them. I have seen this insect with a cockroach it had just captured. It soon flew off however, perhaps as I was standing too near. The cockroach gradually recovered from its paralysis and after about fifteen minutes walked away. *Ampulex* stores its prey in a hole or crevice, blocking up the entrance. (Poona).

Trirhogma caerulea. Dark metallic blue, about half an inch long. Uncommon. (Poona).

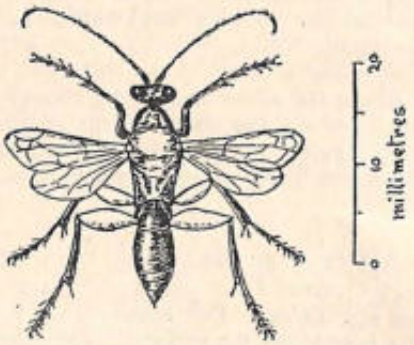


Fig. 12. *Ampulex compressa* ♀

Stigmus niger. A minute black wasp, less than one quarter of an inch long, with conspicuous stigma in the wing. It is often seen on the window pane in houses. (Poona).

Stizus blandinus. A rather heavily built wasp, black, with abdomen light brick red. In Europe a *Stizus* preys on frog-hoppers. (Poona).

Bembex trepanda (Fig. 13). Variegated yellow and black. *Bembex* is partially social, many individuals making their nest burrows in the

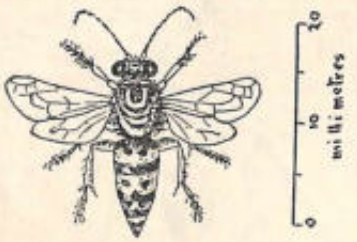


Fig. 13. *Bembex trepanda* ♀

same patch of sandy soil. It preys on flies, and is unusual in that the prey is killed, not paralysed. The nest is only temporarily closed and the mother wasp brings more flies for the growing grub as it needs them. The characteristic of this genus is the long prominent labrum, or upper lip. (Poona. Lonavla).

Philanthus basalis. Small black wasps with yellow bands on the abdomen. The legs are reddish. Often found at flowers. They nest in holes in the ground, closing the entrance with loose earth. I have seen a small Chrysid wasp enter a nest, so presumably it parasitises the *Philanthus*. (Poona. Sinhagad. Lonavla).

Cerceris humbertiana ? A tiny wasp, black with yellowish markings, and the first segment of the abdomen red. The characteristic of this

genus is the strongly constricted segments of the abdomen, as if tight threads had been tied round at intervals. *Cerceris* is said to prey on beetles. (Lonavla).

Oxybelus agilis. Another tiny wasp, with some whitish markings. (Poona).

DIPLOPTERA

Family EUMENIDAE

The True Wasps are divided into Eumenidae and Vespidae. The only constant feature which distinguishes them, is that the former have only one apical spur on the intermediate tibia, the latter have two. Eumenids are solitary wasps ; Vespids are social.

Eumenes petiolata (Fig. 14). A large red wasp, with long narrow petiole to the abdomen, which is yellow, with a black band. All this genus



Fig. 14. *Eumenes petiolata* ♀

make beautiful little clay nests, shaped like an earthenware 'chatti', complete with rim. They store them with caterpillars, closing the cell and usually plastering the whole over roughly with mud, so that the 'chatti' is no longer seen. (Poona).

Eumenes affinissima. Small and black with a few yellow markings. All *Eumenes* have the long narrow petiole. (Poona).

Eumenes esuriens. Like *Eumenes petiolata*, but half the size. (Poona).

Eumenes conica. Large, red, with black markings. This wasp often enters houses in order to build its nest. It is frequently parasitised by a Chrysid wasp, *Stilbum cyanurum*, bright metallic green which may often be seen in the house searching for *Eumenes*' nests. (Poona).

Eumenes flavopicta. Large, with very long thin petiole; yellow and black bands. (Matheran. Sinhagad. Lonavla).

Rhynchium brunneum. *Rhynchium* differs from *Eumenes* in not having the long petiole. This species is dull red with black markings. It often enters houses in order to make its nest in some hole in the furniture. It lines the hole and closes it with mud. It stores caterpillars, which I have seen it bring to the nest flying, held under the body by the six legs. (Poona).

Rhynchium metallicum. Jet black all over. (Poona).

Rhynchium nitidulum. Only to be distinguished from the above by the curious projections from the sides of thorax. (Poona).

Odynerus ovalis (Fig. 15). A small black and yellow wasp with no petiole. It makes its nests in the perpendicular banks of streams or



Fig. 15. *Odynerus ovalis* ♀

ponds. The nest is at the end of a short tunnel, at the entrance to which it constructs a fragile earthen tube, hanging downwards. I have seen it stated that these bent tubes discourage parasites from entering. *Odynerus* stores caterpillars for the grub. (Poona Lonavla).

Odynerus miniatus. A tiny wasp, smaller than the above. (Poona).

Family Vespidae

These are the True Social Wasps.

Icaria marginata. Very common. A small red wasp. They make the nest of 5–40 cells, of wasp-paper. The cells all open downward and are attached by a strong 'stalk' to the underside of leaves branches etc. They often build in houses. A distinguishing characte of *Icaria* is the very retractile end segments of the body, which ar usually folded into the large bell-shaped second segment in telescop fashion.

Icaria ferruginea (Fig. 16). Larger than the above, red with broa yellow band on abdomen. (Poona. Purandhar).

Icaria variegata. A common tiny red wasp with yellow and black markings. (Poona. Lonavla).

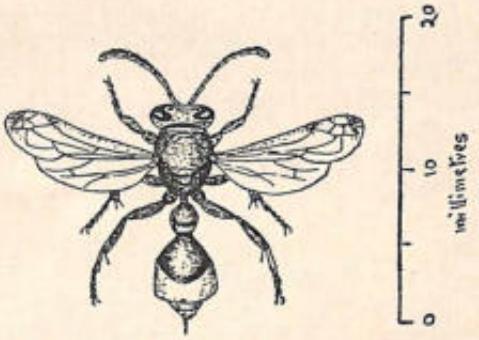


Fig. 16. *Icaria ferruginea* ♀

Polistes stigma. *Polistes* has no petiole as *Icaria* has. (Poona. Lonavla).

Polistes hebraeus (Fig. 17). Large yellowish, with some black markings. (Poona).



Fig. 17. *Polistes hebraeus* ♀

Vespa cincta. A large wasp with conspicuous yellow band round the abdomen. The sting is said to be dangerous. (Poona. Lonavla).

BEES

Nomia westwoodii. A small black bee, one-third of an inch long with greenish yellow bands on the abdomen. A solitary bee, nesting in tunnels in the ground. (Purandhar).

Megachile disjuncta. *Megachile* comprises the Leaf-cutter bees. They line their nests with pieces of leaf which they cut in the following way. The bee sits on the edge of a leaf, the legs holding it on either side. It then begins to cut in a semicircle towards its tail.

As the cutting goes on the piece of leaf is rolled up between the legs. As the last cut is made, it flies off with the cut piece rolled up between its legs. They nest in holes, often in houses; some make mud cells. I found one nest, put among the roots of a fern, made entirely of rose petals. The nest is filled with honey and pollen for the larva. *Megachile disjuncta* is black with a conspicuous yellow band round the waist. (Poona).

Megachile lanata (Fig. 18). Bright rusty red hair on the head, thorax and top of abdomen. The rest of the abdomen with thin white



Fig. 18. *Megachile lanata* ♀

bands. A common species, which often enters houses to nest. It makes mud cells. (Poona. Lonavla. Sinhagad).

Megachile cephalotes. A small black bee, with thin whitish bands on the abdomen. (Poona).

Megachile albifrons. Black, with snow white pubescence on head, sides of thorax and bands on the abdomen. (Sinhagad).

Parevaspis carbonaria. A black rather hairless bee with darkish wings. It is parasitic on *Megachile.* (Poona).

Ceratina viridissima. A tiny bright metallic green or blue bee. Common at flowers. They are said to nest in hollow stems. (Poona. Sinhagad. Lonavla).

Coelioxys decipiens. Black, with white markings and bands on the abdomen. The abdomen is rather long and, remarkably pointed, shaped somewhat like a carrot. These bees are parasitic upon *Megachile.* (Poona).

Crocisa emarginata. *Crocisa* is parasitic in the nests of *Anthophora* and can often be seen examining walls or banks for the nests. This species is black with markings and bands of a beautiful bright blue, varying in shade. (Poona. Matheran).



Leaf-cutter Bees (*Megachile disjuncta*) in action.

Crocisa ramosa (Fig. 19). Another beautiful bee, jet black with snow-white spots. (Poona. Sinhagad).



Fig. 19. *Crocisa ramosa* ♂

Anthophora zonata (Fig. 20). Stoutly built bees, with bright shining blue bands on the abdomen. *Anthophora* have remarkably long tongues.

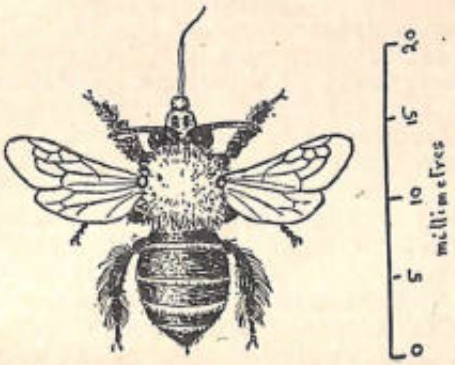


Fig. 20. *Anthophora zonata* ♀

They fly very rapidly and are also often seen hovering quite still in front of flowers. They are gregarious, nesting in holes in steep banks or in walls, many together; but they are not truly social. (Poona. Sinhagad. Lonavla).

Anthophora fallax. Rather smaller than the above, with white bands. (Poona. Sinhagad).

Xylocopa dissimilis. These are the Carpenter Bees, which excavate holes in wood to make their nests. I have seen nests in the beams of house roofs and in bamboo poles. The mandibles must be immensely strong, as they bore beautifully neat holes in the hardest wood. This species is a large black bee, one and a quarter inch long with irridescent wings. (Poona. Lonavla).

Xylocopa latipes (Fig. 21). Another large black bee. The male has curiously flattened front legs, yellow and fringed with long thick yellow hairs. (Lonavla)

Xylocopa amethystina. Black, but about half the size of *Xylocopa dissimilis.* (Poona).



Fig. 21. *Xylocopa latipes* ♂

Xylocopa aestuans. Black, with bright yellow thorax. (Poona. Matheran).

Xylocopa rufescens. Brown, with golden brown thorax. (Bombay).

Apis dorsata. *Apis* comprises the honey bees and are social, the communities consisting of a single fertile female or queen, workers and males. This species is the large Rock Bee which places its combs in the open, under eaves of roofs, on the under side of branches, or under overhanging rocks. (Poona. Lonavla).

Apis indica. In the wild state, it nests in hollow trees, holes in walls, or even abandoned white-ant mounds. It has been successfully domesticated, and takes readily to hives. (Poona. Lonavla).

Apis florea. The smallest of the *Apis* genus. It places its combs in the open, in trees, or bushes, or in creepers on the sides of houses. It is very common in the district. (Poona. Lonavla).

Melipona iridipennis. Sometimes called 'Mosquito bees'. They are social and are tiny black bees, hardly one quarter inch long, often seen at flowers. For the size of the bee, they carry enormous loads of pollen on the hind legs. I have found nests only in holes in walls, the entrance usually very narrow and sometimes with a curious trumpet-shaped tube of wax projecting. The tubes I have seen were about one inch in diameter at the end and projecting only about two inches. (Poona).

My thanks are due to the Rev. A. E. Bean, S.S.J.E., for the action drawings.

DUCKS UNLIMITED:

And Wild Life Preservation in Ceylon

BY

Philip K. Crowe

(With a plate)

Few non-hunters seem to realize that the survival of game in many parts of the world depends primarily on sportsmen; yet it is certainly logical to surmise that those who derive their greatest pleasure and relaxation from shooting should be those who make the greatest effort to ascertain that their sport continues. Certainly many who do not shoot have contributed greatly to the preservation of wild life but, in most countries where protection exists today, the generosity and interest of the hunters have exerted the major pressure to save the game.

Take ducks in America. Fifty years ago countless millions of wild fowl filled the skies as they winged across the United States to and from their breeding grounds in Canada. 'There will always be ducks' said the hunters and the ornithologists. Then suddenly, in the twenties, the migrations fell off alarmingly. The Wild Life Service estimated that not more than 30 million ducks were left out of an estimated normal of 200 million. The great banners of waterfowl that used to wave across the skies had shrunk to tattered ribbons. Something had to be done and done quickly.

The sportsmen met the challenge. A small group, headed by Joseph P. Knapp, formed the 'More Game Birds in America Foundation' and hired 2,000 biologists and observers to conduct an International duck census. The result of this survey revealed that the trouble lay not in over shooting but in the breeding grounds. Draining of the Canadian marshes, to plant wheat to meet the needs of a hungry world during two world wars, was having its baleful affect on the wild fowl population.

The survey estimated that 70 per cent of the prospective North American duck population died on these far northern breeding grounds, and that nearly 90 per cent of all the ducks that flew over the United States were bred in these same marshes. Only 23 million acres of land in America was considered good breeding territory for ducks while Canada had 640 million acres. In the vast wet lands of Alberta, Manitoba, and Saskatchewan lay the Continent's 'duck factory'. The answer obviously was in Canada but, in 1937, there was no way in which U.S. Government funds could be spent in another country to improve waterfowl breeding grounds; the job had to be done privately.

At the foundation meeting set up in Washington, the matter of a title for the organization was brought up and 'Ducks Ltd.' was suggested. 'Limited, hell!' said one outspoken member, 'what we want is ducks unlimited'. And ten days after incorporation, 'Ducks Unlimited', financed by American and Canadian sportsmen, started its first big project, the restoration of 50,000 acres in Big Grass Marsh in Manitoba. There

was no time in those pioneer days for permanent dams; the earth was pushed with bulldozers, holes were blasted in the prairie to hold water. Without water the ducks died. Everyone helped. The Canadian Provincial Governments turned over 60 million acres of poor wheat land; thousands of farmers promised cooperation. One dour old Scotch wheat farmer said 'Dead ducklings ruin my hay', and then his face softened and he added 'I sort of like the living things on my land.'

While these first dams were being built, reports from the field showed that other causes besides drought were cutting down the flocks. Crows and magpies devoured 15% of the eggs; fires destroyed another 12%; so did Indians, skunks, coyotes, wolves, squirrels, and jackfish. In fact, these great northern pike were estimated to consume 8 million ducklings a year! 'Ducks Unlimited' attacked the enemies on all fronts. Wire nets kept out the fish; a bounty was placed on crows and magpies; and the Indians were persuaded to give up eating duck eggs by giving them funds to buy other food they liked better. Even beaver were imported to build their water-holding dams and give the Indians a better living from trapping. Today the record is impressive. 'Ducks Unlimited' has established 3,000 miles of shoreline nesting areas; built 614 dams; banded 70,000 ducks and geese; planted thousands of aquatic plants; and maintains 600,000 acres of water on the prairie provinces of Canada.

All this has cost money, more than $5,000,000 to date, and it has all come from duck hunters. Have the results justified this expenditure? By 1947, ten years after 'Ducks Unlimited' started functioning, the duck population had risen to 160 million and in every year, but one, an increase has been noted. This year's census will probably show that the total is again approaching the norm of 200 million ducks, which the scientists think is about the right number for the continent to carry.

The interesting fact about this recovery in America's duck population is that it has taken place *in spite of a greatly increased number of hunters.* Moreover, more than 2 million duck licenses are issued yearly in the United States, a four-fold increase since 1934, and if these license-holders and the generations after them are to find sport in the skies more money must be raised to open up new breeding grounds in the north country. It is a challenge that Ducks Unlimited, financed by the sportsmen of America, is willing to face.

Here in Ceylon we also face a crisis in the Island's wild life. According to Major W. W. A. Phillips, one of the Island's leading authorities, the last half century has seen great changes in the status and distribution of the Island's unique wild life; some notable forms are already extinct, or verging on extinction, and others have been sadly depleted in numbers and restricted in range. He predicts that the next half century will undoubtedly see the extinction of many valuable species.

Not all of these species can be saved but a concerted effort by the sportsmen of Ceylon could go a long way towards aiding the government to preserve many of those birds and animals which provide the hunter with his happiest hours. An organization dedicated to protecting the Island's wild life already exists, The Ceylon Wild Life Protection Society, but it lacks funds and the whole-hearted support of the sportsmen. Some people seem to think, in fact, that the Society is opposed to legitimate sport. This is not the case. No one knows better than the members of the Society that the animals shot under license in the government preserves constitute but a minute fraction of the numbers killed illegally.





Ducks Unlimited : Scenes in the Grey Lodge Wildfowl Refuge, California.

(Photos : Salim Ali)

So far, however, the Society has made no real effort to attract and organize the Island's sportsmen.

Even for many of Ceylon's rigidly protected fauna the end seems near. The most dramatic and tragic example of approaching extinction is provided by the Ceylon elephant. At the beginning of this century, it was estimated that at least 2,000 of these great beasts roamed the Island's jungles. Then, the herds migrated into the hills during the dry season and elephant paths could be seen along the ridges of the mountains. There was even a small resident herd in the Horton Plains area. Today, experts say there are less than half this number left and they declare that, since the rate of depletion by killing and capturing is about twice the normal rate of increase, the writing is on the wall for Ceylon's noblest animal unless draconian steps are taken immediately to save it.

Two forms of our wild life are already virtually extinct. The Ceylon Hog-Deer, which used to be plentiful in the Galle area, has vanished. Pressure of population to open new lands to cultivation has driven this interesting little deer from the coastal area and, since it was apparently unable to survive in the inland hill country, it has been killed out. Another inoffensive mammal, the Dugong, has become so rare in the shallow seas of the Mannar area that for all practical purposes it is also extinct. Major Phillips thinks that, even with strict protection, it is now doubtful if this unique species, from which the ancients drew their tales of mermaids, can recover. Several years ago I saw one swimming in a tank of turtles and offered to purchase it in order to set it free. The fisherman who had netted it told me, however, that there would be no use in this gesture as it would immediately be caught by someone else. Sluggish and trustful, the Dugong seems doomed.

The wild buffalo, protected from shooting by his resemblance to his tame brothers and a perpetual closed season, is still found in good numbers in the national parks, but illegal capture, for domestic use, has all but exterminated it in other areas. On a five day trip down the Mahaweli Ganga, which flows through one of the Island's few remaining isolated jungle areas, I saw only a few tracks of wild buffalo.

Spotted Deer and Sambar reproduce rapidly; they are still plentiful, therefore, in the national parks and shooting reserves, but outside of these protected areas they are becoming increasingly rare. I have made many motor trips around the Island and have kept careful notes of all wild life seen. Even on the long stretches where the roads run through heavy jungle, as on the link between Puttalam and Anuradapura, and Anuradapura and Trincomalee, I saw pitifully few deer, and all of these during the day. Night shooting from cars has driven the surviving game deep into the forests. Lights on the road at night may mean death to them.

The deer are protected by law, however, and ostensibly derive some benefit from the closed season. No laws cover the Sloth Bear, Leopard, Crocodile, or Wild Pig. Outside the reserves, they can be shot the year round, and this indiscriminate slaughter goes on twelve months a year. In the Wanni I saw a she-bear with two cubs which a local 'sportsman' had shot from a blind over a water hole. He said he had no use for the skins, could not afford to mount the heads, and had only shot the trio for fun. On another occasion I saw the skin of a leopard cub that would not cover a baby. The hunter who had shot it tried to sell it to me for a 'trophy'. Pig's flesh cannot be touched by Moslems but Moorish poachers frequently shoot pig to sell the flesh.

The sale of the flesh and skins of all wild life is prohibited by law but they can be bought in almost any village near a jungle area, and the vats of the government tannery in Colombo are always full of skins in and out of season. The Crocodile, which performs a useful purpose in cleaning up dead animals in the tanks, is now extinct outside the protected areas. Its belly skin sells for a price that makes the fine for selling it a minor hazard.

The primates have also suffered. The Grey Langur or Wanderoo, and the Red Monkey have been greatly reduced in numbers. There is some point in shooting the Red Monkey as it is very destructive to crops, but the big Langurs gain most of their sustenance from the jungle and are shot only by the Tamil labourers for their flesh.

The birds have also suffered. The peafowl, Asia's largest and most beautiful game bird, is continuously poached for its feathers, flesh, and oil. The ayurvedic belief that the oil, emanating from a peafowl's legs, is a specific for a number of diseases results in a constant illegal market for the unfortunate bird. Legitimate hunters kill only a few peafowl for it is an extremely wary and keen eyed fowl ; it takes a long, lucky shot to bag one during the day. At night, however, the big birds roost in trees and it is then that the poachers slaughter them as they huddle, silhouetted against the sky, in the moonlight.

The Painted Partridge, formerly plentiful in the Uva hills, is now virtually extinct except for small numbers in the country around Nilgala. Major Phillips believes that the extinction of this beautiful little partridge is not so much due to over-shooting, trapping, and egg-stealing as to the burning of the grass and patna lands. The Grey Partridge has also decreased alarmingly, and is now confined to the Mannar area and a few islands off the coast there. I had some good partridge shooting on Iranitivu but since then have heard that a party of market-hunters invaded the island and shot virtually every bird they could find. As the partridge cannot leave the island, the distance to the mainland being too great for them to fly, it would not be difficult to exterminate them.

The Comb-duck and the Glossy Ibis have gone completely from Ceylon. Occasionally, a straggler from India is identified but both of these rare and interesting birds have ceased to breed in the island's tanks. In 1880 the famous ornithologist, Legge, reported that Comb-ducks were fairly common in the north and east and about the same period Layard noted that the Glossy Ibis was seen in abundance in the north of the Island. Despite laws protecting them, Egrets, Herons, and Storks are being persecuted to a point where they too may face extinction. Unfortunately all these beautiful birds are edible, as well as providing fine feathers for the children.

Even eagles and other large raptores, whose flesh has no food value whatsoever, are shot by irresponsible hunters. The Rufousbellied Hawk-Eagle is virtually extinct and the numbers of Legge's Hawk-Eagle and the proud Whitebellied Sea Eagle are decreasing yearly. The Malabar Pied Hornbill, which looks like a bird from the pre-ice age and takes off slower than a heavy bomber, is now rare outside the reserves, and the Ceylon Broadbilled Roller can only be found in a few remote localities.

Blame for Ceylon's vanishing wild life is of course due to a number of factors of which the most important is probably the steady increase in the Island's population. In 1900 only 3½ million people lived in Ceylon. Today there are nearly 9 million and by 1980 it is predicted there will be

18 million. Ceylon's rate of increase, 2·8%, is the third highest in the world and is exceeded only by Venezuela and Panama. Pressure for food, from the increasing number of mouths, naturally results in opening up of more land to cultivation with an inevitable effect on the habitats and feeding-grounds of the wild life.

The Wild Life Department is doing a heroic job with an inadequate and underpaid staff. The Ranger of one large reserve that I know is not even provided with a jeep; he is expected to patrol an area of several hundred square miles on foot or bicycle. The poachers of course have cars. It is estimated that great numbers of the guns now in use on the Island are illegally possessed and must be assumed to belong to these same poachers, but according to the Ministry of Home Affairs steps are being taken to issue licenses to *all* applicants. It has also been decided to return those illegal firearms which were confiscated during the previous regime. The reason given for these decisions was that the people need these guns ' for protection in remote areas '.

No one would quarrel with the right of the villager to protect himself and his chena from attack by wild animals, and with this in view licenses for 1,11,357 guns were issued in 1955, certainly an adequate arsenal to cope with a few hundred elephants and bears. During the same period only 2,081 game licenses were purchased and the official kill of Axis deer was 80, sambar 5, and peafowl 10,—a minute fraction of the number of protected animals and birds destroyed either illegally or ostensibly in defence of crops.

The net of all this is that, unless there is strong public support for stricter protection, much of the Island's wild life will continue to diminish and some will become extinct. Now is the time for all sportsmen to help stem this tragic tide by banding together under the aegis of the Wild Life Protection Society and embarking on a plan of positive action.

The ducks were saved in America, and the wild life can be saved in Ceylon.

CHAPTERS ON THE HISTORY OF BOTANY IN INDIA

II. THE ADVANCES, AND IN PARTICULAR THE PLANT COLLECTING, OF THE THIRTIES AND FORTIES OF THE 19TH CENTURY

BY

I. H. BURKILL

(*Continued from Vol.* 51, *p.* 878)

My first chapter carried the history of the science of botany in India as far as the time of Wallich's long leave, 1826-32, leave in which he took to London the collection of bundles of dried plants, that had grown up in the Calcutta Botanical Garden, and was allowed to draw from India House bundles that had been deposited there; all the specimens thus assembled he sorted, like to like, i.e., he assigned them to species, made them up into sets, and distributed these sets to, as he said, 20 centres of botanical work in 8 different countries, that they might do the great service of interesting the botanical world in the flora of India and of keeping botany in India in line with the advance of the science by ensuring the necessary international specific nomenclature.

This, the second chapter, carries the history forward a couple of decades. Although it covers a very much shorter time, it requires as many printed pages, and the names of the collectors are as many. That this should be the case indicates how greatly the two decades make a period of intensification. They make also a period of widening outlook and considerable achievement of reputations made or maintained and of strenuous undertakings. The beginning was in the nature of an awakening, for Wallich's leave extended long enough for Wight and Royle to require absence from India during it, whereby India was deprived entirely of its leaders in the Science.

Who were those left in India when the three were away? It will aid the reader to form an idea of the situation if they be enumerated. The seniormost was the missionary J. P. Rottler, whose knowledge of the flowering plants of southern India was considerable; he possessed a good reference herbarium and would name the specimens of others; but he was already 78 and losing his vigour. Bernhard Schmid, also a missionary, had moved from Tinnevelly to the Nilgiri Hills, where he was now at the beginning of his botanizings. Lieut.-Colonel W. H. Sykes, holding the post of Statistical Reporter, Bombay, was collecting plants in the Deccan; but he was not botanically minded and the collection went without determinations until entrusted to Royle about 1840. In Ceylon, James Macrea by a little collecting was adding to the herbarium at Peradeniya, but probably merely increasing the material without making determinations. The surgeon Alexander Gibson and the administrator J. S. Law were not out of their initial years in India and John Graham arrived in Bombay only in the year

of Wallich's departure. On the other side of India, although the scientific membership of the Asiatic Society had strengthened, as the *Centenary Review* of the Society makes evident (p. 17), William Carey alone remained.

While conceding that the contemporaneous absences of Wallich, Wight and Royle created a situation, the pause of which made the years 1828-32 a dividing line, there was an associated circumstance not to be overlooked. It was that every botanist who resided in India, from Koenig to the years named, had been taught, thought and classified in the Sexual System of Linnaeus, a cramping, fettering system, bound to be superseded; and the first signs of supersession by the Natural System reached India after Wallich's departure on leave. The reader will now appreciate my use of the word 'awakening' as a character of the period under review.

It is rightly said that a system of classification demands knowledge of everything that is to be simplified by it. The objective justifies the system; and the Linnaean System simplified the arrangement of cabinets of specimens, lulled the born collector for whom it was prepared and was a means of getting on with what was immediately in hand, but raised a cloud of dust against the philosopher. Reynolds Green, writing in his *History of Botany in the United Kingdom* (p. 124; 1914) as a philosopher, condemns the Linnaean System more than it deserves. It was a product of its time, a ready help in assimilating in some order the flood of new species that emerged from the world-wide explorations of the latter part of the 18th century, a short cut or key. As meeting the situation it was a masterpiece. Not only did it do this, but by its simplicity it popularized Botany. The professors of the medical schools seized it, so to speak, with both hands and spread it out before their classes with the result that all the surgeons who came to India had a knowledge of it. Others joined the surgeons for, being so easy of comprehension, it took Botany to a place in a liberal education and even into the drawing rooms. India was affected by this diffusion in that the proportion of medical men who studied plants in India fell from two in three to one in three. Justifying my allusion to Botany in the drawing rooms, I would refer to the interest taken by three eminent ladies: the wife of the Marquis of Hastings, Governor-General from 1814 to 1825, would ask those who collected plants to give her duplicates that she might send them to a museum in Edinburgh in which she was interested; the wife of the Earl of Amherst, Governor-General from 1825 to 1829, was not only a keen gardener who sought out beautiful plants and got them into cultivation, but possessed a small herbarium; the wife of the Earl of Dalhousie, Commander-in-Chief, spent the warmer months of the year 1829 at Simla, where between Sabathu towards the plains and Mashobra deeper into the mountains she collected about 600 species. The Countess was competent enough to make determinations and very enthusiastic, as Carey who met her in Calcutta on the eve of her departure for Simla, has recorded for us.

The advances of Botany needed a little time before Europe was in a position to spread them to India. Fifty years passed from the publication by Linnaeus of his Sexual System to the publication by Antoine-Laurent de Jussieu of the Natural System, and rather over

sixty from Linnaeus's publication to Koenig's bringing the use of it to India, Koenig and A. L. de Jussieu being contemporaries. The Natural System, devised and advocated in France, had to pass to and be taught in Britain, before it could follow to India; and the first teacher of it in Britain was William Jackson Hooker (afterwards Sir William), Professor of Botany at Glasgow, 1829-41; the second, John Lindley, Professor of Botany in University College, London, 1829-60. I shall have cause to mention both, not as visiting India but as exercising a considerable influence on those who botanized in India. Their influence began at the time of Wallich's long leave, or forty years after the publication of A. L. de Jussieu's *Genera plantarum* (1789).

I said (in chapter 1, p. 846) of my first period that no aspect of botany was studied except classification: the same is nearly true of the second period; but the classification had now a deeper insight.

A single illustration will bring home to my readers why it was so enormously to the benefit of the Science that the Linnaean System, having served for a short time, should pass away. Let us liken each system to a container of sufficient dimensions to hold all the units to be classified if accurately placed. The container by the Linnaean System would have directions for placing in its lower parts; that by the Natural System directions at all levels. It is obvious which of the two is the better. Could the theory of the origin of species have been arrived at by a Linnaean systematist? And is it not clear that the theory and the Linnaean System are incompatibles?

In the first chapter, heavy type was used to indicate the appearance in the narrative of the more important botanists: in this chapter it will be used more often as the history becomes more intricate.

William Carey and his Connections

William **Carey** (1761-1834) occupies a somewhat unique position in the history. He was a wonderful linguist. As the son of a village schoolmaster, he sought at first to find a way through life as a schoolmaster; then, in missionary fervour, he volunteered for a difficult life in India and landed in Calcutta in the year of the transfer of Roxburgh from Samalcottah to Calcutta, i.e., in 1783. To earn a living he became an indigo planter in Malda; and at that place he mastered the Bengali language into which he translated the New Testament. He had his translation ready when fortuitously a trained printer joined the Mission at Serampore, a printing press was obtained and Carey moved to the press. He had no aptitude for business, but was a born teacher and a perfect editor. He had become a friend of Roxburgh when still at Malda and acquainted with Colebrooke. After moving to Serampore he could easily reach Roxburgh's doorstep by boat; and the intimacy ended in Carey being Roxburgh's editor.

It has been stated (chapter 1, p. 870) that in 1813 Roxburgh, before he sailed from India for the last time, put into Carey's hands a manuscript copy of his *Flora Indica*. A delay in Ceylon gave him a chance of botanizing and he found a little information to insert in the copy which he sent by post to Carey. Though in the two years left to him before his death (1815) he continued to work on another

copy of the Flora that he had taken with him, nothing more was added to the copy that he had entrusted to Carey. After his death Carey consulted Wallich regarding publication, and Wallich with characteristic impulsiveness volunteered to bring the MS. up to date by inserting his own finds. Carey agreed; and the first volume was issued in 1820. The second volume was delayed by Wallich's year in Nepal, but appeared in 1824. The third volume was never prepared because Wallich's affairs became too much involved. After Wallich had gone on leave in 1828, the Baptist Mission Press at Serampore holding the copyright, two of Roxburgh's sons approached Carey, asking him to print the whole work from the copy that their father had left with Carey; and this was done, save that for some undeclared reason the ferns were omitted; and the work appeared in three volumes in 1832. There is no sign of Carey in the text save for the editing; but Carey had become a botanist and was active. Prain in the preface to his *Bengal Plants* (p. 18) says that between Roxburgh and Carey 'little or nothing had been left . . . for successive generations of botanists to add' to the list of higher plants that occur in Central Bengal. Carey assuredly sent dried plants to Roxburgh which Roxburgh mixed with his own, but proof is lacking.

Carey almost immediately after he had domiciled himself at Serampore (1800) was appointed to teach Bengali in the Governor-General's new College in Fort William. This and a tremendous hunger for books drew him into Calcutta so much so as to make him equally a man of Calcutta as of Serampore. But except for a short paper on the agriculture of Dinajpur (*As. Res.* 10, p. 1; 1808) he published nothing in any way botanical. He cultivated a garden in Serampore assiduously. In the year 1820 he called together a meeting in Calcutta to originate an Agricultural and Horticultural Society. The meeting was badly attended, but getting official support he got his way, and the Agricultural and Horticultural (Agri-Horticultural) Society of India came into existence. It never operated far from Calcutta in spite of the word 'India' in its title. When Carey's move had been made, one of the two Tytlers who at that time showed an active interest in economic plants, R. Tytler, wrote that he had already ventilated in Allahabad the idea of a similar society; and we may take it that the time was ripe for Carey's move, though it expended its efforts in the introduction into gardens of plants suitable for them and very doubtfully touched agriculture at all. Wallich became its Secretary, or one of its secretaries, soon after its foundation and the Society was allowed the use of a part of the Botanic Garden as a nursery, of which it had the use until 1872. Wallich and his successors apparently saw no rivalry, though much of what the Society did was what they also were doing. Wallich wrote appreciatively of the Society's work in *Hooker's Journal of Botany* at a relatively late date (5, p. 137; 1853). The Society started *Transactions* of its own and provided an outlet for papers in economic botany.

Jacquemont on one of his visits to Carey's garden met there Professor and Mrs. **Mack** (he miswrote the name Mac). John Mack was a scholarly man from Edinburgh who had become a teacher in the College that the Mission had founded. He was not a botanist, but took an interest in some branches of Natural Science; and when in

1826 he and his wife visited the Khasia Hills on a tour of inspection, they made a collection of dried plants which they gave to Sir William Hooker. The excellence of the specimens received commendation.

To Serampore in 1827 a Danish surgeon, Joachim Otto **Voigt** (1795-1843) went to occupy the post which had been Wallich's 20 years earlier; and in Serampore he became a disciple of Carey. When Carey died he took charge of Carey's garden dedicated, as it was, to public service. He formed a herbarium which at his death was given to the University of Copenhagen and duplicates were given to Sir William Hooker which, therefore, are now at Kew. As will be mentioned later, Voigt had charge of the Calcutta Garden for two months in 1842 and the occasion gave him the opportunity of uniting catalogues of the Serampore and the Calcutta gardens into one under the title *Hortus Suburbanus Calcuttensis*. Voigt made more of it than a mere catalogue by embodying economic information, records of failures, experiences of himself and Carey at Serampore, and some information supplied by J. W. Masters, who had served as Head Gardener under Wallich (for Masters see pp. 61 & 64 forward).

Henry **Piddington** (1797-1858) was another who came under Carey's influence. After a few years at sea he settled in Calcutta and made a reputation as a meteorologist. But before he became absorbed in weather observations and after he had allowed himself to be elected a Secretary of the Agri-Horticultural Society, he prepared, manifestly at Carey's suggestion, his *English Index to the Plants of India*, which is a dictionary of vernacular names with botanical equivalents. Piddington calls himself a tyro in Botany; and this was his only publication that directly interests us. He remained for long active in the Agri-Horticultural Society.

The Unobtrusive Leadership of Robert Wight

Robert **Wight** (1796-1872) qualified in Medicine at Edinburgh when Daniel Rutherford was the professor. Rutherford fired no enthusiasms, and Wight did not leave the University a botanist. But when in 1819 he had entered the medical service of the East India Company and had found that the amusements of his associations in cantonments did not provide a congenial outlet for his energy, he turned, as he explained later in a letter to Professor von Martius, to the vegetable kingdom for occupation and in the leisure of his regimental duties studied the plants about him. He was soon sending collectors out to bring to him plants from distances beyond the limits of his own excursions. His station being Samalcottah (Samalkot), where successive official Madras botanists from Roxburgh forward had lived, the tradition of employing men of the country-side as plant-collectors was alive, and moreover it is not unlikely that he received help from Shuter. He managed to get three botanical works, an early edition of Linnaeus's *Genera plantarum*, Willdenow's *Species plantarum* and Persoon's *Synopsis*, by which he proceeded to determine his finds. These books kept him working by the Linnaean System which doubtless would not be strange to him. Perhaps it was well for this lone traveller that he had the easier artificial System to encourage him,

though as will be seen, he was not slow in discarding it when his opportunity came.

Wight was transferred successively to Rajahmundry and Vellore. When he had been collecting for about four years, he needed help with his nomenclature, and made up a bundle of specimens which he addressed to Robert Graham, the new professor at his old University; but the bundle was lost at sea; and it seems as if Wight could not immediately make up another. However, he did so in 1826 and this packet he sent to Sir William Hooker, professor at Glasgow. By way of comment on the change, the reader may be reminded of Francis Hamilton's remark: 'Dr. Hooker at Glasgow I see frequently . . . he is more active than Graham.' Wight doubtless had chosen well and his material got attention. In the same year, Wight was taken from regimental duties and given the post of Botanist that had been successively Koenig's, Roxburgh's, Russell's, Heyne's and Shuter's. Koenig had travelled to Siam on it and the others to various destinations. Wight immediately travelled, going right to the very south of the Indian Peninsula on a zigzag course. Such journeys were of course costly because so much equipment had to be carried, food and a tent, employing a fair number of attendants, including an armed guard. Heyne, journeying from Samalcottah to Hyderabad, had a party of 40. Wight's much longer journey extended over 2½ months; it took him among other places to the Palni Hills where he found a flora quite new to him. But when in the next year he proposed a much longer journey, he was abruptly brought to earth by the abolishing of his post and by being sent to Negapatam, again in medical charge of a regiment.

Wight had been giving bundles of dried plants to other botanists, not all in Britain. Delessert in Geneva was one of the recipients.

After 2½ years at Negapatam, whence he collected as much as he could by sending out collectors, he took leave and brought all that he had to London in time to find Wallich in the middle of his work of distributing the Calcutta and India House material. The excellence of Wallich's arrangements so pleased Wight that he would have had what he had brought with him absorbed; and indeed Wallich had some of Wight's plants which he had obtained from India House to which Wight must have sent them. Wallich evidently could not take more; and Wight betook himself along with his newer collections to Scotland, where he found a co-adjutor in G. A. Walker Arnott.

George Arnott Walker **Arnott** (1799-1868) had been a school-fellow and also with Wight at the University; but while Wight was studying Medicine, he was studying Law. In the end he did not adopt the Law as his profession; instead, as Wight was becoming a botanist in India, he betook himself to Paris and studied Botany there. Returning from Paris, he worked with Sir William Hooker in Glasgow. Having met Bentham, he joined the last named in a tour of the Pyrenees. Could Walker Arnott, after study in Paris, after work with Sir William Hooker in Glasgow, and after a botanical exploration along with Bentham, have been a follower of the Linnaean System? That he was not; and he carried Wight into the Natural System, as they wrote conjointly their excellent *Prodromus Florae Peninsulae Indiae orientalis* on the material that Wight had brought back with him.

The first volume appeared in 1834, and then Wight's return to India arrested the work at a point which would have been one-third of the whole. The two collaborated in a couple of supplementary papers and that was the end of their association in work for India.

Wight, while engaged on the *Prodromus* was a welcome guest in Sir William Hooker's house; and Hooker happened to be engaged in preparing the plates for his supplement to Sowerby and Smith's *English Botany*. The idea of illustrating in a comprehensive way the flora of Britain, as that work did, gave rise in Wight to a desire to illustrate the flora of India in a similar manner, and out of that desire were born all these of his books: (i) *Illustrations of Indian Botany* with plates numbered 1 to 41, reproduced from Hooker's Botanical Miscellany, 1834, (ii) *Illustrations of Indian Botany* with plates numbered 1 to 182 in two volumes, 1840-50, (iii) *Icones plantarum Indiae orientalis* in six volumes, with plates numbered 1 to 2,100, 1835-53, and (iv) *Spicilegium neilgherriense* in two volumes with plates numbered 1 to 202, 1846-51. To effect his purpose, he had to learn the art of lithography, which he did in Sir William Hooker's house, to train his artists, and to secure a printer. The printer worked in Madras city; Wight suffered from transfers to the Nilgiri Hills and then Coimbatore, as he told von Martius in a letter, at the inconvenient distance of 300 miles from his printer. He bore the expenses himself and the loss which, he says, was made tolerable by the Government taking 50 copies.

Wight on returning to India in 1833 was posted to Bellary; then his regiment was ordered to march to Palamcottah at the extreme south of the Peninsula. Wight found the transport of his impedimenta most inconvenient. After arriving at Palamcottah, he was sent on a mission of inspection to the experimental spice-garden at Kuttálam (Courtallam), a pretty place at the open end of a depression in the Ghats through which winds off the Indian Ocean carry coolness and humidity. Wight revelled in this place which gave him his second experience of the southern mountain flora; his first had been when he climbed the Palni Hills in 1826. But he contracted fever and was driven to take a period of leave which he used for a visit to Ceylon. He took with him two of his collectors and met there General G. W. Walker and his extremely energetic wife with whom he botanized.

At this point in my narrative it is desirable to record what had been the course of Botany in Ceylon after Koenig's visit in 1781 (see pp. 874-5 of the first chapter). I commence, therefore, with another missionary, Joham Peter **Rottler.** As Koenig was the first of the Tranquebar botanical missionaries, so Rottler was the last. Rottler (1749-1836), after an education at the University of Strasburg, joined the Mission (1776) and lived in India for 60 years, for the first half working from Tranquebar and for the second from Madras city. He travelled and collected plants in many places and co-operated with others in making up sets of dried plants which had various destinations. One went to J. C. D. von Schreber at Erlangen and is believed to have been transferred later to Munich; another went to Delessert at Geneva; Wallich received two bundles on his return from his long leave; Wight was able to obtain a set; and in some way, earlier than

Wallich's leave, a set had reached India House which Wallich was allowed to have and distributed as 'Herb. Madras'. It is improbable that one set was like another; the Geneva specimens, for instance, are not to be assumed as of contemporaneous origin with what entered Wight's collections. Rottler at his death had a considerable herbarium which he bequeathed to the Vepery Mission and the Mission sent it to King's College, London; this collection, the college gave to Kew in 1872; but there is a suspicion that it had ceased to be entire. Rottler's specimens were commonly devoid of any locality of collecting.

Rottler made two visits to Ceylon, one in 1788, the other in 1795. The conditions in 1795 were very favourable for collecting, as he had been engaged to travel with Hugh Cleghorn (1781-1834), Private Secretary to the Governor of the island and after that the first Colonial Secretary, that he might serve as interpreter in a tour of inspection. The tour over, he remained to continue the collecting. By arrangement, specimens were sent to India House in 1797. Rottler's biographer, Thomas Foulkes, states that he was informed by Cleghorn's grandson that they were subsequently put into the collection at King's College. Rottler's mastery of Tamil led to the preparation of a dictionary. Of its three volumes only one was printed before Rottler's death; the other two were issued in 1837 and 1839. In the dictionary are to be found the first equatings of botanical and Tamil plant-names. Five years after the third part had been issued, the Tamil botanical dictionary of Simon Casie Chitty came out as a further effort at passing the terminology of Botany into southern India.

But to return to Ceylon, after Rottler the next to botanize in Ceylon was William **Kerr,** chosen by Sir Joseph Banks in 1812 for the management of the Garden in Colombo where he died in 1815, to be succeeded by Alexander **Moon,** likewise chosen by Sir Joseph Banks. Moon moved the government garden to Peradeniya, where he died in 1825. His successor was James **Macrae,** chosen by Lindley; he served from 1827 to 1830. Kerr, Moon and Macrae had graduated for appointment by travel in search of plants for cultivation; and the establishing of such in Ceylon was their first duty. Moon was the best equipped for the work and published in 1824 *A Catalogue of Ceylon Plants* which holds the names of 366 species that he had alive in the Peradeniya Garden, together with the names of plants found outside that he recognized, bringing the total to 1127. Moon made no acknowledgement of help from Europe, but there are specimens in the herbaria of London indicative of correspondence. Macrae sent specimens to Lindley and added also to the collection of dried plants which Moon had started; but Macrae's time in Ceylon was very short. After Macrae's death Peradeniya had in turn 5 care-taker superintendents; one of these was J. G. **Watson,** accepted on the recommendation of Wallich when on leave in London; another was J. G. **Lear,** an employee of the horticultural firm of Knight of Chelsea, who being in Ceylon was locally taken into employment. During Watson's service, the traveller Baron Karl **von Huegel** spent four months in Ceylon. Contact with Watson is not recorded and of the visit little is in print except that he collected and dried plants extensively, as

recorded in a privately printed memoir of 1904 wherein the places that he visited are named; and Bentham visiting Vienna in 1839 saw there the Baron's collections.

Almost throughout the years of these care-taker superintendents General G. W. Walker was in Ceylon; and the General was virtually *in loco parentis* to the Garden.

George Warren **Walker** (——1844) had been Governor of St. Helena and from that island he and his wife had been active in sending plants and seeds to the Glasgow and Edinburgh professors, i.e., to Sir William Hooker and Robert Graham. After a subsequent period of leave, the General was sent in 1830 to Ceylon as adjutant-General, where in unhurried journeys of inspection through all parts of the island, the palanquin bearers who carried him would command his interest by drawing attention to flowers seen by the way, and these the General collected. Wight having gone to Ceylon, as recorded, went on one of these journeys with the General. It is obvious that Mrs. Walker would travel less than her husband; but she ascended Adam's Peak on one occasion and wrote a long account of her experiences which Sir William Hooker printed (*Compan. Bot. Mag.* 1, p. 3; 1835). She did most of the correspondence regarding their plants, but he the business of despatching etc. They looked to Hooker and to Graham for determinations, and sent much to them, enriching at the same time the herbarium at Peradeniya. The General expressed his complete disapproval of J. G. Watson as merely a collector and entirely unable to read the Language of Botany; and he begged that a scientific man should be placed in charge of Peradeniya. Watson certainly collected; and the fact that he obliged Wallich with dried garden plants when Wallich asked for them may be kept in mind in connection with Wallich's selection of him. He sent dried plants also to Lindley. It is not unlikely that the General's protests reached quarters influential enough to secure the appointment of George **Gardner,** the first botanist as distinct from horticulturist to be in charge of Peradeniya.

Wight's visit to Ceylon in 1836 and contact with the General led to an undertaking on Wight's part to name up the Peradeniya collections; and these were entrusted to him for the purpose. Wight then proceeded to supplement the Ceylon material, placing again in Ceylon in 1837 two collectors. If, as seems to have been the case, the whole of the Peradeniya herbarium was packed and sent to Wight, its size at the time would not have been great.

In 1838 another botanist of the Army arrived in Ceylon; this was John George **Champion** (1815-45). He was stationed at first in the centre of the island and later at Galle. He did not meet Wight but they corresponded. Champion was at Galle when Prince Waldemar of Prussia, making a tour of the East, landed at the port of Kalutara which is between Galle and Colombo, bringing with him as his personal physician the young and inexperienced botanist Werner **Hoffmeister.** Champion took the physician botanizing, while the Prince proceeded to Kandy and was shown round the Garden at Peradeniya by the artist Harmanis De Alwis. At this date General Walker was no longer in the island. Threats of war in the north of India had caused his transfer to Madras in 1837, then to Calcutta, then to Meerut; finally,

after a visit to Mussoorie, he and his wife ended at Simla. In 1844, Champion, who had taken the unofficial position towards Peradeniya that had been the General's, corresponded with Wight regarding the loaned collection, and saw that it was back in place for the use of Gardner. Wight evidently had had it for a long time.

Before Gardner's arrival another botanist had reached the island; this was William **Ferguson** (1820-87), a professional surveyor. Gradually he developed a special interest in economic plants, in ferns, and in seaweeds. However, his years of activity really belong to the third period of this history.

George **Gardner** (1812-49) had been a pupil of Sir William Hooker and, when qualified in Medicine, had travelled for 5 years in Brazil. It is interesting that to have travelled seems to have remained a qualification for the Ceylon appointment. It is doubly interesting that an occupant should have been chosen with a botanical qualification. Unfortunately the seeds of ill-health were in him and almost immediately he was obliged to take leave; this he did by returning Wight's visit; he went to the Nilgiri Hills and botanized there with Wight. In 1846, Wight had joined the editorial staff of McClelland's *Calcutta Journal of Natural History,* and now Gardner was added. Griffith had become an editor two years earlier. Gardner now used the opportunity it afforded him of publishing. An editorial staff including Griffith, Gardner and Wight was a strong one botanically; but the financial support which the journal obtained was inadequate. The Asiatic Society of Bengal a few years earlier, manœuvring to finance its output of print by offering for sale separately the scientific and literary papers that it accepted for the *Asiatic Researches,* had observed that it was left with unsold scientific parts when the corresponding literary parts of volumes were sold. This demonstration regarding demand might have pointed to difficulties that McClelland's venture had to face.

Wight's short period on the staff of the journal was almost his only connection with northern India, except correspondence with Wallich and Griffith, so completely did he belong to the Peninsula where his authority in taxonomy extended from Ceylon to Bombay and from Ceylon to the Circars. It was indicated in my first chapter (p. 873) how John Graham accepted that authority; it will be indicated how it was passed on through Gibson and Dalzell; Nimmo's friendship with Wight was built on it; and from what has just been recorded, it is clear how it was established in Ceylon.

Immediately before the illness which led to Wight's holiday in Ceylon, he had had information that his employment was to be changed. He told Walker Arnott that he anticipated a roving life and that it might be for a year or longer. It proved not to be a roving life and it lasted 17 years. He was removed from the Military Department and told to enquire into the state of Agriculture in southern India and to conduct experimental cultivation of cotton, tobacco, senna, sugar, coffee, spices, and madder and to enquire into the possibilities of cinchona. Cotton was put into the front. For a time he resided in Madras city where he undertook the management of a garden started by a new Agri-Horticultural Society and was drawn into the affairs of the Madras Society of Literature and Science,

contributing several papers to their Journal, always such as had an interest beyond his own subject of taxonomic botany. From Madras city he was moved to the Nilgiri Hills and then to Coimbatore. Ten bullock carts were required to move his collections and machinery from the one to the other. Without doubt, he collected much in the Nilgiri Hills; at Coimbatore he was but a short distance from the Anamallai Hills; but C. E. C. Fisher does not find that he collected in them (see *Records Bot. Survey Ind.* 9, p. 5). In 1853, his retirement came. The collections which he then brought to London for final elaboration were in a very large measure made up of southern hill-plants got by his collectors. These plants were distributed from Kew in 1869.

Wight left India too soon to have any part in the establishment of Cinchona. The first individual plant to reach the East was in Java in 1851 and further plants in 1854; it was not until 1860 that planting commenced in the Nilgiri Hills and the establishment there was the work of William Graham McIvor, Superintendent of a Botanic Garden established at Ootacamund.

Further Collecting in Southern India

When in 1828 Wallich brought together all the collections that he could command, he had a small number of species from the Nilgiri Hills collected by Leschenault and a larger number collected by P. J. Noton of the Bombay Mint. In 1827, an association called 'Unio Itineraria' i.e., the Travel Union, was formed in Germany at Esslingen near Stuttgart, with the object of maintaining a collector or collectors of plants in the field whose collections were to be divided among the subscribers. Under the guidance of Ernst Gottlieb Steudel and Christian Friedrich Hochstetter, the Union prospered; they handed it over as a going concern in 1842 to the charge of Rudolp Friedrich **Hohenacker,** to whom it occurred that there might be a market for dried plants from that part of India where Rheede's *Hortus Malabaricus* had been illustrated. Hohenacker sought for but failed to get someone to collect actually in Rheede's country, i.e., near Cochin, but found a missionary, **F. Metz,** resident at Mangalore, 240 miles further north, prepared to do the collecting. Hohenacker could scarcely have been expected to know that Mangalore is outside the climate of Cochin: it is beyond where the second annual peak of rainfall which characterizes the Equator has died away and is where the months of April and May have a dryness that influences the vegetation. F. Metz of the Basle Mission was not a botanist, but a collector ready to earn as much as he could, that he might put up mission buildings. Hohenacker sought for someone in Britain to name the plants when they had been collected, but in vain; and he accepted the services of Frederik Anton Willem Miquel who was at the very beginning of his career. Miquel naturally was slow. The first dividend came at the end of 1847. The plants distributed then are labelled Kanara and may be assumed to have come from within the District of South Kanara. Next, Metz had a short period of collecting about Mercara in Coorg; he was now at an elevation probably not reached at all by men who brought Rheede's plants together. Then the Mission moved Metz to

the village of Keti at a few miles from Ootacamund in the Nilgiri Hills and holding still less of Rheede's vegetation than at Mercara.

However, he had not done much collecting before he decided to cease in consequence of heavy losses between gathering and shipment. He had been a diligent agent whose specimens, indifferent at first, improved as he gained in experience. Some authors quote these specimens as Hohenacker's, which is misleading, for Hohenacker was only an intermediary.

Another missionary was living in Ootacamund when Metz was moved to Keti whose interest in the plants of the Nilgiri Hills was deeper. This was Bernhard **Schmid** (1787-1857). His first place of residence in India was in the District of Tinnevelly. There his health broke down, driving him to the Nilgiri Hills, where, it seems, his botanical interests were aroused. Not wholly recovering, he returned to Europe, taking with him or having to follow him a small collection of dried plants and some coloured drawings. He had been trying to determine what to call his plants by the use of Roxburgh's *Coromandel Plants* and Persoon's *Synopsis,* neither work likely to be really helpful. At the end of the year 1831, Baron Karl **von Huegel,** who has been mentioned already, had reached Bombay, and from Bombay, he worked his way southwards, reaching the Nilgiri Hills in February and botanizing there with Schmid for six weeks. Karl Alexander Anselm von Huegel (1795-1870) was of German ancestry, but Austrian adoption—a great collector who enriched the Vienna Museum considerably by what he brought to it. He records that Schmid conducted him about the country-side and put his herbarium freely at his disposal. Doubtless, specimens still exist which Schmid put into von Huegel's hands. Schmid had a list of 471 species which he recognised and might name to the genus and only rarely to the species. In 1836, he returned to Europe and being a native of Weimar which is only 20 miles from the University town of Jena, it was natural that he should make contact with Jonathan Karl **Zenker,** the professor of Botany in that University. The date and manner of making contact is not known; but the result was that Schmid gave to Zenker the materials from which Zenker published in 1845 a decade of *Plantae indicae quas collegit Bernardus Schmid,* followed by a second decade in 1847. Zenker died in 1848, and there were no more decades. The botany of the two published was entirely Zenker's; and Zenker had had to build on to the original drawing by dissections and perhaps sundry details. Zenker has been accused of disregarding the work of others assuming novelty for whatever he had.

At the time of von Huegel's visit to the Nilgiri Hills, a resident medical officer was preparing a guide-book, his name R. Baikie. Von Huegel helped him by supplying notes on the climate and vegetation, posting them back to Dr. Baikie from Ceylon, to which he proceeded after leaving the Nilgiri Hills. These notes were incorporated by Dr. Baikie in the text of the book *Observations on the Neilgherries* (1834); Schmid provided his list of 471 species and Baikie appended it together, with three coloured plant-portraits. If the three portraits represent, as is probable, the foundation that Zenker had for his plates, a good deal of each of Zenker's plates was due to Zenker. Schmid returned to Ootacamund in 1845 and remained there for the rest of his

life. Before returning he visited London and called on Sir William Hooker at Kew. This visit resulted in a promise to give dried plants to Sir William, who provided the drying paper; and it is recorded in the *Kew Bulletin* (1901, p. 52) that Schmid sent nearly 1,000 during the next few years. He sent lesser numbers elsewhither: Urban records (*Jahrb. Bot. Berlin*, 1, p. 61; 1882, mis-spelling Schmid's name) the receipt in 1848 of 41 specimens; and it is recorded by Thomas Thomson that the Calcutta Garden received a bundle. In 1857 Schmid, aware that his life was near its end, asked Sir William Hooker what he should do with specimens still in his possession and was advised to offer them to Hohenacker. If Hohenacker received them, they were added to Metz's plants. It is apparent that the greater part of the flowering plants which Schmid collected are now in the Kew herbarium. Schmid had been collecting ferns and mosses. Just before his death he received a list of determinations of ferns that he had sent to Gustav **Kunze**, the Professor at Leipzig, and forwarded it to the Madras Society of Literature and Science. It was printed in their Journal (19, p. 79: 1858). His family received soon afterwards a list of mosses determined by Johann Karl August **Mueller** of Halle; and this list appeared in the same volume (p. 84).

In the year of Schmid's death a second edition of Baikie's guide book appeared, edited and much altered by W. H. Smoult, but Schmid's list was unaltered. Smoult was a man of Calcutta, interested in economic plants.

The following were collectors of plants in the Nilgiri Hills of Schmid's time:—Sir Frederick **Adam**, Governor of Madras from 1832 to 1837; two missionaries, Thomas **Foulkes** and another named **Weigle**; and the energetic 'botaniste-agriculteur' George Samuel **Perrottet** of Pondicherry. The first two sent their collections to Sir William Hooker; the third collected the mosses that reached J. K. A. Mueller; and the collections of the last were on sale in sets in 1853 and 1857. Perrottet's were by no means all from the Nilgiri Hills; he collected widely, even up to Bombay.

Metz's collecting in Coorg has been mentioned. He was not the very first to interest himself in the flora of Coorg, for in 1811 a surgeon named David **White** published an account of the Cardamom cultivated along the Ghats (*Trans. Linn. Soc.* 10, p. 228). Rottler in some way obtained plants from Coorg. In 1834, the State was extensively explored by Captains William **Munro** and George Stevens **Gough** who made rather large collections. William Munro (1818-80), ultimately a General, began his collecting in India in Coorg and continued it in many other parts of India until 1848, when he took considerable collections to London to work up with the help of Bentham. Previously, he had given specimens liberally to Wight and Griffith. George Stevens Gough, later the second Marquis Gough, appears to have done more collecting than what he did with Munro in Coorg and in the Nilgiri Hills. There are other collectors of south-western India who need naming. One was Charles **Mitlett**, a tea-merchant who yearly spent the tea exporting season in Canton, but between the seasons was able to travel back to Ceylon or Malabar: little is recorded of what he collected in these places, but of what he collected in China much (see Bretschneider, Hist. European Bot.

Discoveries in China, p. 288; 1898). Another was Thomas **Lobb**, an employee of the horticultural firm of Veitch: he in 1848 collected showy plants on the western side of the Ghats and in Mysore. A third was the Rev. E. **Johnson**, who resided in Travancore and contributed a list of orchids, which he had found, to the *Madras Journal of Literature and Science* (19, p. 215; 1858).

In Ceylon a great interest in the ferns arose, and three men became specialists in these plants. One was Sir William **Norris** (1793-1859) who had been in Ceylon as Puisne judge, then Recorder of Penang, and lastly in Ceylon again as Chief Justice. He did not confine his collecting to ferns; but they were his greatest interest, and he sent his difficulties to Sir William Hooker for determination. The other two were in business in Colombo, George **Wall** (? 1821-94) and Thomas W. Naylor **Beckett**. They became friends of Thwaites when he succeeded Gardner as Superintendent of the Peradeniya Garden, and worked conjointly at the ferns with him. The collection of Beckett is at Liverpool.

The zoologist Thomas Caverhill **Jerdon** (1811-72) collected plants in many parts of southern India and retained his collections until his death, after which they were given to Kew.

John **Campbell**, an army officer, brother of William Campbell, who was the first secretary of the Edinburgh Botanical Society, collected during the years 1835-37 about Hyderabad and in the Circars, and sent plants to Wight.

'The Assam Delegation'
to Enquire into the Possibility of a Tea-Industry in North-Eastern India

For a century before the foundation of the Calcutta Botanical Garden, merchants had known that it was possible to obtain seed of the tea bush and grow the plant, but that the production of commercial tea did not follow. And so it was that the bush was brought into the Garden soon after its foundation as something of interest and then introduced afresh by Lord Macartney's Embassy to China in the year of Kyd's death (1793), certainly then with an emphasis on possibilities. According to **Wallich**, whose knowledge of the Garden was not contemporary with either of its introductions but began in 1807, the bush as he knew it from that date to 1828 was always sickly; but did not die. Merchants in India perhaps took no interest whatever in its presence in the Garden; but they could not forget what large profits would follow successful production of commercial tea in India. Govan, when superintending the Saharanpur Botanical Garden, advocated trying tea there. But India got no further. It was in London that a movement was started; a Mr. Walker, a member of the East India Company, moved the Company to action; he had read in the library of the Company at India House Francis Buchanan's account of the raising of crops in the Shan Hills and of trade in the leaves to the Burmese; and he had found in a copy of Don's *Prodromus Florae Nepalensis* that Edward Gardner, when Resident in Nepal in 1820, had found there a bush in cultivation and had sent a twig to Wallich in Calcutta (see Communications Relative to the

Cultivation of the Tea Plant in India, (1839). As Wallich was in London when Mr. Walker moved the Company, he was asked to comment; and along with informing the Company that the bush was unhealthy in Calcutta (he did not diagnose the cause), he suggested that suitable situations might be found in the mountains of India, perhaps in Kumaon, Sirmur or Garhwal, 'corresponding entirely with those in China and Japan in which the cultivation of the tea shrub is carried to the greatest extent and perfection'. The Directors put the papers, including Wallich's memorandum, into the hands of Lord William Bentinck, who had just been chosen to be the new Governor-General; and he on his arrival in Calcutta in 1833 laid them before his Council with a recommendation for attention. Wallich by this time was back in India and became inevitably one of the members of the 'Tea Committee' which was nominated by the Council to formulate proposals for action. The Secretary of the Committee was a merchant, G. J. **Gordon.** The mercantile community was further and well represented. One of the official members was James William **Grant** (1788-1865), a man of wide interests whom I shall need to name again. He was the Grant to whom Griffith dedicated his genus *Grantia;* and he was for a short time, two years after nomination to the Tea Committee, in temporary charge of the Calcutta Botanical Garden. The Tea Committee first of all sought advice at Saharanpur from Hugh **Falconer** who had succeeded Royle; and Falconer advised exactly as Royle would have done that trials should be made in the near-by Himalaya, 'from Dehra Dun up to 3,000 ft.'. Wallich concurring pointed out the presence there of his seed collector, Robert **Blinkworth,** who could be made available to assist. So he was; and it seems that he was involved in planting in Kumaon or Garhwal to the end of his life. As a second recommendation the Tea Committee asked that seed be procured from China; and it was decided that Gordon should go to get it. Wallich thereupon volunteered to act as secretary and was appointed to do so, being thus brought to the very centre of the Committee's business. He offered to go to the north-western Himalaya, where he would have made extensive plans for the receipt of what Gordon was to get; but the Government decided that this was not necessary. Plans were made for the distribution of the seed to come from China and most of it was to go to the north-western Himalaya; the Nilgiri Hills were to receive a fair quantity and the balance was assigned to unspecified places in southern India. What arguments were adduced to give second preference to the Nilgiri Hills cannot be stated. Assam was not thought of; then suddenly it came into view, by the discovery that a rumour of several years earlier that tea actually occurred there was founded on fact. The story of the discovery is complicated by the number of men who had a part in it.

In 1823, a certain Robert **Bruce** travelling up the Brahmaputra, as others were doing, on the look out for a business opening, was successful in getting into relations with a Singpho chief; and from the Singphos he learned that they prepared for themselves a tea locally. As he told no one, his position remains somewhat shadowy. In 1824, the first Burmese War broke out. Many an officer during the fighting and exploring would have had a chance of learning as

much as Robert Bruce had learned; and it would seem that it was then that the rumour referred to above reached Calcutta. But the only record of this rumour is in a much later circular of the Tea Committee. The Governor-General's agent on the North-eastern Frontier in 1826 was a capable officer by name David **Scott**; and into his possession came a leafy twig from Manipur, said to be of a shrub which gave tea. This he sent to Calcutta. A statement that it came from Tezpur was an error. Wallich with caution decided that the specimen probably represented a species of the genus that gives tea, but not the tea bush itself; and he put it away as *Camellia* (?) *scottiana*. Scott died without doing more. Pemberton afterwards told Griffith that this plant was only known from one spot, which may well have been true as to the knowledge; but according to Sir George Watt, who explored in Manipur in 1883, there is much wild tea in eastern Manipur.

When the Burmese War broke out, a younger brother of Robert Bruce, **Charles Alexander Bruce,** arriving in India as part of the personnel on one of the Company's ships, volunteered for war service and was given charge of a gun-boat or gun-boats on the Brahmaputra; and he remained in Assam after the war, policing the upper waters of the river. In 1831, he passed under the orders of a new political officer, Captain **Charlton.** The two from this date took parts in the exposure of Tea in Assam that can scarcely be distinguished. While it is evident that Bruce had opportunities of knowing more than Charlton by reason of longer residence, Charlton had the administration in his hands, and whatever knowledge there was to be passed on passed through him to the Governor-General's Agent at Gauhati. This was Francis **Jenkins** who had succeeded David Scott in the position. According to C. A. Bruce, the Singphos reminded him of his brother's interest in the Tea. Robert had died. Records show that Charlton had a knowledge of the presence of Tea at least in 1832, for in that year he wrote to Jenkins regarding it and, more than that, he tried to send a living plant to the Calcutta Garden. Wallich presumedly had not yet returned, and Charlton tried to get it to its destination by the services of the surgeon, John Tytler, but he failed.

Charlton brought seedlings into his garden; but this may not have been until 1834. The Singpho village of Bisa in the Lakhimpur Frontier Tracts near the Burhi Dihing river is likely to have been the place whence they came, for Bruce appears to have been familiar with the growing there. It is 30 miles in a straight line from Sadiya. Charlton who had submitted specimens to Jenkins in 1832, submitted more in 1834. Dr. H. H. Mann suggests (in 'Bengal: Past and Present,' 72, p. 11) that Jenkins had asked for them which is extremely probable, for it is certain that neither Charlton nor Bruce had clear ideas of the importance of the presence in Assam of the Tea bush.

Charlton sent leaves to Jenkins in May and leaves with fruit in November. These Jenkins forwarded to Wallich who determined them as representing *Camellia theifera*, the true source of Tea. He immediately informed the Tea Committee (24 December 1834), and the Committee recommended that a Delegation be sent to study the conditions under which Assam produced it, Wallich to be in charge with another botanist and a soil expert to support him, the botanist to be

William **Griffith** and the soil-expert John **McClelland.** Jenkins expected that the area of the Tea bush in Assam would be found to be the margin of the tea-growing area in China and had ideas of using the occasion for ascertaining the nature of the country of northern Burma and towards Yunnan.

William Griffith (1810-46) was mentioned in my first chapter (p. 876) as having been brought to Wallich in London by his teacher Lindley, and as having drawn up accounts and made illustrations which Wallich put into his *Plantae Asiaticae Rariores.* Wallich was so impressed by Griffith's ability that, on learning that he was about to sail for India, he made up for him a small bundle of named plants to help him to recognise species which he was sure to meet. Griffith then reached Madras already with a reputation. From Madras he was sent to Mergui and he was in that distant post when wanted by the Tea Committee.

John McClelland (1805-85) had joined the medical service in India in 1830 and was in Kumaon, when he likewise was wanted. His interest was in Geology; but at times in his career he turned botanist and collected rather considerably; in 1849 he did this in the Bengal district of Birbhum and in 1855 in Lower Burma. The two young men, Griffith 24 and McClelland 29, were ill-matched with Wallich, who at 48 was old for his years.

Francis Jenkins (1793-1855, ultimately a Major-General), after proving his ability as an administrator at Nagpur, succeeded to the post of Agent to the Governor-General at Gauhati in Assam. He would have the Delegation cross the Khasia Hills and he would send them from Gauhati up-stream; but that was not all; he sought to arrange that a party would come to the Assam border from the Residency at the Burmese Court to meet at the frontier a party that he would send from Assam. As it required a little time to get Griffith to Calcutta, Jenkins had time for planning. Finally Wallich, Griffith and McClelland left Hugli by boat on 31 August 1835, to thread the Gangetic delta and then the jheels of Sylhet to Terrya Ghat, whence they climbed to the plateau, Griffith both in the jheels and on the plateau meeting a vegetation the like of which he had not seen before and collecting with that intensity which was his, Wallich to whom the plants were not altogether new relatively indifferent. Disastrously, Wallich had not brought enough drying paper, and a quarrel resulted when Wallich deprived Griffith of his means of collecting. McClelland seems to have silently sided with Griffith, as he saw Wallich removing Griffith's specimens from the plant-presses to make room for his own. Wallich afterwards could write generously of Griffith (see for instance in Hook. Journ. Bot. 1841, p. 192); but Griffith never forgave Wallich, though in his private diary he wrote at the time the excuse for Wallich that he was ill, and when ill was irritable. Griffith had already planned his own 'Flora Indica'; and this could have irritated Wallich, for Wallich would not forget his own failure to produce an extended edition of Roxburgh's *Flora Indica.*

During the assembling of the Delegation, Gordon returned from Canton with the first of the several consignments of Tea seed that he was destined to procure. The missionary G. Gutzlaff had helped him and was in a good position to do so for he served the Chinese

Inspector of Trade as an interpreter. Of this first consignment of seed, 20,000 were set aside for Assam and 20,000 for the north-western Himalaya; the balance, which was small, was allotted to the Nilgiri Hills. An attempt to forward the consignment in a germinated condition was made, possibly with injudicious haste, and the seed for Assam arrived the worse for that at their destination, Sadiya, early in 1836. The Delegation must have been in the Khasia Hills when the seedlings left Calcutta; its three members arrived at Gauhati on 23 November 1835, and left for Sadiya nine days later, reaching Sadiya 16 January 1836, just ahead of the seedlings. Before that date, Charlton had had the misfortune of being wounded in repelling a raid into the valley, and he was in hospital, Bruce being in charge of affairs. Charlton's garden with the transplanted tea plants in it was a mass of weeds and its fence broken through by straying cattle; however, the young plants were there for the Delegation to see. Bruce took the Delegation forthwith to Bisa, where two areas were examined. On the way back to Sadiya another, 12 miles above Sadiya, was visited. Next, a site for a nursery for the seedlings from China was selected, the position being Saikhoa (alias Chykwa) within a few miles of Sadiya. Bruce then took the Delegation to the Muttack country on the east side of where Dibrugarh now is; and for more than a month they wandered very uncomfortably from one area where the Tea bush was to another. Lastly they went down stream and visited an area in the neighbourhood of Jorhat. McClelland, whose report on the soil seems to have been excellent, thus got the facts on which to form his judgment. Griffith thought that Bruce's knowledge was superficial and in this doubtless was right; Bruce grew knowledgeable later. As soon as the Jorhat area had been seen, Wallich, extremely anxious to get away from what he thought would end his life, went down stream, taking Bruce with him, the others of the Delegation thinking that Wallich had left them behind with the intention of excluding them from a hearing. They made a short expedition into the Naga Hills; and then Griffith passed under the direct orders of Jenkins.

When Bruce had cause in 1839 to report to the Tea Committee on subsequent work, he gave a map showing in how many further areas he had found the Tea bush.

By Jenkins's arrangements Griffith was to join the exploring party for the Burmese boundary in the next cold weather; meanwhile he was established at Sadiya, and stayed there except for an attempt made with Jenkins's approval to penetrate the Mishmi Hills along the beginning of the route which Wilcox had used when in 1827 he succeeded in establishing the volume of the Irawadi at Manchi and therefrom the not altogether remote position of its origin. Griffith, however, was very soon turned back by want of porterage, but not without considerable collections. Immobilized in Sadiya by the rains, he threw his energy into detailed examinations of the plants about him, carrying his investigations as far as his microscope could take him in accordance with a habit that he had formed either at, or more probably before, coming to India and now, with the lure of his 'Flora Indica' ahead, intensified. At Mergui, his regimental duties had been light enough to have allowed him to commence collecting these

descriptions; at Sadiya he had nothing to prevent him from getting on with them until in February 1837 came the time for joining the party for the Burmese frontier. It was led by Major A. White. Griffith, before he started, examined the nursery of Tea seedlings at Saikhoa and found the last of them perishing. Major White's party ran into great difficulties; for that reason it could not keep together but trailed out; and the forward part got to the top of the Patkoi Range with the hinder part unable to catch up. Griffith was in front when a messenger arrived to say that the party from Burma was not far away. This party was led by Dr. George Thomas Bayford and had been two months on the way. It was to be another two months in getting back. There was a meeting between it and the front of Major White's party on 5 March 1837; but the transport had got into such a state that both parties had to go back, and Griffith's extremely forward position made it expedient that he should join the Burmese party rather than go back as Major White did; he and Bayford therefore went to Ava. It was a wonderful journey: the track was not unknown, but was through lawless country and uncivilized stock, by habit resentful of strangers, though perhaps opportunely rather cowed by the tramp of armed men through the hills during the fighting of the Burmese war. Passage had to be bought, Griffith says, expensively. A remark by McClelland in an obituary notice that 'Griffith travelled with only one servant' has been misinterpreted into 'travelled with only one companion'. It was not so; but he travelled in a very small party and must have foregone largely the making of collections. Yet he collected even in the Hukawng Valley which he crossed, then reached the limits of Chinese seeking amber and jade, and so Mogaung, from which place transport by water was available. Griffith got the Tea bush once; and Captain S. F. Hannay, a member of the Assam party, when he had been in Burma earlier had seen it once, so that the journey seemed to confirm Jenkins's idea of continuity between Shan tea growing and Singpho encouragement, the Singphos finding it worth while to fell rival shrubs to increase their limited supplies—the occurrence natural, the local abundance consequently artificial.

From Mogaung to Ava, Griffith and Bayford used water-transport and reached the end of their adventure in May.

Griffith's diary, reproduced as pp. 60-108 of the appropriate volume of his *Posthumous Papers*, gives in detail what he saw on his journey and pp. 115-145 give a report which he made to the Government.

Griffith must have remained for several months in the neighbourhood of Ava; then he descended the Irawadi to Rangoon, taking along with him considerable collections. He contrived to reach Calcutta by sea in May 1838. After the manner in which Wallich had left him at Jorhat, breaking up the Delegation, he had not expected to be required to make a report on Tea, but he was asked to do so. Complaining that the facts were no longer fresh in his memory and that the collections of the Delegation, which had been for two years at Calcutta in Wallich's possession for study, had not yet been got into such order that he could profit by them, he obeyed the demand and reported to Wallich who sent the report to the Agri-Horticultural Society for publication (*Trans.* 5, pp.—85). In it,

Griffith, on data much too meagre, sought to argue that the genera associated with the Tea bush in Assam, by occurring also in the tea tracts of China, showed the bush endemic in both places. He was disappointed that Wallich had not cleared the ground for him.

Griffith's connection with Tea ceased with the report. On the other hand, C. A. Bruce had become wholly absorbed; his activities may be judged by a pamphlet printed in 1838, entitled *An account of the manufacture of Black Tea as now practised in Saddiya* and by a report which he sent in 1839 to the Tea Committee which distributed it, and the Asiatic Society of Bengal printed it (Journal, 8, p. 1297), as also the Madras Society of Literature and Science (Journal, 10, p. 169). The number of patches or plantations under his charge becoming too numerous, they were divided into two groups, half under him and half under John White **Masters** who had been Head Gardener in the Calcutta Garden under Wallich. Next, the Assam Company having been established, the Government made over the larger part of the patches to its care, glad to be freed from what was under them a costly undertaking. The Company retained Bruce and Masters until 1843 and then tried new controls. Masters went back into the service of the Government and became sub-assistant under Jenkins in the Nowgong District in which position he made an expedition into the Naga Hills and on it collected plants which were sent to Calcutta. Later he was Extra Assistant Commissioner of Golaghat and when he retired in 1862 was awarded a special pension for 'his very high character as a public officer'.

Jenkins caused large collections of dried plants to be made about Gauhati. Under him at that place as the Government Apothecary was Charles J. **Simons** who collected both in the valley and in the Khasia and the Mikir Hills. The earlier of these collections were sent to the Calcutta Garden, the last to Sir Joseph Hooker. Jenkins obviously helped Thomas J. **Booth** to make his horticultural expedition from Bishnath into the hills of the Daphlas at the south-eastern corner of Bhutan. Booth had been sent to India by his uncle Thomas Nuttall, the eminent American botanist.

Griffith's Further Service

Griffith was not allowed to stay long in Calcutta after his return from Burma, but was detailed to accompany the Mission of Captain Robert Charles Boileau Pemberton to Bhutan. Again he left Hugli by water on the last day of the month of August; this was exactly three years from his earlier departure. He chose to cross the Khasia Hills again, as he had done with Wallich, but varied the route. From Gauhati, he went with the Mission which penetrated the mountains northwards to a depth of about 80 miles, then turned west and crossing high passes, one of 12,500 ft., regained the plains by the Buxa Duars as the rains of 1838 were commencing. Jenkins would have liked to keep Griffith in Assam; but the Governor-General, Lord Auckland, had other work for him and attached him to the army of the Indus which was preparing to march on Kandahar. Lord Auckland expressed the wish that the military authorities would give Griffith every liberty consistent with safety.

So Griffith, leaving Calcutta, went over the northern plains to Ludhiana from which he wrote that he would rather be in Lower Bengal than in a sandy place where the flora was so sparse. He followed the Sutlej to the Indus and the Indus to Shikarpur; then went with the army through the Bolan Pass to Quetta, botanized all the way to Kandahar and from Kandahar to Kabul. When he left Afghanistan, it was by Peshawar. If a map be consulted it will be seen that he went round the central massif, not through it; but he reached considerable heights in the north-western parts of the country. When the army was being withdrawn, he asked leave to remain with surveyors who were finishing their work; and this was granted. He stayed until it was unsafe to stay any longer; and the last part of his exploring was in the latitude of Kabul, which he examined very thoroughly. Unfortunately he had a long illness during this extension of his time, suggesting that his excellent constitution was not completely proof against the strains that he put on it. He made many friends among the officers who were prepared to collect for him; otherwise he engaged local men to collect and bring plants to him. It is noteworthy how many of the officers who collected were men of note for their ability. These he records as giving him dried plants. Firstly the surgeon David **Ritchie** (1809-66). He had been a pupil of Robert Graham in Edinburgh. His service during this war took him to Herat whence he brought a collection to Griffith. Griffith, whose travels towards Herat ended at Kandahar, was particularly grateful for this, which, he remarked, proved to him that the flora of even the hottest parts of Afghanistan is European in character. Ritchie, though he published nothing, remained a collector through the rest of his Indian career, collecting in Bombay, Sind, the Punjab, and Central India, and the herbarium which he built up was given after his death to the Royal Botanic Garden, Edinburgh. Another co-adjutor was a surgeon on the Bombay staff named **Grant** who brought plants from Saighan to Griffith. Griffith acknowledges also the services of Captain E. **Sanders** who continued to collect for him until his death, shortly before Griffith's, and of Lieutenants Thomas **Hutton,** an excellent zoologist, and Henry Mortimer **Durand,** afterwards knighted for his eminent services. Sanders had collected for Griffith between Kandahar and Herat; and these specimens would have linked up with Ritchie's, but were lost in fording a river. Hutton and Durand collected chiefly about Quetta.

Griffith was not a man to miss an opportunity, and on his way back to Calcutta he doubled his easier marches to provide time for diverging northwards to Simla and Mussoorie, and southwards to Jabalpur. But the season was mid-winter and not good for collecting the flowering plants, though both divergings afforded him a glimpse of country that on no other occasion he could have seen. He had suggested travelling within the mountains the whole way from Kabul to Simla, but that was disallowed. Evidently by visiting Jabalpur, he enlisted the help of Donald **Macleod** who was at the time Principal Assistant to the Commissioner at Jabalpur; and Macleod made a collection for him. William **Munro,** mentioned earlier as having commenced collecting in Coorg, was about this time at Agra whence he sent specimens to Griffith. Griffith, unable to visit Nagpur

himself, sent a collector to that place. Further he had material thence from Markham **Kittoe.** Kittoe earlier had been sent from Orissa to enquire into a report that coal was available inland; he collected then and at various places at various times between the Circars and Nagpur.

Another illustration of Griffith's intention to get collections from places that he could not visit is his sending of collectors from Calcutta to Darjeeling in 1843. He kept a personal collector for years in the Khasia Hills. All this was done to make his 'Flora Indica' as extensive and complete as possible. He relied on Wight for the Peninsula.

When Griffith had arrived in Calcutta from Afghanistan, he occupied himself in sorting and arranging his collections, eliminating to some extent duplicates from which Sir William Hooker and Lemann profited; but Lemann passed what he received to Bentham. Meanwhile he was appointed surgeon at Malacca, an appointment which pleased him as promising leisure, and a delightful flora. The forest began only four miles from the town and from his dwelling he would see the alluring outline of Mount Ophir. Within a very short time of his arrival at his station, Sir William Norris came from Penang to botanize with him on that mountain. In 1842 Wallich's health gave way and Griffith was summoned to Calcutta to take charge of the Garden. Wallich's departure was urgent; and as time was needed for Griffith's journey **Voigt** was invited from Serampore to bridge the gap. Griffith arrived at the beginning of December 1842. It was a bad day for the Garden when this happened, for he proved to be quite unsuited: he destroyed its amenities as a pleasure garden because it did not satisfy him as a taxonomic chart: he declared that the association of the two are incongruous. The consequences of what he did are given in the next section. His acting appointment lasted for exactly two years, save that he was only on his way to Calcutta during the first three months. Wallich returned from his leave in August 1844. Griffith, released by his return, remained in Calcutta, busy with his own affairs, mainly the arranging of his collections, preparing them for despatch to Britain where in the leave which could not be put off much longer, he would work on them towards his 'Flora Indica'. More duplicate material was eliminated to the benefit of Wight and Gardner in Ceylon. He arranged serially his Assam species under numbers 1 to 1,460, his Bhutan species 1 to 1,191, and his Afghan species 1 to 1,275. It would seem that the names of the actual collectors disappeared in the arranging. What happened to subsidiary localities is not evident. Then in December 1844 he returned to Malacca and had scarcely taken full charge of his duties when he was taken ill; and died (9 February 1845) from, it would be, those fell consequences of malaria that killed Jacquemont.

Wallich's Second Period of Service and the Destruction of the First Calcutta Botanic Garden

It is necessary to return to the year 1832, that is the year when **Wallich** resumed his post at the Calcutta Botanical Garden. This he did with diminished success, which may be attributed to a

loss of health. My preoccupation, consequently, at the commencement of this section is Wallich's health. He had been declared ill at different times; he had been driven out of India in 1812, when he took a voyage to Singapore. His health was given as a reason for his taking leave in 1828. In 1830, Sir William Hooker wrote of him as 'greatly enfeebled by twenty years of incessant bodily and mental fatigue' (*Bot. Miscel.* 1, p. 42). Griffith in 1836, when with him on the Assam Delegation, recorded that he could not sleep and was in a nervous state, fearing that he would not return from Assam alive, and that his marches were so short as to be of only five miles. At the end of the Delegation, he almost fled from the country. Minutes of the committees on which he served tend to record absences. In 1842, he was driven by ill-health out of India and went to the Cape. When he returned in 1844, it was for no more than two years of work. Wight in 1845 wrote 'Wallich's botanical day is over'. In 1847, he left India for the last time. During the few remaining years of his life he distributed with Bentham's help a residuum of the great collections that he had handled so well during his leave of 1828-32. He died in 1854. The above justify the conclusion that Wallich, after returning from leave, was not the man that he had been.

I have had occasion to refer to his quarrel with Griffith. Rather unwillingly I have to refer to another, because of its bearing on happenings to the Garden. In the month of August, 1838, Wallich demanded the dismissal of his head gardener, J. W. **Masters,** accusing him of gross misconduct in abetting attacks on the management of the Garden. Masters protested; but the Government replied that discretion in the matter was with Wallich. And Wallich got his way.

John White Masters (*c.* 1792-1873) had gone to Calcutta to help in the carrying on of a school; at a date after Wallich's return in 1832, he was engaged by Wallich as Head Gardener in the Botanical Garden. After his dismissal he went to Assam and was given charge of Tea plantations as has been recorded (p. 61). When recording it, I called attention to the high character that he had. It is not possible to judge between Wallich and Masters; but it is necessary to note that Wallich was under criticism.

A writer called him 'Wallich who goes somewhere every year' implying neglect of his charge by absence; and the statement at one time was not untrue: in 1826, he had travelled through the sub-montane forests of Oudh; in 1827, in the teak forests of Burma; in 1828 he took leave and was away till 1832; in 1835, he was in Assam. But he had not been away between the Assam Delegation and the year of the dismissal of Masters. In the issue of McClelland's *Calcutta Journal of Natural History* of July, 1840 (1, p. 302), Wallich was editorially accused of neglecting the Garden; it is not said in what way. In the issue of July 1841 (2, p. 288), a more precise accusation is made. Wallich had reported to Government at the end of 1840 on what he called 'the exertions and progress which have been made during the last five years', detailing at great length the number of living plants sent out. The list is long enough to justify a remark that Royle printed at this time (Essay on the productive resources of India, 1840), to the effect that the influence of the Calcutta Garden

had altered the horticulture of Bengal; but what the reviewer in McClelland's journal wrote was: 'Dr. Wallich seems unfortunately to be impressed with the idea that the introduction of plants into the Botanic Garden and the neighbourhood of Calcutta is the great object of the institution'. The reviewer develops only one complaint: it is that the Garden had ceased to have any field parties out collecting seeds and plants; but he means to say 'whatever the activity in horticulture, there is inadequate botany'. As already recorded, Wallich's health broke down so completely in August 1842 that he left India hastily and Griffith arrived towards the end of the year to act for him. **Griffith** immediately wrote a report on the Garden; and we, trying to read history, bringing the two fault finding statements in McClelland's journal alongside this report and remembering the intimacy between McClelland and Griffith, become convinced that the McClelland-Griffith combination issued the unsigned accusations. We may therefore examine Griffith's report and form an opinion on the accusation that Wallich had 'neglected' the Garden, which, I think, must be that ill-health had taken the energy out of Wallich, who was passing into a condition of marking time. Griffith arrived in Calcutta to act with his mind made up; he knew what he wanted. Printed copies of the letter that he wrote asking approval for what he would do bear the date 1 May 1843. But printed in his *Posthumous Papers* is a letter from him to Wight, dated 23 January 1843, which must have been written before the other. However, the month is of small importance. In the letter to Wight, Griffith tells him that he had the sanction of Government for his alterations; turning to the other letter we find the proposals. The Garden, he states, was 'literally choked with trees', some of them mutilated and some fallen. The students of the Medical College came weekly for a lesson in recognizing the sources of their drugs and for them the medicinal plants were labelled in Bengali; but otherwise there was no labelling. It had been a custom to dry specimens cut from plants when they flowered in the Garden and preserve them in a reference collection kept in a seed-shed where they could be looked up if the name of any plant were questioned. The plant names were otherwise retained in the memories of the older and more experienced staff (or misremembered). But Griffith found that the safeguard had been allowed to get into disorder. It had existed from early days, broken up by Wallich when he went on leave, renewed on his return, and then disordered. Griffith, rightly convinced of its importance, had the Garden collected over and not only made up a Garden set, but caused four others to be made which he was prepared to deposit elsewhere. Of the specimens which Wallich had had dried after 1832, Thomas Thomson said the labels showed that Wallich had had trouble in deciding what the names should be, so confused had the Garden records become. Griffith stated that the library was also in disorder. Yet again, Roxburgh had laid out a Linnaean garden, i.e., a border of selected plants spaced to exhibit the Linnaean System of Classification; and it, too, had been in disorder before Voigt took over. It is very easy for such borders, where annuals are likely to be common, to get out of order by the scattering of their seeds with a consequent volunteering in wrong positions. Griffith says so much of disorder

that his indictment was serious; and he could scarcely say so much without foundation. He asked for fundamental changes as well as corrections of what had gone wrong. He would gather into one place nurseries that were scattered about the grounds; he would replant so as to get related species in apposition and have a garden of the Natural System to contrast with the Linnaean System, as well as formal flower beds; he would fill the many small tanks with earth taken from one single large tank; the surface left over would be allotted to trees planted like with like; above all, he would build up a working herbarium—a public herbarium, he called it—in the top storey of the Superintendent's house, placing it there because the situation was airy. Roxburgh had asked for that top storey that he might very largely live in it, and it was only accessible through the lower private quarters of the house; Wallich had stored his dried collection in the basement, which one must say was thoroughly unsuitable but completely accessible. As to the reference collection in the seed-shed, Griffith asked that the Government would give 'rigorous orders' for its strict maintenance. Towards the 'public herbarium' he put aside a quantity of his own duplicates. He would increase it by sending out collectors, selecting them out of his staff; and he would do all without asking for additional funds. Of these proposals, he wrote to Wight: 'The Government have approved all my suggestions and plans for improvements of the Garden. My plans are for a Natural Garden (i.e., a border exposing the Natural System) flanked by a garden of medicinal plants and a garden illustrating the useful plants of Lower Bengal. The first will occupy a large circle or ellipse with interior circles or ellipses, the central, the smallest, for Acotyledons; the second for Monocotyledons and the two outer for Dicotyledons. Whatever this arrangement be, the same will be that of the flanking gardens. The situation in front of the Conservatory will be convenient for the Natural garden—trees and large shrubs will not be admitted; but they are to occupy other parts and be in groups of Natural Orders and Classes'. Then he adds: 'I apprehend, however, that all my labour will be thrown away for want of time to complete the work before the period of my acting appointment expires'. Then why did he begin it? His apprehension was right; Wallich returned in August 1844, and the work stopped. Griffith must have had to enlarge the open place in front of the Conservatory to accommodate his circles. Now these were in the full sun, trees excluded; and trees are the natural clothing of the land in a climate as that of Calcutta. Griffith had not thought things out; the shade loving ferns had a central position; and we find him later admitting to Wight that he was short of ferns that would tolerate the position. The impracticability of Griffith is evident.

Griffith found his teaching work heavy. He was of course new to it. He realised the need of a local Flora for the students, and suggested that he would write one. Such a work by Griffith would have been in the Natural System; but the Calcutta students were doomed to the Linnaean System for yet a very long while.

Wallich having resumed charge, Griffith moved into the residential part of Calcutta and busied himself until December completing the arrangement of his collections and packing what he would need in

London on the leave that he was anticipating. He had undertaken to get Voigt's *Hortus Suburbanus Calcuttensis* printed and had to see that through the press. His friends noted signs of bodily wear, but his mind was as vigorous as before; he warehoused his collections, married and went to Malacca where at once he reorganized his collecting. Then he became ill and rapidly worse. Alarmed at the prospect of the collapse of all his hopes, he willed the materials that he had assembled, dried plants, plants in spirits and copious notes, to the Company whose officers had encouraged him to go so far. It is interesting that transfer by will was required, and very interesting that he was individualistic in suggesting no botanist to take his work up. Wight, as soon as he heard of Griffith's death, suggested that a full set of Griffith's dried plants should be retained in India at Calcutta and even offered to mount the specimens. Like Griffith, he wished to see a public herbarium at the Garden. The Government accepted the printing and ordering of Griffith's notes and drawings and the making available of his collections of dried plants without specific plans for maintenance; and they entrusted the work to **McClelland,** Griffith's most intimate friend after Wight. Wallich becoming ill again, it was convenient to put McClelland in charge of the Garden temporarily, for he needed the Garden's artists and the Garden's facilities for arranging Griffith's material. Griffith, had he lived, was to be Wallich's successor; on his death the choice fell on Falconer who at the time was in Britain on leave, the length of which was extended on purpose to enable him to finish his examinations of the vast supplies of fossil bones that he had taken to London. McClelland, completely infatuated towards Griffith, now in charge of the Garden, resumed the remodelling of it on Griffith's plans. Sir Joseph **Hooker,** arriving in Calcutta in January 1843, saw the resultant desolation and wrote to Falconer to warn him of it (see Life and Letters, 1, p. 235; 1918). When he came later to write his *Himalayan Journals,* he put his impressions in this form (1, p. 3; 1854): 'Of the Gardens it is exceedingly difficult to speak; the changes had been so great and from a state with which I had no acquaintance. There had been a great want of judgment in the alterations made since Dr. Wallich's time when they were celebrated as the most beautiful gardens in the East, and were the great object of attraction to strangers and townspeople. I found instead an unsightly wilderness without shade (the first requirement of every tropical garden) or other beauties than some isolated grand trees which had survived the indiscriminating destruction of the useful and ornamental which had attended the well-meant but ill-judged attempt to render a garden a botanical class-book'. The Garden had been and still was a playground for Calcutta, perhaps then more so than later. It seems strange that Calcutta did not protest as the destruction developed; but, Hooker commented, Calcutta seemed to think little of its Garden. It may be recalled that the Garden had been known as 'Wallich's pet' in the twenties of the century. Granted that its condition had deteriorated then, had Calcutta lost enough of its pride in it to be indifferent, though the change in the form which it took must have been distressing? One feels exceedingly sympathetic

towards Wallich who saw the ruin, and perhaps through his ill-health, felt powerless.

Wallich published very little during the second half of his service. Griffith, blaming him for not having brought back to Calcutta a set of his plants, said that he had prevented himself from the continuation of his work by depriving himself of the means of recognizing his own species. It has been suggested that Wallich, when distributing his plants from London, had entertained the idea of not returning to India, in which case he would not need to allot a set for personal use in India. The suggestion is plausible. When he found after returning that he had spoilt his means of recognizing the species that he had in the Garden, as already explained, he had it collected over and then found himself, as Thomas Thomson noted, in frequent doubt as to the proper names. Still more would he find himself in doubt in regard to wild species. Why were the growing plants without labels? Gardeners in Europe at the time used painted wood or stamped strips of lead for labelling what they grew. It had been possible with a larger effort to do something in Calcutta; but there is no record of Wallich having tried to label the species. He seems to have considered quantity of species in the Garden his aim rather than quality, and that would mean retention though unhealthy (as in the case of the Tea bush) of that which did not stand up to the saturated soil and excessive humidity, the trees that Griffith said were 'fallen'.

In regard to the absence of a working herbarium, it seems that Wallich did not wish for one. He told Sir William Hooker how difficult it was to take care of dried plants; he collected sparingly when in the Khasia Hills with Griffith, and he retained no field collecting parties. But he could not avoid collection of dried plants being sent to him, just as they were sent to India House to be taken care of. Collectors assumed that he ought to do so. On his way back to Calcutta in 1832, Rottler, seeing him in Madras, gave him what would seem to have been the first bundles of a new accumulation. Vicary followed in 1833, in sending plants from Saugor. The Assam Delegation resulted in stimulating Jenkins to collecting. Schmid sent a small bundle. These and other gifts resulted in a collection of collections, which is a different thing from a working herbarium. The quantities increased from Griffith's time forward; and Thomas Thomson inherited charge of a not inconsiderable store when, in 1854, he succeeded Falconer as Superintendent of the Garden: he then made an inventory which he sent to the Asiatic Society of Bengal for publication (Journ. 25, p. 405, reprinted in *Hook. Journ. Bot.* 9, p. 33) and from it we learn what additions had come in to that date. Along with the bundles already indicated, the collection had held one of the three sets which McClelland had constructed from Griffith's material. Kittoe's gatherings had gone into it; there was a small bundle of plants from the District of Jessore presented by a missionary, J. **Barry**, a larger collection from Birbhum made by McClelland, Khasia Hill plants collected by the geologist Thomas **Oldham**, a smaller bundle from the same hills from the surgeon Joseph **Fayrer** (afterwards knighted), and plants both from the hills and the Assam valley from the pharmacist C. J. Simons; H. F. C. **Cleghorn** had sent plants

from the northern districts of the Madras Presidency; and Gibson's herbarium from Bombay had been given; also Sind plants from Stocks, Jabalpur plants from R. H. Beddome, and Simla plants from Edgeworth. Vicary gave plants additional to his first gift. Thomas Thomson possessed a large herbarium of his own. It must be obvious from this that the botanists in India in general thought that there should be a working herbarium at Calcutta; but such a herbarium had never as yet been organized.

McClelland's last act, before surrendering his charge of the Garden in 1847, was to issue a Guide-book with a map, which is very difficult to interpret because there is no permanent feature in it except the great Banyan tree; even the river banks are not there. The map shows, of since lost features, Griffith's circles and the places allotted to 'orders and classes' in the arboretum, but does not give an idea how far these positions had become occupied. A list in it of species in cultivation is not for the garden as a whole and is in general unhelpful as a historical record.

When Sir Joseph Hooker was leaving India in 1850, he saw the Garden again with Falconer, now in charge, 'very busy . . . replanting the greater part of the grounds'. It was necessary to fill up tanks that by injudicious cuttings were destroying the most valuable parts of the land, to drain many acres and to raise embankments to prevent the encroaching of the river (*Himalayan Journals*, 2, p. 244; 1854). The Garden had had an internal economy by which its own need in timber, cordage, bamboos, etc. was met; this economy had been destroyed.

Griffith as a Botanist

Sir George King in an address to the British Association in 1899 said of **Griffith** (p. 6): 'No botanist (of India) ever made such extensive explorations nor himself collected so many species (estimated at 9,000) as Griffith did during the brief thirteen years of his Indian career; none ever made so many descriptions of plants from living specimens. His botanical predecessors and contemporaries were men of ability and devotion: Griffith was a man of genius'. This will not be disputed. Professor W. H. Land (in F. W. Oliver's 'Makers of British Botany', p. 179; 1913), estimating his calibre, calls attention to his prodigality of labour and to his penetration in search of facts. Griffith worshipped Robert Brown and Francis Bauer, Brown for his refusal to stop in taxonomy short of the ultimate power of his microscope, and Bauer for the faithfulness of his delineation. One may say that what he wanted was the absolute truth, and this from his 'teens. Thoroughness came to him as a student; he would let no character escape examination in the plant before him and he would examine every available plant to the limits of available time. Just before his death, he was seeking what he could do with a more powerful microscope than he had had. I have referred to the opportunities that he used at Sadiya for sitting at a table with pen and pencil, preparing the descriptions to which Sir George King referred, each description supported by drawings. These were material which McClelland had for publication; they were not, as they stood, ready

for his 'Flora Indica', but for reference in writing the Flora when the opportunity should arrive. He condemned in strong terms the basing of a System of Classification, as Linnaeus had done, on a selected character. When Lindley brought into Botany the use of the word 'nixus' or 'inclination towards', its idea caught him; but Lindley's unremitting attempts at betterment did not. He would not venture a conclusion halfway as Lindley did. Otherwise, he was devoted to the Natural System with the conviction that Lindley would have taught him. His explorations with his microscope took him into fields of reproduction where he could not reach a solution; but he did his best (for this see Professor Lang's account of him). He was a wider student of plants than any contemporary in India; none but he attempted the determination of mosses. Ferns he collected with great assiduity, content to leave the naming to Sir William Hooker, who seems to have received more Indian material from him than from any one else. Animals he collected for others and sent them to the India House.

The preparation of descriptions, as at Sadiya, was a continuation of work that he was already doing at Mergui at the beginning of his Indian career. Arduous travel cut into his opportunities; Malacca he hoped would enrich them. He went there in 1841; a couple of years earlier, he had thoughts of long leave coming to him in 1842; at returning to Malacca, in 1844, he was sure that it could not be far ahead; and then he died in 1845, considerable preparations having been made towards the return to London, where only he could consult books and collections, which would ensure nomenclatural accuracy in his Flora. Incidentally, it must be mentioned that Sir William Hooker had moved his large collections to Kew when he was appointed Director of the Royal Botanic Gardens in 1841, and London offered unparalleled resources for what Griffith proposed. That he would have completed it is to me more than doubtful; he had no ability to measure time and the area of his target had become too large; it had become the flora of the whole face of Asia towards the Indian Ocean. Hooker's *Flora of British India* with its 14,500 species may be used as a measuring rod. It took the labour of Hooker for a quarter of a century, through which he commanded a great deal of assistance; and the design was compressed; but Griffith would have started. He does not seem to have estimated how many species he would be called on to describe, though he made some rough guesses at the sizes of his collections from various parts of India, 1,900 from Tenasserim, 1,700 from Assam, supplemented by a further 1,000 from his own personal collector, 800 from the Mishmi Hills, 1,000 from Bhutan, and over 1,200 from Afghanistan. The intensity of his examinations led him to observing the limits of variation and he declared that Variability had to be used as a character in defining species; some had it more than others. Such a conviction implied extension of his descriptions. He had a way of requiring the course of development and would have been an organographer rather than a morphologist had the distinction come in his time. He was so critical of past work that he wrote to Wight that he held, say, a third of the genera recognized as genera on sufferance, convenient for use but needing

testing. He lived to work at generic level and sought to make them stable. Surely a great object!

The Interior of Northern India

When the Afghan War was over, the officers who had dried plants for Griffith became scattered in cantonments towards the centre of India and mostly not remote. Ritchie returned to Bombay and then he was sent to Sind where he renewed his collecting; he made a considerable personal herbarium which, increased by many moves, remained in his possession until his death in Scotland in 1866. Hutton was sent to Neemuch in Rajasthan and Durand to Meerut, but probably these two did no more botanical collecting. Meerut, with a little diversified flora, had been the collecting place of several beginners. Finlayson had been there; Royle testifies to his collecting, but whither his plants went is not evident; Royle apparently began his Indian collecting at Meerut. The following also collected there: Falconer, Vicary, Thomas Thomson and Edgeworth. The last named was stationed in Bundelkhand towards the end of his service and explored the district of Banda with considerable thoroughness. Griffith, Macleod and Beddome have already been mentioned as collectors of Jabalpur.

Edgeworth, the First Ecologist

Michael Pakenham **Edgeworth** (1812-51) was sent to Edinburgh as a student of languages when, as it happened, the present Botanic Garden was being laid out; and he found pleasure in watching the progress. There was no formal teaching, but a gathering of knowledge from William McNab who had the business in hand. Then he went out to India in the administrative service and was sent to the north-western plains. From Ambala, when stationed there, he made short journeys into the Himalaya and collected. At Ambala the daily tasks of administration focused his attention on the relations of crops to soils and then, extending his interest to the relations of the spontaneous plants to the same soils, he wrote a paper (*Journ. As. Soc. Bengal*, 7, p. 751; 1838) which may be regarded as the first ecological paper published in India. Edgeworth's other publications were taxonomic or dealing with geographic dispersal.

Among his friends were two who supplied him with specimens from deep in the Himalaya. One was Captain William **Hay**, Superintendent of the Hill States, with his office in Simla. He became Lord William Hay while still at Simla, and later the Marquis of Tweeddale. He travelled deep into the mountains towards the upper Indus, drying specimens which he gave to Edgeworth. The other friend was **Lance** who visited Spiti and Lahul and Dras to the north of the snowy barrier across Kashmir; and again the plants collected were given to Edgeworth. Edgeworth submitted these to Bentham through whose herbarium they passed to Kew. He was stationed for a time at Multan and investigated its flora thoroughly.

The ecological work next done in India after Edgeworth's was that of Hugh **Cleghorn**, whose first paper after he came to India was

on hedges, the plants used for them and the plants that use them as situations (*Ann. Mag. Nat. Hist.*, 1, p. 435; 1850). Later, Cleghorn published an account of the sand-binding plants of the Madras shore.

Three Botanical Explorers of Kashmir who were allowed Entry during the life of Ranjit Singh

At the end of my first chapter (p. 877), I gave an outline of Jacquemont's visit to India, one summer of which he devoted to collecting in Kashmir. His success in gaining entry led to permission being given to two others, Godfrey Vigne and Baron Karl von Huegel. The latter has already been mentioned as having botanized in the Nilgiri Hills and in Ceylon. Godfrey Thomas **Vigne** (1801-65) had left Britain in 1832 without plans for a visit to the north-western Himalaya: this he explains in his book, *Travels in Kashmir* (1842); but the desire came after his arrival in Bombay at the end of a journey through Persia. He spent the summer months of 1834 in Simla, where he made contact with the three Gerards and with Sir George Everest, then the Surveyor-General; and perhaps the plan of his rough surveying came out of this. With Ranjit Singh's permission he entered Kashmir in 1835. Describing his baggage, he names a plant-press as part of his outfit; but there is evidence of its use in only two parts of his wanderings. In the same year Baron **von Huegel** obtained a like permission; and it happened that the two met in Srinagar and, having met, travelled together about the Valley and left together for Lahore. Vigne seems not to have collected plants in that summer; von Huegel probably did; if so, his specimens went to the Hofburg Museum in Vienna. He wrote a large book in four volumes *Kashmir und das Reich der Siek* (1844) in which there is no botany. Vigne returned to the mountains in 1836 and remained in them until 1838, during which time he collected in two places; one was on the edge of the Deosai plains near Dras and the other was in the Astor valley. When Vigne reached London he took his bundle of plants to Royle in which he was a bit late for Royle's convenience, as Royle had published almost the whole of his *Illustrations of the Botany of the Himalayan Mountains*; but Royle supplied Vigne with a short account of the flora of Kashmir, which Vigne printed as a supplement to his own book. Royle had found determinations of the species difficult in consequence of imperfect drying and rough handling; but he preserved the specimens which are in his herbarium at Liverpool. Determination today would be easier than it was to Royle in consequence of the flora having now become relatively well-known.

In 1836, Sir Alexander Burnes started on a Trade Mission for Kabul taking with him Hugh **Falconer,** the successor to Royle at Saharanpur. Circumstances altered the purpose of the Mission which, as far as Falconer was concerned, became one of economic exploration; and Falconer, detached at the Afghan border, tried to find a way up the Indus but after three marches was held up at Derband, deflected and passed into Kashmir, wintered there and in 1837 travelled via Tragbol and the Kishenganga valley to the upper Indus where he found Vigne,

across the Indus near Skardo, and to Askoli, collecting all the way. Vigne's collection from Astor and Falconer's on his journey from Tragbol to Skardo were the first plants from the Himalaya towards its right-angle bend of the Indus. Royle, as said, could not do much with Vigne's plants, and it has to be added that Falconer's found their way into the back water of India House. But Falconer had his attention all the time on what he saw and wrote to Royle in London a long letter telling him of the plants that he had collected. The Linnean Society printed it in their *Proceedings* (1839, p. 7). Falconer followed Royle and differed from most of the earlier botanists in India in recording the localities whence his plants came; these were written in Persian or Devanagari script against his specimens; clearly he required his collectors to do this. Again following Royle, he paid special attention to anything economic. The Botanic Garden at Saharanpur, indeed, kept very closely to its first intentions and under William Jameson who succeeded Falconer in 1842 was little but economic. Falconer's earlier papers, with one exception, were on economic plants and in pairs. The information to give which was purely economic he put into a paper for the Agri-Horticultural Society in Calcutta, and the information of more narrowly scientific value he sent elsewhither. In this way, he wrote on 'Kut' or 'costus' (*Saussurea lappa* C. B. Cl.=*Aucklandia costus* Falc.), on asa-foetida and on the paper plant, *Monotheca buxifolia* Decne, which he called *Edgeworthia buxifolia*. At heart Falconer was a geologist; it is recorded of him that as soon after landing at Calcutta as was possible he was in the Asiatic Society's Museum on a geological quest. His arrival in Saharanpur coincided with the discovery in the Siwalik rocks, through the digging for the Jumna canals, of plentiful bones of extinct animals and he made for himself a great reputation by studying them. A diligent collector of plants, he was more so a collector of these bones, so that when proceeding on leave in 1841, while he had 76 packages of plants, he had 5 tons of the bones; and when he had arrived, the plants were put into India House to be taken care of, and there they lay until after his death in 1865.

Griffith's death led to Falconer being appointed to the post of Superintendent of the Calcutta Botanic Garden. Wight had foreseen this, and wrote that he regretted how much more Falconer was a zoologist than a botanist. Falconer, after taking over, was soon required to go to Tenasserim to report on the forests and there he made considerable collections of plants.

Penetration of the Himalaya between the Rivers Sutlej and Kali

The reader will recollect that the first botanically minded visitor to this part of the Himalaya was General Thomas **Hardwicke** who went on a diplomatic Mission to the ruler of Garhwal, whose capital bears the same name, Srinagar, as the capital of Kashmir. Hardwicke entered the Himalaya at Kaldwara and followed a trail which crosses the mountains to the Alaknanda valley some thirty miles back in a straight line. The Alaknanda river is here at an elevation

of about 1,700 ft. and flows westwards to enter the Ganges within the hills. The next penetration was a little further westwards; in it William Spencer **Webb** reached Jumnotri where the river Jumna takes its origin. His companion Felix Vincent **Raper** wrote a report on the travel (*As. Res.* 11, p. 449; 1810) which names various plants as observed to occur. This was immediately followed by **Moorcroft's** dash through the Himalaya and out on the Tibetan side at the Manasarowar Lake where the Sutlej has its origin. The plants which he brought back were sent to Robert Brown in London. Hardwicke's and Moorcroft's introductory contributions to a knowledge of the mountain flora were made before the Nepalese War of 1814-15. The peace made at the end of it enabled Webb to continue his survey and, as already recorded (chapter 1, p. 869), Wallich promptly placed his collectors Kamrup and Blinkworth under Webb's protection. Thus he reaped a harvest of hill plants. Botanizing in the Himalaya after this moved again westwards following the establishing of the cantonment of Sabathu and the associated sanatorium of Simla. The first permanent house at Simla was built in 1822. In 1817, that is to say before Simla came into being, the surgeon George **Govan,** not yet with the Garden at Saharanpur under his charge, travelled for a short distance into the mountains from Sabathu in the company of the surveyor **Alexander Gerard.** In the next year Alexander Gerard, starting again from Sabathu and joined by his brother **Patrick Gerard,** penetrated via Spiti as far as Shipke. Again a year later, i.e., in 1818, the then Surveyor-General James Dowling Herbert, taking Patrick Gerard with him, went by Kotgarh which is 40 miles east of Simla to Shipke.

An explanation is due for the termination of penetration at Shipke: Shipke is the place where Tibetan authority is met in this part of the Himalaya, a political terminus, but not the boundary of the Himalayan flora. Commonly, in human geography, highlanders flow over the rim of a plateau and this the Tibetans have done conspicuously in three places, the Chumbi valley between Sikkim and Bhutan, the Kyerong valley to the north of Khatmandu, and a wide-angled area on the east of Lahul in which is Shipke. It followed that at Shipke a number of early explorations were unwillingly terminated.

In 1821, Alexander Gerard with his surgeon brother **James Gilbert Gerard** visited the Shattul and Borendo passes. The next penetration, which was also in 1821, was a further move westwards; Moorcroft travelled via Kangra and Kulu into Lahul and forward to Leh in the Upper Indus valley where he remained longer than the Government thought reasonable, wintering there and emerging over the Zoji pass into the Vale of Kashmir. As before, he collected a little. On this occasion, the collection was sent to Wallich.

There were three Gerards. Alexander (1792-1839) had commenced surveying in the Punjab plains in 1812. In 1817, his work was transferred to the hills. James Gilbert (1794-1835) was in the medical service. Patrick (1795-1838) was an army officer, whose service was continuously in the hills. Of the three he made the closest relations with Wallich, and it was against a specimen which had reached Wallich from Patrick that the name *Pinus gerardiana* was written, in consequence of which Lambert stated that the pine was dedicated

to him. The three brothers held closely together, and Vigne records spending an evening with the trio. Alexander wrote *An account of a journey through the Himalaya* (*Edinb. Phil. Journ.* 10, p. 295; 1824), i.e., of the journey to Shipke in which Patrick joined him. James wrote *An account of the Spiti valley and the circumjacent country* (*As. Res.* 18, p. 238; 1833). The three between them kept meteorological records at Sabathu or Kotgarh in 1817 and continued to do so for a long time.

Spiti proved to be the botanists' way into the remoter Himalaya from the front westwards of the Ganges.

Judged by the circumstance that Govan, when he returned to Scotland in 1823, took with him a collection of plants, it seems likely that in the trip of 1817 he collected, but that is not established. He did not record the trip; but he recorded another made through Nahan, the capital of the State of Sirmur (*Edinb. Journ. Sci.* 2, p. 277: 1828). At Nahan, he had a nursery as a branch of the Saharanpur Garden and therefore he must have had cause to visit it; but the elevation is only about 1,000 ft. above Saharanpur, and the climate can differ in little. Govan communicated plants that he collected to Wallich and they were distributed in the great distribution of 1828-32. His interests seem to have been mainly geological: but he could discuss mountain plants with the Countess of Dalhousie when they met in Scotland; and he had in his possession specimens which he could give to her. **Royle,** succeeding Govan at Saharanpur, found his medical work too heavy in his first years to allow him to leave the station, so he trained collectors to procure hill plants for him, but when he asked them to go as far as Kunawar they ran away. However, a good friend in the regiment stationed there, Lieutenant E. **Maxwell,** had a collection made for him. Wallich's tour of inspection of the Oudh forests in 1826, brought him as far as Hardwar and Dehra Dun, but not actually into the mountains. Mussoorie (so named from *Coriaria nepalensis,* the masuri of the hill men) took its origin from Dehra Dun, by an officer stationed in Dehra Dun building for himself a house. It was there before Wallich's journey. It was called the Potato patch from that valuable plant having been raised first in its garden. Royle soon had in Mussoorie a larger garden for acclimatizing, one of 40 acres, and therefore cause for visiting the station. He recorded no visits, nor any travel at all, save a journey to the summit of the Chur mountain through Sirmur in the direction of Simla. He closed Govan's Nahan nursery; the garden at Mussoorie was obviously much more serviceable. By 1828, he had plant-collectors more reliable than the first that he could send as far as the Vale of Kashmir in the company of home-going shawl pedlars. He used the pedlars also for procuring plants from Kashmir, surely on a large scale, for Jacquemont looked round the Saharanpur garden in 1830 on what he calls hundreds of plants from the Vale of Kashmir, which represented species that he had already seen in the hills, and guessed from their origin the elevation of the Vale before he had actually been there. In 1828, when Wallich was proceeding on leave, the artists of the Calcutta Garden were sent to work under Royle. If Royle had asked for them, it was because he had already planned to write his *Illustrations of the Botany of the Himalaya mountains;*

if he had not asked for them, then the use of them suggested the writing. The latter is the more probable because from the time of the arrival of the artists he redoubled his efforts to get material together. He ransacked the bazaars for trade products perhaps more assiduously than he had been doing, and he certainly intensified his field collecting. He sent collectors to Kashmir in 1829 and 1831 and in the latter year caused Kunawar to be explored again.

It is of interest that two of the friends who supplied dried plants to him, George William **Trail** and A. D. **Lindsay**, shared his economic occupations; the first was the author of an account of the rural economy of Kumaon and the second of a similar paper on the uplands of Pithoragarh, west of the Kali valley. Another friend who collected for Royle was James Stephen, an army officer who visited the Bamsaru pass, whereby one may get from the Ganges to the Jumna watershed. Another friend of the Army was a Major Cohen.

It has been recorded already (chapter 1, p. 877) that Jacquemont passed through Saharanpur when he first entered the Himalaya and left his collections to date in Royle's care; he called again to recover them. Another visitor to Saharanpur of the same year was a traveller who remains mysterious. Royle calls him Mr. R. **Inglis** of Canton and an address-list of members of the Asiatic Society of Bengal records his name with China as his country. He had travelled to Shipke; returning to the plains he called on Royle and showed him plants that he had collected. He did not give his collection to Royle, but sent it to Robert Brown. Robert Brown later, when Royle had settled himself in London and was working on his *Illustrations*, passed the bundle over to Royle for such use as he could make of it. Inglis's plants are in Royle's herbarium at Liverpool. It is intriguing to find a man from Canton, whom one cannot identify, going to the Tibetan border in the Himalaya.

Royle invited subscriptions to his *Illustrations* in quarterly parts and worked nearly to time in the years 1833-36; but fell out of time after that and did not get the last part out until 1840. Meanwhile, he had become Professor of Materia Medica at King's College. When the book had been finished he divided his specimens into three sets; the best he kept for himself and it is now at Liverpool; of the other two, he gave one to the Linnaean Society and he sent the other to Berlin.

Why did Royle from Saharanpur pay attention in particular to the Vale of Kashmir and to Kunawar? Because they were centres of population and his botanical collecting started with an economic bias.

The sanatoria, such as was Simla, brought botanists into the mountains who were less interested in the plant as useful than as something classifiable and satisfying to whatever urge to collect that was in them. The first of the Simla botanists was the Countess of Dalhousie who made a collection of about 600 species between April and October, 1829. Royle's friend, G. W. Trail, seems to have visited Simla at that time. Jacquemont paid three short visits in 1830 and Inglis one. The three Gerards were in and out of Sabathu. Then Lord William Hay had his office in Simla. G. T. Vigne spent the cold weather of 1833-34 there, but he probably did not collect at all. Baron von Huegel was there in 1835 and Vicary was at Sabathu.

So far 10. The Countess's plants found a resting place in Edinburgh; Royle's along with what Royle obtained from Trail, Vigne and Inglis, are now at Liverpool; the Gerards' were sent to Wallich and so went into the great distribution; Hay's were given to Edgeworth who shared them with Bentham; von Huegel gave his plants to the Museum in Vienna, and Vicary's were sent to the Calcutta Garden, a scattering indeed! Continuing, Griffith paid his short visit to Simla in 1841 and his friend Captain Sanders, now a Major, was there. In 1844, General and Mrs. Walker made a collection in Simla which they sent to Sir William Hooker. In 1845 the Artillery officer, Edward Madden, was there and while he was there the first Sikh War suddenly broke out. On the eve of this, Prince Waldemar of Prussia who has been mentioned (p. 50) as touring in Ceylon with his botanist-physician, Werner **Hoffmeister,** arrived in Simla. He had visited Khatmandu and then penetrated the north-western Himalaya as far as Shipke, Hoffmeister ventured on to the battlefield of Ferozshah, where a musket ball from the Sikh lines killed him. His collections were sent to Berlin and there entrusted to Johan Friedrich **Klotzsch** for a report. Klotzsch decided that Hoffmeister had collected 456 species, to 108 of which he gave new names (Bot. Ergebn. d. Reisen des Prinzen Waldemar von Preussen; 1862). Scarcely ever has a worse piece of taxonomic work been presented to the botanic public: on the test, when it came in the working up of the *Flora of British India,* barely a dozen of Klotzsch's so-called new species were found good. The work is abundantly and well illustrated and that is its only merit. Hoffmeister had not labelled the individual gatherings and consequently even a geographic value is denied. Berlin and Kiel seem to have shared the specimens. In 1847, R. S. Simpson collected in Simla, and in June and July of that year Thomas Thomson was there awaiting his companions of the Kashmir Boundary Commission and had all the leisure that he could desire for collecting the flowering plants of these two months. These plants, which he collected with his usual thoroughness, went into the collections of Hooker and Thomson and so were distributed from Kew in 1855. Lastly, making 18 individual visitors in all, James William Grant needs mention to bring the Simla list to the year 1850. There was plenty of material for a Simla Flora by then, but no way of bringing it together.

Kunawar, because it is so accessible from Simla, received visits from Jacquemont, Inglis, Hay, Madden, Hoffmeister and Thomas Thomson; and earlier Royle, as recorded, had had it doubly collected over.

The hills west of Simla received less attention. Edgeworth collected in Nandi and Kangra. William Hawtayne Parish visited Nandi and Kulu in 1847, collecting in particular ferns, and added what he got to the collections of Hooker and Thomson. William Jameson (1815-92) of the Bengal Medical service, early in his Indian service, collected where Parish had been. He succeeded Falconer at Saharanpur in 1842, and held the post until 1875 with considerable effect in promoting the cultivation of economic plants, but with little further work in investigating the wild hill plants.

Beautiful collections were made on the western side of Kashmir by James Edward **Winterbottom** (1803-54). After taking a medical

degree in Oxford, he spent his life in travel. In 1846, he went to Java and then returned westwards to India; proceeding to the north-west, he entered Kashmir through Hazara and travelled through the mountains to Astor, to Skardo in the Indus valley, and to Gilgit beyond. This was followed by a short visit to Khatmandu; and then he joined Richard Strachey to make his great journey to the sources of the Sutlej. Winterbottom returned to Britain, but set off wandering again and died away from home in 1854. His joint work with Strachey has its place in the next section; his herbarium remained in the possession of his family until 1900, when it was given to Kew.

A few words need to be said regarding work centred on Mussoorie. Naturally as Royle had founded a garden as a branch of his in Saharanpur, collecting in that direction remained an interest of Saharanpur. Falconer when he had succeeded Royle, sent collectors through the whole countryside up to the Niti Pass; and Jameson knowing that Hooker and Thomson contemplated a *'Flora Indica'* added material. Edgeworth had a period of service there.

Three Attempts to Examine the Himalayan Flora in Depth

Early in the Survey of the north-western Himalaya the Ganges was a boundary between two fields of work: W. S. Webb, who had been the first in the survey of the mountains, was told to continue where he had commenced, and J. D. Herbert to survey west of the Ganges. That is how the latter came to journey to Spiti in 1819 (see p. 74). Botanical work followed the pattern of the Trigonometrical Survey, and there were two botanical journeys right through the north-western Himalaya, one on each side of the Ganges. A third was far away in Sikkim, with the whole length of the forbidden land of the Kingdom of Nepal separating it. It was a need of fixing the northward limits of Kashmir that evoked the Commission of Major Alexander Cunningham, Dr. Thomas Thomson, and Captain Henry Strachey on Herbert's side of the Ganges.

Thomas **Thomson** (1817-78) had been a pupil of Sir William Hooker in Glasgow and a fellow-student of his son Joseph Dalton Hooker. He entered the medical service in Bengal and was sent to the northern plains (1839) where he botanized diligently through Rohilkand, whence he made short trips into the Himalaya. In 1847, orders came to him at Ludhiana, where he then was, to proceed to Simla to join the two named with him above for the purpose of examining the most northern mountains at the back of Kashmir. He had to wait until August before the three could start; then they took the road through Kunawar to Spiti, where Henry Strachey left the others that he might proceed to the upper part of the Indus, where he was to survey; Cunningham and Thomson directed their way towards Leh, where they parted. Thomson's work was to explore the routes from a little above Leh down to the right-angled bend below Rondu, and also the valleys of Nubra and Shyok. He was caught by winter and compelled to stay at Skardo until the Zoji Pass was passable. He crossed it to the Vale of Kashmir, only to ask for a second season in the parts where he had been. He returned through Zanskar and going beyond the Indus visited Karakoram. Thomson must have gathered practically

all the flowering plants that occur in the parts that he visited, just as Griffith had gathered practically all to be had about Kabul.

Henry Strachey (1816-1912) was the elder brother of Sir Richard Strachey. He did not possess the zeal for collecting of his brother but enough to make him collect, though sparingly. He did a work of most arduous surveying. He had visited the sources of the Sutlej in the year before he was put on the Commission (*Journ. As. Soc. Bengal*, 17/2), and in 1847 he went to the sources of the Indus.

Richard Strachey (1817-1908; afterwards Sir Richard) had entered the Bombay Engineers and transferred to the Bengal Engineers. He was sent to the Jumna Canals until, in 1846, the survey of Kumaon was entrusted to him.

In enumerating the Simla botanists I have named Edward **Madden**. He (1805-56; ultimately a Lieut.-Colonel) had developed a great interest in mountain passes, perhaps initiated by considerations of mountain warfare; and, immediately after the Sikh war, we find him visiting the Shattul and Burum passes (1845), and later the Pendras pass (1846), and then the Pindari glacier. He collected plants on these expeditions and described his experiences in the *Journal of the Asiatic Society of Bengal* (15, p. 79: 16, p. 226). Illness caused him to go to Almora, where he met Sir Richard Strachey who was commencing his survey. A common interest resulted in a joint paper. Madden retired and in retirement he became President of the Edinburgh Botanical Society; and he gave his official presidential address to the Society on the distribution, chiefly altitudinal, of trees in the Himalaya. After retirement, he had been sending dried plants to Kew. Strachey in the course of his survey was at the Pindari glacier a year after Madden and again in the next year. In 1848, Winterbottom, having left Kashmir and having made a short visit to Khatmandu, joined Strachey to proceed from Almora to Milam and over very high passes to the Manasarovar Lake, the source of the Sutlej, at 15,000 ft. As stated, Winterbottom made beautiful collections in Kashmir and now, with Strachey, did the same in Kumaon and within the limits of Tibet. Not only were the dried plants well selected, the labelling was excellent. Strachey returned to Britain and spent 1850 determining his species and then distributing sets of them with a printed list. This list was reprinted in Atkinson's *Gazetteer of the North-west provinces of India* (II, 1882) and, after a revision of the names by Duthie and others, republished in 1905. It is said of it in the introduction rightly that it gives a cross-section of the Himalayan flora from the plains of Rohilkhand to the loess plateau of Tibet.

The third cross-section, that of Sir **Joseph Hooker** in Sikkim, was all but contemporaneous with the two in the north-western Himalaya. Joseph Dalton Hooker (1817-1911; knighted in 1877) was the second son of Sir William Hooker. Having decided on the outlines of his travel, he arrived in India in January 1848, at which date Thomas Thomson was in the remoter parts of Kashmir, and Strachey, arranging for but not yet engaged in his great journey to the Manasarovar Lake. He made his way through Chota Nagpur and by Patna and Purnea to the Sikkim Himalaya and established quarters at Darjeeling. Then he commenced an intense effort to acquaint himself thoroughly with the plants obtainable there through the activity

of a crowd of up to 18 collectors. In a letter to his sister (Life and Letters, 1, p. 260), he described his morning's work, the arrival of the collectors with the spoil of the previous day in baskets on their backs, himself preparing labels, setting aside that to be drawn and that to be dried. When he felt that he had started this well, he made a short trip to the mountain of Tonglu. When the autumn had come, he made the first of his journeys through the mountains. With sanction he entered Nepal and travelled up the Tambur valley, that is to say on the further side of Tonglu and Kinchinjunga, to the passes into Tibet. This occupied him from the middle of October to the middle of January, when he regained Darjeeling over the Islumpo Pass and through Pemionchi. Then followed an early spring collecting of the plants of the outer hill faces to secure what had been missed in the previous year. At the commencement of May he started up the Tista valley and spent the summer close to the political boundary of Tibet. The two thrusts, one up the Tambur and the other up the Tista, were not so remote from each other as were Thomson's and Strachey's, and phytogeographically may be counted as one. Hooker went to the frontier in two successive years and so did Thomson.

Hooker would have liked to spend the next summer in Nepal, but that could not be arranged. Instead, Thomson joined him and they moved the collecting to the Khasia Hills where they worked with great intensity from early June to late November. While they were there, Thomas **Lobb** (see p. 55) passed by with his train of collectors of living plants. I do not know what motley of transport he was using, but it tickled the imagination of Hooker to call it Lobb's circus. From the Khasia Hills, Hooker and Thomson moved to Chittagong, then to the Sundribans and so to Calcutta. Both returned to Britain in 1851. Their collections were pooled, worked up into sets, and distribution began in 1855, distributed just as Wallich's were to secure international agreement in nomenclature; Thomson worked up his diary into his book entitled *Western Himalaya and Tibet* (1852), and Hooker wrote his *Himalayan Journals* (1855); the two conjointly issued the first volume of their projected *Flora Indica* (1855). Then lack of financial support compelled abandonment. As the first 280 pages hold a valuable review of the state of knowledge of the flora of India, making it much more important than the rest, it is a pity that we cannot alter the premature title.

Sir Joseph Hooker had been able through his father to arrange from India for the publication of his *Rhododendrons of the Sikkim Himalaya;* and the parts followed one another from 1849 to 1851. It is appropriate here to mention John Ferguson **Cathcart**. He (1802-51) was of the administrative service in Bengal, where he collected a herbarium; and it was his pleasure to employ an artist to make plant-portraits of the most striking flowers, much of the work being done in Darjeeling. After his death the plant-portraits were given by his sister to Sir Joseph Hooker who used them for the *Illustrations of Himalayan plants selected from drawings made for the late J. F. Cathcart.*

The combined collections of Hooker and Thomson were computed at 150,000 specimens, representing roughly 3,500 species from Sikkim,

3,000 from Khasia Hills, about 1,000 from the plains of north-eastern India, the same number from the plains of north-western India and lastly 2,000 from the north-western Himalaya.

As soon as it was known that the two would write a Flora, help flowed in. The collecting of Jameson has been mentioned; James William Grant sent plants from Kunawar; Jenkins and his associates in Assam increased their collecting; Falconer, now in Calcutta, sent so many men to Khasia to collect that Hooker suggested the path-sides were becoming stripped of vegetation; the Government of France responded with a set of Jacquemont's plants, and Andrew **Fleming**, a geologist then mapping the Salt Range, sent a considerable collection.

While Hooker and Thomson were busy tidying their work by distributing their duplicates, Wight happened to retire, bringing to London his last collections. Wight made these up into sets which were distributed from Kew in continuation of the Hooker and Thomson sets. Hooker contrived to get out of India House Falconer's 76 boxes of dried plants deposited in 1844 and these, somewhat deteriorated by their 20 years of waiting, were distributed also.

Western India

In my first chapter (p. 873) the progress of the Bombay botanists was carried to the publication of John Graham's *Catalogue of the plants growing in Bombay and its vicinity*. A mistake was made there: Dr. Lush did not work in Ratnagiri, but in Poona. The error, which is regretted, has been corrected in this journal (52, p. 228). **Lush**, who had taught in one of the London medical schools before he went to India, was perhaps the first experimental worker on cotton, antedating Wight's work; but Wight's lasted longer. Lush had experiments not only in the Dapuri Garden but in Khandesh and in Dharwar. He published on cotton in 1835 or shortly before Wight had charge of experiments.

Alexander Gibson succeeded Lush at the Dapuri Garden in 1838. He had arrived in Bombay three years before John Graham. John Sutherland Law had arrived two years before and Lush one year before. John Graham was in Bombay 11 years before the publication of his *Catalogue of Bombay plants;* Lush 12; Law 13; and Gibson 14. Before any of these were in a position to study the Bombay flora, William Henry **Sykes** (1790-1872, ultimately a Lieut.-Colonel), an excellent man of business and a zoologist of considerable competence, collected plants in the Deccan, chiefly about Poona. He held the post of Statistical Reporter, Bombay, from 1824 to 1829, but continued to collect to 1831. Wallich indicated on the map that ends his *Plantae Asiaticae Rariores* his travelling. The collections amounted to about 1,000 species. He did not study them; but John Graham had the use of them and Gibson also. They were given to the Linnaean Society and the Society asked Royle about 1840 to make determinations. In 1863 when the Society withdrew from curating small collections, Sykes's was sold and found a home in the herbarium of van Heuckx in Antwerp.

Joseph **Nimmo** seems to have been born in India, his father the captain of a ship trading in and out of Surat or Bombay, but this is a surmise. As a young man he was in Government service at Surat (1819), but lost his appointment; and it is not known what his employment was later. His means were apparently restricted and, in correspondence with Sir William Hooker, he more than once apologised for not being able to do more collecting. Wight, with whom he corresponded, thought highly of him; he corresponded with Royle also, seeking determinations. Wight indeed calls him 'the acknowledged head of the corps botanique of Bombay—a gentleman whose diligence in collecting is only equalled by his liberality in distributing the proceeds'. I think that Nimmo must have had a greater influence than appears on the surface and perhaps saw Graham through the accumulation of data for his Catalogue as he finally finished it and saw it through the press. John Sutherland **Law** (1810-1855) was born in India (as were Royle and Hugh F. C. Cleghorn) and resided in India from 1829 to 1854, firstly at Thana, and later at Dharwar or Belgaum. He made a considerable herbarium by which Gibson much benefited and was generous in giving plants to Sir William Hooker and to the Oxford Garden. Alexander **Gibson** (1800-67) did considerable service for Botany in the Bombay Presidency. The Government employed him as a vaccinator in the Deccan and in Khandesh; and that wandering employment brought to him a most intimate understanding of village life and the plants of the open country. He seems to have been at the beginning rather a lone figure, as Wight was, and it was Law who helped him out of that. When Graham's *Catalogue* appeared Gibson checked his collections by it. A year before it came out he had written his *General sketch of the Province of Guzarat* (*Trans. Bombay Med.-Phys. Soc.*, 1, p. 1; 1838), and in the same year he was put in charge of the Dapuri Garden at Poona. Two years later he published a report on Teak (*Trans. Bombay Agri.—Hort. Soc.* 1840, p. 120) and a year later reports on Senna and Tobacco. Six years after this (1847) he was appointed Conservator of Forests and held the post until retirement in 1860. He was the first of such officers that India had; the attempt, very much earlier, to arrest the over-exploitation of the Teak supplies having been a police measure which proved ineffective. Gibson as a forest officer was after a time to have Dalzell associated with him. Nicol Alexander **Dalzell** (1817-78) arrived in Bombay in 1841, at which date Gibson was not yet a forester, but a promoter of any kind of crop likely to be useful, i.e., he was in charge of the Dapuri Garden. Dalzell had an Edinburgh degree but not in Medicine, and he took an appointment in the Custom House, botanizing in his leisure. Next he took a subordinate position in the Forest service and worked his way up. He intercalated descriptions in a copy of Graham's Catalogue; they were sketchy, but Gibson approved of them and financed the printing. In this way, Dalzell's and Gibson's *Bombay Flora* originated (1861). It is Graham's Catalogue expanded. Bombay had a second vaccinator-botanist; this was John Ellerton **Stocks** (1822-54), a pupil of Lindley, with a medical degree. He reached Bombay in 1847 and was sent to vaccinate in Sind. A year after commencing work there, he found it possible to reach Shah Bilawal in Baluchistan (see Hook. *Lond.*

Journ. Bot. 7, p. 550; 1848) and a year later to go as far as Quetta and Nushki (Hook. *Journ. Bot. and Kew Miscell.* 2, p. 303; 1850). Griffith had been to Quetta a year before Stocks, but there was this difference between them, Griffith came by the Bolan pass, but Stocks from the southward. In 1852, Gibson being on leave, Stocks acted as Conservator of Forests, having charge privately of Gibson's herbarium which he enriched. In 1853, he brought his personal collections to Kew to work on them, but died in 1854.

Dalzell succeeded Gibson as Conservator of Forests in 1860. Gibson's plants were given to the Calcutta Garden. The line of botanists in charge of the Bombay forests was continued by the appointment of Eyre Champion **de Crespigny** (1821-96). He had reached India in 1845. The posts of Conservator of Forests and Superintendent of the Dapuri Garden were combined in his case. He made a herbarium which is now at Manchester. So also is a Bombay herbarium of ferns made by another medical man, Andrew H. Leith.

On p. 62, I referred to David Ritchie (1809-60), a surgeon of the Bombay service, as providing Griffith with dried plants from Herat. He during 35 years, 1831 to 1866, collected considerably. In 1838 he was in Afghanistan; later at different dates he was in Sind, the southern Mahratta country, the western Punjab, and Central India; and his collections were in his possession at his death. Then they were given to the Royal Botanic Garden, Edinburgh.

During the period under review, Herbert John **Giraud** reached India (1842) and became a teacher in the Grant Medical College; and Bernard Kaspar Kamphoven, a Danish botanist, visited Bombay (1845) and made a collection which is at Copenhagen, with duplicates at Kiel.

Wight's Immediate Successors in Madras

Wight was in India to the last years of this chapter; among those who joined him the most conspicuous was Hugh Francis Clarke **Cleghorn** (1820-95). He had been born in India, and had received a medical degree in the University of Edinburgh and with it returned to India in 1842. It has been recorded that Wallich was nominated Professor of Botany in the Calcutta Medical College in 1837; Giraud, as recorded in the last section began teaching in the Grant Medical College and had the title of Professor of Botany in 1845: Cleghorn was made Professor of Botany and Materia Medica in Madras in 1851, where judging by his versatile writing, he was assuredly an inspiring teacher. So too Giraud seems to have been. Cleghorn in his first years collected plants in the northern parts of the Madras Presidency which were sent to the Calcutta Garden. In 1856, he left his teaching for the post of Conservator of Forests and was finally Inspector-General (1867). His herbarium is at Edinburgh.

A less purposeful collector of Madras of these years was Gideon Thomson, a younger brother of Thomas Thomson. He made large collections through collectors which passed into his brother's possession and then were distributed through Kew. A resident in Tinnevelly, L. D. Thomas, sent a small bundle of plants to Sir William Hooker in 1844.

Mosses Studied; but Lower Cryptogams Await Further Development of the Microscope

Francis Buchanan collected a few mosses when in Nepal in 1802. Edward Gardner, who was Resident at the Court in Khatmandu in 1820, collected more, and after him Wallich. Royle collected some in north-western India; and Wallich had 113 numbers for distribution when in London. Sir William Hooker had commenced describing Indian mosses in 1820 in his *Musci exotici*, and with Robert Kaye Greville continued this in the *Edinburgh Journal of Science*, 1-3 (1824-25).

At the other end of India Schmid collected mosses in the Nilgiri Hills and gave them to Zenker at Jena, who, when he died in 1848, had done nothing with them. **Karl Mueller** of Halle, obtaining possession of these, described them in 1853, twenty years after their collecting. Schmid, on receiving a list of the determinations, just before his death passed it over to the Madras Society for Literature and Science: and it appeared in their journal (19, p. 84; 1858). Perrottet collected in the same part of India and his specimens were worked up by **Montagne** (*Ann. Sci. Nat.* sér. 2, 17, p. 243; 1842). Wight collected on occasions. **Griffith** collected mosses vigorously in the Khasia Hills when on the Assam Delegation and worked them up when at Sadiya. He alone in India touched their taxonomy; otherwise the naming of Indian mosses required that they be sent to specialists in Europe. William **Mitten** made a complete review of these plants as known to him from India in 1859 (*Journ. Linn. Soc.* Suppl. 1). He names the following as collectors: Bélanger, Booth, Buchanan, Foulkes, Edward Gardner, George Gardner, Gough, Griffith, J. D. Hooker, Law, Mack, Maxwell (a Ceylon collector), McIvor, Parish, Perrottet, Royle, Schmid, Richard Strachey, Gideon and Thomas Thomson, Walker, Wallich, Wight and Winterbottom. It is evident that the date for study of the mosses had come; and it may be commented that students of them had contrived to get them into fair order without much magnification.

So too the date for the study of the Hepatics had come. The collectors of mosses were prepared to collect Hepatics also. Falconer went further and published in 1851 a new genus. Through the years 1844 to 1847, **Gottsche's, Lindenberg's** and **Nees Von Esenbeck's** *Synopsis* was in course of publication. It occupies a place parallel to Mitten's review of the mosses. By the number of Indian species known to these authors, Wallich comes first, and Perrottet second.

Of Algae and Fungi there is little that need be said. Rottler had collected some of the larger seaweeds; Strachey and Winterbottom had collected lichens to which Churchill Babington gave names. Royle did not let Chara pass unnoticed. Bisbee has occupied himself in a search into references to fungi (see Butler and Bisby in Sci. Monogr. no. 1 of Imp. Council of Agr. Res., 1931).

Fellowship as an Aid to Individual Effort

To this point the investigations of botanists in India have been referred to as the occupations of individuals; and their corporate

efforts kept in the background. Wight called a friendly working together of the Tranquebar missionaries a botanical Society, but surely there was no scientific society as such bodies are understood. The missionaries were united as missionaries, and the words 'United Brothers', which Wight indicates as the name of the society, was no more than a name for the Moravians to which these missionaries belonged. As United Brothers, they agreed to using this as the name of the Mission to transmit dried plants to Banks. Instead of the United Brothers, the first Society formed in India was the honoured Asiatic Society (of Bengal) which Sir William Jones called into being in 1784 or two years before the founding of the Calcutta Botanic Garden. Its business was to be learned; and Science was within the ambit of its learning. The Society's journal, *Asiatick Researches*, the first volume of which appeared in 1788 contained one botanical paper. The Society asked that communications to it be polished, expected them to be of some length, and hedged their printing with rules that made it very deliberate, so deliberate that the founder's aspiration for an annual volume devolved into a volume at an interval of, on the average, 2¾ years. That was not a marching with impatient Calcutta, and, when the Society was about 30 years old, provoked demands for a change, a dropping of some of the dignity for the sake of a quicker return. In what group of members protest was strongest, I do not know; but one botanist, William Jack, isolated in Sumatra, recorded his wish for a journal that would accept and print quickly notes that needed record such as if not recorded tended to delay larger things, and in his words encumbered his work. Though the Society in the third decade of the 19th century debated its course, it at that time somehow could not contrive reform, or rather its attempt at reform led nowhere. Carey's Agri-Horticultural Society had in 1829 started the printing of *Transactions* and took papers with an economic appeal, somewhat relieving the pressure for reform. Further relief came in an interesting way. James Dowland Herbert, who has been mentioned as surveying in the north-western Himalaya, being in Calcutta as the Deputy Surveyor-General, started in 1829 at his own risk a little venture called *Gleanings in Science*. It came out monthly and had a popular appeal. In 1830, he left Calcutta putting the *Gleanings* into the hands of a relatively new man, James Prinsep; and Prinsep in 1830 was elected a Secretary (there were two) of the Asiatic Society. To him it occurred as of advantage to make the *Gleanings*, which punctually recorded the proceedings of the Society, into an organ of the Society. The council consented. The punctual *Gleanings* now became the *Journal of the Asiatic Society* (he added *of Bengal*) and made a way for prompt printing. The gain was never lost and the *Asiatick Researches* slowly died.

In Madras in 1834, the Society for Literature and Science commenced a journal parallel to the *Journal of the Asiatic Society of Bengal* as an outlet, and an Agri-Horticultural Society was formed in 1836 likewise providing an outlet. Bombay had done similarly slightly earlier. Wight used the *Madras Journal of Literature and Science* during the years when he was in Madras; and Gibson made

use of the Bombay Agri-Horticultural Society's *Transactions* for the publication of his paper on Teak.

The Surgeons had societies of their own in all three Presidency cities, and if, as they sometimes did, they printed a botanical paper they were not out to help the botanists. The few occurrences that there were need not be named. Bombay had a Geographical Society which printed a paper on the rural economy of the District of Ellichpur, but not another with the slightest botanical interest.

In 1840 McClelland seems to have thought that the biological sciences might sustain a quarterly and began his *Calcutta Journal of Natural History*. This was premature, and publication ceased in 1847. McClelland after three years secured as co-editors Griffith (1844), Wight (1846), and George Gardner (1846), who were obviously glad to have the outlet; but their competence did not save it. All other publications printing papers on Natural history had the backing of an association of members behind them.

Retrospective

Two men dominate this chapter, Wight and Griffith. The mantle of Roxburgh, left behind when he was transferred to Calcutta, may be said to have been picked up by Wight who extended the influence of Roxburgh's *Coromandel Plants* over the whole Peninsula. Griffith was the follower of no one who had preceded him in India; he came as a fresh impulse out of the school which was in a position to influence Botany in India. He showed no interest in economic botany which was a gate that helped a number of others to official recognition. To him the plants of India needed recognition, and that demanded all the energies which he used up with such prodigality. It was greatly to the credit of the rulers of India that they recognized and used his genius and that after his death they did what was immediately in their power to save as much as possible of his work.

Griffith's intensity of examination led him to turning over in his mind the implications of variability where he was probably halted by Swainson's dictum varieties 'do not perpetuate the peculiarities that they possess'. Swainson's writings had impressed Griffith.

Within the period, actually in 1835, the Company had decided on an educational policy in which taxonomic botany was recognized as needed in the medical schools; it was also recognized comtemporaneously as fitting a man for the control of experimental horticulture and preliminary forest conservation. Bombay's interest in supplies of Teak brought the last recognition to the front in Bombay.

The taxonomic outlay had got so far that ecology could appear, and with Sir Joseph Hooker's work phytogeography also. Furthermore, as I have suggested, the taxonomy was spreading from the large and obvious to the less easily studied mosses and hepatics, but the period left the still smaller plant-life virtually unstudied. Publication for the botanists seeking print became a little easier.

(To be continued)

MARINE NEMATODES FROM THE BAY OF BENGAL

I. PHASMIDEA

BY

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(With a plate)

In January 1956 the writer made a large collection of free-living marine nematodes at Cox's Bazar, located on the Bay of Bengal below Chittagong near the Burma border. Most of the nematodes were obtained off Sonadia Island, a sand island about two miles from the mainland. The island has sand banks on its south side and broad mud flats on the north side. The prevailing current is from the southeast. The species reported here are of the Class Phasmidea, a group which is plant-parasitic, animal-parasitic, or free-living in soil and freshwater, but rarely in the sea.

Family RHABDITIDAE

Rhabditis (Choriorhabditis) marina Bastian, 1865 var. **bengalensis**, new variety

Description : Transparent body with fine striations ; lateral fields with six fine incisures, about 1/6 the body diameter wide, beginning just behind the stoma and ending just behind the spicule head. Six distinct lips with small papillae. Cervical papillae just above the level of the excretory pore. Stoma typical, 15μ deep, with conspicuous telorhabdions. Oesophagus with swollen corpus, slightly narrowed isthmus, and valvate bulb. Excretory pore just above the oesophageal bulb ; excretory sinus cell in the curve of the bulb. Testis extending almost to the oesophageal bulb, reflexed 218μ. Spicules 48μ long, cephalated, with internal division. Gubernaculum 20μ long. Bursa faintly striated, enclosing the tail tip. Genital papillae : 3 pairs of large preanal papillae, equally distributed ; 2 groups of 3 pairs each of postanal papillae. Fifth papillae turned outward at the tip ; all papillae extending to the bursal margin. Phasmids just behind the sixth pair of genital papillae. Tail 1.5 anal diameters long.

Male : 1.12 mm. ; *a*, 20 ; *b*, 5.8 ; *c*, 35.1.

Habitat : Living within a large clump of branching filamentous alga (*Siphonocladus*), collected from a sandy bottom in 1 foot of water at low tide.

Type locality : Sonadia Island, Bay of Bengal, Cox's Bazar, East Pakistan.

Discussion : This specimen differs from the published descriptions (e.g., Schuurmans Stekhoven, 1935 ; Meyl, 1955) and our own observations (at Woods Hole, U.S.A.) of the typical form of *Rhabditis marina* in the distribution of the preanal genital papillae. In *R. marina* the first pair of papillae is in line with the head of the spicules and the second and

third pairs are close together just anterior to the anus. While there is variability in the female tail (Osche, 1954), the position of the genital papillae is a constant character. Therefore we are designating a new variety to embrace our unique specimen.

Family Cephalobidae

Halicephalobus new genus

Definition: Cephalobidae, Panagrolaiminae. Lips 4, distinct. Prorhabdions distinct. Meso- and metarhabdions broken or obscure; telorhabdions distinct. Oesophagus with well-defined median bulb. Isthmus shorter than corpus. Terminal valvate bulb. Prodelphic ovary, doubly reflexed. Differs from all genera of Panagrolaiminae except *Tricephalobus* Steiner, 1936, in the possession of a median oesophageal bulb, and from all other genera in the double flexure of the ovary.

Type species: *Halicephalobus limuli* n. sp.

Halicephalobus limuli new species

Description: Cuticle with fine striations, 1μ wide. Faint lateral fields, 1/8 to 1/10 of the maximum body diameter wide. Lips 4, distinct, the lateral lips seemingly confluent with the ventro-submedial. Stoma cylindrical, total length 11–12μ. Prorhabdions distinct. Posterior part of stoma almost as wide as the anterior part, inclined slightly ventrally. Ventral telorhabdion more prominent than the dorsal one. Ventral metarhabdion distinct and unbroken (in living worms); dorsal metarhabdions broken. Musculature surrounds the base of the prorhabdions Oesophagus composed of a long corpus, a swollen median bulb, a narrow isthmus, and a terminal valvate bulb. The nerve ring crosses at the mid-isthmus. The excretory pore is ventral to the nerve ring, just anterior to the terminal bulb. Cervical papillae located midway between the nerve ring and the terminal bulb. Phasmids indistinct, probably at 33% of the tail length. Prodelphic ovary, extending 12–17.2% of the body length forward, reflexing and extending 7.1–14.6% of the body length posterior to the vulva, then reflexing again to just before the vulva. Post-vulvar uterine sac lacking. One egg with shell in the uterus at a time, 52 × 18μ, with a large distinct nucleolus. Tail uniformly tapering to a tip, conical, 4.5–5 anal diameters long.

Female: 426–460μ; *a*, 20–21.3; *b*, 4–4.8; *c*, 6.7–7; V, 59.3–61.2%.

Habitat: Among algae and debris around the leg bases of the king or horseshoe crab (*Limulus*).

Type locality: Mouth of a small freshwater stream, Cox's Bazar, Bay of Bengal, East Pakistan.

Discussion: Four specimens of *Limulus* were collected in January, 1956, killed in 5% formalin in sea water, and preserved in a 5 gallon can with several fishes. After 5 months, scrapings of algae and debris were taken from the leg bases of the king crabs and examined. Hundreds of individuals of *Halicephalobus* were found, including many which were living and producing ova. The formalin at this time was still concentrated enough to preserve all the specimens in the can in good condition, but when living worms were transferred to fresh 5% formalin in distilled water they were killed. Some of the living nematodes were placed in tap water in a Petri dish, where they continued to survive and lay eggs.

Juveniles hatched out and grew to maturity, but there seems to have been no further reproduction. A few of the nematodes were still alive after 6 weeks. At no time were any males found, and reproduction seems to be without males.

Many members of the Family Cephalobidae have previously been reported from haline biotopes (e.g., Meyl, 1955). The commensal association of free-living marine nematodes with snails, crabs, crayfish, and gammarids is also well known (Baylis, 1915; Cobb, 1928; Chitwood, 1935; W. Schneider, 1932; Timm, 1951; Kinne and Gerlach, 1953).

Chitwood and Timm (1954) observed that *Rhabditis marina* can survive in either sea water or tap water. The writer has kept *Rhabditis ocypodis* Chitwood, 1935, alive for more than 6 weeks in both tap water and artificial sea water (3.1% saline). *R. ocypodis* is a commensal of the 'ghost crab', *Ocypode albicans*, on North Carolina (U.S.A.) beaches. Osmotic regulation or osmotic adjustment of marine nematodes has never been reported (cf. Krogh, 1939), but would make an interesting study. In unpublished experiments we have shown that *Paracanthonchus caecus* (Bastian, 1865) is poikilosmotic rather than homoiosmotic. Due to the impermeability of the cuticle osmotic adjustment does not take place through the cuticle, but probably is a function of the ventral excretory cell and, to a lesser extent, the intestinal cells.

Family TYLENCHIDAE

Tylenchus marinus new species

Description: Body cylindrical, transparent, tapering rapidly anteriad from the middle bulb and finely tapering posteriad from just behind the anus; posterior half of tail uniformly tapering to a fine point. Cuticular striation very fine, not observed on the head. Lateral field with 4 faint incisures. Head not set off, not supported internally by sclerotized pieces; cheilorhabdions unsclerotized. Stylet fine, 12.8μ long, without distinct basal knobs but with sclerotized attachment points. Oesophagus tylenchoid; middle bulb well set off, with small valves and weak musculature; somewhat expanded terminal bulb, not extending over the anterior end of the intestine. Excretory pore opposite the beginning of the terminal bulb. Ovary single, outstretched, extending almost to the base of the oesophagus; short post-vulvar uterine sac. Cervical papillae opposite excretory pore. Phasmid at the end of the conical portion of the tail. Tail 11.7 anal diameters long, with uncinate tip.

Female: 610μ; a, 32; b, 5.6; c, 6; V, 71%.

Habitat: Living in the top inch of bottom mud on a mud flat at low tide.

Type locality: Sonadia Island, Bay of Bengal, Cox's Bazar, East Pakistan.

Discussion: The systematic position of this species is difficult to determine since the male is lacking. The only known genus of marine tylenchs is *Halenchus*, represented by *H. fucicola* (de Man, 1892) Cobb, 1933; *H. mediterraneus* (Micoletzky, 1922) Cobb, 1933; *H. zosterae* (Allgén, 1934) Chitwood, 1951; and *H. mexicanus* Chitwood, 1951. The first two species have a hooked tail, as in our specimen, but the oesophagus of *Halenchus* is characterized by the presence of free oesophageal glands overlapping the anterior of the intestine. It also has internal cephalic sclerotizations and a striated lip region. The plant-parasitic

genus *Ditylenchus* does not have such a lengthy tail. We are placing our specimen provisionally, therefore, in the genus *Tylenchus*.

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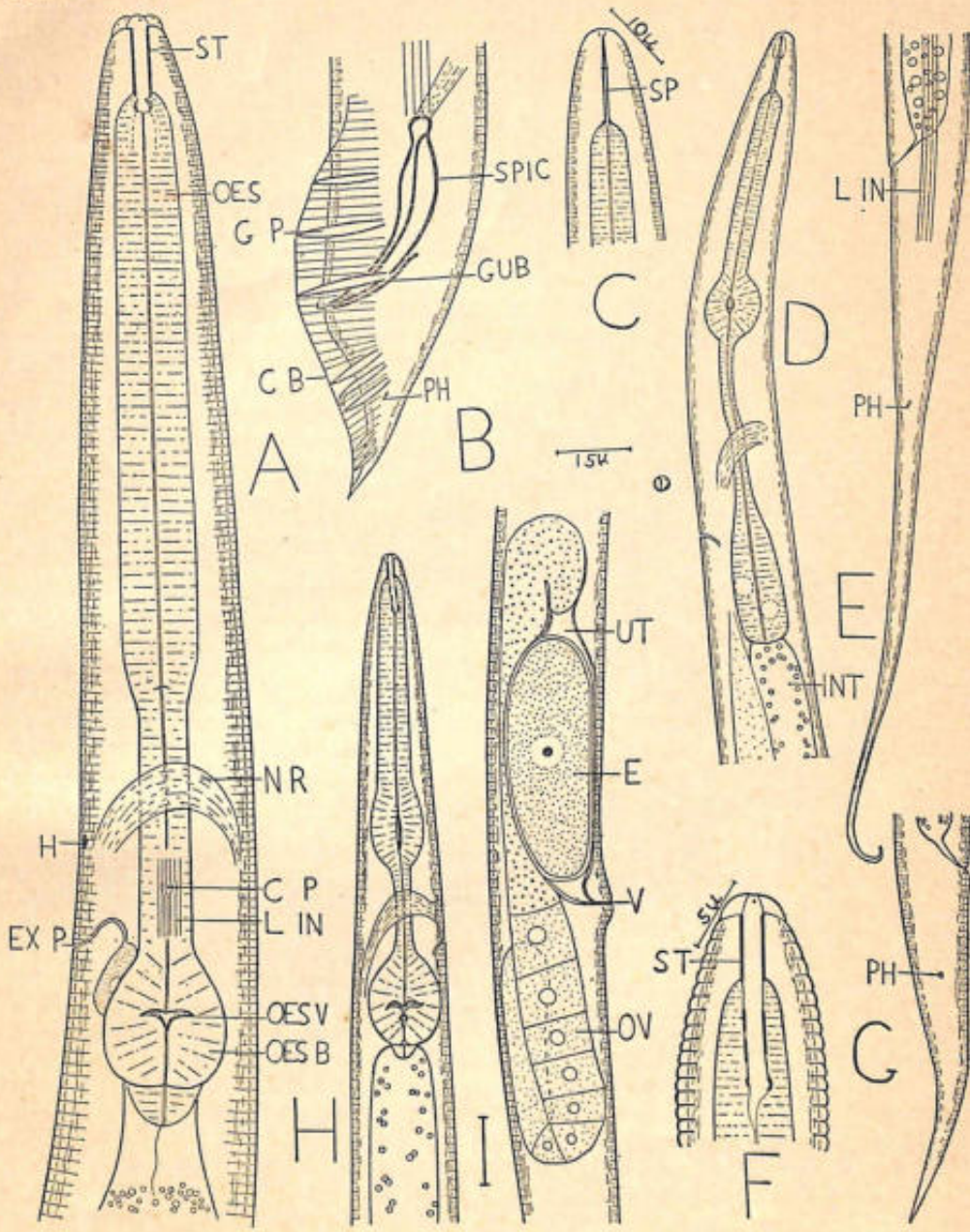
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Abbreviations on Plate

CB — copulatory bursa
CP — cervical papilla
E — egg
EX P — excretory pore
GP — genital papilla
GUB — gubernaculum
H — hemizonid
INT — intestine
LIN — lateral incisures
NR — nerve ring
OES — oesophagus
OES B — oesophageal bulb
OES V — oesophageal valve
OV — ovary
PH — phasmid
SP — spear
SPIC — spicule
ST — stoma
UT — uterus
V — vulva



Marine Nematodes from the Bay of Bengal

A—B. *Rhabditis marina* var. *bengalensis* new var. A. Oesophageal region. B. M tail. C—E. *Tylenchus marinus* n. sp. C. Head. D. Oesophageal region. E. Fem tail. F—I. *Halicephalobus limuli* n.g., n. sp. F. Head. G. Female tail. H. Oesopha region. I. Female reproductive system.

(For abbreviations see end of text)

VEGETATION OF PILANI AND ITS NEIGHBOURHOOD

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INTRODUCTION

Pilani in its present phase is a very promising venue for the study of plant succession as the place is undergoing a process of rapid physical developments and changes. An arid sun-scorched sandy area broken by a dreary succession of shifting sand dunes, spotted with trees and scattered and meagre growth of desert plants, is being rapidly converted into the verdure of a cultivated region. The growing plantations of trees such as the large leafy *Ficus*, *Melia*, *Dalbergia*, *Prosopis*, *Albizzia*, *Jacaranda*, *Poinciana*, etc. lining the streets flourish well and impart a green and wooded appearance. The magical transformation is due to the endeavour of the Birla Education Trust.

The earliest attempts to study the vegetation of the place include those of Mulay and Ratnam (1950), and Ramachandra (1950). A synecological study of the vegetation around a temporary pond was made by Ratnam and Joshi (1952). Recently Nair and Joshi (1955) studied the sand dune vegetation of Pilani and its neighbourhood. Bakshi (1954) gave a detailed account of the vegetation of the place covering an area of 40 square miles, and has given a long list of 312 plants. It was found that Bakshi's list requires some correction as it includes a considerable number of plants not found either in the wild or in the cultivated state in the area Bakshi surveyed. He has also omitted a large number of plants and therefore the present paper is called for.

Bakshi has described in detail the ecological features of the vegetation of the area. However, a few words must be said about these aspects to give the reader a general idea of the floristic composition with regard to different habitats.

The rainfall rarely exceeds 15″ and the rainy season is from July to September. The cold season begins towards the close of November and extends up to February. The temperature sometimes falls below freezing point. The spring is of short duration, February and March, and the area blossoms at this period becoming a mass of colour for a short time. From the middle of April to the middle of June the days are very hot and the temperature shoots up to 115° F. Dust storms are also not infrequent in these months.

Bakshi writes, 'as in Jodhpur (Sarup, 1952) there is a constant breeze in Pilani from the south-west to north-east from about February to October with a velocity of nearly 8-10 miles per hour. The velocity increases during May to 20 and the direction changes from west to east'. This is very surprising as there is no anemometer in Pilani or in its close vicinity to determine the speed of the wind.

The nature of the soil varies from locality to locality and based on this three types of localities can be marked out :

(*a*) *Localities with more or less stable dunes.* Vast stretches of sand dunes occur in Pilani. These dunes, though formed of loose sand, are not shifting ones and support a shrubby stunted vegetation especially of *Capparis decidua, Gymnosporia montana* and trees like *Prosopis spicigera* and *Balanites roxburghii.* These sand dunes are in a definite direction, generally from south-west to north-east. The soil is calcareous and these dunes put on a green appearance even after very slight showers.

(*b*) *Localities with sand dunes of the moving type.* Like the above area sand is piled up into dunes but they are at the mercy of the winds. The area beyond Vidya Vihar up to the bed of Khantli, a purely rainfed stream, in the west has mostly a rolling topography due to vast stretches of hummocky sand dunes in succession. However, there are indications that the desertic character of the area is fast fading or already lost in some places due to encroaching vegetation. Several spots in this locality, which were full of shifting sand dunes until seven years ago, have been completely colonized by thick growth of *Calligonum polygonoides* and *Saccharum munja.* Sand dunes of the shifting type are also common on either side of Pilani-Loharu and Pilani-Chirawa roads. Sometimes rocky projections raise their heads. The direction of sand dunes in these places depends upon the configuration of such rocky ridges and prominences. The soil is calcareous, as in the above case, and the vegetation in this area is very scanty. Moving dunes in association with rocks are found about two miles north of Pilani town and also near Narh along Pilani-Chirawa road.

(*c*) *Localities with stable sand.* Under this heading come the cultivated fields, the villages, and the Vidya Vihar colony and its neighbouring places. In this area sand has become stable due to prolonged weathering and is different from typical desert soil. The top layer is compact and fertile due to accumulation and admixture of organic matter. It is neutral or slightly alkaline and the pH increases with depth. This is due to increasing proportions of calcium formed due to leaching. This type of soil can grow good crops.

The general character of the vegetation corresponds with the physical aspect, the nature of the soil and irrigation. The Vidya Vihar and its neighbouring areas support a fairly good vegetation. Pure desert until a few years ago, this area at the present time is an extensively green and cultivated tract. Obviously water plays an important role in the development. Water is pumped up from deep wells and is supplied to the various parts of the place. This water supports the luxuriant growth of plants. The Vidya Vihar area is surrounded by cultivated fields interspersed here and there with dunes mostly of the Barchan type. The dominant indigenous trees of the locality are *Prosopis spicigera, Tecoma undulata, Anogeissus pendula, Acacia arabica,* and *Balanites roxburghii.* Wherever sub-soil water is available, agricultural operations are carried on by the villagers.

Beyond the cultivated areas come with incongruous suddenness vast stretches of sandy plain with patches of thick growth here and there. The grayness of the area is increased by spiny and thorny plants. The vegetation is a scrub jungle composed mainly of the more dominant species *Prosopis spicigera* and *Capparis decidua,* and wherever thick growth occurs it is mainly a *Prosopis-Capparis* association. The common plants of the locality are *Tecoma undulata, Anogeissus pendula, Salvadora oleoides, Balanites roxburghii, Acacia arabica, Mimosa hamata,*

Zizyphus rugosa, *Gymnosporia montana*, *Calotropis procera*, *Leptadenia spartium*, *Ephedra foliata*, *Clerodendrum phlomidis*, *Lycium europaeum* etc. In summer the ground lies bare except for a few hardy perennials and the area puts on a turf of greenery after the rains. The ground vegetation just after the rains consists mainly of *Tephrosia purpurea*, *Trianthema* sp., *Tribulus terrestris*, *Aerua tomentosa*, *Phyllanthus madraspatensis*, *Phyllanthus niruri*, *Achyranthes aspera*, *Cleome viscosa*, *Polygala eriopteria*, *Polygala abyssinica*, *Mollugo* sp., *Crotalaria burhia*, *Corchorus acutangulus*, *Boerhavia diffusa*, and grasses mainly *Eragrostis* sp., *Cenchrus* sp., *Andropogon* sp., *Cyperus rotundus*, etc. In subsequent months the vegetation is rather scanty, as most of the above-mentioned plants dry up. In winter only a few plants, such as *Argemone mexicana*, *Achyranthes aspera*, *Heliotropium* sp., *Trichodesma indicum*, *Coronopus didyma*, *Launea* sp. etc., are found.

In loose rippled sand *Calotropis procera*, *Crotalaria burhia*, *Aerua tomentosa*, *Panicum turgidum*, *Cenchrus biflorus*, *Citrullus colocynthis*, *Mollugo* sp., *Eragrostis* sp., etc., are the early colonizers. The stabilized dunes show an interesting elevational zonation, and this aspect was dealt with in some detail by Nair and Joshi (1955).

The vegetation in the rocky areas is very sparse. In the crevices and other places where some soil has been formed grow *Orygia decumbens*, *Cnicus wallichi*, *Clerodendrum phlomidis*, *Pupalia lappacea*, *Stachytarpheta indica* and grasses such as *Conchrus*, *Eragrostis*, *Andropogon*, etc. The common tree species in these rocky areas is *Acacia senegal*.

Additions to Bakshi's List

Nymphaeaceae

Nymphaea stellata Willd. Cultivated in gardens.

Menispermaceae

Cocculus cebatha DC. A woody climber. Common ; flowers after rainy season.

Cruciferae

Farsetia hamiltonii Royle. Rare ; flowers, July–Sept.

Sisymbrium irio Linn. A medium-sized hairy annual with pinnately divided leaves, end lobes large, but often arrow-headed, flowers yellow, capsules 1½–2½″ long.

Cheiranthus cherii Linn. Cultivated in gardens.

Capparidaceae

Cleome papillosa Steud. A strongly scented, hairy, glandular annual ; leaves cordate, penninerved, lower long-stalked, upper sessile or nearly so ; flowers very small, pinkish to dirty yellow, in racemes ; seeds reniform. Common after the rains.

Polygalaceae

Polygala abyssinica Bresch. Common.

CARYOPHYLLACEAE

Spergula rubra Linn. A green annual of moist places. Leaves opposite; seeds wingless; flowers cold season.

PORTULACACEAE

Portulaca grandiflora Linn. Cultivated in gardens. Flowers red, opening at noon.

TAMARICACEAE

Tamarix dioica Roxb. A small tree with drooping branches. Flowers pinkish in peduncled and panicled spikes. Disc of flower 5-lobed, anthers purple.

MALVACEAE

Bombax malabaricum DC. Cultivated. A few plants in Vidya Peeth garden.

Hibiscus micranthus Linn. A small shrub; flowers axillary, single, pink or white. Seeds cottony. Rare in rocky areas.

Thespesia populnea Corr. Three plants have been introduced in the nursery in 1955.

Sida grewioides Guill. Common in dry places. Flowers white or yellow. Corolla slightly exceeding the calyx.

STERCULIACEAE

Guazuma tomentosa Kunth. A few plants cultivated.

TILIACEAE

Grewia oppositifolia Roxb. A small under-sized tree. Leaves large (2–4 by 1–2·5") with stout petioles. Peduncles leaf-opposed or few axillary. Fruit one- to 4-lobed, black when ripe. Often cultivated by the villagers for the fruits. Leaves lopped for fodder. The bast fibre is used for ropes. The wood has an unpleasant smell when burnt. Flowering from April to August.

Triumfetta pilosa Roth. Herbaceous or shrubby; lower leaves ovate, upper lanceolate, all stellately hairy; flowers yellow in fascicled leaf-opposed cymes. Spines of fruit hooked. Rare; flowers during cold season.

Corchorus antichorus Raeusch. A small woody perennial. In dry places; capsule straight or curved, cylindric, beaked, four-valved. Common. Used as fodder for camels. Flowers Sept.–Oct.

Corchorus urticaefolius W. and A. Capsules short, slightly three-angled, bent downwards, valves with transverse partition. Leaves cordate or ovate, acuminate. Common; flowers rainy season.

ZYGOPHYLLACEAE

Tribulus alatus Delile. Leaflets five pairs or less. Common during rainy season.

Fagonia bruguieri DC. Branches trigonus, grooved ; leaflets ovate, fleshy. Internodes very short. Leaves three-foliate in the lower, one-foliate in the upper parts.

RUTACEAE

Feronia elephantum Correa. Cultivated in the Botanical garden.

Citrus medica Linn. The following varieties are cultivated.
var. *medica.*
var. *limonium.*
var. *acida.*
var. *limetta.*

Aegle marmelos Corr. Cultivated particularly near temples. Flowers April and May. The fruit ripens a year later.

LEGUMINOSAE

Crotalaria juncea Linn. Cultivated ; rare.

Indigofera linifolia Retz. Flowers during the rainy and cold seasons.

Indigofera subulata Vahl. Common during the rainy season.

Indigofera trigonelloides J. & S. Rainy season, frequent.

Trigonella foenum-graecum Linn. Common during the rainy season.

Alysicarpus tetragonolobus Edgew. Rainy season.

Vicia hirsuta Koch. Rare. A wiry herb. Flowers cold season and after.

Dolichos biflorus Linn. Cultivated.

Erythrina suberosa Roxb. Cultivated in gardens.

Phaseolus pauciflorus. Cultivated.

Phaseolus semierectus Linn. A few plants from the farm area in Sept. 1955. Most probably introduced along with other seeds.

Caesalpinia pulcherrima Linn. Cultivated.

Cassia siamea Lamk. Planted along roadsides and also in gardens. Introduced in 1949.

Cassia tora Linn. A small shrub. Rare ; flowers during rainy season.

Cassia obovata. Rare ; flowers during rainy season.

Poinciana regia. Planted on roadsides. Frequent. Flowers Feb.–March.

Acacia jacquemontii Benth. A thorny bush with sweet-scented yellow flowers in globose heads. Bark used for tanning. Branches lopped for fodder. Flowers Feb.–May. Rare.

Acacia leucophloea Willd. A small tree. Easily recognised by its terminal panicles of flowers and brown velvety pods. Flowers Aug.–Nov.

Mimosa rubicaulis Lamk. A shrub with smaller prickles (0·1″ long) than *Mimosa hamata*. Flowers pink turning to white, in globose spikes in axillary fascicles. Fruit flat square. Sutures slightly prickly. Flowers July to Sept. Rare. (Gamble considers the North Indian plant clearly distinct from Lamarck's species and calls it *Mimosa himalayensis* Gamble. (*Vide* Kew. Bull. 1920, p. 6.)

COMBRETACEAE

Quisqualis indica Linn. Cultivated in gardens.

CUCURBITACEAE

Momordica balsamina Linn. Bracts variegated. Common during the rainy season.

Bryonia laciniosa Linn. A few plants were seen in August 1954 in the farm area.

Cucumis trigonus Roxb. A trailing herb. Stems with rigid hairs. Leaves 3–5-lobed, roughly circular in outline, covered with hairs on both surfaces. Male flowers in small clusters. Female flowers standing single. Fruit small, yellow when ripe. Flowers August–November.

Cucurbita moschata Dusch. Cultivated.

Ctenolepis cerasiformis Naud. A monoecious climber. The stipuliform bract is the characteristic feature of the species. The only other report about this plant from Rajasthan is from Harsh Nath by Nair and Nathawat (1956).

FICOIDEAE

Mollugo spergula Linn. Very rare. Just after the rains.

Trianthema hydaspica Edgew. Very rare. Flowers after the rainy season.

Orygia decumbens Forsk. In rocky places. Frequent. Flowers July–October.

RUBIACEAE

Spermacoce stricta Linn. Erect herb ; both carpels dehiscing ventrally. Seeds polished.

Oldenlandia corymbosa Linn. Common after the rainy season.

Oldenlandia brachiata Hook. An annual ; stem four-angled. Rare. Sept.–Nov.

COMPOSITAE

Dicoma tomentosa Cass. A densely white tomentose herb. Heads solitary, subaxillary and terminal. Rare.

Pulicaria wightiana Clark. Common. Flowers Oct.–Jan.

Launea pinnatifida Cass. Common during the cold season.

Cnicus wallichii DC. Robust shrub with spreading branches. Leaves sessile, pinnatifid, tomentose, lobes ending in long slender, rigid spine; rare; flowers in cold season.

Sonchus asper Hill. Rare, cold season.

Echinops echinatus DC.

SAPOTACEAE

Achras sapota Linn. (*A. zapota* Linn). An evergreen tree, cultivated in most places. Flowers appear throughout the year, the fruits ripen mainly during March, April, August and September.

Mimusops hexandra Roxb. A handsome tree. Flowers Nov.–Dec. Calyx lobes 6, stamens 6, alternating with 6 staminodes. Ovary 12-celled. Cultivated.

APOCYNACEAE

Lochnera pusilla K. Schun. A small annual with white flowers; common in the fields as a weed.

Ervatamia coronaria Stapf.—*E. divaricata* (Linn.) Alston. (Syn. *Tabernaemontana coronaria* R. Br.) A small shrub of gardens. Flowers white, fragrant at night, inodorous during day. Follicles with 3–6 seeds embedded in a red fleshy aril.

Ervatamia dichotoma Blatter. A small shrub. Only two plants in Chandra Bhavan.

Wrightia tomentosa Roem. A rare deciduous tree. Young parts tomentose; corona of orange-coloured scales. Follicles black, 8–14″ long, laterally compressed. Flowers rainy season.

Plumeria acutifolia Poiret. Cultivated in gardens. Flowers white. Fragrant.

Allamanda cathartica Linn. A woody climber with large bright yellow flowers. Cultivated.

ASCLEPIADACEAE

Ceropegia tuberosa Roxb. A perennial herb. Rare. Flowers during rainy season.

Cryptostegia grandiflora R. Br. A large evergreen ornamental woody climber with rose flowers. Cultivated.

Asclepias curassavica Linn. A Mexican plant, common in gardens.

BORAGINACEAE

Heliotropium indicum Linn. Leaves up to 4" long. Fruit beaked; common in moist places. Flowers Oct.

Heliotropium subulatum Hochst. Spikes not bracteate. Fruit not beaked; nutlets rounded tuberculated on the back. Flowers cold season.

Heliotropium ovalifolium Forsk. Spikes with persistent bracts, fruit not beaked. Nutlets densely silky on the back. Flowers cold season.

Heliotropium marifolium Retz. Spikes bracteate, bracts conspicuous, leaf-like, lanceolate. Fruit bristly, subglobose, nutlets brown.

Arnebia hispidissima DC. A diffuse hairy herb. Flowers small, white in racemes. Nutlets tuberculated on all sides. Common. Flowers hot season.

Sericostoma pauciflorum Stocks. A straggling undershrub of sandy soil. Flowers Dec.–Feb.

CONVOLVULACEAE

Cuscuta reflexa Roxb. Parasite on small trees or shrubs. Flowers Sept.–Feb. Rare.

Merremia pentaphylla Hallier. Cultivated.

Ipomea quamoclit Linn. Rare, in gardens.

SOLANACEAE

Lycium europeum Linn. A thorny shrub. Flowers white, Oct.–March. Common in sandy areas.

Cestrum nocturnum Linn. Cultivated in gardens for the fragrant flowers.

SCROPHULARIACEAE

Anticharis linearis Hochst. (*Doratanthera linearis* Benth). A Small herb with purple flowers. Common, August–December.

Russelia juncea Zucc. A Mexican shrub with rush-like green and ribbed stems, branches slender in whorls. Common in gardens. Flowers most part of the year.

Linaria minor Desk. Cultivated in gardens.

BIGNONIACEAE

Tecoma stans Juss. (*Stenolobium stans* Seem) A large shrub; leaves pinnate; flowers yellow, corolla with red lines on the inside. Cultivated in gardens and also as a hedge plant; common. Flowers Sept.–April.

Tecoma capensis Lindl. (Syn. *Tecomaria capensis* Spach). A rambling shrub indigenous to south Africa. A few plants cultivated in gardens.

Millingtonia hortensis Linn. Indian cork tree. A tall tree with white fragrant flowers in panicles. Believed to be indigenous to Burma. Common in gardens; spreads naturally by root suckers. Flowers March–April.

Kigelia pinnata DC. Sausage tree. A medium-sized tree, indigenous to tropical Africa. Commonly cultivated on the sides of roads.

Jacaranda mimosaefolia D. Don. (Syn. *J. ovalifolia* R. Br.). A handsome tree with beautiful blue flowers in terminal panicles. Flowers April. In gardens.

PEDALIACEAE

Pedalium murex Linn. In sandy places; rare.

ACANTHACEAE

Blepharis scindica T. Anders. A spinous bristly small shrub with flowers in strobilate spikes. Flowers Sept.–Oct. Rare, in sandy areas. As far as we are aware, this is the first report of the plant from Rajasthan.

Peristrophe bicalyculata Nees. An erect herb. Stem six-angled. Flowers in trichotomous cymose panicles. Flowers pink; Oct.–Jan.

Thunbergia sp. Cultivated in gardens.

VERBENACEAE

Vitex negundo Linn. A hedge plant; rare.

Clerodendrum inerme Gaertn. An evergreen unarmed shrub. Grown in gardens. Flowers white.

LABIATAE

Ocimum basilicum Linn. Cultivated.

Ocimun canum Sim. Rare.

Leucas urticaefolia R. Br. Common.

PLANTAGINACEAE

Plantago amplexicaulis Cav. A sparsely hairy annual with a short branching stem; leaves sheathing, radical, narrowly lanceolate; many axillary scapes exceeding the leaves and ovate spikes. Sepals four with thick green midrib and membranous margins. Corolla white, lobes concave. Capsule two-seeded. Seeds boat shaped fused with the pericarp. Common in stabilised soil during cold months. This is the first report of the plant from Rajasthan.

AMARANTACEAE

Nothosaerua brachiata Wt. An erect slender branching herb; stems sparsely hairy; leaves elliptic-lanceolate, narrowed at the base, Spikes cylindrical. Perianth 3–5-lobed; stamens 2, free; ovule single; flowers October to December. Borders of fields and moist places.

Aerva lanata Juss. Rare. Flowers rainy season.

Alternanthera bicolor In gardens. Rare.

Celosia argentea Linn. Cultivated in gardens. Often found as an escape but never wild.

CHENOPODIACEAE

Chenopodium glaucum Linn. Common, January–April.

Atriplex crassifolia C.A. May. Frequent cold season.

POLYGONACEAE

Rumex dentatus Linn. The enlarged perianth in fruit with a smooth tubercle on the back, and margins irregularly toothed. Common in winter.

Antigonon leptopus Hook. Coral creeper. Cultivated in gardens. Flowers July–November.

Muehlenbeckia platyclados Meiss. A glabrous shrub indigenous to Solomon Islands. Recently introduced in the Botanical garden.

EUPHORBIACEAE

Euphorbia dracunculoides Lamk. A dichotomously branched slender annual, 10–20″ high with sessile, linear or linear-lanceolate leaves, lower alternate, upper opposite. Floral leaves shorter; involucre subsessile, solitary in between the branches, campanulate hairy on the inside, lobes ovate ciliate; glands crescent-shaped; styles free to the base, bifid; testa of seed brownish white leprous. Caruncle small. This plant was first noticed in Pilani in Feb. 1954, near the Engineering College. In the years that followed it was noticed at several spots, during the months of January–March.

Euphorbia millii Ch. des Moulins (Syn. *E. splendens* Bojer) Cyathium is closely subtended by two broadly ovate bright red bracts. Cultivated as a pot plant, very rare.

Phyllanthus emblica Linn. Only very few plants. Cultivated.

Fluggea leucopyrus Willd. A rigid bushy shrub, branches terminating in sharp thorns. Frequent. Flowers July–August.

Crozophora obliqua A. Juss. A herb; leaves stellately tomentose on both sides. Stamens five, ovary covered with stellate hairs and scales. Rare.

Croton sparsiflorus Morung. A low shrub; Leaves ovate to lanceolate, serrate at apex; leaf stalk has a pair of bracts (?) at the base. Flowers in slender racemes at the ends of branches; male flowers at the upper region, female flowers very few, stamens 10–15, outer perianth green, inner white (absent in female flowers). Capsule hairy, three-angled; seeds shining, spongy white, cap conspicuous. Flowers most part of the year. A native of S. America. Introduced in

Bengal in 1898 or so, after which it has spread rapidly throughout India. However, this is the first report of the plant from Rajasthan. In Pilani the plant was first noticed by the authors in 1953. Now colonies of it occur at various places in the area.

Poinsettia pulcherrima Grah. A few plants cultivated in gardens.

Bridelia stipularis Blume. A scandent shrub with dark grey bark. Flowers monoecious, greenish yellow, in axillary clusters. Male flowers sessile. Female pedicelled. Rare. This appears to be the first record of this plant from Rajasthan.

Breynia rhamnoides Muell. An evergreen shrub; leaves distichous, alternate; stipules short setaceous. Flowers monoecious in few-flowered, axillary clusters. Male flowers : calyx with six inflexed teeth, stamens three, pistillode absent. Female flowers : Calyx campanulate, six-lobed, enlarged in fruit. Rare.

URTICACEAE

Ficus glomerata Roxb. Cultivated. Rare. Fruit edible.

SCITAMINACEAE

Musa sapientum Linn. Rare, cultivated.

AMARYLLIDACEAE

Crinum asiaticum Linn. Cultivated in gardens; common.

Crinum latifolium Linn. Common in gardens.

LILIACEAE

Aloe vera Tourn. In gardens.

Ruscus hypophyllum Linn. A small shrub 12–18″ high. Leaves replaced by phylloclades. Cultivated in gardens.

Sanseviera cylindrica. In gardens, not rare.

Yucca sp. In gardens, rare.

Dracaena angustifolia Roxb. Cultivated in gardens.

PALMAE

Phoenix dactylifera. Only very few plants. Cultivated.

PANDANACEAE

Pandanus sp. A few plants cultivated around Shivganga. Introduced in 1953.

COMMELINACEAE

Tradescantia sp. Very rare. Cultivated.

GRAMINEAE

Cenchrus ciliaris Linn.

Cenchrus prieri (Kunth) Maire

Saccharum munja Roxb. A tufted perennial grass spreading rapidly by suckers. A good fibre is obtained from the plant. Common.

Saccharum spontaneum Rare, cultivated.

Melanocenchris royleana Nees. (*Gracilea royaleana* K K. f).

Cymbopogon parkeri Stapf.

Sporobolus orientalis Kunth.

Sporobolus glaucifolius Hochst.

Sporobolus virginicus Kunth.

Poa aspera Jacq.

Setaria glauca Beauv.

Setaria verticillata Beauv.

Tragus biflorus Schut.

Dactyloctenium scindicum Boiss. (*Eleusine scindica* Duthie).

Dichanthium caricosum A. Camus.

Brachiaria ramosa Stapf (*Panicum ramosum* Linn.).

Brachiaria paspaloides Presl.

Digitaria adscendens (H.B.K.) Henr. (*Panicum adscendens* H.B.K.).

Digitaria sanguinalis Scop. (*Paspalum sanguinale* Linn.).

Digitaria longiflora.

Aristida funiculata Trin. & Rup.

Aristida depressa Retz. (*Aristida adscensionis* Linn.).

Desmostachya bipinnata Stapf. (*Eragrostis cynosuroides* Beauv.)

Eleusine verticillata Roxb.

Echinochloa colonum Link. (*Panicum colonum* Linn.).

Echinochloa stagnina Beauv. (*Panicum stagninum* Retz.).

Eragrostis viscosa Trin.

Eragrostis gangetica Steud.

Eragrostis plumosa Link.

Eragrostis minor Host.

Sorghum halepense (L.) Pers.

Bambusa arundinacea Willd. Cultivated in Chandra Bhavan.

CYCADACEAE

Cycas revoluta Beddome. Cultivated in gardens.

CORRECTIONS, AND LIST OF PLANTS REPORTED BY BAKSHI BUT NOT FOUND IN THE AREA SURVEYED BY HIM

CAPPARIDACEAE

Crataeva religiosa Forst.

VIOLACEAE

Viola cinerea Boiss.

CARYOPHYLLACEAE

Saponaria vaccaria Linn. Bakshi states that it is a frequent weed in the fields. But we have seen it only in the cultivated state in gardens, and it never runs wild in Pilani.

ELATINACEAE

Bergia odorata Edgw.

MALVACEAE

Sida veronicaefolia Lamk.

STERCULIACEAE

Waltheria indica Linn.

GERANIACEAE

Monsonia senegalensis Guill. & Perr.

LEGUMINOSAE

Alhagi camelorum Fisch. Strangely enough Bakshi mentions it to be a common species. Not only in Pilani but also in the neighbouring places the existence of this plant is doubtful (See Nair, 1955 ; Nair and Nathawat, 1956). It is a plant characteristic of western Rajasthan.

Butea monosperma. Bakshi considers it to be a common tree in Pilani. There is only a single tree in the whole of the area surveyed by Bakshi and it was introduced into the Botanical garden in 1953.

Tamarindus indica Linn. Bakshi states that it is a frequent plant of the locality. There are only half a dozen plants (cultivated) in the area surveyed by him.

Acacia modesta Wall.

COMBRETACEAE

Terminalia arjuna Bedd. Five plants are cultivated around Shiv Gana, but Bakshi reports it to be a frequent species of the locality.

CONVOLVULACEAE

Rivea ornata

SCROPHULARIACEAE

Antirrhinum orontium Linn.

PEDALIACEAE

Martynia diandra Gl.

ACANTHACEAE

Adhatoda vasica Nees (*Justicia adhatoda* Linn.). Bakshi mentions that this plant is not infrequent in Pilani, but we have not come across it anywhere in the area surveyed by him. Several attempts have been made to grow this plant in the Botanical garden and elsewhere but failed.

VERBENACEAE

Lantana indica Roxb. Bakshi writes that this plant is frequent in Pilani becoming a troublesome weed in some places. His statement is erroneous as this plant does not occur at all in the wild state. It was in 1953 that a few plants were introduced in one of the gardens and they too do not grow well.

Stachytarpheta indica Vahl. Bakshi mentions about blue flowered plants. We have observed only white flowered plants, and the existence of blue flowered plants is not likely.

LABIATAE

Salvia aegyptiaca

Leonotis nepetaefolia

CHENOPODIACEAE

Kochia indica Wight.

EUPHORBIACEAE

Euphorbia royleana Boiss.

Euphorbia neriifolia Linn.

CONCLUSION AND SUMMARY

The aim of the present paper is to correct Bakshi's account of the vegetation of Pilani and its neighbourhood, and to provide some more information with regard to the vegetation of the locality. 145 new plants have been recorded. A list of plants not found either in the wild or in the cultivated state, but reported by Bakshi, is given.

Excluding known cultivated plants, the flora of Pilani and its neighbouring villages consists of 275 species representing 165 genera and 51 families. Gramineae is the only Monocotyledon well represented.

There are 60 species of monocotyledonous plants of which Gramineae consists of 49 species. Except Leguminosae and Compositae the Dicotyledons are also poorly represented. Of the 215 species of Dicotyledons 34 belong to Leguminosae, 18 belong to Compositae, while the remaining 163 species belong to 44 families. There is only a single Gymnosperm *Ephedra foliata*.

The ratio of Monocotyledons to Dicotyledons is 1 : 11·5 of families, 1 : 4·3 of genera, and 1 : 3·8 of species. The ratio of genera to species is 1 : 1·64.

23 families have 1 genus each, and of the remaining 28 families 11 have 2 genera, 2 have 3 genera, 4 have 4, 6 have 5, 1 each has 6, 7, 15, 16, and 24 genera respectively. The families having 6 or more genera are Amarantaceae, Euphorbiaceae, Leguminosae, Compositae, and Gramineae. Of the 165 genera, 101 are represented by a single species, 32 by 2 species, 14 by 3, 3 by 4, 6 by 5, and 2 by 6. The families having 6 or more species are Cruciferae (6), Capparidaceae (6), Cucurbitaceae (6), Asclepiadaceae (6), Solanaceae (6), Tiliaceae (8), Convolvulaceae (8), Acanthaceae (8), Amarantaceae (8), Boraginaceae (9), Malvaceae (11), Euphorbiaceae (12), Compositae (18), Leguminosae (34), and Gramineae (49). These families make more than three-fifths of the flora. The various genera are poorly represented. The largest genera containing 4 or more species are *Mollugo* (4), *Trianthema* (4), *Cenchrus* (4), *Sida* (5), *Corchorus* (5), *Indigofera* (5), *Tephrosia* (5), *Acacia* (5), *Euphorbia* (5), *Eragrostis* (6), and *Heliotropium* (6).

Out of 275 species 21 are trees, 49 are shrubs or undershrubs and 205 herbs. Phanerogamic hydrophytes are not represented in the natural vegetation of the area under consideration. *Cuscuta*, *Striga*, and *Cistanche* ate the parasitic genera of phanerogams. Climbing plants are well represented. 32 species of climbers belonging to 12 families are present in the flora of the area. The largest numbers of climbers belong to Convolvulaceae, Cucurbitaceae, and Leguminosae.

The psamophytes of the locality are *Farsetia jaquemontii*, *F. hamiltonii*, *Polygala erioptera*, *P. abyssinica*, *Polycarpaea corymbosa*, *Tribulus terrestris*, *Fagonia* sp., *Corchorus antichorus*, *Zizyphus rugosa*, *Z. xyloporus*, *Crotalaria burhia*, *Indigofera argentea*, *I. cordifolia*, *Tephrosia* sp., *Cassia toara*, *Citrullus colocynthis*, *Mollugo* sp., *Gisekia pharnaceoides*, *Spermacoce* sp., *Oldenlandia* sp., *Pulicaria wightiana*, *Echinops echinatus*, *Launea* sp., *Pluchea lanceolata*, *Calotropis procera*, *Leptadenia spartium*, *Lycium europeum*, *Pedalium murex*, *Boerhavia diffusa*, *Aerua tomentosa* *Calligonum polygonoides*, *Cyperus arenarius*, *Cenchrus* sp., *Saccharum munja*, *Digitaria marginata*, *Panicum turgidum* *Aristida depressa*, *Eragrostis* sp., *Sporobolus* sp., *Setaria* sp., and *Andropogon annulatus*.

The data presented in the previous pages suggest that there is a close similarity between the flora of Pilani and its neighbourhood and that of Chirawa (Nair, 1956). The dominant families and genera of western Rajputana and the area under consideration are practically the same (see Blatter and Hallberg, 1918–1921 ; Sarup, 1951 : Sankhala, 1951 : Sabnis, 1929). However, the absence of some of the very characteristic plants of western Rajasthan, e.g., *Alhagi camelorum*, *Euphorbia royleana*, *E. neriifolia*, *E. jodhpurensis*, *E. nivulia* etc. is very striking.

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DIFFERENTIAL RESPONSE TO FORM AND PATTERN IN TWO SPECIES OF INDIAN HONEYBEES[1]

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(With two text figures)

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1. INTRODUCTION

Honeybees are the most important among the social Hymenoptera as agents for pollination in plants. This is mainly due to their faculty of flower constancy, by which is meant the attachment of honeybees to flowers of a particular species of plant for obtaining nectar and pollen for a considerable period of time. In returning to the same type of flower and in being able to distinguish between flowers of different species of plants, the honeybees are supposed to make use of certain clues, such as the colour, form, scent, and the position of the flowers. However, it is only in the European honeybee *Apis mellifera* that these factors of sensory physiology and behaviour have been analysed and have been proved to be of importance in the phenomenon of flower constancy. It was with the object of investigating the possible importance of 'form' in the flower constancy shown by Indian honeybees that the present work was undertaken.

Considerable work on the problem of discrimination of form and pattern in *A. mellifera* based both on spontaneous preference and on preference induced by training has been done in Europe, especially by German workers.

Von Frisch (1914) trained honeybees to select a sunflower-shaped pattern from a gentian-shaped one, but neither he nor Hertz (1929a)

[1] Dedicated to Prof. K. von Frisch on his seventieth birthday.

could succeed in training the bees to distinguish between such figures as triangles, squares, and circles. However, the bees could distinguish these patterns from the subdivided ones, and they could easily be trained to choose only the more subdivided pattern. Hertz (1929b) also performed experiments on the spontaneous, as opposed to induced, form-preference in *A. mellifera*. She did these by training bees to feed from a uniform white surface and then offering them a choice of two alternative black-on-white patterns on which they had never been fed. They preferred any black figure to the white background and so Hertz came to the conclusion that their spontaneous preference regarding various figures was related to the quantity of outline, irregularity and size of patterns, and the independence of their components. There was no absolute criterion of attractiveness, but the attractiveness of any pattern depended upon its value relative to that of other objects which the bee could see at that time. At any rate, bees preferred the most contrasting patterns. Later, Hertz also performed experiments with three dimensional models. The result was that bees responded to the shadows of these three dimensional models in the same way as they did to the black parts in the black-on-white patterns.

Gertrud Zerrahn (1933), who trained honeybees to one pattern and then presented them with a choice of two patterns which were similar in character but different in their degree of subdivision, also concluded that the bees had a spontaneous tendency to alight upon whatever pattern possessed the greatest length of contour. Wolf and Zerrahn-Wolf (1935) offered untrained honeybees a free choice of pairs of chessboard patterns and they concluded that the reaction of bees to patterns depended only on the rate of change in the stimulation of their eyes. Wolf (1933 a, b) demonstrated the importance of 'flicker' in bee vision, and concluded that the quick variation in the stimulation of the facets would cause the bee to alight, and discover groups of flowers.

This simple hypothesis, however, can not explain all the observed facts. After taking a review of all the work done on this subject, including her own work, Hertz (1935) concluded that the amount of outline possessed by different black-on-white patterns was certainly not the only quality by which they were distinguished; a figure was perceived as a complex thing, which might have several different properties which could be used for alternative training.

From the foregoing, it appears that our knowledge of the subject of form discrimination in honeybees is far from complete. The conclusions reached by Hertz, Wolf, and Zerrahn are partially contradictory. Ribband's book (1953) contains a wealth of information on the vision of honeybees and yet his section on 'Perception of Form and Pattern' leaves the impression that much more data are necessary. There is, however, a certain measure of agreement on one point, namely that, when the bees are confronted with a pair of figures of similar general character (but differing in the amount of contour or degree of subdivision), they prefer the figure with greater contour to the one with less, as long as they are able optically to resolve both patterns and consequently recognise them as such.

In attempting to investigate the response of the Indian honeybees to form and pattern, the following problems were posed:

(i) What preferences, if any, do the various species of Indian honeybees show for one of two patterns similar in all respects except in their length of contour (or degree of subdivision, contrast, degree of brokenness, etc.)?

(ii) If there is such a preference, is there a point of subdivision of pattern at which this preference is reversed? And if so, when?

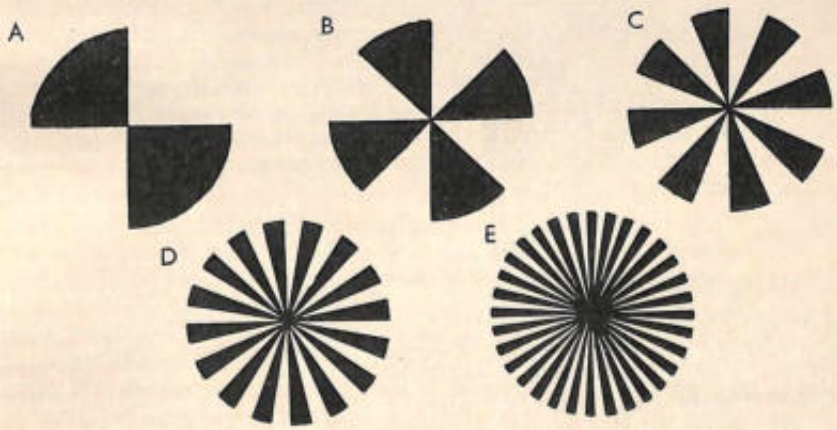
(iii) Does the choice of pattern depend on the distance at which the bee decides on which of the two to alight?

2. Materials

Results recorded in this paper have been obtained from experiments on *Apis indica* and *Apis florea*. During the training of the bees and the tests, the experimental table was covered with a uniform light grey paper. During the test this background of light grey served to provide a strong contrast to all other patterns provided which were made in jet black.

Two series of patterns (or figures) similar to some used by Zerrahn (1933), one later referred to as the star series, and the other the chequerboard (or chessboard) series, have been used in these experiments. In the star series of patterns, photographic black paper was cut and stuck on light grey (same as the background colour) cardboard discs.

The radius of each pattern was always the same, namely one inch. The star series consisted of five gradations of patterns of increasing complexity shown in text figure 1 (A-E). Pattern A showed

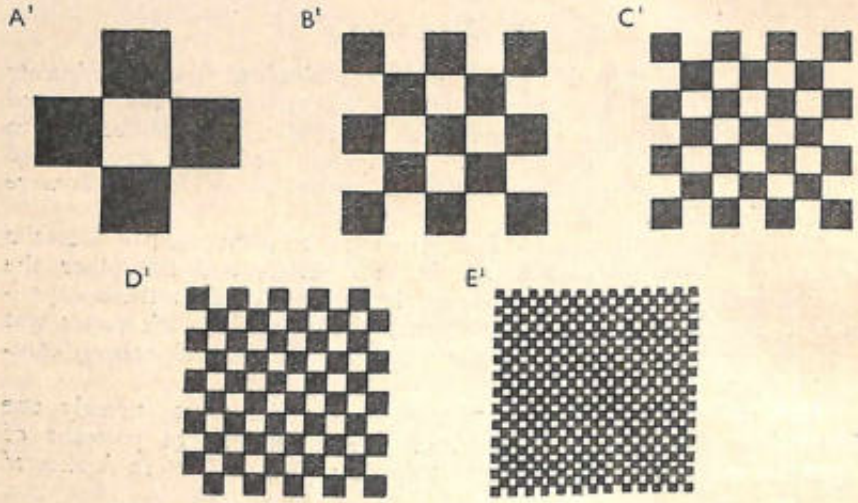


Text-figure 1. Star series of patterns A to E.

the least amount of contour between black and light grey. The amount of contour increases successively through B, C and D to reach its climax in E. Two specimens of each grade of pattern were prepared. In addition to these patterns, two specimens each of solid black discs and solid medium grey discs of the same diameter as the black rays

in the star series were prepared. The medium grey chosen (M 15 of the standardized Baumann series) was approximately intermediate in shade between the light grey and the black used in these experiments.

In the chessboard series two figures each of five grades of patterns of increasing contour complexity were prepared. Here, however, the black parts of the figure were not stuck on light grey squares but were painted jet black in Indian ink on it. The five grades in the chessboard series are designated as A′, B′, C′, D′, and E′ (figure 2). The least subdivided pattern A′ presents the least



TEXT-FIGURE 2. Chequerboard series of patterns A′ to E′

amount of contour of black and light grey, while the degree of subdivision as well as the amount of contour increases successively through B′, C′ and D′ to reach its climax in E′. Two specimens of medium grey squares (M 15) were also prepared for the chequerboard series.

3. METHOD OF EXPERIMENTS

At the beginning of the experiments with each of the two species of honeybees the bees had first to be lured to the experimental table in order to perform the experiments. The method of luring both *A. indica* and *A. florea* is essentially the same. The bees are lured either directly from the hive when it is accessible, or else from the flowers on which they feed in nature. During luring a piece of filter paper smeared with honey is held near the bees. When one of the bees happens to crawl on this honey-soaked filter paper it feeds from it. After feeding, the bee returns to the hive and apparently alerts its companions, for in a short while a group of about ten to fifteen bees is seen feeding from the filter paper. The filter paper together with the bees thereon, is then slowly transferred, by stages, to the experimental table where concentrated sugarwater drops are uniformly

scattered over a transparent piece of 'Perspex' (I.C.I.) which, in its turn lies above the light grey paper which forms the background colour. The filter paper together with the bees on it is finally kept near one of these sugarwater drops. When the honey on the filter paper is exhausted, bees discover the sugarwater drops and commence feeding on them. The filter paper is then discarded. Thereafter, the bees regularly visit the experimental table and feed on sugarwater drops. The sugarwater drops are renewed as soon as they are exhausted. This part of the experiment is called the training. The bees in this case are being trained to associate food with the light grey colour of the uniform background. If the bees have been fed for a sufficiently long time on a given spot, they automatically visit the same spot at approximately the same hour on subsequent days. This fact obviates the need of luring the bees to the experimental table every day.

The perspex, referred to above, is of the same appearance as glass but differs from it inasmuch as it does not cut away the ultra-violet rays to the same extent. During the training of the bees as well as the tests, a piece of perspex covers the whole arrangement, either of the light grey paper alone or with the patterns on it as the case may be. This is to ensure that the bees do not train themselves to the smell of the light grey paper.

During training the perspex, over which sugarwater drops are laid, is cleaned at frequent intervals by means of a moist cloth. This precaution is taken to ensure that the bees do not associate the bee scent with food. This has been shown to occur in *A. mellifera* and so is suspected to occur also in the Indian species of honeybees. Care is also taken during training to see that the bees do not form large clusters round a single sugarwater drop; for if this is allowed to happen the bees might get trained to an accumulation of their own shapes and colour, instead of to the light grey colour and this factor may distort the results to be obtained in the test.

After training to the light grey background, tests are performed with figures on which the bees had not been fed. In the test, two specimens each of two patterns for which the bees' inborn preference is to be tested are kept on the light grey paper which is already on the training table, and this whole arrangement is covered over by a new clean sheet of perspex. The patterns are laid out on the table in such a manner that all of them have an equal chance of being visited by the bees. In the tests, no sugarwater drops are offered over the perspex. Ordinary water drops were offered instead on the perspex directly above the patterns, in some of the tests, while in the rest there were no drops. The presence of water drops in the test merely serves to enhance the number of visits on all the patterns offered, but does not materially alter the nature of the results. In the tests where the perspex is raised, the presence of water drops greatly facilitates accurate recording of the number of visits, which is otherwise very difficult. The number of visits that the bees pay to each of the patterns offered is recorded. When a sufficient number of visits have been recorded the test is closed down, and training the bees to light grey paper is resumed in the manner described above.

During each test the experimental table is turned once through an angle of 90°, so as not to give any pattern (also called 'figure' in this paper) an advantage over the other only because of its position.

The reaction of bees to figures were tested under two main conditions:

(a) with the figures covered only with a layer of perspex, and

(b) with perspex raised over the figures so that it covered the whole arrangement at a distance of $1\frac{1}{2}$". For this purpose a frame was designed which could be used to raise the perspex and which, at the same time, prevented the entry of the bees from below it.

4. Observations

The results obtained in the experiments with the two species of honeybees are recorded below in the form of tables. The signs in the column at the extreme right in the table show which pattern (the less subdivided or the more subdivided) out of a pair is preferred by the bees, and to what extent? The signs used to indicate the preferences are +, + +, and + + +. These are explained below Table 1. The preferences shown by the bees in these experiments are entirely spontaneous or inborn, inasmuch as the tests are not preceded by training the bees to any particular pattern. It is significant that the choice between the two patterns by the bees is based on relative and not on absolute characters of the patterns in question.

Table 1 and 2 show the results of experiments with *A. indica* in which the star and the chequerboard series of patterns respectively were used. Tables 3 and 4 record the results of experiments with *A. florea* in which also the star and the chequerboard series of pattern respectively were used.

Table 1

Apis indica. Star series of patterns

Expt. No.	Patterns offered	Perspex raised or not?	Percentage of visits on each of the patterns	Total No. of visits	Remarks*	
					Less sub.	More sub.
1	A & B	No	A–33·3, B–66·7	42		+ +
2	B & C	No	B–33·3, C–66·7	120		+ +
3	C & D	No	C–50 , D–50	32	equal	equal
4	C & D	Yes	C–71·4, D–28·6	49	+ +	
5	D & E	No	D–54·2, E–45·8	35	+	
6	Black disc & E	No	Black 13·6, E–86·4	44		+ + +
7	B & E	No	B–33·3, E–66·7	37		+ +
8	B & E	Yes	B–71·4, E–28·6	63	+ +	
9	A & E	No	A–32·5, E–67·5	40		+ +
10	A & C	No	A–25, C–75	32		+ + +
11	A & C	Yes	A–67·5, E–32·5	40	+ +	
12	M15 & E	No	M15–15·3, E–84·7	13		+ + +
13	M15 & E	Yes	M15–52, E–48	48	+	
14	M15 & D	Yes	M15–46·2, D–53·8	54		+

* Slightly preferred +, preferred + +, greatly preferred + + +.

TABLE 2

Apis indica. Chequerboard series

Expt. No.	Patterns offered	Perspex raised or not?	Percentage of visits on each of the patterns	Total No. of visits	Remarks	
					Less sub.	More sub.
1	B′ & E′	No	B′ – 75·5, E′ – 24·5	49	+ + +	
2	Black sq. & C	No	Black – 20, C′ – 80	35		+ + +
3	B′ & D′	No	B′46·6, D – 53·4	30		+
4	B′ & D′	Yes	B′ – 67, D′ – 33	59	+ +	
5	D′ & E′	No	D′ – 81, E′ – 19	37	+ + +	
6	Black sq. & E	No	Black – 29·6, E′ – 70·4	27		+ +
7	M15 & D′	Yes	M15 – 63·1, D′ – 36·9	38	+ +	

TABLE 3

Apis florea. Star series of patterns

Expt. No.	Patterns offered	Perspex raised or not?	Percentage of visits on each pattern	Total No. of visits	Remarks	
					Less sub.	More sub.
1	A & B	No	A – 34·7, B – 65·3	46		+ +
2	A & B	Yes	A – 45·9, B – 54·1	49		+
3	A & C	No	A – 23·8, C – 76·2	88		+ + +
4	A & C	Yes	A – 38·9, C – 61·1	77		+
5	A & D	No	A – 26·8, D – 73·2	97		+ +
6	A & D	Yes	A – 50·5, D – 49·5	175	equal	equal
7	A & E	No	A – 24·3, E – 75·7	111		+ + +
8	A & E	Yes	A – 47·1, E – 52·9	89		+
9	B & E	No	B – 39.4, E – 60·6	152		+
10	C & D	No	C – 55·3, D – 44·7	94	+	
11	D & E	No	D – 52, E – 48	104	+	
12	M15 & D	Yes	M15 – 49·7, D – 50·3	119	equal	equal

TABLE 4

Apis florea. Chequerboard series

Expt. No.	Patterns offered	Perspex raised or not?	Percentage of visits on each pattern	Total No. of visits	Remarks	
					Less sub.	More sub.
1	A′ & B′	No	A′ – 42·6, B′·57·4	54		+
2	A′ & C′	No	A′ – 24·3, C′ – 75·7	82		+ +
3	A′ & D′	No	A′ – 27·3, D′7·27	117		+ +
4	A′ & D′	Yes	A′ – 46·4, D′·53·6	114		+
5	A′ & E′	No	A′ – 48·7, E′ – 51·3	78		+
6	D′ & E′	No	D′ – 55·5, E′ – 44·5	63	+	
7	D′ & E′	Yes	D′ – 55, E′ – 45	69	+	
8	M15 & D′	Yes	M15 – 48, D′ – 52	98		+

5. Discussion

One of the most significant and interesting results obtained from the present study was that both the species of honeybees, even when they were trained to feed only from a uniform light grey surface, visited in overwhelmingly large numbers the black-on-light grey patterns offered to them in the test, whereas the grey background to which the bees had been trained attracted only very few.

In *A. indica* it is seen (Table 1) that among pairs of star patterns which differ but little from each other as regards the amount of contour (or the degree of subdivision) they present, the more subdivided figure is nearly always preferred (though sometimes only slightly) to the less subdivided one, as seen in Experiments 1 and 2, or at least the less subdivided figure is never preferred to the more subdivided one (e.g., Expt. 3). If the difference in the amount of subdivision is greater between the two figures, as in Expt. 10, the more subdivided pattern is markedly preferred to the less subdivided one.

If this inference is correct, then it is to be expected that the preference of the subdivided figure will cease (or even be reversed) as soon as the limit of the optical resolution of the pattern in question, by the eyes of the bee is reached. This supposition, in fact, seems to be correct in the case of *A. indica*. The results of Expt. 5 show clearly that a point is reached when the less subdivided figure (D) (text figure 1) is preferred to a more subdivided one (E). Thus, at the level of subdivision as exemplified by E, the limit of optical resolution for *A. indica* is reached.

Though we find in the abovementioned case that the less subdivided figure is slightly preferred to the more subdivided one, yet the difference in the percentage of visits between the two is small; that is to say, there is no sudden reversion of preference. This might be explained by the assumption (confirmed by direct observation) that the distance at which each bee discriminates between the two patterns is not constant, but varies round a certain median value, most probably according to a Gaussian curve. Consequently, for a certain number of bees which decide at a greater distance, the finer pattern will have become already blurred while other bees, flying low, still recognize and therefore prefer it.

If this interpretation is correct then the preference for the less subdivided figure should visibly increase if the bee is forced to make her choice between the two at a greater distance. This has been effected by the abovementioned device of raising the perspex so that the distance between it and the plane of the figures becomes $1\frac{1}{2}$". In this case, $1\frac{1}{2}$" is the minimum distance from which each bee can view both the patterns and choose between them. In fact, in Expt. 4 (Table 1) where this has been done the less subdivided figure C is definitely preferred to the more subdivided one D. This result is substantially different from the result obtained in Expt. 3, where the same patterns were used but without raising the perspex. The same phenomenon is even more strikingly illustrated by Expts. 7 and 8, as also by Expts. 10 and 11. In all these cases, the bees behave as if for all or most of them the more subdivided patterns E, D and

even C become blurred when viewed from a distance of 1½". We assume that such blurred star figures of black-on-light grey appear rather like medium grey discs to the bee. The fact that the finely divided star pattern D when confronted with a medium grey disc (M 15) under a raised perspex is almost exactly as attractive to the bees as the latter (Expt. 14) fits in with this assumption. The same holds for the star pattern E (Expt. 13). It is obvious that when the perspex is not raised above the plane of the figures, a greater proportion of bees will always be able to distinguish and prefer the finer pattern, hence even the border line pattern E is preferred to B (Expt. 7) and to A (Expt. 9). However, the preference of E is not quite commensurate with its degree of subdivision.

The results obtained, when the chequerboard series of patterns are offered to *A. indica* in pairs (Table 2), are in conformity with the results obtained with the star series and thus substantiate the hypothesis of the form discrimination of *A. indica* outlined above. The limit of optical resolution is reached for the bees at E′ (text figure 2) of the chequerboard series, as shown by Expt. 5. The only puzzling result is that of Expt. 7. Here the compact figure M 15 not only reaches the attractiveness of the finely subdivided figure D′ but surpasses it when the perspex is raised. This is contrary to the assumption that the visits on this could never more that equal those on D′, even if the chequerboard becomes completely blurred and therefore similar to a grey square of the same luminosity.

Results of a similar nature are obtained with *A. florea*. Results of Expts. 1, 3, 5, 7 and 9 in Table 3 illustrate the fact that the untrained bees when confronted with pairs of star patterns always prefer the more subdivided patterns to the less subdivided ones. These results are quite comparable to those obtained with *A. indica*. That, from a certain degree of subdivision of pattern, the preference of the bees is reversed in favour of the less subdivided figure is shown in *A. florea* by the result of Expt. 10. Here the less subdivided figure C is preferred (though slightly) to the more subdivided figure D. Thus it seems that for a certain amount of bees the limit of optical resolution of patterns is almost reached in *A. florea* between C and D of the star series of patterns. This is in contradistinction to the case obtained in *A. indica* where, as shown by Expt. 3 of Table 1, the limit of resolution is not quite reached between C and D. The fact that in *A. florea* the bees already prefer figure C to figure D seems to indicate that they have a lower visual acuity as compared with *A. indica*.

The result of Expt. 11 under Table 3 corresponds with the result of Expt. 5 in Table 1, thus showing that for both *A. florea* and *A. indica* the finely subdivided pattern E has less attraction than the less subdivided pattern D. Results of Expts. 2, 6 and 8 in Table 3 show that, as in *A. indica*, the preference is reversed in favour of the less subdivided pattern in *A. florea* when the perspex is raised 1½" above the plane of the figures offered. The only result which does not fit in is that of Expt. 4 in Table 3. For this experiment seems to show that *A. florea* still prefers pattern C to pattern A, even when the perspex is raised by 1½". This result differs from the result of Expt. 11 in Table 1 where under similar conditions *A. indica* showed

a definite preference for pattern A over pattern C. Expt. 12 in Table C shows that for *A. florea* pattern D is very much similar to a medium grey disc when the perspex is raised to a height of $1\frac{1}{2}$" above the figures in the test. This result agrees with the result obtained with *A. indica*.

Table 4 contains the results of experiments on *A. florea* in which the chequerboard series of pattern were used. In experiments 1, 2 and 3 the patterns displaying greater contour are preferred to those showing less. Expt. 5 shows that the most subdivided pattern of the series, E', is slightly preferred to the least subdivided one, namely A'. Unfortunately the same experiment was not performed for *A. indica* but a closely comparable experiment, Expt. 1 in Table 2, shows that the most subdivided pattern E' is not preferred to one of the less subdivided patterns B'. In fact B' is nearly thrice as much visited as E'. This fact seems to indicate that *A. florea* has a greater visual acuity than *A. indica*. But this is contradictory to the previous hypothesis. Also Expt. 8 shows that, unlike *A. indica*, the medium grey M 15 is confused with pattern D' when the perspex is raised in the test to a height of $1\frac{1}{2}$". Other results in Table 4 are similar to those obtained with *A. indica*.

Thus, as in the case of *A. mellifera*, a figure or pattern which presents a greater contour is preferred to one with less both by *A. indica* and *A. florea*. This preference, however, is shown only as long as the eye of the bee is able to resolve a pattern as such. Beyond that limit the preference of the more subdivided figure is reversed, most probably because such a figure seems blurred to the bees. In my experiments the reversal which occurred when the distance between the contours reached a certain absolute value was not sudden but gradual. This points to the fact, confirmed by observation, that the distance at which the bees make their choice between alternative patterns is not the same for all of them, but there is a median value around which the other values of distance lie, most probably along a Gaussian curve. It is intended, in future work, to obtain comparative values of visual acuity for the different species of honeybees by introducing an arrangement whereby the bees would be compelled to make their choice between different patterns at certain constant distances. The results obtained are likely to lead to a more definite conclusion than is possible on the basis of the present work, purely from the point of view of difference, if any, in the visual acuities of the different species of bees. The results thus far obtained seem to suggest that *A. florea* might have a slightly greater visual acuity than *A. indica*.

6. Summary

As in the case of the European honeybee, *A. mellifera*, a pattern which presents a greater contour is spontaneously preferred to one with less, both by *A. indica* and *A. florea*. This preference is shown only as long as the bee's eye is able to resolve a pattern as such. Beyond that limit the preference of the more subdivided figure is reversed, most probably because such figure seems blurred to the bees. This reversal is not sudden, but gradual. This points to the fact that the distance at which the bees make their choice between alternative

patterns varies for different species of bees around a median value, most probably along a Gaussian curve. The results thus far obtained seem to suggest that *A. florea* may have a slightly greater visual acuity than *A. indica*.

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BIONOMICS OF THE PUMPKIN CATERPILLAR—*MARGARONIA INDICA* SAUND. (PYRALIDAE: LEPIDOPTERA)[1]

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(With a plate and a graph)

INTRODUCTION

The pumpkin caterpillar, *Margaronia indica* Saund., is noted as one of the important insect pests of cucurbitaceous vegetables grown in this part of the world. The caterpillars attack both leaves and fruits and thus cause considerable damage. The damage to fruits is a direct loss and is prominently noted during August and September. Weekly observations taken during the period of investigation showed that the caterpillars occur on the crop from the first fortnight of June to the second fortnight of November, i.e., up to the pruning time of the crop. The peak of infestation was, however, noticed after 3 to 4 weeks of initial infestation. During 1953-54, the attack was initially noted on parwar (*Trichosanthes dioica* Roxb.) which subsequently spread on tondli (*Coccinia indica* W. & A.) crop.

METHODS AND MATERIALS

The pest was commonly found on tondli and parwar. To judge the incidence of the pest in the fields, three leaves of different stages of growth were selected at random and the population level was recorded. Every week 10 different vines were selected at random and the average incidence of the pest on a medium-sized leaf was worked out. The incidence of the pest damaging the fruits was noted by observing 100 fruits at random. The larvae were reared on tondli leaves in the laboratory in glass petri dishes or glass bowls. The leaves were maintained green and succulent by keeping wet cotton-wool plugs at their petioles. The pupae, as they formed, were taken out, sexed and kept in separate dishes until emergence of the adults. The sex of the moths as they emerged was confirmed and individual pairs were introduced in glass chimneys with hanging paper strips. The moths were fed on sugar solution. The moths laid eggs on the

[1] Being a part of the thesis for the M.SC. (Agri.) degree submitted to the Gujarat University by the former author under the guidance of the latter.

paper strips. Fresh strips were substituted and those with eggs were removed for egg counts. Permanent mounts of the insect material were prepared following the usual method. The material was treated with concentrated chlorine water subsequent to potassium hydroxide treatment, in order to decolorise the material satisfactorily. It was then washed, dehydrated in ascending series of alcohol, cleared in clove oil and mounted in balsam.

Historical Review

Hampson (1896) recorded the insect as damaging cotton leaves throughout the Australian and Oriental regions. In India it was first recorded by Lefroy and Howlett (1909) on cucurbits. Fletcher (1914, 1921) has given a general description of the life stages of the insect and has reported that it occurs in the plains of India, Burma, and Ceylon on snake gourd, cucumber, turia (*Luffa*), *Cucurbita pepo*, and kaddu. Ramkrishna Ayyar (1923, 1940) observed that it occurs on melon and various other cucurbitaceous crops. He has briefly described some of the life stages without giving the details regarding its bionomics. Other important records are by Pruthi (1936) and Sevastopulo (1948) from India, by Gosh (1925) from Burma, and by the Entomological staff (1923) from Ceylon. Vayssiere and Mimeur (1925) observed that in French Sudan it occurs on egg-plant and cotton. According to them the larval and pupal stages last for 16 and 11 days respectively. In Queensland, May (1946) found it to be most common on watermelon. He observed that the larval and the pupal periods last for 3 weeks and 5 days respectively.

Geographical Distribution

The insect has been recorded by various authors from various Indian territories, Burma, Ceylon, Fiji, Oriental and Australian regions, Netherland Indies, Samoa, Mauritius, Tonga Island, Indo-China, Japan, French West Africa, French Equatorial Africa, West Africa, and French Sudan.

Host-plants

Within India the insect has been reported to feed on snake gourd, cucumber, turia (*Luffa*), *Cucurbita pepo*, kaddu, melon and cotton. Outside India, it is reported as feeding on *Momordica charantia* L., *Ficus glomerata* Roxb., snake gourd, melon, New Guinea bean (a cucurbitaceous plant), pumpkin, cotton, soyabean, cucumber, and egg-plant.

However, at various farms of the Institute of Agriculture, Anand, Bombay State, the insect was found breeding on parwar (*Trichosanthes dioica* Roxb.), tondli (*Coccinia indica* W. & A.) and bottle gourd (*Lagenaria vulgaris* Seringe).

Nature of Damage

The larva feeds on the lower surface of the leaves leaving the epidermis of the opposite side in the form of a thin papery translucent membrane. It binds up two adjacent leaves or folds up a single leaf

and continues feeding while remaining inside the fold. The areas attacked by the caterpillars show various irregular patterns of different sizes. Generally the caterpillars remain stationary while feeding and consequently continuous patches of damaged areas result on the host leaves. The damaged patches then dry out, with the result that the leaves get distorted. The larvae attack the tender fruits and often start feeding on the ovary of the flowers and thus the fruit formation is much hampered. Well-developed fruits with hard rind are not damaged, but a good number of developing fruits are attacked. The larva bores a small hole in the fruit for its entry and eats away the inner part, thus rendering it useless.

Studies on Life-history

The Egg: (Plate, fig. A).

The eggs measure on an average 0.799±0.037 mm. along the longer axis and 0.488±0.035 mm. in width. They are thin-walled, normally oval, laid flat, and barium yellow[1] when viewed against a white background. Generally they are laid singly on the undersurface of the host leaves. To study the distribution of the eggs laid, 112 eggs were examined and it was found that 46 were laid singly, 16 in groups of 2 each, 12 in groups of 3 each, 8 in groups of 4 each, and a single group each of 7, 8 and 15 eggs. The moths did not show any marked preference as to the host material for laying the eggs.

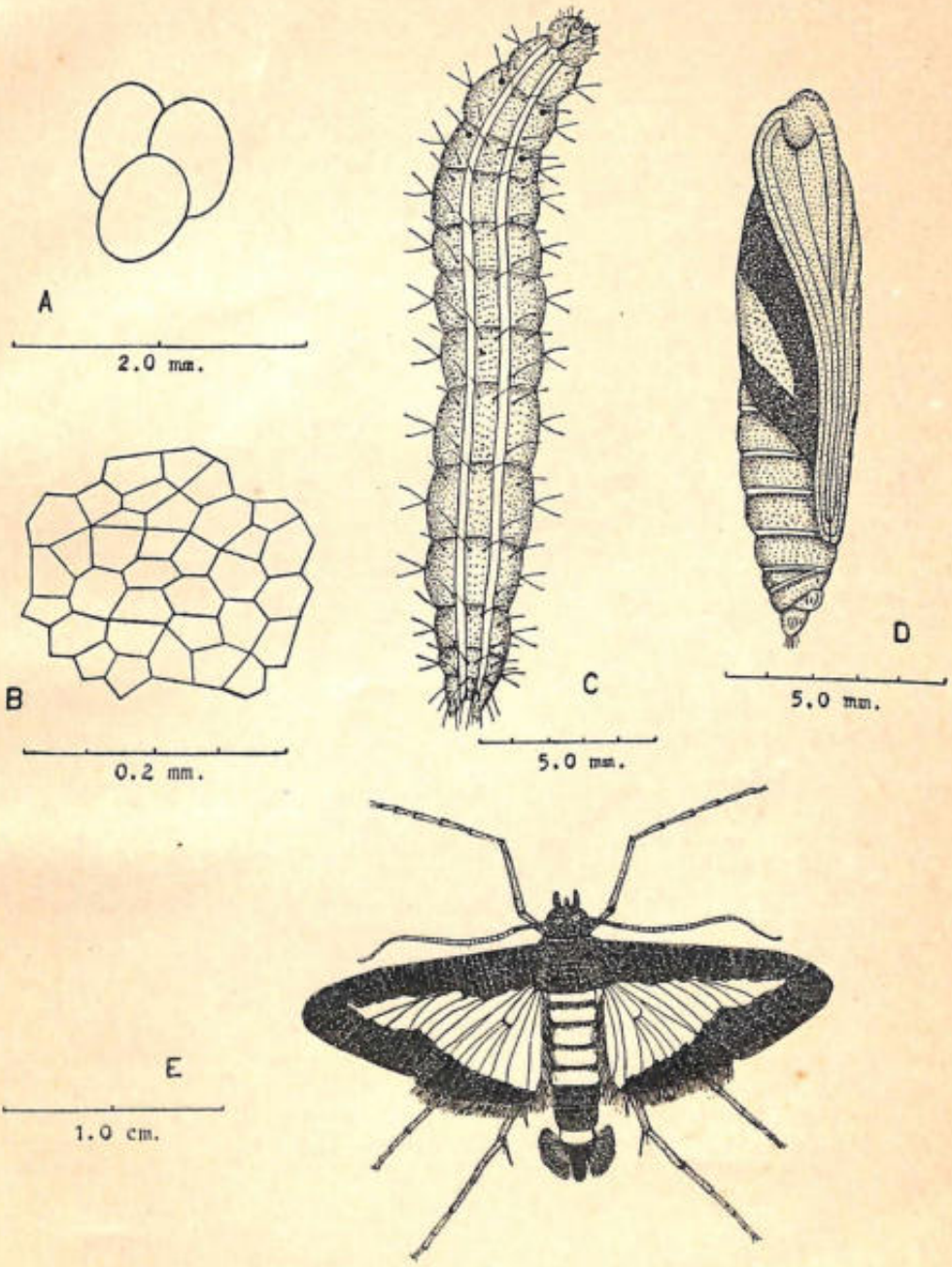
Although the natural shape of the eggs when laid is cylindrical with bluntly rounded ends, the shape varies according to the pressure on its flexible chorion from the surfaces on which they are laid. The chorion is thin, transparent, and appears with pentagonal reticulations when viewed under high magnification (Plate, fig. B). Appearance of the larval eyes in the form of two dark spots on one end indicates the nearness of the end of the incubation period. The incubation period of eggs varied from 3 to 6 days under different conditions of temperature, whereas at a constant temperature of 87.0±1.5°F. they took 3.0 days to hatch. The data obtained are given below: (Table 1.)

Table 1

Incubation period of eggs of *Margaronia indica* Saund.

S. No.	Period of study	Temperature in °F		No. of eggs observed	Incubation period of eggs in days	
		Average	(Min.–Max.)		Average	(Min.–Max.)
1	August 5 to 13, 1952	77·0	(73·0–80·0)	265	4·0	(4–4)
2	January 10 to 19, 1954	68·18	(60·9–80·0)	382	5·8	(5–6)
3	Incubator	87·0±1·5	...	395	3·0	(3–3)

[1] The colours have been described following Ridgway (1912).



The Pumpkin Caterpillar, *Margaronia indica* Saund.

A.—Eggs.
B.—Reticulation on the egg chorion.
C.—5th instar larva.
D.—Pupa of *M. indica* Saund.
E.—Adult.

From the data presented in the table, it is evident that with the increase in mean temperature, the incubation period of eggs decreases considerably.

The Larva:

The tiny larvae break the egg-shell near their head region at the time of hatching. They move about for some time and later become semi-stationary. In the first two instars, they feed very little. The caterpillars show a distinct tendency to move beneath the leaves irrespective of the leaf surface presented to them. The larvae, prior to moulting, turn pale yellow and suspend feeding. Subsequent to moulting the larvae appear mineral green in colour, are more active, and feed vigorously. They pass through 4 or 5 instars in their larval life of 9 to 14 days.

The full-grown Larva: (Plate, fig. C).

The full-grown larva measures on an average 18.5 mm. in length and is greenish with a pair of white streaks, running more or less parallel from the prothoracic region to the last abdominal segment. These streaks are not well marked in the freshly emerged larvae.

Head: The head is rectangular with a few setae and well-developed epicranial suture. *Ocelli:* 6 pairs of which one pair is posterior to the base of the respective antenna and the remaining five pairs are arranged still posteriorly in a semi-circle. *Antennae:* 3-segmented, situated outside the arms of the epicranial suture. Segment II is about two and half times longer than segment I. Two small conical sensillae and two setae arise from the tip of the segment II. Of these setae one is about twice the length of the whole antenna. Segment III is the smallest of all with 3 apical sensillae.

Thorax and abdomen: Mesothoracic and metathoracic terga present a pair of black specks placed at the base of the subdorsal seta. The larva possesses 3 pairs of well-developed thoracic legs each having a single claw at the distal end. Prolegs, 5 pairs in number, are present on 3rd, 4th, 5th, 6th and 10th abdominal segments. The chaetotoxy of the body segments was observed to be similar. Each segment presented 6 setae on the dorsal side and two pairs of setae arising side by side on the lateral sides. All these setae arise from the apices of minute tubercles and form definite longitudinal rows of setae on the body.

At the time of each moulting the neck-membrane behind the head capsule showed a crosswise split dorsally through which the larva wriggled itself out by alternate expansion and contraction of the body. Prior to moulting, the larva turns pale yellow or yellowish green, but it assumes a mineral green colour subsequent to moulting. Before the prepupal stage, when the larva is full fed, the colour changes to apple green with prominent white streaks. It remains well attached to the leaf surface and shows reduction in length. With the cessation of feeding the larva begins to fold the leaf to prepare its cocoon. At this stage the white streaks disappear and the larva appears lustrous neva green in colour. The cocoon is prepared in two sections. The outer loose cocoon is prepared by binding the leaves together and it provides the bedding for the inner cocoon. The inner

cocoon which covers the larval body is suspended in the hollow of the outer cocoon. The outer loose cocoon prepared by the larva measured on an average 28.4 mm. and the inner cocoon, which is also loosely spun of silken threads, measured on an average 15.7 mm. The prepupal length of the caterpillars measured from 13 to 14.5 mm.

Duration of the larval period.

Studies on larval duration were conducted during 1952 and 1953. The data collected are presented in Table 2.

From the table it is observed that the larval duration is longer in the first and last instars. The larvae passed through four or five instars during different periods of study. The larval duration during the second half of September is observed to be 11.6 days and 12.0 days when the temperature in the laboratory varied from 76.0°F. to 87.0°F. with a mean of 81.68°F. During the latter half of December 1953 the larval period is observed to be 13.04 days when temperature in the laboratory ranged between 64.0°F. and 89.0°F. with a mean of 75.73°F. In the incubator maintained at 87.5± 1.5°F. the larval period is completed within 9 to 12 days with an average of 10.45 days. The larval period in general varied from 9 to 14 days, during different periods of study.

Food consumption and growth of larvae.

An elaborate experiment was arranged with a view to finding out the daily food consumption and the rate of increase in the body-weight of the larva during the period of its growth. The food consumption was obtained by recording the area of host leaf consumed by the caterpillar in 24 hours. The weights were recorded daily in the morning at 8 a.m. on a sensitive chemical balance. Fresh food was then supplied to the caterpillar for feeding. Table 3 gives the data collected during the experiment. During the period of experiment, the temperature in the laboratory ranged between 76.0°F. to 87.0°F. with a mean of 81.68°F.

The average food consumption and the average body-weight gained by the caterpillars are shown on the graph. From this as well as from Table 3 it will be observed that the caterpillars feed comparatively little during the first five days and also gain very little in their body weights. During the three days prior to prepupal condition, they feed voraciously and also gain in their body weight quite considerably.

The Pupa (Plate, fig. D).

The pupa is typically of an obtect type. The freshly formed pupa is mineral green with pale yellow intersegmental region. Subsequently, the body-coloration becomes dark brown. The pupae measured from 12.0 to 14.5 mm. in length and from 3.0 to 3.5 mm. in width. It is bluntly rounded towards the head region and tapers posteriorly to a point with 8 apical cremasters equally situated on lateral sides. With the aid of the cremasters the pupa remains well attached to the cocoon.

RELATION BETWEEN GROWTH AND FEEDING CAPACITY OF THE LARVAE OF MARGARONIA INDICA SAUND.

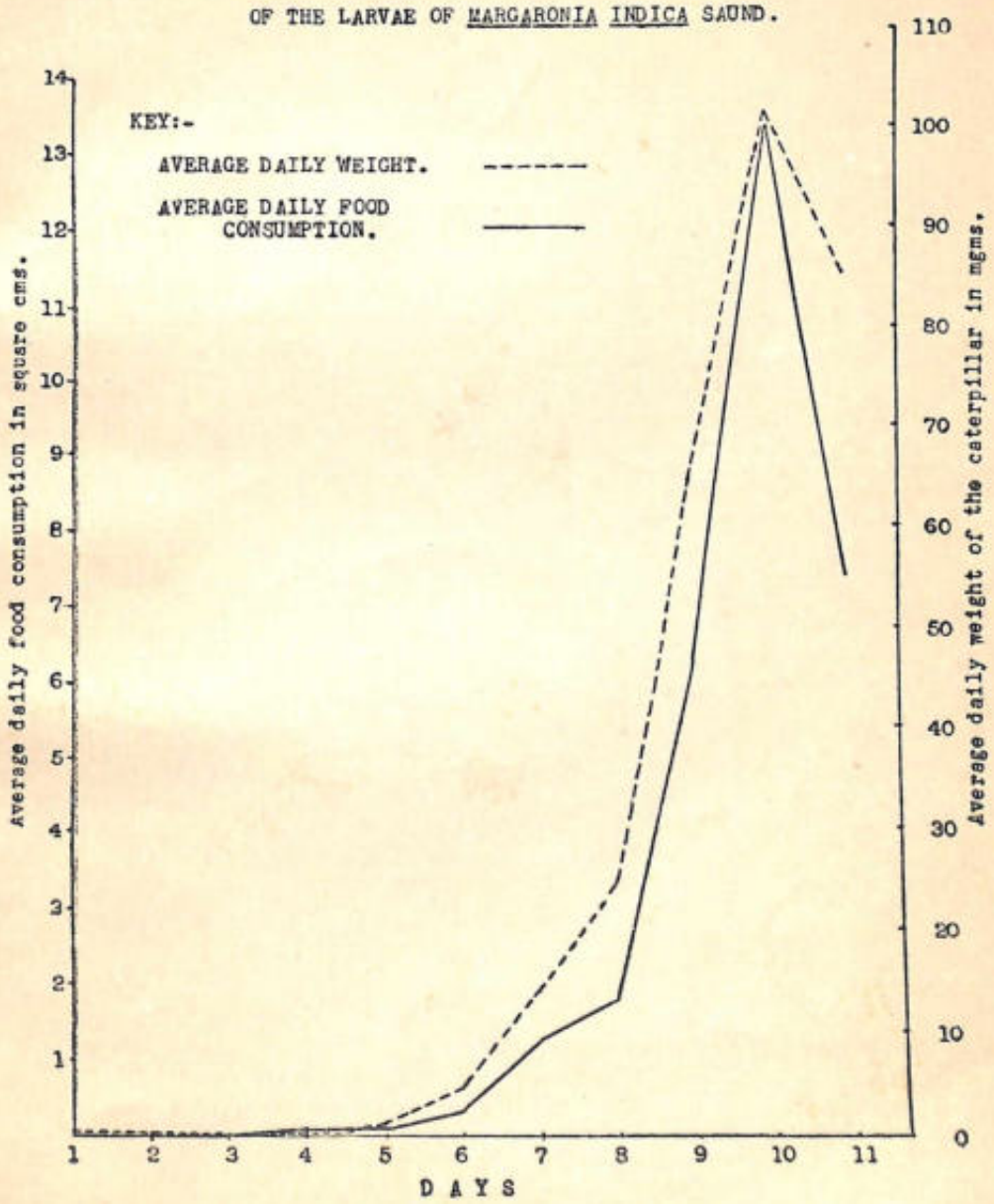


TABLE 2

The number and duration of the larval instars of *Margaronia indica* Saund.

Period of study	Temperature during the period of study (°F.)		No. of observations	Average duration of the larval instars in days					Larval duration in days	
	Average	(Min.–Max.)		I	II	III	IV	V	Average	(Min.–Max.)
September 15 to 30, 1952	81·68	(76·0–87·0)	10	3·4	1·2	2·0	5·0	...	11·6	(11–12)
			4	3·5	1·0	2·0	1·0	4·5	12·0	(12–12)
December 15 to 31, 1953	76·73	(64·0–89·0)	27	2·85	2·00	1·85	2·19	4·15	13·04	(12–14)
Incubator	87·5±1·5	...	33	2·09	1·24	1·48	5·64	...	10·45	(9–12)

TABLE 3

Average daily food consumption (sq. cm. of leaf area of *Coccinia indica* W. & A.) and the weight (in mg.) of the caterpillars of *M. indica* Saund.

Age of larva in days	Daily consumption of leaf area in sq. cm. and daily body-weight in mg. of individual caterpillar									
	G_1		G_3		G_8		G_9		Average	
	A	W	A	W	A	W	A	W	A	W
1	...	0·2	...	0·2	...	0·2	...	0·2	...	0·2
2	0·01	0·3	0·012	0·3	0·62	0·3	0·01	0·3	0··13	0·3
3	0·017	0·4	0·00	0·3	0·036	0·4	0·030	0·4	0·021	0·38
4	0·16	1·0	0·069	0·4	0·19	0·4	0·04	0·6	0·115	0·6
5	0·25	2·2	0·077	1·0	0·038	1 2	0·14	1·0	0·126	1·35
6	0·402	4·4	0·45	4·0	0·48	5·0	0·38	4·8	0·428	4·55
7	1·83	18·6	1·27	14·4	0·85	10·2	0·95	13·2	1·225	14·1
8	3·30	43·4	1·10	18·6	1·04	17·0	1·52	20·2	1·74	24·8
9	2·45	57·4	8·45	76·6	5·6	49·0	8·15	75·2	6·16	64·55
10	5·10	61·6	16·85	125·6	11·45	98·8	19·9	120·0	13·33	101·5
11	2·82	50·2	10·30	96·0	10·35	92·8	5·85	102·0	7·33	85·25

A = Leaf area in sq cm. consumed by the caterpillar.
W = Weight of the caterpillar in mg.

Out of 104 pupae observed, it was noticed that a day prior to emergence of the adult, the pupae showed development of black bands along the margins of the wing-pads. Male pupae developed black coloration on the posterior end, whereas in female pupae no such coloration developed. At the time of emergence of the moth, the pupal covering ventrally showed a longitudinal split from the apex of the head to the second abdominal segment in the region of rostrum.

Sex Differentiation in Pupa.

In the male pupa, the 9th and 10th abdominal segments presented black coloration for a day prior to emergence of the adults. This development of black coloration is due to large number of black scales on the ventral side of the anal tuft of the male moth. No such coloration developed in the female pupae.

The position of the genital pores also differs in the male and the female pupae. In both sexes the anal aperture is situated on the ventral side of the 10th abdominal segment in the form of long dark streak with inwardly bent ridges at the sides. The genital aperture

in the male pupa is situated on the 9th abdominal segment 0.2 mm. away from the anal aperture. In the female pupa it is situated on the 8th abdominal segment 0.54 mm. away from the anal aperture. The genital aperture in male and female pupae measured on an average 0.32 mm. and 0.29 mm. in length respectively.

Duration of the pupal period.

The results of various observations made on the duration of the pupal period are summarized below in Table 4.

TABLE 4

Duration of the pupal period of *M. indica* Saund.

S. No.	Period of study	Temperature in °F.		No. of pupae observed	Pupal period in days	
		Average	(Min. – Max.)		Average	(Min. – Max.)
1	Aug. 1 to 15, 1952	77·00	(72·0 – 82·0)	11	6·55	(6 – 8)
2	Aug. 19 to 27, 1952	79·66	(76·0 – 82·0)	14	6·07	(5 – 7)
3	Sept. 7 to 15, 1952	80·39	(75·0 – 86·0)	10	6·0	(6 – 6)
4	Sept. 16 to 28, 1952	81·88	(76·0 – 87·0)	38	5·92	(5 – 7)
5	Sept. 27 to Oct. 6, 1952	84·3	(79·0 – 92·0)	18	5·67	(5 – 7)
6	Dec. 26, 1953 to Jan. 14, 1954	71·58	(60·0 – 86·0)	19	9·90	(9 – 13)
7	Incubator—1	87·0 ± 1·5	...	16	5·75	(5 – 6)
8	Incubator—2	89·6 ± 1·5	...	17	5·24	(5 – 6)

From Table 4 it is evident that the pupal period varies with temperature. During August to October (average temperatures 77.0°F. to 84.3°F.) the period varied from 6.55 to 5.67 days. During December/January (average temperature was 71.58°F.) the period was 9.90 days. The shortest pupal duration observed was 5.24 days in the incubator maintained at 89.0 ± 1.0°F.

The Moth (Plate, fig. E).

The moth measured on an average 0.962±0.09 inches across the wings and 0.49 ±0.04 inches in length. The costal margin of the forewing is banded dusky drab in colour. The band is continuous on the head and first two thoracic segments. It further extends to the humeral margin of the forewing and hindwing and is continuous on

the 5th and 6th abdominal terga. The rest of the wing is white with chinese violet lustre when held across the light. A globular tuft of scales is present at the posterior end of the abdomen. In male the scales in the middle are thickly set and present a black triangular patch on both the dorsal and ventral surfaces. In female the scales in the middle of the tuft are light coloured and the whole tuft appears orange in colour. The sex ratio worked out for 105 individuals was 54.29 females to 45.71 males.

Longevity and fecundity of M. indica Saund.

To study the egg-laying capacity of the female and the longevity of adults the moths were caged in glass chimneys in pairs. The data obtained are given in the table below:

TABLE 5

The longevity and fecundity of *M. indica* Saund.

Number of observation	Number of pairs	Pre-oviposition period in days	Ovi-position period in days	Number of eggs laid by the female	Post-oviposition period in days	Total life in days	
						Male	Female
1	1	2	2	53	0	5	4
2	1	1	3	249	1	4	5
3	1	1	2	57	0	4	3
4	1	2	2	298	1	4	5
5	1	3	1	22	2	5	6
6	1	1	2	205	1	3	4
7	1	2	1	23	4	4	7
8	1	1	2	366	0	3	3
Average		1·63	1·88	159·1	1·13	4·0	4·63

The total adult life ranged between 3 to 7 days at the mean laboratory temperature of 81.0°F. The average pre-oviposition and post-oviposition periods were 1.63 and 1.13 days respectively. The oviposition period was, on an average, 1.88 days. The egg-laying capacity of a single female varied from 23 to 366 (average 159.1) eggs per female. The females survived a little longer than males.

SUMMARY

Although the Pumpkin Caterpillar has been recorded on wide varieties of host-plants from different countries, no complete record of its bionomics has hitherto been published. The egg, larval, and pupal periods varied from 3 to 6, 9 to 14, and 5 to 13 days respectively

during different period of study. The egg-laying capacity of the female varied from 23 to 366 eggs. The pre-oviposition, oviposition, and post-oviposition periods varied from 1 to 3, 1 to 3 and 0 to 4 days respectively. In both pupae and adults the sexes differ morphologically. The number of larval instars varied from 4 to 5. The rate of feeding is greatly accelerated during the three days prior to the prepupal stage.

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THE BIOLOGY OF SCORPIONS[1]

BY

MAX VACHON

(With a plate and 17 figures)

INTRODUCTION

Scorpions are arthropods celebrated in both history and legend, and there is no lack of material for those seeking the reasons for their wide reputation for supernatural powers and their significance in painting and sculpture. Biologists, and palaeontologists too, can find much to interest them in scorpions. It is impossible to discuss here all the features which make them so fascinating; the present article is restricted to certain peculiar features of their biology and morphology, and attempts to explain some of the apparent contradictions which are found.

Scorpions and the related spiders belong to a group of arthropods that has been distinct for several hundred million years. Scorpions differ in many ways from insects, the whole head and thorax forming a single unit, the cephalothorax, covered by a shield. Behind the cephalothorax come an abdomen of seven segments and a tail with five, terminating in a further segment, the poison gland.

In front of the head there are two small pincer-like appendages pointing forwards; these are the chelicerae (figures 5, 8). There are

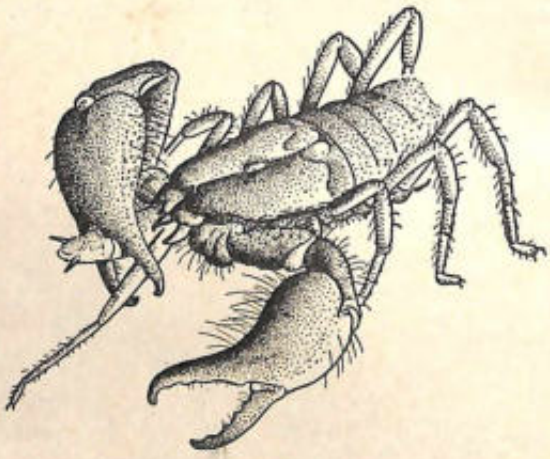


Fig. 8. *Heterometrus scaber* (Thorell) feeding.

[1] Reprinted from ENDEAVOUR, Vol. xii, No. 46 (April 1953), with the kind permission of its editor and publishers.

We are indebted to Dr. A. P. Mathew for the notes which appear within square brackets in the text. Also for kindly supervising the preparation of some of the figures, and supplying text figure 17—EDS.

five pairs of legs, the first pair of which, the pedipalpi, are strong and terminate in claws. The bases of these two legs form part of the mouth (figure 13). The remaining four pairs are alike, and are used for locomotion.

Behind the legs and covering the ventral part of the cephalothorax, i.e., at the start of the abdomen and behind the genital region (figure 13), there are a pair of curious appendages, the pectines or combs.

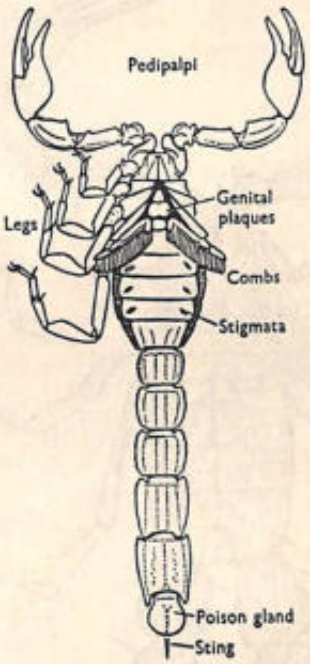


Fig. 13. *Androctonus australis* (L.), female. Ventral surface, showing the parts of the body. Total length 8 cm.

These are peculiar to the scorpions, and are found in both young and old of both sexes. With the poison gland, they serve to distinguish scorpions from all other arthropods.

A rare anomaly, which has attracted much attention, consists in a doubling of the tail. Figure 1 shows an adult female with two identical tails, each perfectly formed. This division of the rear end of the body sometimes also affects a portion of the abdomen; it originates during embryonic development, a case of incomplete twinning. The anomaly was known in antiquity, for Pliny, citing Aelian, placed these double-tailed scorpions in a class by themselves.

Scorpions as Living Fossils

Scorpions are one of the oldest forms of life still to be found on the surface of the earth. Only a few hundred fossilized specimens are known, but it must be remembered that we are dealing with a

land animal whose chances of fossilization may well have been slight. Examples recorded from many parts of the world show us that the scorpions have remained essentially unchanged for hundreds of millions

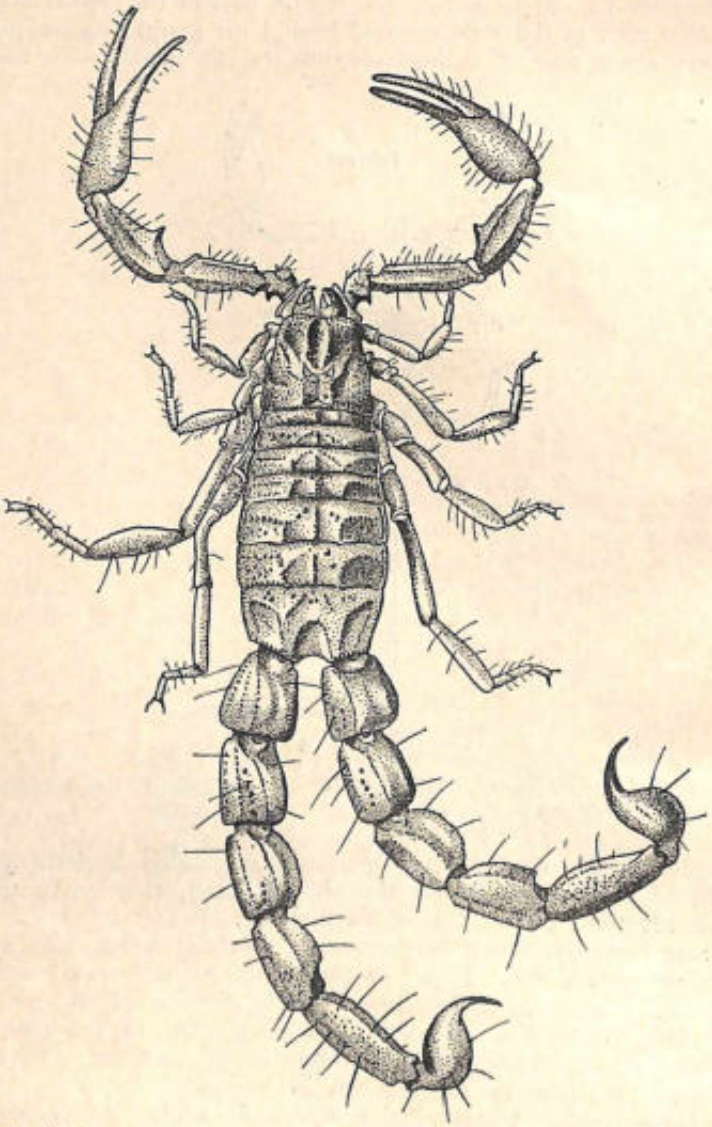


Fig. 1. *Buthotus alticola* (Pocock), adult female from Afghanistan, with two perfect tails. Length of body 9 cm. (After Gaillard).

of years. Fossil scorpions resemble the present-day *Pandinus* (figure 4) in possessing a pair of chelicerae, a pair of pedipalpi, four pairs of legs for locomotion, a poison gland, and ventral pectines. It is

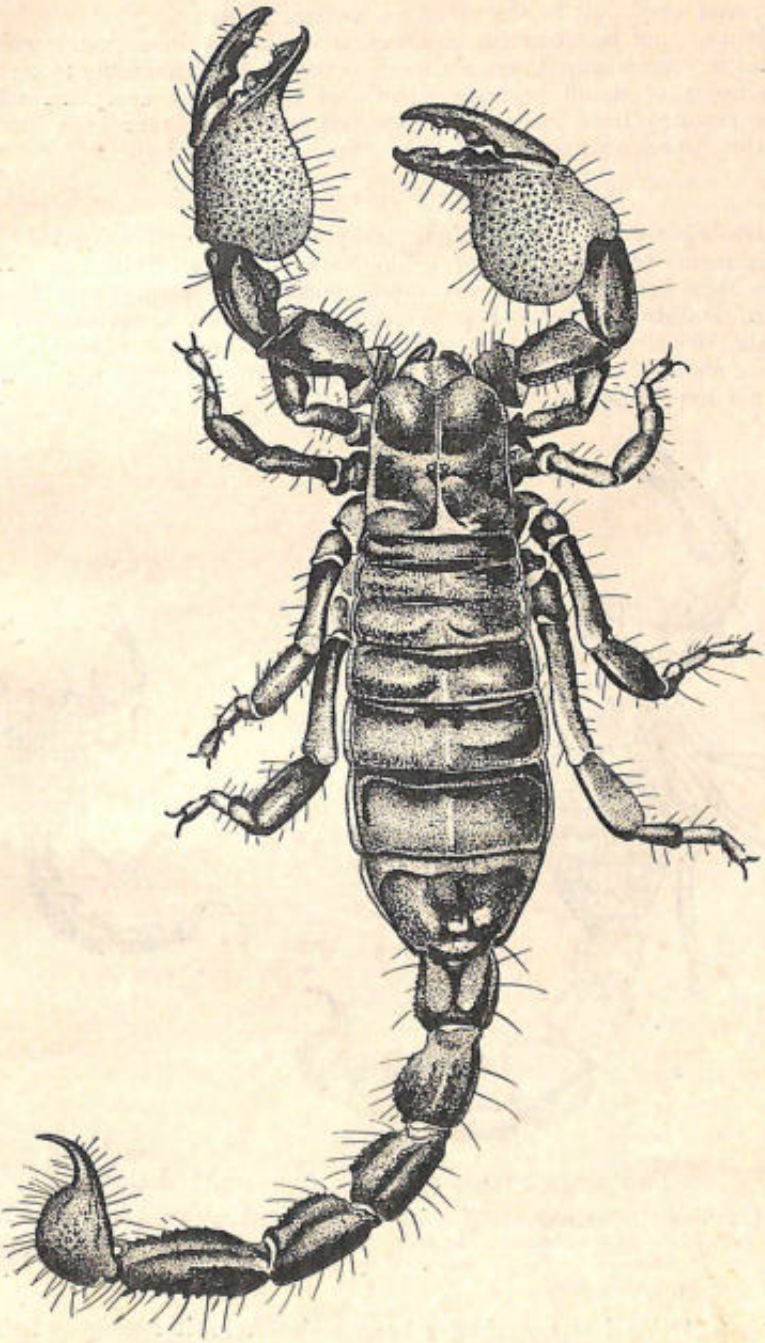


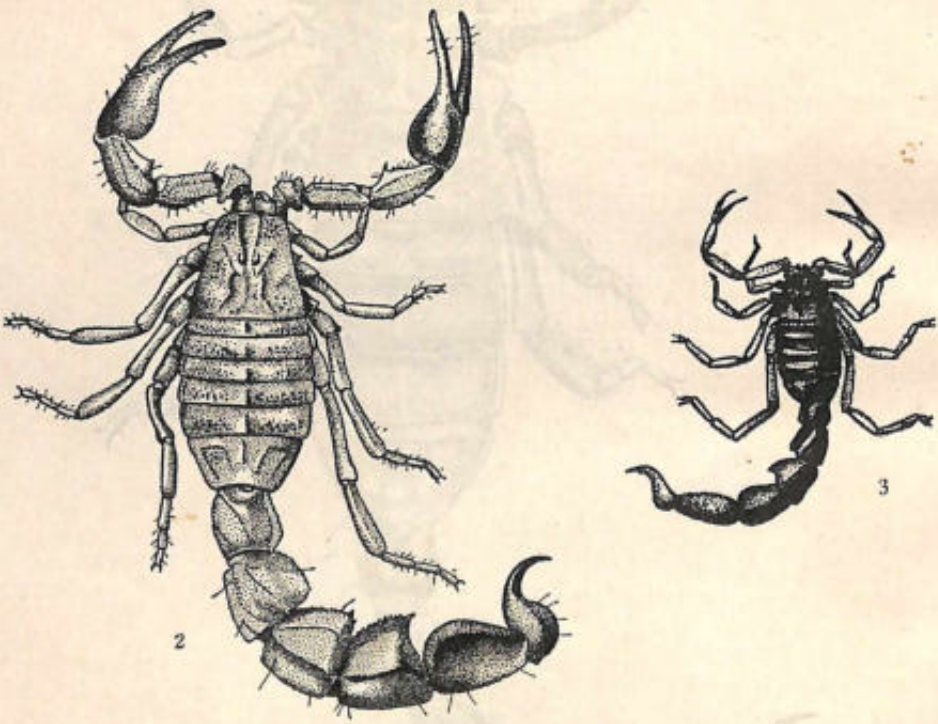
Fig. 4. *Pandinus imperator* (C. L. Koch), adult female from French Guinea. Length of body 18-20 cm. (After Gaillard).

thus impossible wrongly to classify a fossil scorpion, and modern scorpions may well be described as 'living fossils'.

It must not be assumed, however, that the scorpions have remained completely unchanged from the earliest times. It is possible to discern differences of detail between fossil and present-day scorpions which have resulted from an evolutionary process; these have been studied by the American arachnologist A. Petrunkevitch (5, 6).

The Stability of the Scorpions

During vast epochs of time, scorpions have been subjected, like other forms of life, to great geological and climatic changes. How have they been able to resist these changes, to adapt themselves to them, and to survive? I have recently published a revision of the north African scorpions (9), of which two examples (figures 2 and 3) are shown here, and in the course of this study I have put forward certain hypotheses to explain their sustained success.



Two characteristic scorpions from north Africa

Fig. 2. *Androctonus australis* (L.) *hector* C. L. Koch, a lethal species from the northern borders of the Sahara. Length of body 9.5 cm. (After Gaillard).

Fig. 3. *Orthochirus innesi* E. Simon, a species from the Saharan oases. Length of body 3 cm. (After Gaillard).

North Africa has not always been a desert as it mainly is today; in the course of time it has undergone a succession of wet and dry periods. After the final rainy period of the Quaternary, a long dry

period set in which transformed a region of luxuriant growth into a desert. How did the Tertiary fauna withstand this catastrophe? The present distribution of the scorpions of the Sahara is characteristic: they are few in numbers and are split up into small colonies, last relics of a past greatness. There are regions virtually devoid of water where scorpions, like most other animals, have completely disappeared; there remain, however, large or small regions, from mountains to oases, where conditions, though much changed, still permit life to continue. Moreover, scorpions live in the soil, under stones, or in burrows, and they can thus relatively easily find surroundings which fulfil their requirements and which are to some extent stabilized. Finally, it must not be forgotten that even large changes in the general climate are much diminished in the superficial layers of the soil. Extensive researches into microecology, especially that of insects, indicate that the micro-climate in the layer beneath the surface is largely independent of the external general climate.

Scorpions have thus managed to survive in conditions of heat and drought, first because of their subterranean habitat, and secondly because there remain here and there areas where their old conditions of life still obtain. Above all, however, they have survived because of their ecological plasticity.

It is generally believed that scorpions are characteristic of dry or desert regions, but I consider this to be wrong. They are but the remains of an ancient fauna, still quite abundant, which lived under quite different conditions of temperature and humidity. If they have survived, it is because of their great adaptability—their capabilities are great, their demands few. I cannot sustain this argument here in detail, but I can mention some remarkable experiments on the feeding and respiration of scorpions. They can, for example, remain in an inert condition at freezing point for a period of weeks, and yet return in a few hours to a normal mode of life. They can withstand, without hurt, total immersion in water for days on end, or the blocking of seven out of their eight lungs (4). They have remarkable possibilities of haemopoiesis (i.e., making blood) and a very small respiratory coefficient. Moreover, they are sluggish creatures and thus consume little energy in moving about. More important still, they can gorge themselves with food in a few hours, or survive without feeding for many months, even for more than a year. In my opinion, scorpions are a striking example of creatures whose persistence derives not from the fact that their surroundings have remained unaltered, but from the fact that they are able to neutralize large changes in their surroundings by resorting to their subterranean habitat; in addition, their remarkable physiology enables them greatly to vary the tempo of their existence. Largely unaffected by extremes, they are virtually independent of their surroundings; herein lies the most certain guarantee of the immortality of their race.

Detection and Capture of Prey

The food of the scorpion consists of living creatures of many kinds that share its habitat, insects (both adults and larvae), spiders, millepedes, and even small rodents. The mode of capture of prey

has often been observed, and descriptions by early naturalists are well known. Here I illustrate certain characteristic attitudes. At rest, or 'sleeping' (figure 5), the scorpion is motionless, with its ventral

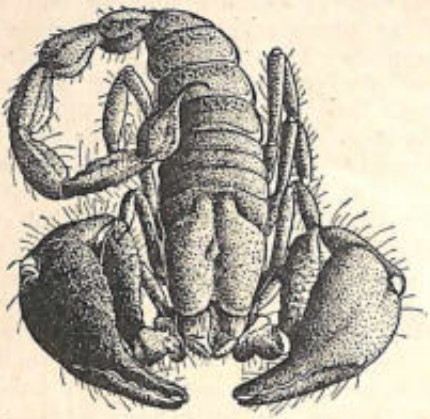


Fig. 5. *Heterometrus scaber* (Thorell) the large black scorpion of the West Coast of India. Length of body 13 cm. Posture at rest.

surface against the ground, the tail curved on the flat, and the legs folded. When hungry, or if a victim is detected, the attitude of the animal changes (figure 6); it moves slowly forward, supported on its

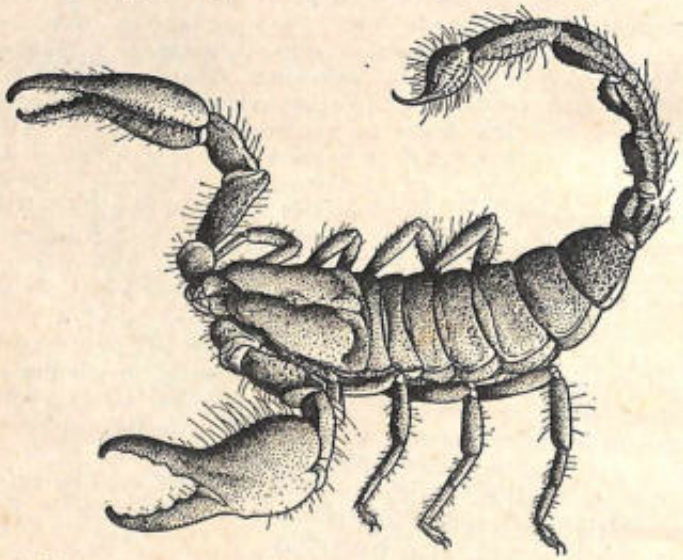


Fig. 6. *Heterometrus scaber* (Thorell). Posture when on defensive or in search of prey.

hind legs, with claws open and extended and tail raised and pointing forwards. Often the scorpion will then hesitate, and the final act of

capture seems almost accidental, an act of defence rather than of attack. If the prey is active, the scorpion may even withdraw for a time, but it waits patiently and finally achieves its aim. Then, especially if the victim struggles, it inserts its sting (figure 7) where

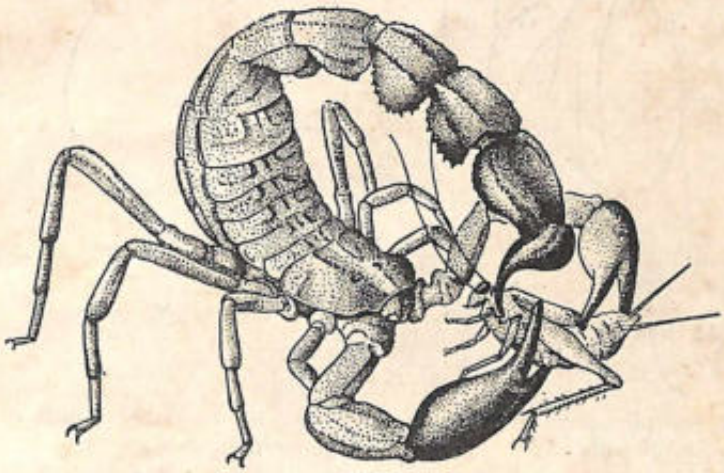
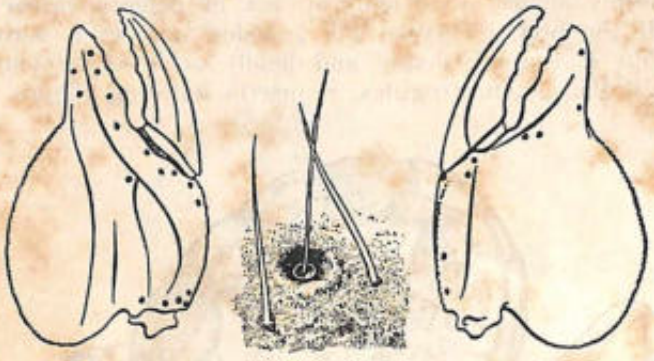


Fig. 7. *Androctonus australis* (L.) *hector* C. L. Koch, capturing and stinging prey.

best it can, often without any delay, and the prey, held in the claws, is carried towards the chelicerae. These seize it and inflict deep wounds, through which the contents of the victim's body escape and pass into the scorpion's mouth. The chelicerae play the most important part in this operation. They break down the tissues of the victim, of which there finally remains nothing but a mass of unabsorbable residues; these are sometimes got rid of by using the claws as tooth-picks.

It is not entirely clear how the scorpion first detects its prey. The eyes are too crude to be of much assistance, and in any case the scorpion is a nocturnal animal for which visual impressions can be of no great significance. Other sensitive organs must therefore be concerned, notably the sensory hairs or trichobothria found only on the pedipalpi. These hairs are present at birth, and do not alter in number or position during growth. They are of considerable importance in classification (figures 10, 12), and certainly represent very primitive characters. The trichobothria are easily recognizable by the shape of their point of insertion, which resembles the top of a well (figure 11), by their fineness, and by the thinness of the membrane which links them to the integument. They are richly supplied with nerves, and can certainly detect minute air-currents such as those caused by movements of the prey. They are, in fact, like tiny receiving-sets, pointing in all directions and spaced out along the pedipalpi, which when extended act as huge antennae.



10 11 12

Fig. 10. Claw of *Scorpio maurus* (L.), a scorpion from north Africa, living in a burrow. External view, showing the sensory hairs.
Fig. 11. Sensory hair, much enlarged, between two ordinary hairs.
Fig. 12. Same claw as in figure 10 (internal view).

External Digestion

The scorpion has to macerate its prey, because the mouth is able to take in liquids only. There is a powerful pharynx, which sucks the liquid contents of the victim into the large middle intestine, where it can be digested. Scorpions are not peculiar in sucking their prey, but are unusual in that digestion is effected outside the body by means of powerful enzymes ejected periodically during feeding; in this they resemble some other arachnids. As the scorpion feeds, from time to time it ceases to suck and liquid is regurgitated upon the victim. It appears that this liquid originates in the middle intestine, which is rich in glandular tissue, and that the scorpion actually regurgitates its digestive fluid during its meal. The study of external digestion in other arachnids, particularly spiders and pseudo-scorpions, leads to the belief that the breaking-down of the tissues of the victim is caused not only by this intestinal fluid but by secretions form, specialized glands, analogous to salivary glands, which are poured into or over the victim at the moment of regurgitation. The anatomy of the scorpion is not sufficiently well known for this analogy with other arachnids to be perfectly reliable, but it does seem that the regurgitated fluid is activated by other substances secreted from the specialized glands, and sometimes, as in certain spiders, by the poison itself. I have recently pointed out (8) that the poison must not be considered solely in connection with the capture of prey: it is related to the feeding-process as a whole and forms but a part, albeit the best known, of the physiological complex which constitutes the external digestion. In scorpions, too, the poison has its role in this complex; it not only cuts short the victim's resistance but aids, by catalytic or other chemical action, in the digestive process itself.

Reproduction and Nutrition of the Embryo

In scorpions the sexes are distinct, though they resemble each other in all but small details. Fertilization necessitates the coming



The Rock Scorpion *(Buthus* sp.*)* with young on her back.

together of the two sexes and is accompanied by curious display. Maccary (2) and Fabre (1) have described some of these displays, the *promenades à deux* in which male and female walk 'hand-in-hand'; and the *arbre droit* in which the two animals appear to be fighting (figure 9). The conclusion of these nuptial dances I have not observed,

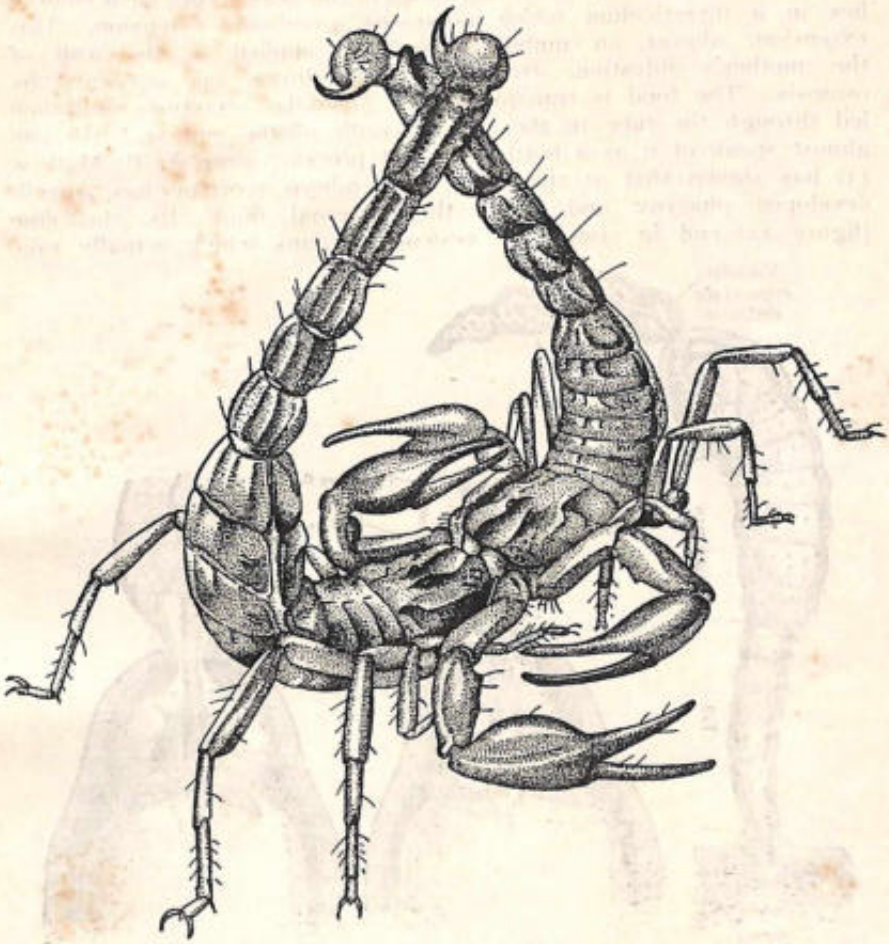
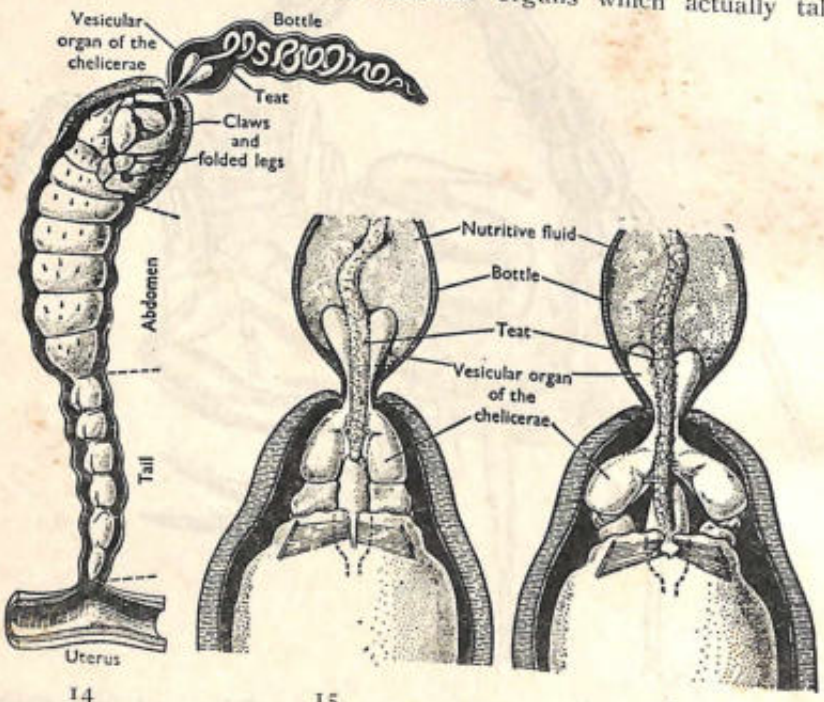


Fig. 9. Posture known as the *'arbre droit'* (after Fabre, and from personal observations) preceding copulation in *Buthus occitanus* (Am.), a scorpion from Languedoc, France. The female is on the left.

but anatomical investigation bears out the statements of early writers; the male fertilizes the female directly in a true copulation, which is rather rare in other arachnids. In the course of this act, the male protrudes certain special organs to form a temporary penis, with which he inserts the sperm and finally places in position a vaginal plug, a kind of post-nuptial hymen (9, pp. 31-6).

The course of development of the fertilized eggs inside the mother differs according to whether the eggs are rich in yolk (as in the

Buthidae) or are completely lacking in yolk (as in the *Scorpionidae*). In the first case, the eggs pass quickly into the oviduct and develop there, consuming the yolk with which they are filled [e.g., as in *Euscorpius, Isometrus, Buthus* etc.]; in the second, the fertilized egg remains in place and becomes closely commingled with the maternal tissues. At the end of its development [in the latter type] each embryo lies in a diverticulum which possesses a tubular extension. This extension, almost an umbilical cord, is applied to the wall of the mother's intestine, from which it draws off nutrients by osmosis. The food is transformed by glandular secretions and then led through the tube to the actual mouth of the embryo. We can almost speak of it as a bottle and teat process, since A. P. Mathew (3) has shown that at this stage the embryo scorpion has a well-developed pharynx and sucks the maternal fluid. Its chelicerae (figure 15) end in contractile vesicular organs which actually take



14 15 16

Figs. 14-16. Embryos of *Ischnurus ochropus* C. L. Koch, from East Africa.
(14) Diverticulum of the uterus containing an embryo, showing the 'feeding-bottle'.

(15 and 16) Diagrammatic representation of horizontal sections of the anterior part of the diverticulum, showing the relationship between the embryo's chelicerae and the teat; the latter can be carried to the mouth of the embryo by the chelicerae (fig. 16).

hold of the teat and carry it to the mouth. I have described this remarkable process of embryonic nutrition [in *Ischnurus ochropus*] elsewhere (7). [The embryonic nutrition in the S. Indian *Heterometrus* (=*Palamnaeus*) *scaber* as described by Mathew (3 & 3a) is similar in

principle, but differs in many details (fig. 17).] We see that although so much alike in outward appearance, there exist great internal differences between various scorpions. In some the embryo is left to feed itself on the yolk of the egg, while in others embryonic nourishment is a complex affair resulting from a process of mutual adaptation between the organs of mother and young.

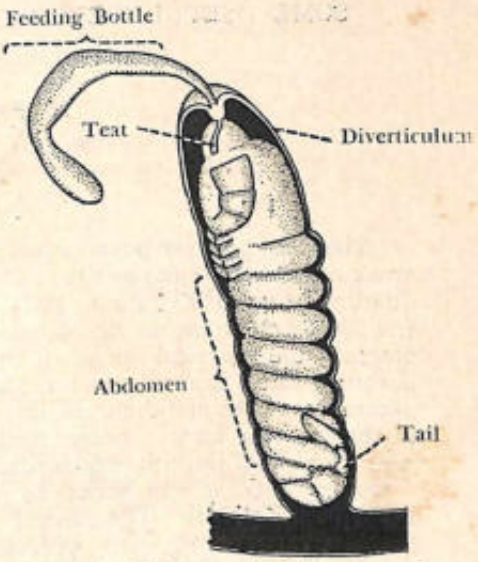


Fig. 17. Embryo of *Heterometrus scaber* in the diverticulum showing the 'feeding bottle' and its 'teat' which is inserted at the mouth opening. In the diagram the left chelicera and part of the pedipalp are removed so that the teat may be seen. (A. P. Mathew).

Conclusions

The scorpions are members of an ancient race whose fossils go back to very early times. Their essential morphology has remained unchanged for hundreds of millions of years, and this has gained for them the name of 'living fossils'. Yet they are none the less products of evolution. The complexity of their digestive processes, carried on in part outside the body, and the mode of nutrition of the embryo in some species, requiring a close adaptation between mother and young, both bear witness to an anatomical evolution of long duration. Equally, the complex system of the sensory hairs and the elaborate nuptial dances must have evolved over immensely long periods. Ecological studies show that scorpions possess a plasticity rendering them largely unaffected by external changes. They are an example of a type which early achieved a high degree of perfection; they have subsequently continued without substantially changing, degenerating, or disappearing, but also without giving rise to new forms.

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SOME USEFUL WEEDS IN AND AROUND CUTTACK

BY

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INTRODUCTION

There is no systematic account of the Flora of Orissa State; no work of this nature has yet been done since its separation from Bihar in 1936. Haines (1925), Prain (1903), Bal (1942) and Mooney (1950) have not laid much stress on the detailed study of the flora of this State. Recently the Botanical Survey of Orissa has started with a view to discovering rare, economic and medicinal plants. This State has rich natural resources and there are many virgin forests with valuable plants in the ex-State areas. Some preliminary work has been done on the useful weeds of Cuttack and its neighbourhood.

Cuttack city is surrounded by two rivers, i.e., the Mahanadi and its branch the Kathjuri. The general soil of the city and its neighbourhood is sandy loam and also alluvial at some places. A number of weeds grow up in different seasons and these become abundant in the rainy season. Some of them are used locally as medicinal plants, foodstuff, and fodder. These weeds are not totally undesirable; some of them have various important uses. With a view to finding out the local names and the uses of these common weeds the present work has been undertaken.

COLLECTION AND OBSERVATION

The important and dominant weeds have been collected during their flowering seasons. The plants described in the list are arranged in the same order as in Haines's *Botany of Bihar and Orissa* for convenience. Most of these plants have been collected by the author with the help of Mr. N. K. Chayu Patnaik. They have been pressed and preserved in the Herbarium of the Botany Department of Ravenshaw College, Cuttack.

ENUMERATION OF PLANTS

MENISPERMACEAE

1. Cocculus villosus DC.

Local name	...	Dadaya (Or.)
Habit	...	A climber on hedges.
Flowers	...	November to April
Uses	...	The juice of the leaves mixed with water has the property of coagulating into a green jelly-like substance which is taken internally, sweetened with sugar. The roots and leaves are used in rheumatic pains.

2. **Cissampelos hexandra** Roxb.

Local name	...	Akanamini (Or.)
Habit	...	A lofty climber.
Flowers	...	April to August.
Uses	...	The root is used in fever, diarrhoea, urinary diseases, dyspepsia, etc.

PAPAVERACEAE

3. **Argemone mexicana** Linn.

Local name	...	Agara or Kantakusuma (Or.)
Habit	...	A prickly herb.
Flowers	...	April to June.
Uses	...	The oil from the seed is purgative, and the oil is also used in various kinds of skin diseases.

CAPPARIDACEAE

4. **Cleome viscosa** Linn.

Local name	...	Chota anasorisa (Or.)
Habit	...	A pubescent herb.
Flowers	...	July to September.
Uses	...	The juice of the leaves is locally poured into ear for ear-ache.

5. **Gynandropsis pentaphylla** DC.

Local name	...	Anasorisa (Or.)
Habit	...	A strong smelling weed.
Flowers	...	July to September.
Uses	...	Used as a substitute of *Cleome viscosa*.

VIOLACEAE

6. **Ionidium suffruticosum** Ging.

Local name	...	Madan masta (Or.)
Habit	...	Herb with pink flowers.
Flowers	...	December to March.
Uses	...	The leaves and tender stalks are demulcent.

CARYOPHYLLACEAE

7. **Polycarpaea corymbosa** Lamk.

Local name	...	San Jatjatia (Or.)
Habit	...	Erect herb.
Flowers	...	August to November.
Uses	...	Used locally as a remedy for the bites of venomous reptiles.

PORTULACACEAE

8. **Portulaca oleracea** Linn.

Local name	...	Bada balbalua (Or.)
Habit	...	A prostrate or erect, sub-succulent herb.
Flowers	...	July to October.
Uses	...	It is locally used as an article of diet in scurvy and liver diseases.

9. **Portulaca quadrifida** Linn.

Local name	...	Balbalua (Or.)
Habit	...	A prostrate, creeping and sub-succulent herb.
Flowers	...	July to October.
Uses	...	Same as in *P. oleracea*.

FICOIDRAE (AIZOCEAE)

10. **Mollugo spergula** Linn.

Local name	...	Pita sag (Or.)
Habit	...	A herb near ponds.
Flowers	...	February to April.
Uses	...	The juice is applied in itch and other skin diseases. The leaves are used as an article of diet.

11. **Trianthema monogyna** Linn.

Local name	...	Puruni (Or.)
Habit	...	A succulent herb.
Flowers	...	July to October.
Uses	...	The root is used as a medicine, generally in acute anaemic conditions.

MALVACEAE

12. **Abutilon indicum** G. Don

Local name	...	Pedipedica (Or.)
Habit	...	Annual shrub
Flowers	...	September to January.
Uses	...	Used in various diseases. The roots are useful in leucoderma.

13. **Sida cordifolia** Linn.

Local name	...	Bisiripi (Or.)
Habit	...	An erect undershrub.
Flowers	...	August to December.
Uses	...	The leaves and roots are said to have medicinal value; leaves for healing sores.

14. **Sida veronicaefolia** Lamk.

Local name	...	Bajramuli (Or.)
Habit	...	A perennial herb.
Flowers	...	September to April.
Uses	...	The leaves are used as local application in cuts and bruises.

TILIACEAE

15. **Corchorus acutangulus** Lamk.

Local name	...	Bana-nalita (Or.)
Habit	...	An erect herb.
Flowers	...	September to November.
Uses	...	The dried leaves are used in dysentery.

EUPHORBIACEAE

16. **Croton sparsiflorus** Morung

Local name	...	Gandha tulasi (Or.)
Habit	...	A herb.
Flowers	...	May to September.
Uses	...	The latex is used in cuts and wounds.

17. **Euphorbia hirta** Linn. Syn. *E. pilulifera* (F.B.I.)

Local name	...	Chitakuti (Or.)
Habit	...	A herbaceous weed.
Flowers	...	All the year round.
Uses	...	The latex is applied locally in case of eye complaints. The plant, as a whole, is slightly stimulant and narcotic.

18. **Jatropha curcas** Linn.

Local name	...	Jahaji, Baigaba (Or.)
Habit	...	A large shrub.
Flowers	...	May to October.
Uses	...	Used as a hedge plant. The juice of the stem and leaves is applied to wounds.

19. **Phyllanthus niruri** Linn.

Local name	...	Badianla (Or.)
Habit	...	An erect annual herb.
Flowers	...	August to December.
Uses	...	Used in dysentery.

20. **Phyllanthus urinaria** Linn.

Local name	...	Bhuinanla (Or.)
Habit	...	A suffruticose annual.
Flowers	...	July to December.
Uses	...	Used in sleeplessness of children.

RHAMNACEAE

21. **Zizyphus jujuba** Lamk.

Local name	...	Barakoli (Or.)
Habit	...	A small tree or shrub.
Flowers	...	March to October.
Uses	...	Fruits are eaten when ripe and these make good jams. The bark and seeds are used for diarrhoea and the decoction of root for fever.

VITACEAE

22. **Vitis quadrangularis** Wall.

Local name	...	Hadavanga (Or.)
Habit	...	Sarmentose shrubs.
Flowers	...	July to October.
Uses	...	The upper part of the plant is used for bowel complaints and a poultice for broken bones.

23. **Vitis trifolia** Linn.

Local name	...	Amala-lata (Or.)
Habit	...	A herbaceous climber.
Flowers	...	April to September.
Uses	...	Seeds and roots are used for the treatment of yoke sores of buliocks.

24. **Vitis pedata** Vahl.

Local name	...	Guali lata (Or.)
Habit	...	A large climber.
Flowers	...	August to September.
Uses	...	This plant is used as domestic medicine, because of its astringency.

PAPILIONACEAE

25. **Clitoria ternatea** L.

Local name	...	Aparajita (Or.)
Habit	...	Twining herb.
Flowers	...	From October to December.
Uses	...	The roots and flowers have medicinal value. Used in urinay disorde 's.

26. **Crotolaria juncea** Linn.

Local name	...	Chanapata (Or.)
Habit	...	A stout shrub.
Flowers	...	August to January. Yellow.
Uses	...	Yields fibre and used as green manure.

CAESALPINACEAE

27. **Cassia occidentalis** Linn.

Local name	...	Chakunda (Or.)
Habit	...	An undershrub.
Flowers	...	August to October.
Uses	...	Roots, seeds and leaves are known to be purgative, and are also useful in cough and whooping cough. The plant is also used for skin diseases.

MIMOSACEAE

28. **Mimosa pudica** Linn.

Local name	...	Lajkuli (Or.)
Habit	...	Prickly shrub.
Flowers	...	July to March.
Uses	...	The leaves and roots are used for piles and fistula.

CUCURBITACEAE

29. **Cephalandra indica** Nand.

Local name	...	Kainchikakudi (Or.)
Habit	...	A climbing herb.

Flowers ... August to December.
Uses ... The leaves mixed with butter are applied as a liniment to sores. The roots have also medicinal value.

UMBELLIFERAE

30. **Hydrocotyle asiatica** Linn.

Local name ... Thallkudi (Or.)
Habit ... A herb with long creeping stems.
Flowers ... November to January.
Uses ... It is useful as a tonic in diseases of skin, nervous system and blood.

RUBIACEAE

31. **Oldenlandia corymbosa** Linn.

Local name ... Ghar-podia (Or.)
Habit ... A diffuse annual herb.
Flowers ... June to January.
Uses ... It is used in jaundice, liver complaints, and chronic malaria.

32. **Spermacoce hispida** Linn.

Local name ... Sana ghar-podia (Or.)
Habit ... Procumbent herb.
Flowers ... October to December.
Uses ... The roots and seeds have medicinal value.

COMPOSITAE

33. **Blumea lacera** DC.

Local name ... Pokasunga (Or.)
Habit ... A hairy herb.
Flowers ... October to March.
Uses ... The expressed juice of the leaves is a useful anthelmintic. It is used in cases of thread-worm.

34. **Eclipta alba** (Linn.) Hassk.

Local name ... Kesadura (Or.)
Habit ... A slender herbaceous weed.
Flowers ... August to February.
Uses ... The boiled decoction of the root is drunk as a purgative and emetic. It is also used in various skin diseases, specially leprosy, chronic skin diseases, and ring-worm. The leaves and flowers are also used in tooth-ache. The juice of the leaves is used as a hair tonic.

35. **Enhydra fluctuans** Lour.

Local name ... Hidimichi (Or.)
Habit ... A prostrate herb.

Flowers ... December to January.
Uses ... Used as a vegetable and laxative. It is claimed to be useful in diseases of skin and nervous system.

36. **Gnaphalium indicum** Linn.

Local name ... Naka-chunkuni (Or.)
Habit ... Hoary or woolly herb.
Flowers ... March to July.
Uses ... The leaves have medicinal value.

37. **Grangea maderaspatana** Poir.

Local name ... Agnikumari (Or.)
Habit ... A procumbent weed.
Flowers ... December to May.
Uses ... The leaves are regarded as valuable stomachic.

38. **Tridax procumbens** Linn.

Local name ... Bisalyakarani (Or.)
Habit ... Herb.
Flowers ... November to June.
Uses ... The stem, leaves, and roots are used in case of wound and cuts.

39. **Vernonia cinerea** Less.

Local name ... Pokasunga (Or.)
Habit ... An annual herb.
Flowers ... August to April.
Uses ... A poultice of leaves is applied to the head for headache. Bruised leaves are applied for ring-worm by some people.

40. **Xanthium strumarium** Linn.

Local name ... Bana gokhara (Or.)
Habit ... An erect herb.
Flowers ... November to February.
Uses ... It has proved useful in urinary diseases.

APOCYNACEAE

41. **Vinca rosea** Linn.

Local name ... Sada-behari (Or.)
Habit ... A herb.
Flowers ... All the year round.
Uses ... The juice of the leaves and flowers is used as an application for wasp stings.

ASCLEPIADACEAE

42. **Calotropis gigantea** R. Br.

Local name ... Arka (Or.)
Habit ... A stout shrub.

Flowers ... December to July.
Uses ... The latex is locally used for wounds and tooth troubles. The leaves are also used for fomentation for the diseases of the chest.

GENTIANACEAE

43. **Canscora diffusa** Br.

Local name ... Banbana (Or.)
Habit ... A herb.
Flowers ... All the year.
Uses ... The plant is used as a laxative.

BORAGINACEAE

44. **Heliotropium indicum** Linn.

Local name ... Hatisundha (Or.)
Habit ... A small herb.
Flowers ... October to May.
Uses ... The plant is locally used as application for boils, sores and stings of insects.

CONVOLVULACEAE

45. **Cuscuta reflexa** Roxb.

Local name ... Nirmuli (Or.)
Habit ... A leafless twining parasite.
Flowers ... October to December.
Uses ... Seeds are regarded as carminative.

46. **Evolvulus alsinoides** Linn.

Local name ... Bichhamalia (Or.)
Habit ... A much branched diffused perennial herb.
Flowers ... July to December.
Uses ... The leaves and roots are used in dysentery.

SOLANACEAE

47. **Datura fastuosa** Linn.

Local name ... Dudura (Or.)
Habit ... A small shrubby plant.
Flowers ... July to November.
Uses ... The leaves, seeds, and roots are used in medicine. The leaves and roots are smoked in asthma.

48. **Nicotiana plumbaginifolia** Viv.

Local name ... Hemaraj (Or.)
Habit ... Annual herb.
Flowers ... February to March.
Uses ... The leaves have medicinal value.

49. **Solanum nigrum** Linn.

Local name ... Nununnia (Or.)
Habit ... Gregarious herb.
Flowers ... Most of the year
Uses ... The berries and the juice are said to have laxative and diuretic properties.

50. **Solanum xanthocarpum** Schrad. & Wendl.

Local name ... Ankaranti (Or.)
Habit ... A prostrate prickly herb.
Flowers ... December to June.
Uses ... Fruits and roots are used in medicine. Root is used in cough, asthma, and catarrh. Root is locally used as a preventive against small-pox.

SCROPHULARIACEAE

51. **Herpestis monniera** H. B. & K.

Local name ... Brahmi (Or.)
Habit ... A creeping sub-succulent herb.
Flowers ... August to February.
Uses ... Used as brain tonic.

ACANTHACEAE

52. **Andrographis paniculata** Nees.

Local name ... Bhuinimba (Or.)
Habit ... A herbaceous weed.
Flowers ... March to August.
Uses ... It has reputation as a bitter tonic in dysentery. It is also used as substitute and sometimes adulterant of chiretta (*Swertia chireta* Buch.-Ham.)

53. **Asteracantha longifolia** Nees. Syn. *Hygrophila spinosa* T. Anders.

Local name ... Koilikhia (Or.)
Habit ... A robust spiny herb.
Flowers ... October to December.
Uses ... The leaves and roots have medicinal value.

54. **Barleria prionitis** Linn.

Local name ... Daskeranta (Or.)
Habit ... A prickly shrub.
Flowers ... April.
Uses ... It is used in medicine for various diseases. It is locally used as hair tonic.

55. **Adhatoda vasica** Nees

Local name ... Basanga (Or.)
Habit ... A tall shrub.
Flowers ... February to March.
Uses ... The juice mixed with ginger is used as a remedy for cough.

VERBENACEAE

56. **Clerodendrum inerme** Gaertn.

Local name	...	Genguti (Or.)
Habit	...	A straggling shrub.
Flowers	...	December to April.
Uses	...	It has reputation as a febrifuge.

57. **Lantana camara** Linn. var. **aculeata** Mold.

Local name	...	Naga-airi (Or.)
Habit	...	A straggling shrub with small prickles.
Flowers	...	All the year round.
Uses	...	Leaves are used to relieve indigestion.

58. **Vitex negundo** Linn.

Local name	...	Begunia (Or).
Habit	...	A shrub
Flowers	...	Most of the year.
Uses	...	The roots and leaves are regarded as tonic and febrifuge. The decoction of the leaves is given in headache and catarrh.

LABIATAE

59. **Anisomeles ovata** Br.

Local name	...	Bhutamari (Or.)
Habit	...	A strong smelling annual herb.
Flowers	...	September to November.
Uses	...	The plant is used in medicine as carminative, astringent, and as tonic.

60. **Leucas aspera** Spreng.

Local name	...	Gaisa (Or.)
Habit	...	An annual herb.
Flowers	...	September to January.
Uses	...	The juice of the leaves is applied in chronic skin diseases.

61. **Ocimum basilicum** Linn.

Local name	...	Sugandha (Or.)
Habit	...	An aromatic herb.
Flowers	...	September to December
Uses	...	The seeds and leaves are used as medicine. The juice of the leaves mixed with ginger and black pepper is given in cold and fever.

62. **Ocimum sanctum** Linn.

Local name	...	Tulasi (Or.)
Habit	...	An undershrub and sometimes cultivated.
Flowers	...	October to February.
Uses	...	The leaves are used in cough, cold, and bronchitis. The preparation is applied to skin in ring worm.

NYCTAGINACEAE

63. **Boerhaavia diffusa** Linn.

Local name	...	Ghodapuruni (Or.)
Habit	...	A diffuse herb.
Flowers	...	August to November.
Uses	...	Used locally in jaundice.

AMARANTHACEAE

64. **Achyranthes aspera** Linn.

Local name	...	Apamaranga (Or.)
Habit	...	A herbaceous plant.
Flowers	...	October to January.
Uses	...	It has got a reputation as medicinal plant.

65. **Alternanthera sessilis** Br.

Local name	...	Madaranga (Or.)
Habit	...	A prostrate herb.
Flowers	...	July to January.
Uses	...	Used as a vegetable. Also medicinally in dysentery and liver disorders.

66. **Amaranthus spinosus** L. Ridley

Local name	...	Kantaneutia (Or.)
Habit	...	A prickly herb and a common weed.
Flowers	...	Throughout the whole year.
Uses	...	The leaves are used as spinach. It is claimed to be a good cattle fodder which increases milk. The roots are used externally for curing inflamed wounds and for ripening boils.

67. **Aerua lanata** Juss.

Local name	...	Paunsia (Or.)
Habit	...	A perennial weed.
Flowers	...	November to January.
Uses	...	The flowering tops and roots are used in the treatment of head-ache.

68. **Celosia argentea** Linn.

Local name	...	Ganjachulia (Or.)
Habit	...	A glabrous erect annual herb.
Flowers	...	August to December.
Uses	...	Seeds are used in diarrhoea.

POLYGONACEAE

69. **Polygonum plebejum** Br.

Local name	...	Muthi saga (Or.)
Habit	...	A diffusely branched prostrate herb.
Flowers	...	February to May.
Uses	...	Used as a vegetable and the root is very useful astringent.

ARACEAE

70. **Amorphophallus campanulatus** Blume

Local name	...	Olua (Or.)
Habit	...	A stout herb with a single aerial leaf.
Flowers	...	November to February.
Uses	...	The corm is used as a vegetable. It is used in medicine for dysentery.

71. **Pistia stratiotes** Linn.

Local name	...	Borajhanji (Or.)
Habit	...	A floating weed.
Flowers	...	February to May.
Uses	...	The plant is cooling and demulcent.

CYPERACEAE

72. **Cyperus rotundus** Linn.

Local name	...	Mutha (Or.)
Habit	...	A weed of gardens and waste grounds having small black tubers.
Flowers	...	July to December.
Uses	...	The rhizomes are used in medicine in stomach troubles and dysentery.

GRAMINEAE

73. **Cynodon dactylon** Pers.

Local name	...	Duba (Or.)
Habit	...	A trailing herb (runner).
Flowers	...	Most of the year.
Uses	...	It is good fodder for cattle. The bruised grass is applied to wounds or cuts to stop bleeding.

COMMELINACEAE

74. **Commelina benghalensis** Linn.

Local name	...	Kanasiri (Or.)
Habit	...	A sub-succulent creeping herb.
Flowers	...	July to November.
Uses	...	Used as a vegetable and a good fodder. It is said to have medicinal value.

DISCUSSION

This is preliminary work and the investigation of the flora of Orissa is in progress. Weeds are not always undesirables. Though these plants disturb the growth of the cultivated plants, they are of use in some way or other. Plants almost universally considered troublesome become of great value under special circumstances. We have got a vast wealth and variety of plants which grow under natural conditions in waste places,

ditches, ponds, river banks and forests. Most of these plants are used even to-day as folk-medicine. Vegetable drugs have been known all over the world for centuries. Medicinal plants are mostly used in crude form locally. Families like Malvaceae, Euphorbiaceae, Vitaceae, Compositae, Solanaceae, Acanthaceae, Verbenaceae, Labiatae and Amaranthaceae have a large number of useful weeds in this locality.

Summary

Preliminary work has been done to find out the useful weeds of Cuttack and its neighbourhood. Most of the weeds are found to be useful in some way or other Some of these plants have high medicinal value. The detailed investigation is still in progress.

Acknowledgements

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NOTES ON THE HETEROCERA OF CALCUTTA

BY

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

PART III

(*Continued from Vol.* 53 (4), p. 658)

The present part includes the families Uraniidae, Epiplemidae and Geometridae. The first two are both very small groups and the third, in my experience, is very poorly represented in the plains of India. The treatment is on similar lines to previous parts.

URANIIDAE

Micronia aculeata Guen.—One at light, unfortunately I have no record of the date of capture.

EPIPLEMIDAE

Dirades theclata Guen.—Fairly common. Records for vi and x. Now *D. adjutaria* Wlk.; *D. theclata* is the African species.

GEOMETRIDAE

ORNOCHROMINAE (Hampson's ORTHOSTIXINAE)

Eumelea ludovicata Guen.—Uncommon. Records for x and xi. The Fauna treats it as a synonym of *rosalia* Guen.

Ozola microniaria Wlk.—One in x.

HEMITHEINAE (Hampson's GEOMETRINAE)

Pseudoterpna ruginaria Guen.—A single specimen bred in iv. Larva on *Nephelium litchi*. Now *Pingasa*.

Agathia lycaenaria Koll.—Imagines not common. Records for i, ii, viii, x, xi and xii. Larvae common on Oleander and I have not been able to find any distinguishing character to separate them from the larvae of the next species.

A. laetata F.—Imagines common. Recorded in iii, x, xi and xii. Larvae common on Oleander.

Uliocnemis cassidara Guen.—Common. Records for i, ii, iii, vii, x, xi and xii. Larvae reared *ab ovo* fed on *Zizyphus jujuba* (Rhamnaceae), *Lagerstroemia indica* (Lythraceae) and *Ixora* sp. (Rubiaceae). Now *Comibaena*.

Lophomachia picturata Hamps.—Uncommon. Recorded in x and xi. Not in the Fauna.

Euchloris quantula Swinh.—One f. *glareosa* Swinh. in x. Now *Chloeres.*

Comostola confusa Warr.—Rare. Records for i and xii. Not in the Fauna.

Euchloris subtiliaria Brem.—Common. Records for i, vi, x and xi. Now *Comostola laesaria* Wlk.; *E. subtiliaria* not occurring in India.

Nemoria indecretata Wlk.—Common. Recorded in vi and vii. Now *Microlexia.*

Thalassodes quadraria Guen.—Common. Records for iii, iv, vi, vii, ix, x, xi and xii. Larvae on *Polyalthia longifolia* (Anonaceae).

T. veraria Guen.—Likewise common. Records for i, iii, vi to ix, xi and xii. One larva found on cultivated Chrysanthemum.

Gelasma goniaria Feld.—One in i. The *Thalassodes acutissima* Wlk. of the Fauna, but this is really another species.

Thalassodes rubrolimbraria Guen.—One in xii. Now *Pamphlebia.*

T. avicularia Guen.—One in viii. Now *Ornithospila.*

Hemithea costipunctata Moore—Uncommon. Recorded in xi only. Treated in the Fauna as a synonym of *Thalera caudularia* Guen.

Thalera chrysolineata Wlk.—Uncommon. Records for ii and iii. Now *Berta.*

STERRHINAE (Hampson's ACIDALIINAE)

Ptochophyle togata F.—Common. Recorded in i, ii, vi and ix to xii. The Fauna does not distinguish this species from *permutans* Hamps. Larvae on *Eugenia jambolana* (Myrtaceae).

Somatina anthophilata Guen.—One in i.

Trigodes cuneilinea Wlk.—One in x. Now *Antitrygodes.*

Craspedia emissaria Wlk.—Common. Records for i, ii and vii to xii. Larvae on *Aeschynomene indica* (Leguminosae). This, and all the following *Craspedia* species, are now included in *Scopula.*

C. cleoraria Wlk.—Very common. Records for i to iii and ix to xii. Larvae on a cultivated Lantana (Verbenaceae). The Fauna treats this as a synonym of *fibulata* Guen., from which it is distinct.

C. opicata F.—Common. Records for x only.

C. nictata Guen.—Common. Records for iii, vi, vii and ix to xii.

C. remotata Guen.—Common. Records for i, iii and x to xii. My specimens agree with the figure in the Fauna, but Hampson has lumped a number of species together.

Sterrha macrospila Prout—Common. Records for i, v to vii, ix, xi and xii. Not in the Fauna.

Sterrha sacraria L.—One in vi. Now *Rhodometra*. The Fauna includes it in the Larentiinae.

LARENTIINAE

The only example of this sub-family is an unidentified *Chloroclystis* which I bred fairly commonly.

ENNOMINAE (Hampson's BOARMINAE)

Scardamia metallaria Guen.—Rare. Records for vii only.

Prionia squalidaria Hbn.—Rare. Records for i, iii, vii, x and xi. Now *Osicerda*.

Macaria fasciata F.—Fairly common. Recorded in viii. Now *Semiothisa*.

M. frugaliata Guen.—Fairly common. Records for ii, vi, xi and xii. Now *Semiothisa*.

Tephrina disputaria Guen.—One in viii.

Orsonoba clelia Cr.—One in vii.

Hyposidra talaca Wlk.—Fairly common. Recorded in i and ii. Larvae on Castor.

Dilinia medardaria Herr. Schaff.—A single specimen bred in xi. Larva on *Zizyphus jujuba*.

Hyperythra lutea Cr.—Not uncommon. Records for iii and x.

Biston suppressaria Guen.—Common, also larvae. Records for all months except vii, ix and xii. Larvae on *Cassia fistula*, *Lagerstroemia indica* and *Carissa carandas* (Apocynaceae).

Boarmia sublavaria Guen.—Common. Records for iv, vi to x and xii.

A disappointing list; a Mercury Vapour lamp would, I feel sure, have produced considerably more, both species and individuals.

(To be continued)

SOME BENEFICIAL COCCINELLIDS OF MYSORE

BY

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This list pertains to the further collections made and hosts noted subsequent to those reported by us (1953 and 1955), and is prepared on the same basis as the previous ones. It includes 25 species belonging to 8 tribes, the tribe Scymnini being numerically well represented. Most of the species included here were determined by Dr. R. D. Pope of the British Museum, London, as also the synonymy of *Menochilus* 6-*maculatus* (Fabr.). The identification of *Scymnus* (=*Pullus*) *quadrillum* Motsch. and *Scymnus nubilus* Muls. was confirmed by Dr. A. P. Kapur of the Zoological Survey of India, Calcutta. The mite species mentioned here were determined by Dr. A. Earl Pritchard of the University of California. We are grateful to them.

SCYMNINI

Pullus nubilus Muls. This species was reported by us (1953) under the name *Scymnus nubilus* Muls. as feeding on aphids infesting groundnut, cowpea, jowar, *Phaseolus mungo* and cotton. It has since been found feeding on two more species of aphids, *Aphis nerii* Fonsc. and *Rhopalosiphum nymphaeae* (L.), and the brinjal mealybug, *Phenacoccus insolitus* Green. The predator was found active on the above hosts from January to May.

Chatterjee and Bose (1934) have recorded the species from various places in South India as occurring throughout the year but abundant during July and August.

Pullus picescens Gorh. The species was found feeding on the aphid *Rhopalosiphum nymphaeae* infesting *Trapa*, an aquatic plant, during January 1954. Both young ones and adults were found together on aphid-infested *Trapa* plants.

There appears to be no record of the species in India.

Pullus victoris Motsch. A variety of this species was reported by us (1955) as feeding on *Pseudococcus* sp. infesting *Boehmeria* plant. The species was found breeding extensively on aphid-infested (*A. nerii*) plants of *Calotropis* during March-May 1954 round about Bangalore.

Pullus castaneus Sic. The species was previously recorded by us (1955) as feeding on *Aphis maidis* Fitch, and has been since found feeding on the cotton-aphid *Aphis gossypii* Glov. during April 1954 around Bangalore.

Pullus gratiosus Weise var. The beetles of the species were bred from the fluted scale, *Icerya purchasi* Mask. infesting Casuarina around Mandya (Mysore) during May 1954. This was previously found by us (1955) feeding on *Pseudococcus* sp. infesting *Boehmeria*.

Scymnus (=Pullus) quadrillum Motsch. When this was last recorded by us (1953) the specific determination was doubtful. The determination has

since been confirmed by Dr. A. P. Kapur. The predator has also been found feeding on the cotton aphid *A. gossypii*, and aphids infesting brinjal around Bangalore.

Scymnus sp. ? **guimeti** Muls. Since last reporting (1955) this species on aphid-infested cotton plants around Bangalore, the species has been found on the potato-aphid *Aphis malvoides* Das and on *A. nerii*, infesting *Calotropis* plants during February to April 1954.

Scymnus sp. This undetermined species was bred from the aphid, *A. malvoides*, infesting potato plants around Bangalore during February 1954.

Nephus regularis Sic. The species was found abundantly in the larval and adult stages on mealybug, *Pseudococcus* sp., infesting *Boehmeria* plants together with another coccinellid *P. victoris*, during April 1954, and also to a lesser extent on *Pseudococcus*-infested *Glyricidia* and guava plants.

Stethorus gilvifrons (Muls.) The species was found feeding on the red spider mite (*Tetranychus* sp.) infesting papaya plants around Bangalore during January to March 1954. Larvae and adults were seen in large numbers on the lower surface of leaves particularly on those that were heavily infested with mites.

The species has so far been recorded only from North India (Kapur, 1948) as feeding upon mites infesting apple tree and castor.

Stethorus tetranychi Kapur. The adults of the species, which have very close resemblance to *S. gilvifrons*, were found feeding on red mites, *Raoiella indica* (Hirst), infesting areca palms round about Tharikere (Mysore) during April 1954, and also on *Tetranychus* sp. infesting papaya leaves at Hebbal (Bangalore) during August 1953.

Stethorus sp. nr. **pauperculus** Weise. *Stethorus pauperculus* Wse. has been recorded by us (1953) as feeding on sorghum-mite, *Paratetranychus indicus* Hirst. Adult specimens, which have been identified as *Stethorus* sp. nr. *pauperculus*, have been found feeding on mites, *Eutetranychus banksi* (McG.), infesting castor around Bangalore during April 1954. Both grubs and adults were seen amongst the mite population on the lower surface of leaves

Stethorus parcepunctatus Kapur. The beetles of this species were collected from mite (*R. indica*)-infested areca palms around Tharikere (Mysore) during April 1954.

The species has been described by Kapur (1948) as a new one from material from Kanara (India) without record of any host.

Aspidimerini

Pseudaspidimerus circumflexa (Motsch.) var. **testaceus** (Weise). The predator has been found to be active almost throughout the year and feeding on several species of aphids. The following are the additional aphid-hosts which have not been included in our previous records (1953, 1955):

A. gossypii, infesting *Psidium guava* during November 1953; *Aphis rumicis* Linn., infesting cowpea during January 1954; *Aphis medicaginis*

Koch., infesting *Dolichos lablab ; A. nerii* infesting *Calotropis gigantea ; A. malvoides* infesting potato, and aphids infesting brinjal. It has also been found to feed on the mealybug, *Pseudococcus* sp., infesting *Boehmeria* plants.

HYPERASPINI

Hyperaspis maindroni Sic. Since our last record (1955) of the species as feeding on *Pseudococcus* sp. infesting *Boehmeria* plants, it has been found feeding on *A. gossypii* on cotton. Only adults were found on aphid-infested plants during October 1954 round about Bangalore. It was also collected from *Pseudococcus*-infested *Boehmeria* plants during the above month.

Hyperaspis maindroni Sic. var. **brumoides** Sic. This variety was found together with the above species on aphid-infested cotton plants around Bangalore. A large number of adults were also bred from *Pseudococcus*-infested cotton plants received from Hiriyur (Mysore) during January 1954. Both adults and larvae of the predator were seen actively feeding on young ones of the mealybug, and appeared to have good controlling influence on the mealybug infestation.

PHARINI

Sticholotis cribrellata Fairm. Larvae of this species were found feeding on an undetermined scale infesting the nodal regions of bamboo twigs, and usually covered by sheaths at Hebbal (Bangalore). This was reported by us (1955) as *Sticholotis* sp. nr. *cribrellata* feeding on the same species of scale, and there appears to be no other record of this in India.

Sticholotis sp. This unidentified species is quite distinct from the other species of *Sticholotis* in our collection and was collected from *Pongamia* galls during April (1954). Host is not known. The beetle is smaller in size than the other species of the same genus so far recorded by us, and with the elytra shining dark and the pronotum and head paler.

CLANINI

Juaravia (= Clanis) pallidula Motsch. Subsequent to our previous record (1955) the species has been collected from *Pongamia* twigs infested with an undetermined mealybug during April 1954 around Bangalore.

Juaravia soror (Weise). This common species of the genus was collected on areca palms infested with mites, *R. indica*, around Tharikere (Mysore) during April 1954. Only adults could be seen during the time of collection. This was last reported by us (1955) on mealybugs, infesting sandal trees.

COELOPTERINI

Pharoscymnus horni (Weise). The adults have been collected from mealybug (*Saccharicoccus sacchari* Ckll.)-infested sugarcane around Mandya (Mysore). The species has also been noted to be quite abundant on *Thevetia* plants infested with hard scale, and cactus infested with *Diaspis echinocacti* (Bouché) during January–June 1954, and more particularly on cactus.

The species has been identified by Dr. A. P. Kapur as *P. horni*, whereas the specimens from the same lot and others appearing same have been put as *Pharoscymnus guimeti* (Muls.) by Dr. R. D. Pope of the British Museum, London. However, the name given by the former has been followed here as it is the correct name for the species.

Chilochorini

Brumus suturalis. This fairly common species, which has been recorded by various workers as feeding on a variety of hosts, like mites, psyllids, aleyrodids, aphids, and coccids, was found in good numbers feeding on *A. nerii* infesting *C. gigantea* around Bangalore during May 1954. Only adults were found during this period.

Coccinellini

Coccinella arcuata Fabr. A variety of this species (var. *octomaculata*) was recorded by us (1953) as feeding on *A. rumicis*, infesting cowpea. The species has since been found in a paddy field near Bangalore. The beetles might have been feeding on aphids found here and there on paddy in the field.

Coelophora sp. This species, which differs from the other species of the genus in our collection, has been found feeding on *Asterolecanium* sp. nr. *fusum* Russel infesting bamboo at Hebbal (Bangalore) during October 1953.

Menochilus 6-maculatus (Fabr.) Since the previous record by us (1955) from Malavalli (Mysore) the species has been collected from cowpea plants infested with *A. rumicis* and on *Calotropis* plants infested with *A. nerii* during April 1954.

Two colour forms have been found together on both these hosts. In one, the elytra are entirely yellowish brown excepting for a very thin, black line along the anal margin of each elytron ; and these narrow black margins form a single narrow black streak along the mid-longitudinal line when the elytra are held together over the body. In another form, each elytron bears a zigzag yellowish-red marking which together form a zigzag cross bar on the elytra when the wings are held together. The rest of the elytra is shining black. The colour pattern of the pronotum is the same in the two series. *Menochilus* 6-*maculatus* (Fabr.) is synonymous with *Chilomenes* 6-*maculatus* (Fabr.) reported in our earlier paper (1953), and the former is the valid name of the species. In addition to the above two colour forms, there are two more principal types of colour patterns in the species in our collection. In one, the beetles show the typical three black markings on each elytron, and in the other type, elytra are entirely shining black with at most a thin paler costal margin in some specimens.

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FURTHER OBSERVATIONS ON THE BIOLOGY OF THE COMMON 'TREE-HOPPER' *OTINOTUS ONERATUS* WALK. (HOMOPTERA, MEMBRACIDAE) IN ORISSA

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SYNOPSIS

Fifteen new host-plants of the membracid *Otinotus oneratus* Walk. are recorded. It infests woody plants during winter and summer. The eggs are laid in parallel rows, each row consisting of 6 to 15 eggs. *O. oneratus* is found all the year round, but is most abundant during the rains and autumn. It takes about a month and a half for its development from egg to adult. The adults sit with their head pointed downward, upward, or towards the base of the branch. They are most active during the hot parts of the day. During mating, the male and female point in opposite directions and copulation lasts about an hour or less. The nymphs and adults are attended by the ant *Camponotus* (*Tanaemyrmex*) *compressus* Latr. The adults of *O. oneratus* are parasitised by a species of *Indoxenos* (Strepsiptera).

INTRODUCTION

Otinotus oneratus Walk. is one of the most widely distributed membracids of India, occurring in Ceylon as well (Distant, 1908, 1916; Behura, 1951; Behura and Sinha, 1951). One of us (Behura, 1951) recorded observations on the habits of *O. oneratus*. The present paper embodies further observations made at Balasore and Cuttack during 1952 to 1955.

HOST-PLANTS

It has already been recorded (Behura, 1951) that the membracid feeds and breeds on fifteen species of host-plants in Orissa. In the present paper, the same is confirmed and an additional fifteen host-plants are recorded from Orissa (Table No. 1.).

In Balasore, the most preferred food-plant of *O. oneratus* is *Datura fastuosa* on which all the stages of the membracid are found in large numbers in August. The plants next in preference are *Cajanus indicus, Cassia fistula* and *Albizzia lebbeck*. During winter and summer, the insects are found in lesser numbers and usually abound on woody plants like *Zizyphus jujuba, Zizyphus oenoplia, Calophyllum inophyllum* and *Bauhinia variegata*. In the gardens of the city of Cuttack,

TABLE NO. 1.

Hitherto unrecorded host-plants of *Otinotus oneratus* Walk. in Orissa

No.	Scientific name of the plant	Family	Local popular name current in Orissa	Locality	Period of infestation as observed by the authors
1.	*Holarrhena antidysenterica* ...	Apocyanaceae.	Koruan.	Kalyanpur (Athmallick).	July.
2.	*Hydnocarpus kurzii* ...	Bixaceae.	Chalmugura.	Khurda.	May.
3.	*Bauhinia variegata* ...	Caesalpiniaceae.	Kanchana.	Balasore.	February.
4.	*Cassia fistula* ...	Caesalpiniaceae.	Sonari.	Balasore.	July-October.
5.	*Cosmos bipinnatus* ..	Compositae.	(Cosmos).	Balasore.	October.
6.	*Calophyllum inophyllum* ...	Guttiferae.	Polanga.	Nardia (Cuttack Dist.).	July.
7.	*Althaea rosea* ...	Malvaceae.	(Hollyhock).	Balasore.	March.
8.	*Albizzia lebbeck* ...	Mimosae.	Sirisha.	Nardia (Cuttack Dist.).	July.
	Pithecolobium dulce ...	Mimosae.	Belati Kaiyan.	Cuttack.	July.
10.	*Artocarpus integrifolia* ...	Moraceae.	Panasha.	Sudhakanthy (Cuttack Dist.).	August.
11.	*Eucalyptus* sp. ...	Myrtaceae.	(Eucalyptus).	Balasore.	January.
12.	*Eugenia jambolana* ...	Myrtaceae.	Jamu.	Cuttack.	July.
13.	*Eugenia malaccensis* ...	Myrtaceae.	Jamurol.	Balasore and Cuttack.	July.
14.	*Sesbania aculeata* ...	Papilionaceae.	Dhanicha.	Cuttack.	May-September.
15.	*Sesbania grandiflora* ...	Papilionaceae.	Agasti.	Balasore.	July-February.

however, *O. oneratus is* most abundant on *Inga dulcis* and *Sesbania aculeata.*

Egg-Laying

The eggs are laid in parallel rows under the soft bark of host-plants. They are embedded vertically and in a slightly inclined fashion. The number of eggs found in each row varies from 6 to 15. They are whitish when laid and gradually turn pink and finally black before hatching. The eggs are laid at all seasons, but in the largest numbers during the rains and autumn.

Seasonal Occurrence

O. oneratus is seen all the year round. In Balasore, they are most common during June to October. The development from the egg to the adult of the membracid on the host-plant *Cajanus indicus* at Balasore during January and February 1954 was found to take about a month and a half, during which five instars were observed.

Habits

O. oneratus is gregarious in nature. The adults and nymphs are found crowded in the nodal and apical parts of the young shoots and on the lower side of the midribs of the bigger leaves. They rest motionless on the host-plants for hours together engaged in sucking the sap. The adults sit with their heads pointed upward downward or towards the base of the branch.

Both the adults and nymphs are very active during the hot parts of the day. They take to the wings on the slightest provocation on clear sunny days, while on a rainy or cloudy day they crawl round the twig and fly away only when much disturbed.

Mating

The mating activity begins from about 10 o'clock in the day. The male crawls over the female so that their caudal extremities meet. Sometimes two or three males are found to crowd on the back and sides of a single female. In copulation, the aedeagus of the male is inserted into the female gonopore, the claspers of the former aiding in grasping the latter's body. Then the head and body of the male are moved through an angle of 180° so that the copulating pair face in opposite directions. Copulation lasts about an hour or less. The hooked nature of the aedeagus prevents quick separation of the pair *in copula,* and when disturbed the female keeps on dragging the male behind her or the pair falls to the ground without being separated. Finally, the male again moves to his original position and withdraws the aedeagus effecting a separation.

Attendance by Ants

In all the host-plants, *O. oneratus* is usually attended by the common black ant *Camponotus* (*Tanaemyrmex*) *compressus* Latr.

The ants keep on moving constantly on the twigs and leaves infested by the nymphs and adults and guard the ant-cattle against any unwelcome intruder. The honeytubes of the nymphs are often kept raised. The ants lick the drops of honey from the tips of the honeytubes as they move among the drove. The adults sometimes ward off the ants by moving their bodies sideways, when the latter coax them for more honey. On transferring some live nymphs and adults of *O. oneratus* to some isolated pot plants at Balasore, the ants were found to begin their march to the unattended membracids within a few hours.

Parasites

Both at Cuttack and at Balasore, the adults of *O. oneratus* were found to be parasitized by a Strepsipteran, a species of *Indoxenos*. The number of parasites collected between October and February 1953-54 at Balasore were, on female hosts—1, 1, 1, 1, 2, 2; and on male hosts—1, 1, 1, 2, 3, 3, 3. Thus the maximum number of parasites collected from a single individual was three. The proportion of sexes in the parasites differed, the number of females being greater than males. The present parasite differs in some respects from *Indoxenos membraciphaga* Sub. bred from *O. pallescens* (Syn: *O. oneratus*) in Mysore (Subramaniam, 1927) and may prove to be a new species.

Parasitization by the Strepsipteran appeared to be not fatal to the host, as some live specimens of *O. oneratus* collected in the field showed that the parasites had already escaped from their bodies, although apparently the latter were leading a normal life. The parasitized membracids are characterised by a nodular growth at the side of the abdomen.

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REVIEWS

1. POWAI THE ANGLING PARADISE. By D. I. Amore. 80 pages: Hind Kitabs Limited, Bombay-1. Price Rs. 4.

A new book on angling is always welcomed by followers of Izaak Walton in India. In fact this little publication on Bottom Fishing goes a long way to fill the gap since Mr. Thomas's classic was first published some 70 years ago. The author is one of our Powai Lake veterans and has also incorporated the views of a number of other old timers. To my knowledge this is the first publication on Bottom Fishing with particular reference to Bombay waters and it will be found indispensable for beginners and visitors from abroad and from other parts of the country.

From the anglers' point of view, the fact that the author deals with a specialised subject, viz. Bottom Fishing at Powai Lake, appears to be a definite advantage as this Lake, which covers an area of 2.6 square miles, provides versatile and varying methods of angling for Bottom feeders such as Rohu, Mirgil, Calabos and Catla, of which the Lake holds very remarkable specimens, particularly Catla, of well over 100 lb. in weight.

A study of the Book will reveal that this Lake, contrary to what we usually call a 'Tank', can be successfully fished by various methods according to season and water level. The author also gives useful information on building rafts and boats suitable for fishing.

The tackle, as described by the author, time-proved by many anglers at Powai, will no doubt be found most suitable for any type of bottom fishing in other parts of the country.

One would have wished that the book contained a number of good photographs depicting the beautiful scenery at Powai and it is hoped that in a future edition this shortcoming will be remedied without an increase in price.

F.R.G.

2. THE TIGERS OF TRENGGANU. By Lt.-Col. A. Locke. Pp. xvi+191 (8.4/5″ × 5½″). 38 plates and 2 maps. Museum Press Limited, London, 1954. Price 16 *sh.* net.

The author was posted as an administrative officer at Trengganu; it was a part of his duty to destroy eleven tigers and eight tigresses. The present book is the outcome of his experience of about three years while he was in charge of the division, and of his studies of the habits of Malayan tigers.

Chapter one is mostly concerned with the background.

Chapter two deals with the distribution, size and habits of the tigers in Malaya and particularly in Trengganu. According to the author every ten square miles in Trengganu held one tiger, which he thinks is less than the estimated density in tiger country in India.

Malayan tigers appear to be smaller than Indian ones. From the measurements of the eleven tigers and eight tigresses shot by him, and from those shot by H.H. The Sultan of Johore, the average length of a Malayan tiger is given as 8 ft. 6 in., and of a tigress 7 ft. 10 in., against 9 ft. 6 in. and 8 ft. 6 in. respectively for the Indian animal.

The Malayan tiger is said to eject a strong smelling secretion from the root of the tail. A similar habit has not been recorded in India. The principal natural food of tiger in Malaya is wild pig. As other game animals are rather scarce, Malayan tigers become cattle lifters more frequently. Malayan tigers are very fond of dogs, while in India leopards are reputed to be so.

The proportion of sexes is given as 60% males to 40% females and the breeding season from November to March. The maximum number in a litter is given as six, which seems to be higher than in India. Milk teeth are kept for about six months. The second set of teeth are hollow, the cavities finally close after about twenty months. The new and permanent canines grow up inside the hollow milk teeth. The cubs are suckled for about five months after birth, after which the mother gives them small game to start with.

The maximum longevity is 25 to 30 years. The author collected all this information in about three years.

Chapter three deals with diet, kills and area covered. As already stated in Chapter two the principal diet is wild pigs with an occasional barking deer, sambar, peafowl, and giant sea turtles, which are turned on their back and eaten at leisure. The Malayan tiger is not averse to domestic cattle, sheep, goat, domestic pigs, dogs, tame monkey and poultry. The bigger animals are killed by biting; the breaking of the neck vertebrae being considered accidental. However, the author has not witnessed actual killing and his description does not agree with that of Dunbar Brander. Perhaps owing to its smaller size the Malayan tiger has to resort to a different method. The bigger animals are dragged and not carried. Like the Indian tiger, the Malayan tiger also starts eating the hind part of the kill. Frequently the Malayan tiger is a carrion eater. Malayan tigers do not, while walking, place their hind feet on top of pugs made by the front feet, as Indian tigers are supposed to do. The Malays use baited spring traps and noose traps to kill or capture tigers.

Chapter four deals with tiger hunting. Beating and stalks are not practicable in Malaya. Sitting up over a kill or accidental encounters seem to be the ways of killing tigers.

Chapter five and six deal with the different cattle lifting tigers the author has shot.

Chapters seven and eight deal with man-eating tigers. All the man-eaters shot by the author were males. From the accounts it would appear that the man-eaters of Malaya are much less cunning and formidable than those of India. In Malaya a man-eating tiger does not become so great a menace as the man-eater in India for the following reasons: (a) smaller area of operation, so easier to locate, (b) greater determination and skill of the Malays!!! (c) experienced hunters more readily forthcoming!!

Chapter nine is a collection of Malay superstition and legends.

During the short time at his disposal the author tried t as much about the Malayan tiger as possible, and has turne very interesting book indeed, though many of his opinions a clusions do not agree with those of people who have stud hunted tigers in India and elsewhere. The author was in th of following up a tiger immediately after wounding it, even a What experienced shikaris in India will think of this pract well be imagined. The author's attempt to make a census o in Malay may usefully be tried in India. His sincere admira a noble animal is apparent all through the book.

B.

3. PELICAN IN THE WILDERNESS. A NATU ODYSSEY IN NORTH AMERICA. By F. Fraser Darling. F ($8\frac{1}{4}'' \times 5\frac{1}{2}''$). With 2 maps and 15 plates (28 photographs). 1956, George Allen and Unwin. 25 *sh*. net.

Dr. Fraser Darling is well known as an authority on w and his writings have done much to bring about an increa cognition in Britain of the importance of Nature Conservatio most recent book describes his travels in America. Somewhere Wall Street and the Pentagon, Broadway and Manhattan, th powered cars, escalators and chromium plating lies the Am the pioneers, the America of wide prairie, virgin forest, des swamp. What have they done with it since the first home established their farms so many years ago? Dr. Darling part of the answer. America is constructed on a vastly larg than anywhere else. Here under a magnifying glass are the u natural principles at work, providing him with abundant conf for views based on observations in tiny insular Britain; and illustration of the consequences of disregarding ecological law

The inter-relation between species in any habitat is so cl interference with one upsets the ecological balance. Man in th of his phenomenal rise to become the dominant species of the age has done this over and over again, often with serious an unforseen consequences. To give only one example, the aut cribes how the extermination of the timber-wolf in North A instead of increasing the number of white-tailed deer, has led decrease. No longer kept on the move by wolf packs, the d in one spot and after finishing all available food starve to de Scotland a role similar to that of the wolf is played by th dog, which drives the sheep from place to place and preven grazing. If we are to control our environment intellige understanding of the factors holding natural communities is essential, and this can only be acquired by a lifetime of observation.

Most interesting perhaps are Dr. Darling's remarks on soi especially relevant in the context of India's plans for expand agriculture under the Five Year Plan. Are we relying too the fertility of our soil to repair damage done by forcing n soil to yield arable crops? Such a practice impoverishes the s

in satisfying present needs we may well be robbing future generations. Other parallels between Indian and American conditions can be drawn. 'There is immediate wealth to be picked up from breaking an ecological climax, as in the felling of Wisconsin's forests.' Writes Dr. Darling: 'The biological shock of doing such a thing is very great . . . .' The hacking of trees round our villages and the large-scale felling of timber by private owners in order to make quick profits are destroying what ought to be valuable natural assets. We are left with land which is practically worthless from the agricultural point of view and which may take centuries to return to the forest that represents the climax vegetation.

In some ways it is a pity that Dr. Darling has adopted the diarist's style, noting down events and thoughts as they occurred to him. Thus we find the price of a haircut in San Francisco next to a discussion on land misuse in California, and, immediately after, we are back in San Francisco's Italian quarter for dinner. Along with some interesting general information and some which is neither interesting nor particularly original there is much of value in the book. We may or may not agree with all Dr. Darling's conclusions, but he has a definite contribution to make to our thinking on matters of ecology, and it is to be hoped that this book will stimulate interest in his more serious scientific publications.

R.R.

4. THE FLAMINGOS: Their Life History and Survival. By Robert Porter Allen. Pp. xv + 285 ($10\frac{1}{2}'' \times 8''$). 15 plates (6 coloured), and numerous line figures from field sketches etc. New York: National Audubon Society, 1956. Price $3.95.

This is the National Audubon Society's Research Report No. 5. Though it covers all the flamingos of the world, it has special reference to the American or West Indian Flamingo, *Phoenicopterus ruber*, which is threatened with extinction in portions of its range. It is the result of some 3 years' field study of the species and analysis of the data collected.

To those familiar with Dr. Allen's previous research reports in the same series, namely on the Roseate Spoonbill and the Whooping Crane, and to any one who, like the reviewer, has had the privilege of seeing this dedicated field ornithologist in action, this magnificent piece of work is only what was to be expected. Indeed the National Audubon Society are to be congratulated on their choice, for here Dr. Allen has done it again!

Properly organized interest in the American Flamingo began to be taken only recently since the realization of its fast declining status by a group of far-sighted naturalists headed by Mr. Arthur Vernay, and more particularly after the founding of The Society for the Protection of the Flamingo in the Bahamas—'the largest remaining stronghold of the American flamingo'. Owing largely to ceaseless persecution by local inhabitants the bird was being rapidly pushed to the verge of extinction.

The Report is divided into the following main sections: (1) Distribution & Migration, (2) Numbers, (3) Food Habits and Ecology, (4) The Breeding Cycle, and (5) Conservation. An Introduction at the beginning provides a very full overall background survey of the flamingo through the ages and throughout the world: legend and early history, classification, comparison of species including detailed descriptions of all the six forms belonging to the three genera currently recognized. The large flamingo of the Old and New Worlds, treated by some taxonomists as races, is given specific rank as *Phoenicopterus antiquorum* and *P. ruber* respectively, with a third species of this genus, *chilensis*, confined to Chile in S. America.

On the map on p. 33 of the Distribution and Nesting of *P. antiquorum* in relation to isothermal lines, reported former nesting is shown in Ceylon. It may be well to point out, however, that a scrutiny of these reports have proved them to be groundless and based largely upon conjecture and speculation.

The author believes that the enormous breeding colonies of the Great Rann of Kutch—the most populous so far known anywhere in the world—send their flocks to E. Africa for the winter months, at least large numbers of them. This is a reasonable speculation, but can only be proved by a large-scale marking of the birds. In fact most of the existing distributional problems connected with the flamingo seem capable of solution only through large-scale marking and adequate follow-up.

An estimate of the present aggregate of the West Indies Flamingo (*P. ruber*) at five of its principal known nesting places is given as 21,500 breeding adults. It shows a slightly downward trend since 1952 when the total of the adult breeding birds was estimated at 23,416. A hope is expressed that the continuation of the present protection programme instituted by the Flamingo Protection Society of the Bahmas, and other agencies, will, with the help of the vital statistics presented in this Report, help to rehabilitate population numbers. It is concluded from an analysis of the data available that formerly the total population numbered something like 95,000 individuals, distributed in 12 major and 17 minor population units.

Apart from human persecution, the West Indies flamingo suffers drastic loss through the periodic hurricane cycles to which its distributional range here is exposed. On account of these recurrent catastrophies it is believed that the numbers of this species were never as great as those of its Old World congener.

Perhaps the most illuminating chapter is that dealing with Food Habits and Ecology. All available information has been skilfully collated and supplemented by the author's own extensive field study. It is pointed out that the factor of high salinity, common to all flamingo habitats, is perhaps of the most consistent vital survival value. High salinity tends to produce the abundance and variety of the minute organisms upon which the flamingo feeds. The large size of the bird's tongue which fairly fills the mouth cavity precludes the swallowing of large food items. The food is confined to vegetable and animal items mostly of tiny or even microscopic size, largely swallowed in the form of organic sand or mud. But a study of the bird's feeding places suggests a great many potential food items

besides those taken from stomachs, so that there is still room for exhaustive studies on the food and feeding habits of the flamingo.

The chapter on The Breeding Cycle describes in detail breeding behaviour, pair formation, courtship, copulation, nest building and other matters connected with incubation; also hatching and early behaviour, herding, and dispersal of the young. The final section of the Report deals with Conservation. The main causes of mortality are put down as human encroachment on erstwhile remote habitats, and natural physical causes such as storms, cold waves etc. One such alone in the Camargue last year is known to have killed off over 2,000 birds. Natural predators do appreciable damage in some areas, but this does not appear to be a major limiting factor. Nearer home, in the case of our Kutch colonies, the growth of the practice, apparently within recent years, among villagers around the borders of the Great Rann of organized rounding up and slaughtering large numbers of flightless young flamingos has become a serious menace. At this stage the young are unbelievably fat and are greatly relished as food by the meat-eating locals. The newly appointed flamingo warden of the Government of Kutch will, it is hoped, be instrumental in curbing this vandalism.

Conditions in all the known flamingo breeding areas are reviewed and the measures for protection already adopted or called for are described or suggested. Dr. Allen concludes that perhaps except in the case of the Andean species *Phoenicoparrus jamesi* about which not enough is known, the overall world position of the flamingos, barring in certain specific areas, e.g., in the Carribean region, is fairly satisfactory and happily presents no serious problems of survival at present.

The Bibliography is impressive. It occupies 21 pages and cites something like 700 separate items covering practically all that has ever been written about the flamingo. The Report is, in fact, a comprehensive epitome of our knowledge concerning the bird.

A frontispiece in colour by R. T. Peterson illustrates all the six flamingos of the world showing their comparative characteristics of size and coloration. The other five coloured plates unfortunately do not all do justice in their reproduction to their original transparencies, but the monochrome plates are good and the line drawings excellent and well-chosen throughout, including the various maps.

S.A.

5. EMBRYOLOGY OF *HETEROMETRUS SCABER*. By A. P. Mathew. Zoological Memoirs, University of Travancore Research Institute. Vol. I, pp. 111. Frontispiece and 14 plates. Trivandrum, September 1956.

The *Memoir* by Dr. A. P. Mathew on the embryology of the Indian scorpion, *Heterometrus scaber*, forms a valuable contribution to the embryological literature on the development of Arthropods. After a historical resumé, the author describes briefly the material worked with and the technical methods followed in the study. He then gives a brief account of the bionomics, the female reproductory system, the structure of the egg, the details of maturation and fertilization, the

segmentation of the egg, the development of the blastula and the processes of gastriation. This is followed by accounts of the development of the mid-gut, the nervous system and certain other organs of the body. Toward the end is given a brief account of the birth of the young ones. This scorpion breeds throughout the year in southern India and is viviparous.

It is clear that the author has carried out a useful and painstaking study of scorpion embryology. He has taken care not only to give his findings in detail but also to discuss them against the background of previous knowledge. In this way the reader is able to judge for himself the value of the findings and the extent to which they are original.

The account is well-illustrated with several text-figures, 14 plates and a frontispiece. We should like to congratulate the author on bringing out this fine *Memoir*. Also deserving of congratulations are the University of Travancore which sponsored the publication and the University Grants Commission of the Government of India which provided financial aid to the publication. We shall look forward to the publication of subsequent Zoological Memoirs which, we hope, will maintain the high standards set in the first *Memoir*.

M. L. ROONWAL

6. THE EARLY EMBRYOLOGY OF *PYRILLA PERPUSILLA* WALKER (HOMOPTERA) INCLUDING SOME OBSERVATIONS ON THE LATER DEVELOPMENT. By Klaus Sander. Aligarh Muslim University Publications (Zoological Series on Indian Insect Types. Edited by Dr. M. B. Mirza). 1956. Price Rs. 5.

Embryological work on insect types has not found favour with Indian entomologists. In fact except Dr. Roonwal's paper there hardly exist any standard papers on the studies of insect embryology in India. Dr. Klaus Sander's present paper is a good beginning in this direction. The author in this paper has brought in a keen sense of observation as he follows the different stages of early development. Regarding the description one feels that it could have been shortened. Immediately after Material and Methods the author could have taken observations, and instead of bringing controversial matter under this heading it would have been better to put it under discussion. Under this heading the different papers on early development could have been discussed and the present observations compared. By doing so a running observation would have made better reading than getting mixed up with comparisons and controversies. Similarly the use of such words as Ental membrane, Mycetom, Vorkeim-Anlage, Symbionts and a number of others are probably not commonly used in the English vocabulary of this nature. A note explaining them would have helped many readers. We feel that in further work of this nature the precision and clarity as seen in the papers of Dr. Heymons, Paterson and Miller would be very helpful to Indian workers.

However, Dr. Klaus Sander has certainly opened up in India a new line of work and we hope that many Indian workers will profit by the same.

P.J.D.

MISCELLANEOUS NOTES

1. MACAQUE MONKEY EATING MUSHROOMS

The macaque monkey, *Macaca mulatta* (Zimmerman), is common in the New Forest estate of the Forest Research Institute near Dehra Dun (Uttar Pradesh), *ca.* 600 metres above sea-level. It moves about the estate in small troops, doing depredation to gardens and cultivation. During the summer monsoon, mushrooms spring up profusely from the ground all over the area. They usually acquire a whitish umbrella-shaped body which attains a height of upto 4 cm.

One day in August, 1955, I saw a large male macaque pulling out and eating these mushrooms with relish. A few days later another male was observed repeating the same performance. The observation seems to be worth recording. As several species of mushrooms grow in Dehra Dun, I am unable to say which species the monkeys were eating.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA,
September 24, 1956.

M. L. ROONWAL

2. LION *V.* TIGER

Col. Kesri Singh's interesting Miscellaneous Note entitled 'Experiments in Implanting African Lions into Madhya Bharat', in Vol. 53, pp. 465-68 of this journal, gives the details of how lions were imported from Africa into Gwalior in 1916. This information is most welcome, especially as we are now concerned with the proposal of moving a few lions from the Gir Forest into some other parts of India. (See my paper entitled 'The Management of India's Wild Life Sanctuaries and National Parks' in this issue of the *Journal*, pp. 1-21.)

An interesting point was raised, also, in the details concerning lions versus tigers in combat. Col. Kesri Singh is of the opinion that the lion was ousted from its habitat in India by the tiger, but this is not confirmed by some naturalists. R. I. Pocock, for example, in his Fauna of British India, Mammalia, Vol. I, pp. 220-221 gives emphasis to the slaughter of lions in India by sportsmen and others, particularly by British army officers during the nineteenth century. This shooting out of lions, he maintains, was the real cause of their disappearance in India, while the more wary tiger managed to survive.

In support of this theory, Pocock points out that lions have also disappeared from parts of Europe, SW. Asia and Africa, where there were no tigers to interfere with them. I am indebted to the Jam Sahib of Nawanagar for the information that in many parts of NW. India, where the lion has disappeared, there were never any tigers to contribute to this.

Pocock goes even further by suggesting that the lion entered India from the NW. and was able to spread as far south as the Narbada River in spite of the previous occupation of many of these parts by the tiger, which (according to him) had probably entered India previously from the NE. to spread down to the tip of the peninsula.

Pocock also is of the opinion that even if a lion and tiger did exist in the same region, their difference of habit and habitat would not necessarily bring them into actual conflict with each other, and that 'an encounter would just as likely end in mutual avoidance as in a fight, and in the event of a fight the lion's chance of success, so far as anything is known to the contrary, would be as good as the tiger's. Hence there does not appear to be a particle of evidence that the tiger played even a subordinate part in the extermination of the lion in Inda.'

Now for the fate of some of the African lions when released into Gwalior forests. Col. Kesri Singh has explained how these three pairs of lions were confined in a 20 ft. stone wall enclosure 'for about 4 years' before being released. Col. Kesri Singh has very kindly informed me in a letter that the size of this enclosure was only 'about 100 ft. square'. This must surely have been a very severe handicap to the lions—to be thus confined for four years and then released straight into tiger country. Imagine a few tigers confined for four years in a similar enclosure in the Gir Forest and then released to fight the Gir lions on their 'home ground'!

Col. Kesri Singh refers to three duels arranged by him between tigers and lions, in which the tigers won on each occasion. In this connection it is interesting to note that the Jam Sahib of Nawanagar has informed me that he has himself witnessed a fight between a lion and a tiger on four occasions, on all of which the lion won.

My own humble opinion is that I do not think much importance should be attached to whether the lion or the tiger was victorious in any particular duel *unless the two animals were equally matched in every respect*. In other words both tiger and lion would have to be the same sex, same age, same weight (relatively), same condition, same duration of captivity, same length of time since last feeding and drinking, etc., etc. The combat would also have to be arranged under such conditions and circumstances that neither animal had any unfair advantage over the other. To organise such a combat would be extremely difficult—in fact almost impossible.

There is also another aspect to be considered. It has been the practice of many makers of nature films, especially of the Hollywood and more recent T.V. Schools, to present only the sensational. Their animal films include staged fights between captive animals unnaturally forced to fight each other, and ferocious charges by deliberately provoked animals, simply to pamper audiences which are ignorant of real jungle conditions and which have become accustomed to a series of excitements and thrills in nature films. This is most unfortunate, since not only are such films an unreal portrayal of wild life, but also when a serious field naturalist produces a genuine wild life film of what he has actually seen, it is likely to appear flat and uninteresting after those made by the 'animal fight' school.

Having seen African lions in East Africa and Indian lions in the Gir Forest, I have immense respect for these creatures. And having seen tigers in various parts of India, I have the highest admiration for these. Both animals in their own different ways and in their own different habitats are equally worthy of our admiration. I would rather think of them as mutually respecting and avoiding each other if they happened to meet in the wild state.

DOYANG T.E.,
OATING P.O.,
ASSAM,
August 20, 1956.

E. P. GEE

3. TRANSFERRING OF THE INDIAN LION TO AN ADDITIONAL LOCALITY

There has been much thought given recently to the moving of lions from the Gir Forest to other parts of their former range. The idea no doubt is to insure the future of this noble animal from possible extinction by man or through epidemic diseases or other natural catastrophies, and as such is to be welcomed. Is there however, any need to do this at all?

In the Gir Forest the lions live out in the surrounding cultivation and less in the forest itself, except in the eastern part of the reserve. Lions are animals of the open country and do not like forests. That they are found in the Gir is no doubt owing to the broken nature of the terrain which allowed the last of the animals shelter from the shikaris who wiped them out over the rest of the country, and possibly also due to the great numbers of cattle grazed in the forest, providing them with a plentitude of food. In former times the lions ranging across the north-west of India must have fed on nilgai and buck which were found in plenty in the areas frequented by the lions. Now where is there a place where these antelopes can be found in the concentrated numbers sufficient to support a pride of lions? As in the case of tiger, cattle are a substitute in place of the lion's natural food, while other forest game such as cheetal can never form the sole diet of the lion. Bearing this in mind, would it be fair to impose economic loss on people living around the proposed new lion sanctuary, and has the danger to these people who are not familiar with the lion and his ways been considered? Finally, what will prevent the lions from wandering away as they apparently did when some were introduced by the Maharaja of Gwalior in his forests several decades ago? These are questions which cannot be lightly dismissed.

Another problem which needs to be looked into before trapping of the lions commences is that of housing them while the full family is being caught, and till they are moved to their new home. It is obvious that the present accommodation in the Junagadh Zoo is limited

and not desirable, since I have found there a tendency among the keepers and some visitors to annoy the animals. This infuriates the lions, which is only natural, as well as removes the respect they have for man in their natural state. What the consequences will be when these animals are released in their new home is too fearful to imagine —witness the killings by the lions which recently escaped from the Junagadh Zoo.

Granted that all the above objections are removed, on what grounds has the need for this sort of transplanting become necessary? Lions have existed in the Gir for centuries and even if in the past epidemics might have reduced the race, they have always managed to multiply again to their former numbers, so it has never been claimed that the present reduction of the once widely spread lion to its limited habitat has resulted from causes other than their destruction by man and by depopulating of the game that comprised their food. Since the killing of lions has been completely banned, the Gir lions have kept on increasing most vigorously, and there is every possibility that if the animals are given continued protection, they will slowly spread out into the country around their present range. This natural increase will create a need to keep their numbers down by judicious shooting. It is therefore apparent that there need be no anxiety about possible extinction of the lion in the Gir and consequently this scheme is quite uncalled for, unless of course it is intended to give another State the pride of being the possessor of Asiatic Lions. This privilege, however, is fraught with much danger and is not worth the effort.

RAJKUMAR COLLEGE,
RAJKOT, SAURASHTRA,
September 29, 1956. K. S. LAVKUMAR

[Mr. E. P. Gee, who is particularly interested in this problem, comments on the above as follows:

'While it is true that the Gir Forest and its surroundings may be an ideal habitat for Indian lions, this is not the sole reason for their survival there. Another reason is that they were protected by the former Nawab of Junagadh, whereas they never received any protection in any other part of India.

As to imposing an "economic loss on people living around the proposed new lion sanctuary", the importance of doing publicity about the lion and its habits in the event of a new home for the Indian lion being proposed, was accepted and emphasised at the last meeting of the Executive Committee of the Indian Board for Wild Life. Only if the State authorities and the people of the neighbourhood are in favour of having lions brought into their area should such a project be undertaken.

The case of (African) lions being introduced into Gwalior State some years ago cannot fairly be cited, as the conditions under which these lions were released into the forest were far from ideal.

In addition to chital, it is presumable that sambar, pig and other such animals will also constitute the food of lions re-introduced into

a new locality within their former range. It was never intended to re-introduce the lion into an area unless there was an adequate *natural* food supply to enable it to survive without *necessarily* having to prey on domestic cattle.

If lions are ill-treated by keepers in the Junagadh Zoo, this should be speedily reported to the appropriate State authorities, possibly with a copy to the Secretary, Indian Board for Wild Life.

It is a fact that the Indian lion is *at present* not only safe but actually on the increase in the Gir; but in addition to the danger of diseases, droughts, famines and other *natural* calamities, there is also the risk of *un-natural* calamities such as wars, civil commotion, total deforestation, uncontrollable killing etc. which have to be guarded against. Moreover, there appears to be a genuine desire on the part of certain other States in India to re-introduce a valuable, important and interesting animal into their forests.'—EDS.]

4. WILD ELEPHANTS IN THE UNION OF BURMA

CENSUS

A careful census made in 1935 put Burma's elephant population at about 10,000 head. Reckoning on 6,000 of these being females, and half of these being of breeding age, and at the rate of one calf in four years, the average annual birth-rate would be 750. From this substract 125 natural deaths each year, which leaves the average of annual increase of 10,000 animals at 625.

WILD ELEPHANT CONTROL SCHEME

A comprehensive scheme of wild elephant control in which game rangers worked in conjunction with kheddah operators was sanctioned in 1935. A number of permanent blocks were selected and the objective of the scheme was the extermination of elephants living outside these blocks. Very considerable damage to crops was done by wild elephants, which would in future be confined to areas as remote from cultivation as possible. It was estimated that a stock of between 4,000 to 5,000 wild elephants would be retained in the permanent blocks. The game rangers were employed chiefly on crop protection up to 15th January, after which most of them were engaged in extermination operations.

PLAN OF KHEDDAH OPERATIONS

All licences for capture of elephants were issued under the elephant control scheme. Under this plan certain areas were closed to operations as elephant sanctuaries, others were classified as areas in which the extermination of elephants was desirable in the interest of the country's development, and the greater part of the forests in which wild elephants occurred was divided into a number of kheddah blocks to be worked over in rotation by kheddah licensees.

Destruction of elephants resulting from the elephant control scheme and other agencies.

1935–36 to 1940–41		
Burma		
Killed	2,810	
Captured in kheddahs	1,262	
Total ...	4,072	... 4,072
Federated Shan States		
Killed	419	
Captured in kheddahs	24	
Total ...	443	... 443
	Grand Total ...	4,515

In justification of the large number of elephants deliberately killed, the Chief Conservator of Forests wrote:

'The elephant control measures adopted in 1936 have produced good results and should prove of lasting value. Further extensive operations should not be necessary. During the period 1935-36 to 1939-40, 2,131 elephants have been destroyed by game rangers, 277 elephants have been destroyed by other agencies, and 911 elephants have been captured in kheddahs. During the coming year, operations will be continued on a reduced scale. It is almost certain that a small staff of game rangers will have to be maintained permanently for crop protection work around permanent elephant blocks.'

The Annual Report on Forest Administration in Burma 1939-40.

'Elephant control scheme in the Mongmit Division (Federated Shan States) was abandoned shortly after the beginning of the year owing to the shortage of ammunition. The abandonment of the scheme has not seen any increase in destruction by wild elephants and it is probable that the villagers would be freed from serious trouble for a number of years to come after the destruction of 179 elephants during the three years in which the control scheme was under operation.'

Annual Report on Wild Life Preservation in the Federated Shan States for the year ending 31st March 1941.

In 'Wild Life Protection in Burma' published during World War II by the Public Relations Department, Government of Burma, Simla, H. C. Smith writes:

'Conducting Kheddah Operations: Some years ago it was estimated that there were about 5,000 wild elephants. As many as 500 have been captured in a year but in future about 200 will probably be the number that can be captured annually without detriment to the stock that it will be deemed advisable to maintain.'

Figures of elephants killed and captured in 1941-42 are not available. During the War period kheddah operations were

suspended. The number of wild elephants shot illicitly must be negligible. Adopting the 1935 formula the increase during the war period 1942-43 to 1944-45 would be about 1,250.

The number of wild elephants in 1945-46 would be about 5,000 + 1,250 = 6,250.

In 1947-48 kheddah operations were conducted in Maritime, Sittang, Hlaing and Northern Circles. From 1949-50 to 1950-51, kheddah operations were confined to Maritime and Northern Circles. In 1951-52 kheddah operations were confined only to the Northern Circle.

The number of elephants shot from 1945-46 to 1951-52 is 29.

The increase from 1945-46 to 1951-52 would be about 2,750.

Present Policy of Government

In order to build up the present inadequate elephant power for the timber extraction industry to its pre-war strength, the Government encourages kheddah operations whenever possible and issues kheddah licenses liberally to those who want to capture wild elephants. Such licenses are issued to cover an area of sufficient extent where elephant herds are seen to forage more or less regularly. The area is properly defined, and within such area a few kheddahs, up to 4 generally, are built in places most likely to be used by elephants in their runs during beats. The license fee is just a nominal sum, but on each captured elephant the Forest Department levies royalty at rates depending on the height of the elephant. The only condition upon which the Forest Department insists is that the area to which the license applies should be possible for Forest Officers to inspect. In other words licenses are given only for those areas where there is sufficient security.

At present such licenses are issued in Maritime Circle and Northern Circle, that is to say in the forests of Arakan, Tenasserim along the coast, and also in the Kachin State. The yearly average of elephants captured is 150.

The total number of elephants captured in Burma and the Kachin State from 1945-46 to 1951-52 is as follows:

Number captured	Number died, released or escaped	Balance
909	140	769

Number of elephants killed in Burma and the Kachin State from 1945-46 to 1951-52 is 29.

Kachin State.

Large herds including many tuskers cause considerable damage to taungya cultivation in the Suprabum and Putao sub-division. In 1952, a rogue elephant was shot to protect the timber elephants of

the State Timber Board. The number of elephants captured during the last three years 1952-53 to 1954-55 is as follows:

Number captured	Number died, released or escaped	Balance
129	28	101

Total number of elephants killed from 1952-53 to 1954-55 is 9.

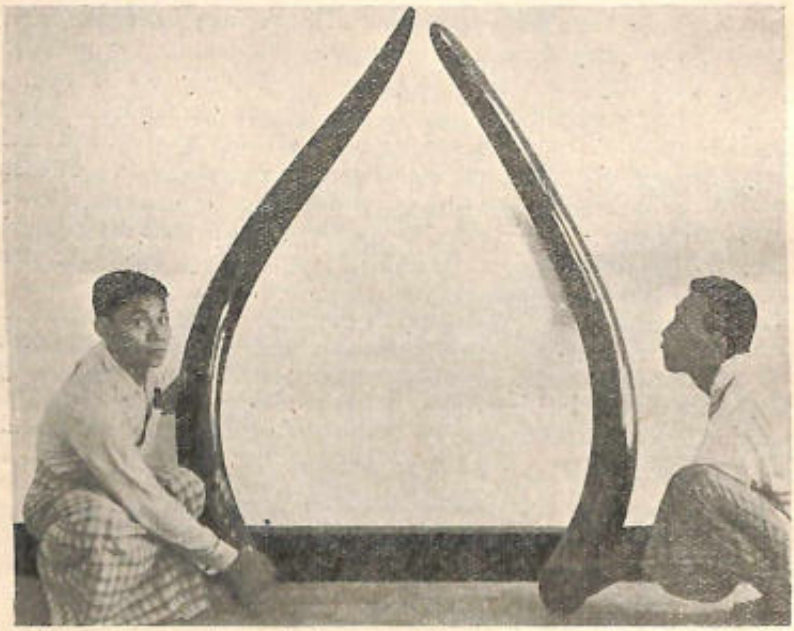
25 Inya Myaing Road,
University P.O.,
Rangoon,
August 23, 1956.

TUN YIN,
B.C.S. (Retd.)

5. A LARGE PAIR OF ELEPHANT'S TUSKS FROM BURMA

(With a photo)

In the Society's *Journal* 37: 468, J. K. Stanford has given a description of a large pair of elephant's tusks which he saw at Lonkhin, in the house of Kansi Duwa. He did not get the opportunity to weigh the tusks then.



This pair was brought down to Rangoon recently and were found to weigh 180 lb., when weighed at the air strip, Myitkyina.

The measurements and weight of these tusks therefore are:

Length	Girth	Weight	Remarks
R-6′-5½	17½″	180 lb.	Owner—Kansi Duwa.
L-6′-7½	17″		

For comparison, measurements and weights of some other large pairs of Burmese tusks are given below.

Extracts from Appendix I—Burma Game Manual 1929.

Length	Girth	Weight	Remarks
R–8′– 9″ L–8′–6″	... ...	... ...	Government House Rangoon (R. W.)
R–7′–3″ L–7′–3½″	17½″ 17″	102 lb. 97½ lb.	The tusks of the sacred white elephant from Mandalay Palace. Owner—The Marquis of Waterloo. (R.W.)
R7′–9½″ L–8′–6″	17½″ 17″	72 lb. 74 lb.	Shot by J. N. Clough. Kyaikto District 1896 (I.F.S.B.)
R–6′–8″ L–6′–5″	18½″ 18¼″	84 lb. 82 lb.	Owner—H. Shaw Dum. (R.W.)
R–6′–11″ L–6′–6″	15½ } 15½ }	106 lb.	Owner—Gordon Smith (R.W.)
R–6′7″ L–5′–9″	17″ } 17″ }	110 lb.	Shot by H. E. Flint. Mogok Forest Division
R6′–2½″ L–6′–1¼″	17¼ 17½	... ...	Shot by A. Hazlehood. Basein Forest Division.

Extract from *The Burmese Forester*. Vol. V, No. 2.—December 1955. (Page 134)

Length	Girth	Weight	Remarks
R–7′–11½″ L–7′–11″	16½″ } 16½″ }	138·6 lb.	A big tusker shot at Hnokeho, Bhamo Division in 1936 by U Su.

25, INYA MYAING ROAD,
UNIVERSITY P.O.,
RANGOON,
August 23, 1956.

TUN YIN,
B.C.S. (Retd.)

6. ALBINO ELEPHANTS

Early in the present century an albino elephant calf was captured by the Government kheddah department in the Katha Forest Division. The calf was presented to the Trustees of the Shwe Dagon Pagoda, but died shortly after arrival at Rangoon as a result of over-feeding by pilgrims.

Later in the century, one was captured in the Toungoo Forest Division. The owner Saw Durmay Po Min, took the albino elephant along with one black elephant for exhibition in Europe and America. On the return journey, the elephant died at

Calcutta. A photo of this albino elephant is published in 'Wonders of Animal Life' Volume 3, page 1,026.

In 1939, a game ranger employed on elephant control in the Ngaputaw Township in the Henzada-Bassein Division, was charged in heavy bamboo jungle by an elephant, which he had to shoot in self defence. The animal on examination, turned out to be an albino. In 1940, a game ranger operating in the Mayu Hills of Arakan Division was also compelled to shoot an albino elephant.

25, INYA MYAING ROAD,
UNIVERSITY P.O.,
RANGOON,
August 23, 1956.

TUN YIN,
B.C.S. (Retd.)

[To the above records may be added that of the white calf born to one of the elephants of the Bombay Burmah Trading Corporation Ltd. In a note published in the *Journal* at the time (Vol. 26, p. 286—Decr. 1918), Sir Henry Macnaughten gave this interesting information: 'A female calf born on 6th March 1918 aroused a good deal of excitement by its unusually light colour, and in view of the importance attached by the Burmese to the birth of a genuine SINPYUDAW it was thought advisable to submit the claims of the calf to a jury of prominent Burmans on the 7th April.

'The points of a SINPYUDAW appear to be as follows:

1. Twenty toes,
2. Pearl eyes,
3. Tail 'Tah Gah Paik,'
4. Red mouth,
5. Light coloured and smooth skin.

'The calf though possessing a rather light skin at birth and pearl eyes failed to fulfil these conditions, having only eighteen toes and a tail that was not up to the requirements. It was therefore at once pronounced to be not a genuine SINPYUDAW.

'The colour has since grown perceptibly darker and on reaching maturity is not likely to differ in any way from the ordinary.

'The fact that the "whiteness" of an elephant depends as much on the possession of certain points as on its colour may be of interest to your readers, as most people appear to believe in the existence of a milk white animal.'

In a letter to *The Field* of 16 Decr. 1926, (reprinted in the *Journal* 32: 214), D. F. Macfie records the birth of a similar calf to one of the Borneo Company's timber elephants in N. Siam. Local experts pronounced it to be a true 'Chang Peuak' or White Elephant, a verdict which was confirmed by a specially deputed official of the Royal White Elephant Department in Bangkok. 'The chief "points" looked for in such elephants' writes Mr. Macfie, 'appear to be (1) a light red skin, the lighter the better, with still lighter coloured patches on belly and inside of legs; (2) white hairs on body and tail; (3) a very light pink palate or roof of mouth; (4) eyes a light bluish-pinky colour; (5) white toe nails. The number of toes does not seem to matter materially, but five on each foot, fore and hind, is considered, I believe, a mark of high caste.'

[In Vol. 46 (p. 396) is published a note by Mr. E. S. Simon (with photograph) of a cow elephant captured in the Travancore forests which, on the basis of the above 'points' was a true 'White Elephant'. This, apparently, is the first record of such an albino in the Indian peninsula.—EDS.]

7. PREDATOR AND PREY AT SALT-LICKS

In forest where there are salt-licks, earth-licks or hot-springs, one finds tracks of wild animals coming from all directions to a single focal point. The same applies, to a certain extent, to an isolated water-hole. Wild elephants, gaur, sambar, chital and barking deer (speaking of NE. India) visit these licks regularly.

It would be interesting to know if predators such as tiger and leopard ever take advantage of the existence of these licks, to lie in wait for their prey. And do the big cats themselves ever visit the licks for medicinal purposes?

It is possible that deer and other animals, when visiting an open salt-lick along well-worn paths, exercise greater care than usual. I have observed barking deer approaching a lick with the utmost alertness and caution, and I feel that this may deter the predators from attempting to ambush them.

E. H. Peacock (*JBNHS* 37: 780) writes: 'Some natural law appears to protect the game at these licks from ambuscade by the carnivora; at least I like to think so. I have never seen or heard of a kill at, or very near, a salt-lick'. Theodore Hubback (*JBNHS* 41: 48 *et seq.*) mentions having twice seen a tiger at salt-licks in Malaya, but does not refer to their drinking there, or killing their prey, or refraining from killing.

F. W. Champion in his book 'The Jungle in Sunlight and Shadow' (page 108) explodes the myth that there is any kind of truce between the jungle animals at times of drought, when water-holes are few and far between.

At the main hot-spring in the forest in Garampani Wild Life Sanctuary in Assam tracks of tiger have often been seen, and once a friend of mine actually saw a fine tiger there in broad daylight. Last October when accompanying the Senior Conservator of Forests to this place we found the remains of a half-grown gaur at this hot-spring. As there were no traces of a poacher's *machan* nearby, we presumed that it had been killed by a tiger or large leopard.

It would be interesting if any members of the Society or their friends can give more information on this interesting aspect of salt-licks.

DOYANG T.E.,
OATING P.O.,
ASSAM,
June 6, 1956.

E. P. GEE

8. INCUBATION PERIOD AND 'MORTALITY RATE' (?) IN A BROOD OF THE MAGPIE-ROBIN [*COPSYCHUS SAULARIS* (LINN.)]

Looking through my notes, I find the following entries in respect of the Magpie-robin which, as throwing some light on the period of incubation and 'rate of mortality' (?) of the chicks, may be worthy of record.

A nest was discovered on 28 February 1953 in a hole *ca.* 9" deep at the tip of a 5-foot bamboo stake in the fence forming the boundary of the Zoological Gardens at Trivandrum. The fence was in bad repair and the stake, loose from its anchorage was leaning forward at such an angle that the nest was hardly more than 3 ft. from the ground.

28-2-1953. Four eggs, greenish and liberally blotched.
14-3-1953. One egg hatched in the afternoon.
15-3-1953. The remaining three hatched.
24-3-1953. Nestlings show a white patch on their bodies; very warm and humid.
29-3-1953. Nestlings looking well.
30-3-1953. At 10.30 a.m., three of the nestlings had disappeared and the 4th was crouched at the bottom of the nest; sometime later, it was found in an erect posture and quite dead. No trace of injury on the nestling; no sign of the others in the neighbourhood; the male parent was found later, calling from a nearby tree. The dead nestling was weighed (9.6 gms.) and transferred to spirit.

It can be seen from the above, that 15 days had elapsed between the discovery of the eggs and their hatching. Assuming that the nest was found the day the clutch was completed, perhaps a coincidence, or within a day or 2 of it which is more probable, the incubation period may be taken to be 15 to 18 days.

The fate of the nestlings remains a mystery. If they had been destroyed by predators, it is hard to see how the fourth could have escaped without so much as a trace of injury. Death from excessive heat or disease or starvation can also be ruled out as in such cases the victims should have been found dead or dying, within the nest itself. And besides, they were looking so well only the previous day!

There is a probability that the young birds had flown from the nest. This seems plausible in the light of the observations made by Dr. M. Nice in the course of her study of the Song Sparrow in America, that in Passerine species the majority attain flight proficiency at about 17 days of their hatching. In the present case, the chicks, already 15 days in the nest, may have gained sufficient strength to fly from the nest. This they might have done and in the 'stampede' that followed, their weakling brother (or sister) might have got choked to the point of death.

An examination of the preserved specimen showed that it had its wing feathers well developed, but the tail was nothing more than a flat knob with no feathers at all. The head and body were bare,

save for a small patch of short, black feathers just behind the bill and a few feathers in a line at the beginning of the spinal ridge. The earliest rudiments of feathers could, however, be made out as a triangular patch on the chin, a thin line along each lower jaw and as a large inverted 'V' commencing from the gullet.

The white patch on the body referred to earlier, which had the appearance of a fungal growth, has disappeared in spirit.

'GOKULAM',
NANTENCODE,
TRIVANDRUM.

N. G. PILLAI

[It appears more than probable that the three chicks left the nest in the natural course and that the fourth, being a weakling, was thereafter abandoned to its fate by the parents. This is not uncommon in passerine birds.—EDS.]

9. SOME NOTES ON THE PLUMAGES OF *CENTROPUS SINENSIS* (STEPHENS)

Stuart Baker (Fauna Vol. 4, p. 190) describes the young of *C. s. sinensis* (Stephens)—'Distribution: Northern India, roughly from Sind and Kashmir through the North-West Provinces, Punjab and United Provinces; the sub-Himalayas as far east as Eastern Assam and south to the Ganges Valley in Bihar and Bengal'—as having the plumage barred in young birds with a great deal of variation. He also records his personal observations regarding females, but not males, breeding in such juvenile plumage. He does not refer to the young of the other two races, i.e., *C. s. intermedius* (Hume)—'Assam, south of the Brahmaputra; Cachar and Sylhet, Tippera, Chittagong, Comilla, Burma, North Malay State, Siam and the Indo-Chinese countries, Yunnan and Hainan'—and *C. s. parroti* Stres.—'Ceylon and India, south of the range of *sinensis*'—implying that they are also barred as in the nominate race.

Whistler and Kinnear in their report on the Eastern Ghats Ornithological Survey, *JBNHS*, 37: 528, drew attention to the question of juvenile plumages in the Crow Pheasant (*Centropus sinensis*). They found some young similar to the adults, while others wore a barred plumage. They thought that this might be of sub-specific significance, but stated that they did not have sufficient material to settle the point.

The Society's collection contains 7 juvenile skins which are barred on the parts mentioned against them:

♂ (Assam). Secondaries and upper tail coverts.
♀ ? (Bihar). Wings and underparts; tail missing.
♀ ? (Bihar). Wings, underparts and entire tail.
♀ (Bihar). Secondaries and central tail feathers.
* ♀ (Nepal). Most secondaries, central tail feathers and tail coverts.
♂ (North Shan State). All wing quills and coverts; traces on all tail feathers and underparts.
* ♀ (Prome Dist., Burma). Most secondaries; upper wing coverts and central tail feathers.

* Bear traces of duskiness, see infra.

A specimen from Gwalior has slight traces of bars on the tips of a few of the brighter purplish feathers of the hind neck, but otherwise it agrees with *parroti*.

Mrs. Cicely Lushington in a letter to the Society in December 1945 wrote: 'The fledglings of this bird in Ceylon, contrary to what is said in text books (Waite: Birds of Ceylon, p. 218), are just like the parents, but a little duller. Mr. W. W. A. Phillips has handled a number of fledglings and says that "he has never found any barrings in the Ceylon form".'

The only unbarred juvenile available in Bombay is one from Khandala, Western Ghats, Bombay State, collected on 4 October 1935. This is a ♂ and shows very slight traces of duskiness in the upper wing coverts. The wing feathers are not yet fully grown.

As the above suggested that the young of *parroti* may differ from those of the other two races in not being barred, I wrote to the British Museum and Mrs. B. P. Hall of the Bird Room very kindly examined the material available there. She writes that in an extensive series of *parroti* from Southern India and Ceylon there are no juvenile or immature specimens with barred wings or tails while there are juveniles, or immature birds, with barred wings and tails from Karnal; Jhang, Bhimbar District, Multan, Jagadhri (Ambala Dist.) and Lucknow; also from Bengal and all countries of eastern Asia.

Duskiness in Upper Plumage

In the course of this examination I was struck by the marked duskiness of the wing coverts in some individuals which contrasted sharply with the chestnut of the rest of the wings. Of 11 males and 20 females of all races, this duskiness was found in 8 specimens, all females of *parroti*, from the following localities: Bombay (2), Orissa and Bastar (4), Ambala (1) and Delhi (1)—all collected between 10 November and 15 January. Females of *parroti* taken in March (1), May (2) and September (2) showed no trace of this duskiness nor did any males taken in January (1), March (2), June (1), August (1) and October (2).

Except for slight traces on two juvenile females from Nepal and Prome, there was no duskiness in any of the other races though we have females taken in November (Meerut), December (Bhagowni, Bihar and Assam), January (Thayetmyo, Burma), February (Jagadhri, Ambala District, Punjab) and March (Bahawalpur, and Prome, Burma).

We have referred to the females from Delhi and Ambala as *parroti* while one collected by Basil Edwards in Delhi was named *sinensis* by Whistler (*JBNHS*, 31: 569).

Mrs. Hall has also referred to 8 adults from Delhi in the British Museum as *sinensis*. From Jagadhri, Ambala District, Punjab, we have in Bombay a female which is definitely *sinensis* while another dusky individual referred to above from the same district appears to be *parroti*. It would therefore appear that the distribution of the two races *sinensis* and *parroti* around Delhi and northward into the Punjab along the Jumna Valley has to be worked out afresh—there is either a mixed population with overlapping characters or both forms occur (?).

Summary

From the evidence available, it appears:

(1) that the juveniles of *C. s. sinensis* and *C. s. intermedius* are barred, while those of *C. s. parroti* are not.

(2) that the females of *parroti* acquire a marked sootiness on their wing coverts between about November and January.

(3) that there is either a mixed population or two forms overlap in the Punjab and northwards along the Jumna Valley.

Messrs Faiz & Co.,
75, Abdul Rehman Street,
Bombay-3,
September 26, 1956.

HUMAYUN ABDULALI

10. THE OCCURRENCE OF THE PINKBREASTED PARAKEET (*PSITTACULA ALEXANDRI*) IN DEHRA DUN

On 14 November 1955, Mr. Gurdial Singh of the Doon School and myself, while sitting under a Toon tree in the school grounds, saw a party of these attractive parakeets fly into the tree, and we were able to watch them through field glasses on and off throughout the afternoon as they moved about in the branches overhead, feeding in clumps of loranthus parasitising on the toon branches. While feeding they were very quiet and their presence in the tree was only felt by the continual rain of leaves and other matter they dropped down while feeding or when attention was attracted by the whirr of wings as a bird flew from one branch to another. The flock consisted of over a dozen birds of both sexes, and when they flew from one tree to another they did so in a compact wheeling mass uttering loud and very distinct trumpeting calls quite unlike those of the Slatyheaded or the Alexandrine parakeet, both of which were around in fair numbers. The pink breast in the males is a very conspicuous feature as is also the rather short tail. Mr. George of the F.R.I. who is a knowledgable bird student of Dehra Dun informs me that this bird has never been mentioned before from the Dun.

Rajkumar College,
Rajkot,
Saurashtra.

K. S. LAVKUMAR

[The western limit of distribution given in the Fauna is 'Kumaon' without any specific locality.—Eds.]

11. EXPERIENCES WITH LITTLE RINGED-PLOVER

(With a plate)

The Little Ringed Plover (*Charadrius dubius*), is not a rare bird in Kashmir. Anyone looking for its nest may with perseverance and a little luck soon find it. It is not an excessively shy bird and seldom looks with great disfavour upon a photographer's hide, and yet my

own attempts to photograph it in the summer of 1944 led to a series of adventures which culminated in the most surprising thing that has so far happened to me as an ornithologist.

My first nest was found on an island of mud in the middle of a marsh. The marsh seemed bottomless and shivered with virgin horror at the touch of human feet. It was a perfect barrier protecting the island. Ditches intersected it in many places, and on the surface of the Lethe'd dullness of their waters the flowers of white water-lily floated like little waxen boats. To reach the island one either walks across the marsh in a series of hurried steps during which the weight of the body is never allowed to rest on one foot for longer than is absolutely necessary; or it is possible to use a rough kind of marsh-shoe consisting of a circle of withies attached by ropes to a central oblong of wood. Two lengths of grass rope tied to the central portion form a thong into which the foot is thrust, but the shoe is extremely uncomfortable to use.

On this first occasion, the island was soon reached. I crept into my hide which was already in place, trained my camera on to the nest and waited for the bird to return. The nest was a mere hollow scraped in the mud and contained three eggs; it was surrounded on three sides by tufts of straight-growing, sharp-pointed grass. Within a quarter-of-an-hour the bird was back and was photographed as it stood beside the nest. Unfortunately, the noisy shutter of my Graflex camera frightened the bird, and it flew off and made no further attempt to return. The plover, on subsequent occasions when frightened by the sound of the shutter would run a short distance from the nest, and then peck furiously at the ground, making the earth fly. Psychologists would explain this behaviour as a kind of 'karthasis', an outlet for pent-up emotions generated by the pull of two opposing emotional forces of equal strength: on the one hand a strong desire to incubate the eggs; and on the other an equally great desire to run away. (Similar behaviour under like circumstances I have also noticed in the case of another member of the family *Charadriidae*, the Common Sandpiper.) Fear, in the Ringed Plover, also finds emotional outlet in a raising of the leg which is shivered violently, an action resorted to by the bird when approaching the nest, literally 'in fear and trembling'.

The incubating bird, once frightened by the sound of the camera did not return a second time until driven back by its mate which until now had remained out of sight. The frightened bird had only flown a short distance away, and it was to be seen pecking at the ground for food, occasionally making a short run, and as it came to a stop performing a little hiccup of a bow. Now its mate came flying over calling, *Sweet-you, Sweet-you*, ordering the other in an urgent voice back to the eggs; together they returned to the nest and stood on opposite sides looking at it, and bowing to each other in their curious jerking fashion. After seeing its mate safely back in the nest, the second bird then flew away. For one reason or another the incubating bird left the nest on five occasions, but each time returned to it.



Red-wattled Lapwing *(Hoplopterus indicus)*



Little Ring Plover *(Charadrius dubius)*

Photographing the Little Ringed Plover seemed easy, too easy to be good, and sure enough ill-fortune stepped in and ruined most of my pictures! The films I was using, being of pre-war stock, had suffered a drop in speed of 400%, and as I had not made sufficient allowance for this all the negatives were badly underexposed.

Another opportunity to return to the marsh came a week later. The shikaris promised me two nests of Ringed Plover and one of Redwattled Lapwing. But Fate still had me in her bad books, and on arrival we found that a pair of Kites had anticipated us by half-an-hour and had eaten every egg. The agitated Lapwings came shouting loudly overhead: *Did-he-do-it? Did-he-do-it? Did, did, did-it.* 'Don't be stupid, of course, he did!', I muttered under my breath. Larks, flying high above this row nearer earth, sang unheeding 'at heaven's gate' and their

> '. . . . notes of music fell as sacramental water
> Sadly sprinkled on a raging world.'

The robber kites came over again, flying low on reconnaissance, and if I had had a gun I would gladly have shot them. We set out, not very hopefully, to look for more nests but of course we found none. Trouble, which had come a single spy at the end of my last trip, now returned a third time to the attack. In a moment of inattention I fell into soft, clutching mud. The shikari was a long distance away but when my own efforts to extricate myself only made me sink deeper, I called for his help; the man reached me when the sucking mud had reached to my hips, but a little hard tugging however soon got me out.

As I sat unhappily cleaning the mud off my legs Fate suddenly decided to withdraw from further offensive operations and, as though to make up for her previous sour behaviour, now treated me to a sight of the Ringed Plovers' nuptial display. The female was searching for food at the edge of a patch of tall grasses when the male came flying over beating his wings rapidly and calling excitedly, *Sweet-you, Sweet-you, Sweet-you.*[1] When he landed nearby, he fluffed out the side feathers of his breast and with bill extended ran towards his mate as if wishing to drive her away. She trotted off a little distance, and awaited her charging knight who, with bill extended like a lance, came after her at a crouching run. A foot or so away from her, he straightened out of his crouch and drawing himself up to his full height walked the intervening distance doing a rapid goose-step, first raising one leg, then the other, in front of him stiffly; a curious, comical, preposterously cock-of-the-walk performance. The rapidly goose-stepping legs looked, from the side, like two blades of a pair of scissors snipping away at speed. The female, as he came nearer, crouched down slightly, while he advanced waving his legs in the air. Once close he jumped on her back and there, for an appreciable time (perhaps 20 seconds), he stood literally 'treading' her, his feet working strenuously. As he did this her tail slowly came

[1] The Handbook of British Birds says of the European race that it 'has a butterfly-like display-flight with long, slow, sweeping wing-beats, often following a zig-zag course'.

up, and lowering his body he met her, and in a trice the deed was done. Immediately, he was off her back and going away at a run, breast feathers again fluffed out and tail twitching. A second later he flew away.

I finally succeeded in photographing the Ringed Plover less than a week later; it was a case of 'third time lucky'. On the rocks and shingle at the edge of the Sind River at Woyil Bridge I took a series of pictures of the bird at its nest, all of which turned out well. After I had photographed the Ringed Plover I moved over to my circular hide which had been set up beside the nest of a Redwattled Lapwing. The lazy shikari had omitted to lace up the top of the hide, and as I had already spent five hours taking pictures, I too felt lazy, and so did nothing about it. I had been waiting only 10 minutes when there was suddenly a noise of flapping and a large bird landed on the top rim of my hide; I looked up at the same time as the bird looked in and it would be difficult to say who was the more surprised, because as the bird scuttled away it dropped something heavy with a thud into my lap. The Osprey flew off to a distant tree and looked back ruefully at my tent while I, rubbing the blood off my thigh, picked up a headless two-pound fish from the ground! After such a gift from the sky I decided to suspend further operations—it is well not to ask too much of good Fortune—and with my headless fish tucked underneath my arm I went back to my houseboat in great glee.

CATHAY CINEMA,
SINGAPORE,
October 2, 1956.

LOKE WAN-THO

12. THE DIMORPHIC EGRETS

It has become a common practice among modern systematic ornithologists to unite under the generic name *Demiegretta* Blyth a number of species and subspecies of dimorphic herons, which, apart from their polymorphic appearance (i.e., their individually variable coloration: slate grey, white or pied) and their partiality for a marine habitat, are rather widely different.

They represent at least two different types of birds, and I have already expressed the opinion (*L'Oiseau et la Rev. franc. d'Orn.*, 1949, pp. 10 *et seq.*) that the generic name *Demiegretta* ought to be restricted only to the typical species *D. sacra* (Gm.), the well-known Reef-Heron. Morphologically this species differs from the others now included in the same genus chiefly in the relative proportions of the tarsus and the bill, and also in the nature of the ornamental feathers.

But, besides this unquestionably distinct type of heron, the identity and validity of the other forms of dimorphic egrets erroneously associated with it [in fact much more closely allied to the Little Egret, *Egretta garzetta* (L.)], are more uncertain and have already been discussed in many papers. It is clear that only a close study of their biological relations comparatively with the Little Egret can afford some definite knowledge on the question.

When only skins or stuffed specimens are compared, it seems extremely difficult to differentiate *Egretta garzetta* from white specimens of *E. gularis* (Bosc), *E. asha* (Sykes) (=*E. schistacea*), and still more so from those of *E. dimorpha* Hart. The colour and the proportions of the legs and toes are the same in all of them, the plumage is identical, with the same seasonal changes of ornamental feathers, etc. As already pointed out by myself (loc. cit.), and more recently by Bannerman for the African birds (Birds of trop. W. Afr., VIII, 1951, p. 22), the colour of the bill seems to remain the only appreciable differentiating character (besides some slight differences in size), being black in the always white *E. garzetta* and also in *E. dimorpha*, both in its slate and white phases, against horny brown or even yellowish in *E. gularis* and *E. asha*, in their dark as well as white phases. *E. garzetta* and the white phase of *E. dimorpha* look practically one and the same bird.

Owing to some uncertainty still prevailing in the respective status of *E. garzetta* and the dimorphic egrets which, so close to it morphologically, are said to live in the same countries: *E. gularis* in West Africa, *E. asha* in the Red and Arabian Seas (including the West Coast of India), *E. dimorpha* in Madagascar and East Africa, it would be particularly desirable to study more closely their ecological relationships in the countries where they occur together. The coloured phases of these egrets seem to be found essentially, at least as breeding birds, along the sea-coasts of tropical and subtropical areas, spreading however to the interior in Madagascar and (? perhaps only as seasonal migrants) in West Africa.

In my opinion, these dimorphic egrets represent most probably nothing but local populations of the widely spread *E. garzetta*, adapted to a marine habitat and it seems hardly necessary to recall that their dimorphic character has long been proved by dark and white birds having been observed paired in the same colonies, and even dark and white chicks having been found in the same nest.

Finally there is another difference of generic value between the Reef-Heron *Demiegretta sacra* on the one hand, and the Little White Egret *Egretta garzetta* and its dimorphic allies on the other. In the Reef-Heron the white phase occurs only in the tropical zone of its habitat, the grey phase being the commoner over the rest of its habitat from Japan to New Zealand. The reverse is the case with the Little Egret: its white phase is by far the most widely spread, the grey phase being essentially restricted to the tropical zone.

We do hope that in India, where both *E. garzetta* and *E. asha* commonly occur in suitable places, probably not side by side, it will be possible to study the problem of their relationship more closely. In India, it seems generally believed that *E. garzetta* has more gregarious habits and that *E. asha* is seen more often as a solitary bird. But we must not forget that in the Red Sea[1] area this latter bird is known to breed in more or less extensive colonies of mixed

[1] Also on the west coast of India.—EDS.

individuals, grey ones and white ones, and the same occurs in the very closely allied *E. gularis* along the coast of West Africa, colonies which are quite similar to those of the Little Egret.

MUSEUM NATIONAL D'HISTOIRE NATURELLE,
RUE DE BUFFON, 55,
PARIS, FRANCE,
October 12, 1956.

J. BERLIOZ

13. BIRD NOTES FROM KUTCH

Maharajkumar Himmatsinhji of Kutch very kindly let me have records from his diary of interesting bird occurrences in Kutch over the last several years, showing how a place like Kutch, situated as it is across a major migration route can always have surprises in store for the regular bird-watcher. With his permission I reproduce some of his interesting observations together with a couple of my own during my visit there in April 1956.

Indian Skimmer: *Rhynchops albicollis*

August 1947 on the Laija Creek west of Mandvi: two birds observed on two subsequent days by M. K. First record for Kutch.

Haircrested Drongo: *Chibia hottentotta*

Seen by M. K. S. Himmatsinhji in January 1948 in the Vijay Villas gardens at Mandvi. Call note very distinct, and through binoculars, the hair-like crest very clearly noted. Tail forks rounded and a high sheen on the mantle. First record for Kutch and possibly for this part of India.

Rednecked Phalarope: *Lobipes lobatus*

Seen by M. K. on Devisar tank north of Bhuj in May 1948, and subsequently also in May 1949. Actively swimming around; and when disturbed, flying a little way to resettle on the water and commence feeding. Chestnut-red on sides of neck and white cheeks very conspicuous. First record for Kutch.

Barn Owl: *Tyto alba*

A live specimen shown at the exhibition held in Bhuj in April 1956. It had been caught at Talvana near Mandvi. This owl not met with in Kutch by Sálim Ali, though it had been noted by Lester.

Blackheaded Bunting: *Emberiza melanocephala*

Noted by M. K. on 9 September and again on the 29th of the same month in 1950. It therefore is also an autumn passage migrant and, as Mr. Sálim Ali mentions, a possible winter visitor. Seen by me in fair numbers on Pachham on 7 April 1956.

Redwhiskered Bulbul: *Otocompsa emeria*

Saw one bird in the Vijay Villas gardens on 11 April 1956. Fifteen of these birds had been released by M. K. S. Himmatsinhji at Mandvi in 1950, and they seem to be quite happy in the shady groves there.

Crow Pheasant: *Centropus sinensis*

This unfortunate but very successful introduction seems to have expanded its range considerably since the Sálim Ali survey, for we noted a bird on the edge of the Banni many miles north of Bhuj.

White Stork: *Ciconia ciconia*

Recorded by Lester in August 1895. Seen by the M. K. on the Ravalpir tank near Mandvi in January 1955.

Grey Drongo: *Dicrurus longicaudatus*

A single bird was shot by M. K. S. Dharmakumarsinhji of Bhavnagar in the Vijay Villas gardens at Mandvi in January (?) 1955.

Pelican sp. ? *Pelecanus* sp.

Eight birds seen by us on the Dhand 11 April 1956.

Glossy Ibis [1]: *Plegadis falcinellus*

Seen by us on the Dhands, 11 April 1956. M. K. S. Himmatsinhji tells me that he has regularly seen these birds in small numbers in winter. Mr. Sálim Ali saw one during the Survey and H. H. the Maharao recorded them on 4 April 1945.

K. S. LAVKUMAR

RAJKUMAR COLLEGE,
RAJKOT, SAURASHTRA.

14. FIGHTING AMONG BIRDS

Last March a Water-Rail was picked up dead on the roadside near a marshy stretch of the River Wey. First thoughts were that it had probably been killed by a passing car. The only discoverable injury, however, proved to be a small hole in the back of the skull. Searching for other possible ways by which it might have met its end, my mind went back to a terrific fight I witnessed between two other members of the Rail family—two Moorhens in fact. A Moorhen is a Moorhen the world over, so although the fight occurred in Southern England it might just as easily have happened in India or anywhere else. Here then is what I wrote down at the time.

'About noon yesterday I looked out of the passage window in time to watch one of the fiercest territorial fights I have ever witnessed amongst birds. The contestants were two moorhens. The snow was nearly six inches deep on the bank of the stream with a till-then unbroken surface so that the forms of the dark contestants were thrown up to perfection against a spotless background. How long the fight had already been in progress I do not know, but from the lengthening pauses, during which they remained interlocked like a pair of in-fighting boxers, they already seemed pretty tired. Their methods of defence and offence were most interesting. Sitting back on the tail, supporting itself from tumbling backwards by half-opened wings, one bird would box and claw at the other, but I am not at all sure that this was intended to injure the other bird so much as to hold

[1] [Mr. Humayun Abdulali saw a flock of some 60 birds on the island in Hamirsar tank, Bhuj, on 21 and 22 April 1956. On the 23rd they were absent.—EDS.]

it off or alternatively to push it down. For it was obviously with the bill that the main damage was being done. One bird would stretch upwards and with a vicious downward jab attempt to reach the back or top of the other's skull. Once I thought the fight was going to end abruptly for one bird suddenly weakened; its head sagged to one side and it laid itself open to a series of vicious blows which rained on the back of its head, such cruel stabs that I quite expected its complete collapse and death. Then it rallied for a space and almost turned the tables on its opponent, both birds fluttering into the air until they once more became interlocked. Lying back on extended wings with feet intertwined and bills agape they lay for a few moments in the snow, gasping for breath and obviously tired to death but still unwilling to cease their strife. A third bird appeared from the stream and mildly interested approached to within a couple of feet but, probably being the lady in the case, took no part in the contest and, after watching for a minute or two, encircled the combatants and then withdrew whence it had come. The fight recommenced with, if anything, greater ferocity and a fearful pecking bout ensued until one bird—I think it was the one that had previously collapsed—suddenly broke away and turning its back literally staggered with a definite list to starboard to the bank. Its opponent did not follow up its advantage with the energy I expected but lurched after it with lowered head and both disappeared into the stream bed. I thought all was over, but not a bit of it for every now and then a fluttering wing-tip or a vicious down-stabbing bill appeared for a fleeting instant above the bank. My wife suggested I should stop the contest, but I felt that if I did so it would only result in further and fiercer fighting so soon as they had regained their breath. The fight had started over twenty minutes previously when I eventually went to investigate. As I reached the point where the two birds had disappeared I saw nothing; but from twenty yards down stream came a sharp danger note and the noise of floundering wings. The fight had drifted downstream and very probably until my advent was still in progress. So fierce had been the struggle that some ten square yards of the snow's surface was beaten down and criss-crossed with feetmarks and impressions of their bodies, and everywhere bright red stains speckled the churned-up snow; not merely a drop here and there but as if the blood had splashed from the vicious stabs or smeared from blood-stained talons. There were however no feathers nor bits of down strewn upon the snow so the scrabbling feet with their long claws were probably not responsible for much of the gore but, as I have already suggested, the boxing matches are seemingly to hold off and press down the opponent so that the advantage goes to him who can gain sufficient height to rain those dreadful pick-axe blows on the vulnerable top and rear parts of the skull. One or both of these birds must have sustained heavy injuries. How often, I wonder, are these fights for territorial supremacy fights to the death?

HAYBARN,
THURSLEY,
SURREY, ENGLAND,
September 5, 1956.

R. S. P. BATES,
Lt.-Col. I.A. (Retd.)

15. BIRD MIGRATION IN INDIA

Recoveries of Ringed Birds since last Report, *J.B.N.H.S.*, Vol. 51 (3) p. 749

No. of Ring	Date	Name of Bird	Place where Ringed	Remarks (adult or young)	Name of Ringer	Date of Recovery	Reported by	Place where Recovered
3394 ...	25-1-1929	Wigeon *Anas penelope* ♀	Manchar Lake, Sind, *ca.* 26° 40′ N. × 67° 60′ E.		R. B. MacLachlan	29-9-1930	Ring Bureau Dept. of Forest Reservation and Hunting, Moscow.	Omskaya oblast, near Tara, 56° 48′ N. 74° 24′ E.
4148 ...	26-12-1936	Wigeon *Anas penelope*	Keoladeo Ghana, Bharatpur State	Adult	Forest Circle Officer	6-4-1939	do.	The Tajik SSR South of Tashkent.
Moscow D-265213.	5-7-1953	Mallard *Anas platyrhynchos* ♂	Near Zolvinsk (Novosibirskaya oblast), 54° 43′ N. 18° 40′ E.	Adult	Ring Bureau, Dept. of Forest Reservation and Hunting, Moscow	December 1955	Shri G. M. Malik, Director, Dept. Fisheries Jammu and Kashmir State.	Mirgund on the Srinagar-Gulmarg road between 12th and 13th miles.
Moscow D-261592.	19-8-1953	Pintail *Anas acuta* ♂	Astrakhan Sanctuary in the area of the Volga River 46° 14′ N. 49° 2′ E.	Adult	do.	25-29-12-1955	Police Sub-Inspector, Viramgaon.	Nal Lake at Shahpur, Ahmedabad District.
B-11422	8-6-1952	*Platalea leucorodia*	Kyzye–Agachskii Preserve near the town Lenkorahj, Azerbaijanian SSR	Juvenile	do.	1-3-1956	Shri K. N. Jauhari, Secretary, Indian Board for Wild Life.	Village Bela Simri P. S. Khagaria. Shot by Shri Anant Prasad Singh, Mukhia of Bela Simri Gram Panchayat.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
July 7, 1956.

EDITORS.

16. THE CHANGING SCENE:

Paucity of Bird Life in Jabalpur (M.P.)

When I first knew Jabalpur in 1904 it was a jungly little station, less than a quarter of its present area; bamboo clumps were everywhere, and game abounded. It was cooler then than now, and frosts were to be expected in the cold season. We do not get them now. Most of the jungle has been cleared for cultivation and building purposes. Rainfall has become uncertain, and subsoil water, and in wells, is lower.

All this change has been coming about gradually during the last fifty years, but it is only during the last four or five that I have noticed the absence of well-known birds. I write only of the Jabalpur Corporation and Cantonment areas, and cannot say what the conditions are outside, as I now rarely go out. But duck, teal and geese, which used to pass overhead, are now not seen. Rosy Pastors were common when silk cotton trees were in bloom. The trees are still here, but not the visitors. Have not seen a single Redstart this cold weather, and only one Grey Wagtail. It was about pittas calling in my garden that I first got into touch with you. They are not here now, and the following have also become rarities: White-eye, Pipit, Treepie, Pied Wagtail, Tailor Bird, Honey-sucker, and various flycatchers, and I am inclined to think that common resident species are fewer in numbers; for example, it is rare to observe a Pied Myna.

Garha,
Jabalpur, P. V. BEATTY
February 26, 1956.

17. SOLAR ECLIPSE AND ANIMAL BEHAVIOUR

I was interested in the Note at p. 708 of Vol. 53, No. 4, of the *Journal*.

I went to Japan in 1936 to help Dr. Royds, the Government Astronomer at the Solar Physics Observatory, Kodaikanal, South India, in making observations at the time of a total eclipse of the sun.

Until the sun was totally obscured, the darkness was no greater than during daylight with heavy cloud, and such birds and domestic animals as came to my notice behaved in no way out of the common. But as soon as the moon's shadow, dramatically racing across the earth's surface at several hundred miles an hour, reached the place, (the time was about 1 p.m., local time), the darkness at once became such as we know in India during a clear moonlight night near the time of the full moon, and all animal noise and movement ceased forthwith. As, some fifty-five seconds later, the moon's shadow passed away with equally dramatic suddenness, the usual animal noises of early dawn were heard on all sides,—cocks crowing, etc.—and normal movement was resumed. It was very remarkable how, for a period of darkness lasting less than a minute, the animal reaction was the same as for a whole night.

I must therefore controvert the second sentence of your editorial note. It should, I submit, be modified to read that 'at the peak of *any eclipse less than total* the darkness is no greater than on some of the heaviest overcast monsoon days.' If at the place of observation the eclipse is total, the circumstances are wholly different. Your foot note, I may add, even in this modified form, would be relevant to the Note to which it was appended, since that solar eclipse was not total at the place of observation (or, indeed, at any other place).

SCOTT CHRISTIAN COLLEGE,
NAGERCOIL,
TRAVANCORE,
INDIA,
October 17, 1956.

G. H. MARSDEN,
M.A. (Cantab.)
Principal.

18. JUMPING SNAKES

'Mr. D. E. Reuben's note in your issue for April 1956 and his query regarding the ability of snakes to jump reminds me that last year I raised the same question in a letter to *Country Life*.

I was moved to write the letter by an article that appeared in that journal about poisonous snakes in which the author remarked on the agility (not amounting to jumping) of *Echis carinata*. I may say that the following incident, which I described in my letter, elicited several replies all of which seemed to indicate that such action by a snake was beyond the experience of the writers.

On an autumn evening in, I think, 1930, I was dressing for dinner in my quarters at the Delhi Gymkhana Club when my bearer, a most observant and reliable man, suddenly shouted to me from the verandah, "Sahib, jumping snake!" On going out to investigate he pointed to a small snake, tightly coiled in the manner of a viper, on a charpoy on the verandah. He said that when he arrived on the verandah the snake, which was lying on the mat outside the door, had suddenly projected itself, "in one", from the mat on to the charpoy, a horizontal distance of some 8 feet, with a rise of 18 inches.

There was an electric light over the charpoy and to ensure the despatch of the snake before it could escape into the surrounding darkness I shot it with a 12-bore gun, somewhat to the discomfiture of the newar of the charpoy.

On submitting the mangled remains next day to that well-known authority, the late J. C. Roberts, I was informed that they were those of an *Echis carinata*.

Admittedly I did not witness the incident myself, but I have no reason to doubt my bearer's testimony, nor does it seem impossible that the muscular power of a coiled snake should enable it to project itself through the air for a short distance, especially as it would have an excellent "take-off" from the rough door-mat.'

6, ARTILLERY MANSIONS,
WESTMINSTER,
LONDON, S.W.-1,
August 28, 1956.

H. A. N. MEDD

19. A PYTHON'S MEAL



The above photo was taken by U Maung Gale, Divisional Forest Officer, Shwebo, on 20th August 1955; shortly after the Python had swallowed a small thamin in Kyaikthin Wild Life Sanctuary.

25, Inyamyaing Road,
University P.O.,
Rangoon,
April 12 1956.

TUN YIN,
B.C.S., (Retd.)

20. DHAMAN OR RAT SNAKE (*PTYAS MUCOSUS*) DRINKING MILK

As it is often stated that no snakes drink milk, the following may be worth recording. This happened at Kheri in the U.P. during the monsoon in 1923:

The milk-drinking Dhaman used to come from the scrub jungle near the bungalow, where we would have waiting for it a saucer of milk near our chairs in front of the verandah. The scrub jungle was quite 20 yards away. Regularly in the evening we would place the

saucer of milk in the same place and regularly the Dhaman would emerge from the scrub and come along and drink the milk. While it approached us, my friend and I had to remain motionless and silent, not even attempting to turn our heads or move a hand. But our eyes were free to watch our guest who after emptying the saucer, returned as silently and gracefully as he came. It was a delightful entertainment.

We had trained the Dhaman to come closer and closer, first by placing the saucer on the edge of the scrub, then nearer and nearer to the bungalow, eventually close to where our chairs would be put in front of the verandah.

HAPPY VALLEY,
MANDERSTON P.O.,
NATAL, S. AFRICA,
August 20, 1956.

J. E. C. TURNER,
I.F.S., (Retd.)

21. STRANGE ACCIDENT TO A FROG (*RANA BREVICEPS* SCHNEID.)

On 15th July 1956 in the cistern outside Cave 3 at the Kanheri Caves, Salsette, Bombay, I saw a foam-nest of *Rhacophorus maculatus* stuck in the angle of two vertical rock walls, a few inches above water. A large frog was seen with his head inserted into the bottom of the nest. On attempting to pick him off, the top of his snout was found to be so firmly attached to the nest, that the whole mass had to be pulled off together. The frog was an adult male of *Rana breviceps*, in an extremely weak condition. He had apparently poked his nose into the nest in an attempt to climb the wall and would no doubt have died in this curious position. The stomach was empty and the guts contained remains of vegetable matter.

MESSRS. FAIZ & CO.,
75, ABDUL REHMAN STREET,
BOMBAY-3,
October 29, 1956.

HUMAYUN ABDULALI

22. THE SPAWNING OF CARPS

I have only now read Dr. Goldschmidt's letter together with Dr. Kulkarni's reply published on page 634 of the December 1954 issue of the *Journal*.

Although this correspondence specifically refers to *Labeo rohita* a similar question has been arousing my curiosity for some time. I refer to the spawning of *Barbus tor khudree* in the Periyar River above the Lake.

The SW. Monsoon rains at the end of May certainly induce these fish to move up the river from the lake, and spawning takes place between July and August. The river is also in flood at the beginning of the NE. Monsoon in October and early November. During November and early December I have taken large numbers of both

clean and gravid fish. This at any rate would indicate that the Periyar Mahseer spawns between June and December, seven months of the year, which is considerably more elastic than the period June-August mentioned by Dr. Kulkarni.

It may be that this can be explained by the rainfall of the Western Ghats, but when Dr. Goldschmidt deduces that fish with 'blood-red discoloration near the vent, and orange spots on the gill covers' had already spawned, I wonder whether this is necessarily so. For mahseer with this spawning livery taken by me in early December have been full of roe or milt. Whether these fish are unsuccessful spawners similar to salmon 'baggots' I must leave for Dr. Kulkarni to say.

Theoretically, it would seem unnatural for a fish to spawn when rivers are in spate, for this must inevitably give rise to a big waste of ova.

I think it likely in the circumstances perhaps peculiar to the upper reaches of the Periyar River that fish move up from the lake with the first monsoon floods and that there are a number of early spawners in June, July and August. A proportion of this early run of fish may not become sexually mature until September and October when they would spawn at the same time as the later, or second run of fish after the main flood months.

During November, gravid fish have been taken by me between one and twelve miles from the point where the river joins the lake, and during the same month I have caught a number of fish in spawning livery and full of roe entering the river from the lake. It is evident that a certain amount is still to be understood about the spawning habits of the masheer here if not of the Cyprinidae as a whole.

BONAMI ESTATE,
FAIRFIELD P.O.,
U.S.T.C.,
March 10, 1956.

J. D. LOVATT

[Dr. C. V. Kulkarni, Director of Fisheries, Bombay State, to whom the above was shown, comments as follows:

'Mr. J. D. Lovatt states in his note "The Periyar Mahaseer spawns between June and December, seven months of the year, which is considerably more elastic than the period June-August mentioned by Dr. Kulkarni". Mr. Goldschmidt's note and my comments on it referred to the spawning of the major carps, viz. Catla, Rohu and Mrigal only. Mahaseer is not conventionally included in this group of the major carps. As such, Mr. Lovatt's comparison of the spawning season of major carps with that of the Mahaseer is not quite relevant.

Dr. Hora,[1] Dr. Hamid Khan[2] and others have pointed out that the Mahaseer spawns more than once during the year. Dr. Hamid Khan found that the Mahaseer in the river systems of Northern India spawn first in January and February; secondly in May and June when

[1] Hora, S. L. (1945): *Proc. Nat. Inst. Sc. Ind.* Vol. XI.
[2] Hamid Khan (1939): *JBNHS.* Vol. 41.

the snow melts and rivers are swollen, and thirdly from July to September when the rivers are flooded with monsoon rains. Thus, there is a strong evidence that the period of spawning of the Mahaseer is an extensive one, which is unlike that of the major carps mentioned above. It is quite possible, therefore, that the Mahaseer in the Periyar Lake may be breeding in the period June to December.'—EDS.]

23. ON THE OCCURRENCE OF MUMMIFIED EELS IN THE INTERNAL ORGANS OF *POLYDACTYLUS INDICUS* (SHAW) AND *POMADASYS* SP.[1]

Accidental inclusions of foreign objects in the body cavity of fishes have been reported by various authors. These include mummified specimens of sand eels (*Ammodytes* sp.) and pipe-fish on the walls of the abdominal cavity of Cod and Haddock (Atwood, 1857), while a variety of other objects like vertebral column of fish, fish hooks, knife and even hermit crab have been found in the body cavity and visceral mass of cod, haddock and pollock (Atwood, 1859, 1869; Collins, 1884; Barret, 1885 and Williamson, 1911). Earlier literature has been reviewed by Gudger (1922). Deraniyagala (1932) found some mummified remains of *Ophichthys apicalis* (Benn.) in the body cavity of large percoid fishes. Smith (1953) observed that *Ophisurus serpens* (L.) has the habit of piercing into the body of other fishes.

During an investigation of the biology of some of the trawl fishes landed at Bombay, certain hard, flattened bodies, apparently resembling small eels were found embedded in the mesenteries and other internal organs of *Polydactylus indicus* and *Pomadasys* sp. On closer examination of the material in the laboratory they were found to be mummified eels, probably belonging to the genus *Ophichthys*. Though the material was shrunk, stiff and to some extent distorted in shape, it was in a remarkable state of preservation which rendered identification possible. The following table (page 200) gives the details of observations.

All the fishes that harboured these eels were closely examined to find if there existed any wound or mark on the walls of the stomach through which they might have entered the body cavity. No such wounds were visible, nor was there any apparent sign of ill-health in any of them.

Coming to the question as to how these eels may have reached such situations normally inaccessible to them, Barret (1855) explains that they might have been swallowed by the host and that with the help of their pointed jaws they might have penetrated the walls of the stomach and worked their way into the body cavity. Though Williamson (1911) is satisfied with this explanation as far as pointed objects are concerned, he thinks that it is hardly the way a hermit crab might have reached the body cavity. The crab, he thinks might

[1] Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam.

TABLE

Date	HOST			MUMMIFIED EELS.		Location.	Remarks.
	Species.	Length cm.	No. of specimens.	Length cm.	Colour.		
19-12-'52	*Polydactylus indicus* (Shaw).	115·4	1	9.9	Brownish.	Abdominal mesenteries	Shrunk.
8-11-'52	,,	106·7	1	13·4	Black.	Fringe of right ovary.	Flattened and dried.
,,	,,	106·3	1	10·2	Grey.	In between the hepatic caeca.	Round and well preserved.
			2	11·6	Grey.	Abdominal mesenteries, tail piercing liver.	...
22-12-'52	,,	113·4	1	8·5	Brown.	Mesentery.	Crumpled.
			2	11·2	Brown.	Hepatic caeca.	...
			3	11·6	Blackish.	Mesentery.	...
			4	7·9	Dull Yellow.	Left ovary.	Very well preserved, Possibly recent inclusion.
			5	9·2	Brown.	Do.	...
			6	11·3	Deep Brown.	Mesentery to liver.	...
1- 2-'53	,,	108·6	1	12·1	Black.	Do.	Crumpled to an earthy crust.
			2	10·3	Grey.	Right ovary.	Round and well preserved.
2-11-'53	*Pomadasys* sp.	54·3	1	11·6	Greyish yellow.	Right ovary and visceral mass.	Well preserved. Portion in between ovary and visceral mass slightly decayed.

have passed through the walls of the stomach at a point where the tissue was weakened, possibly by the attack of some intestinal parasites. So far as the present observations are concerned the earlier explanation given by Barret (op. cit.) seems to hold good, firstly because of the very pointed snout of these eels and secondly because eels often formed an item of food of the adult *P. indicus* wherein this phenomenon was commonly observed (Mohamed, 1955).

My grateful thanks are due to Dr. N. K. Panikkar for his encouragement and guidance.

CENTRAL MARINE FISHERIES
RESEARCH SUB-STATION,
WEST HILL, KOZHIKODE-5,
September 5, 1956.

K. H. MOHAMED

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24. OCCURRENCE OF THE ECHIUROID WORM *IKEDELLA MISAKIENSIS* (IKEDA) IN INDIAN WATERS (GULF OF KUTCH)

(*With a text figure*)

During a survey of the low tide belt of Pirotan Island, 10 miles off Jamnagar, we came across an interesting Echiuroid (a bonellid), *Ikedella misakiensis*[1] (female) which we believe has not so far been reported from Indian Waters, but only found within the vicinity of Shimoda Marine Biological Station, Japan! The specimens collected were fairly large and seem to differ from that described from Japan in certain features, especially in the position of the nephridiopore.

The survey was made on 11 and 12 June 1956, and *Ikedella* was discovered on the 11th morning. An interesting feature about the animal's activity is its relationship with the temperature of the surrounding water. It extends its proboscis only when the water gets sufficiently warm. It was after nearly 2 hours of waiting on those coral rocks that the worms were seen to extend their proboscis into the water. It was observed that the body of the animal is always placed slightly oblique inside the rocks. The rocks had to be broken

[1] Synonym, *Parabonellia*.

before the animals were removed entire. Even during low tide these worms were completely submerged under water.

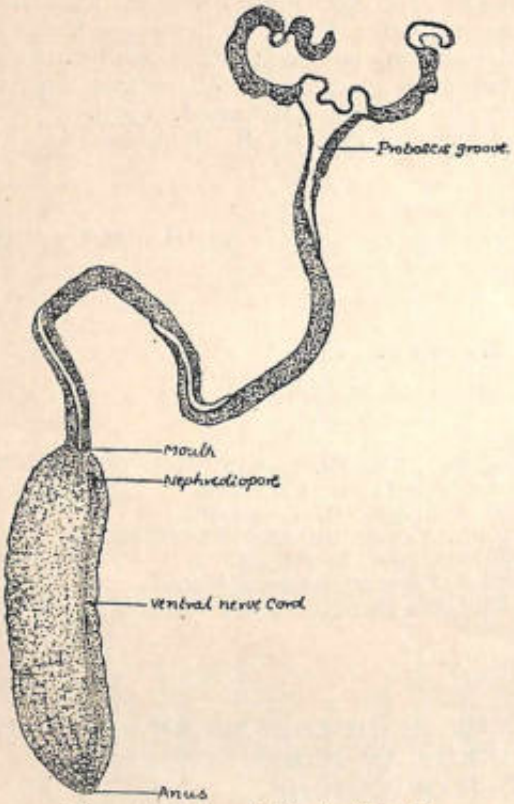


Fig. *Ikedella misakiensis* (Ikeda)
$\frac{3}{4}$ natural size

Description

The colour of the body is pale brown. It is semi-transparent, with a longitudinal white line traversing the body from the anterior to the posterior region, and indicates the position of the ventral nerve cord. The nephridiopore opens in the anterior region of the body on a papilla placed on the left of the mid-ventral line.

The length of the worm from the tip of the proboscis to the anus ranges from 5.6″ to 9.3″ (fig.). The body length ranges from 1.6″ to 3.5″ and is slightly bent ventrally. The body is almost cylindrical and sausage-shaped. The proboscis is ribbon-like, grooved on the ventral side and is dark violet in colour. The outer margin of the proboscis, throughout its whole length, extends on either side as a thin white border which becomes more prominent in the bifid region.

A detailed study of the ecology and anatomy of the worm is in progress and will be published later.

We would like to express our thanks to the Director, Fisheries Department, Saurashtra Government, for the help rendered by his staff during our stay in Pirotan island. Our thanks are also to Dr. Norman Tebble (Annelida Section) of the British Museum for kindly identifying the specimen.

DEPARTMENT OF ZOOLOGY,
BIRLA COLLEGE OF SCIENCE,
Pilani (Rajastan).

P. W. GIDEON, P. K. B. MENON,
S. R. V. RAO[1] & K. V. JOSE

REFERENCE

Sato, Hayao (1935): *Parabonellia misakiensis* (Ikeda) found in the vicinity of the Shimoda Marine Biological Station. *Annoto. Zool. Japan.* **15** (1): 142-144.

[1] Government of India Research Scholar (Senior).

25. THE UNUSUAL RESISTANCE TO STARVATION OF *SACCHARICOCCUS SACCHARI* (CKLL.)

The sugarcane mealy bug *Saccharicoccus Sacchari* Ckll. is becoming increasingly important in the sugarcane growing areas in the Nizamabad district of Andhra State. A comprehensive account of its status on sugarcane has been given by Puttarudriah (1954).

On 4-7-1956, three medium-sized gravid female mealy bugs were taken out from the leaf sheath of a sugarcane plant and put in a small specimen glass tube plugged with cotton wad. 28 numbers of pinkish coloured crawlers were observed on 11-7-1956. By oversight the tube was stowed away without any food supply either to the crawlers or to the female mealy bugs. On 6-8-1956, when the tube was accidentally taken out, the crawlers were found clustered together between the cotton wad and the inside of the tube. No sooner was the wad taken out, than all the crawlers were observed to move about briskly. The female mealy bugs were, however, dead. This shows the remarkable tenacity of the crawlers of the mealy bug: to live without food and in an unnatural environment for such a long time.

GOVT. AGRI: RESEARCH STATION,
RUDRUR P.O.,
NIZAMABAD DIST., ANDHRA.

D. V. MURTHY

REFERENCE

Puttarudriah, M. (1954): *Ind. J. Ent.*, **16** (1): 1-10.

26. SOME INTERESTING OBSERVATIONS ON THE ROYAL CHAMBER IN THE MOUND OF THE TERMITE *ODONTOTERMES REDEMANNI* (WASMANN)

Termite mounds and their peculiarities have been described by different authors[1–4] and it is believed that generally the royal chamber of the mound lies below the level of the ground surface. But some exceptions have been recorded about the royal chamber, in a mound of the termite *Odontotermes redemanni* (Wasmann) at Jhargram. The mound, about 15 in. in height, was peculiar in having the royal chamber located superficially, about 5 in. below the upper dome of the mound. Curiously, the chamber occupied the north-west sector of the mound and not north-east, a position that has been described as 'invariable' by Deoras[1]. The queen in the chamber was however, lying parallel to the magnetic meridian, i.e., in the North-South direction.

It may be pointed out that Mukerji and Mitra[2] recorded two abnormal positions of the royal chamber at the Maithan dam area only during rainy seasons. The present note records the observation

in the summer (April) 1955, and suggests that certain bio-ecological conditions, rather than purely environmental conditions, govern the position of the royal chamber in the termite mounds.

NATURAL HISTORY SECTION,
INDIAN MUSEUM,
CALCUTTA.

B. BANERJEE

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27. SOME COMMON TERMITES OF CALCUTTA

Termites are quite common in Calcutta throughout the year and particularly at the onset and during the rainy season, when they make their appearance in large numbers. Although all the castes of a particular species are not available at one time and at a particular place, a general idea about them can be had from collections made in the different parts of the city. In the present communication, a list of these termites, with short notes about the conditions under which they were found, is given. The collections were made in the months of June–July 1956.

As the classification of the termites is controversial and since Holmgren's (1917) general treatment on the Indian termites requires some important modifications, I have mainly followed Banks and Snyder's (1920) classification, as enumerated by Imms (1951). The genus *Termes*, however, has been omitted, since it shows remarkable morphological similarities with the genus *Odontotermes*, and the two genera have been considered together as the genus *Odontotermes*. All the species mentioned here belong to the Family Termitidae.

Family TERMITIDAE

Clypeus with median eye. Frontanelle present.

Genus ODONTOTERMES. Holmg.

Antennae 16–17 jointed.

1. **O. redemanni** Wasm.

Head of the soldier oval and narrowed anteriorly. The tip of the jaws bent in, and above the left jaw there is a slight projection. This is the most common mound-building termite of Bengal. Nests are quite common in certain suburbs of Calcutta. Two types of workers (Major and Minor) present in the collection.

2. **O. obesus** Ramb.

Head rectangular. Left jaw with tooth in the middle. Large number of specimens (both workers and soldiers) obtained from the compound adjacent to the Zoology Dept., University College of Science, Calcutta. They were found attacking a cut piece of coconut pulp. Two types of workers and one type of soldiers present in the collection.

3. **O. heimi** Wasm.

Major workers collected in large number from an old wooden frame work. Soldiers collected from another place. Workers and soldiers quite common at Jhargram.

4. **O. horni** Wasm.

Stout mandible with pretty big tooth. Workers and soldiers collected from a wooden shelf.

5. **O. obscuriceps** Wasm.

Left mandible bent basally. Soldiers obtained from an old house at Calcutta.

Genus COPTOTERMES Wasm.

Frontanellae towards the anterior end, large and open.

1. **C. heimi** Wasm.

Head narrow at the anterior end and rounder at the hinder end. Soldiers and workers collected from under a log of wood.

Genus MICROCEROTERMES Silv. (?)

Both mandibles equally bent concave on inner side. Serrated internal edge.

1. **Microcerotermes** sp.

Jaws a bit smaller than the size of the head of soldier. Specimens (mainly soldiers) collected from the old stem of a tree.

Genus MICROTERMES Wasm.

16 jointed antennae. Soldiers smaller than the workers.

1. **M. heimi** Wasm.

Small mandibular tooth. Workers and soldiers collected, while attacking a wooden shelf containing books. They were preparing tunnels within the shelf.

2. **M. obesi** Holmg. (?)

Specimens, mainly workers, collected while coming out of a hole, in the compound attached to the Zoology Dept., University College of Science.

Genus LEUCOTERMES Silv.

Rectangular head. Pronotum strongly grooved anteriorly.

1. **Leucotermes** sp.

Antennae 14–15 jointed. Workers collected from debris in Garia, a few miles away from Calcutta.

Genus EUTERMES Mull.

Mandible very small. Head with frontal tube.

1. **E. horni** Wasm.

Vertesae and Frons in one line. Specimens obtained from old wooden debris.

It should be noted that of all the termites mentioned above, the genus *Odontotermes* is the commonest in Calcutta, not only in the particular period referred to above, but throughout the year. The insects are very common in the older houses of Calcutta, and their number increases during the rainy season.

My thanks are due to Prof. D. Mukerji, Reader in Zoology, University of Calcutta, for giving me permission to work in the Entomological Laboratories, Zoology Dept., University College of Science, Calcutta.

NATURAL HISTORY SECTION,
INDIAN MUSEUM,
CALCUTTA,
August 3, 1956.

BARUNDEB BANERJEE

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28. NOTES ON THE COMMON BLACK GARDEN BEETLE *BASILIANUS NEELGHERRIENSIS*

In January last, I again found one of these beetles on our garden path (Lovedale, Nilgiris). They are quite common about here, but I have never been able to find out what they would eat, as they are generally found 'taking a walk' on the garden paths. But as I had been told that it *might* belong to the Carabidae family which is carnivorous, I thought I would try if this one would eat rather raw cooked meat cut into quite small pieces. When it had settled down in its new quarters, I found that it began eating the meat quite a lot.

In strange surroundings, i.e., in captivity, they are very quick to sense, or hear, any 'foreign' approach, and will 'freeze' at once. So that it is not easy to observe them eating, but I found that by approaching *very* quietly, and staying *very* still, I could observe it when it was quite definitely eating the meat.

This beetle I sent to the Bombay Natural History Museum for indentification, and was told that it was not of the Carabidae family, but was *Basilianus neelgherriensis* of the family of Passalidae. It appeared to be something new to find that they would eat meat, so when I again found one of these beetles in the garden about three weeks ago (August) I thought I would experiment once more. This one took longer to settle down; either he was already well fed when I found him, or he had had some definite journey in his mind! It was at least

two days before he would touch any meat, I tried him first with raw meat, but nothing would tempt him. Two days later, however, he quite definitely ate the half-cooked meat which this time I had put in his box all in one piece, about one inch long and a quarter inch broad. Though this time I did not observe the beetle actually eating, the meat's surface clearly showed marks all over it of having been well bitten.

Having once more proved to myself that these beetles will eat meat, at least in captivity, I released *Basilianus neelgherriensis* back into the garden.

I should be very grateful for any remarks these notes of mine may produce from others, and would like to know what is this beetle's natural food. I now know they are wood-boring, so suppose they do a certain amount of harm; but perhaps there is some good they also do.

c/o Miss Heath,
Lovedale P.O., (MISS) M. E. WOLFE MURRAY
Nilgiris,
September 3, 1956.

29. *TARACHE NITIDULA* F., A SEMILOOPER PEST ON COTTON IN SOUTH INDIA

(With a plate)

Introduction

Cotton is one of the important cash crops grown extensively in South India. Like any other crop it is also subject to the attack of a number of pests. Among them three semiloopers figure prominently, namely, *Cosmophila indica* G., *Acontia graellsi* F., and *Tarache nitidula* F. Of the three loopers, in some years *Tarache nitidula* F. assumes the status of a major pest defoliating the leaves. It has a wide distribution throughout the plains of Southern India. Fletcher (1914) has recorded the occurrence of this pest on *Calotropis gigantea* besides cotton. Hussain (1925) has reported it on Punjab Cotton with another species of *Tarache* namely, *notabilis*, during the months of May and August. Taylor and Chopra (1921) have classified it as a major pest of cotton in the Transvaal and the Punjab, effectively controlled by light traps. Lesne (1931) also is of opinion that it is a major pest of cotton. Ramakrishna Iyer (1940) reckons this insect as a sporadic local pest appearing now and then on cotton doing extensive damage.

A severe infestation was noted in the Central Farm, Agricultural College, Coimbatore during 1955 which gave an opportunity to pursue the life-history of the pest as very little is known on its bionomic and control aspects. The following is a short account of the observations made on this pest at Coimbatore.

The Moth: (Fig. 4).

Hampson (1910) has given the following description:

'Head and thorax silvery white; palpi above, antennae, forelegs and the tarsi brownish; abdomen white. Fore-wings silvery white; an oblique quadrate olive-brown patch from costa near base to median nervure and a triangular patch on middle of costa; the terminal area broadly olive-brown shading to purple-grey with the indistinct dark curved post-medial line near its inner edge commencing in the white sub-terminal line with very short streaks on the veins from it to a fine white line just before termen enclosing a series of spots the spot above tornus being blackish; cilia white tinged with brown at tips. Hind-wing white, the veins of terminal area tinged with brown the termen suffused with brown, narrowing to tornus or confined to apical area; cilia white with a brown line through them towards apex.'

Life History:

The moths copulate after a day of emergence, and the female lays 30 to 40 eggs singly on the surface of the leaves. The eggs hatch out in the course of three days. The caterpillars are very active and move on the plant in a looping manner. They feed on the tender leaves biting the edges of the leaflets. There are four moults during the larval stage. The caterpillar feeds voraciously and becomes full grown in 20 to 22 days. The full-grown caterpillar undergoes a drastic contraction in size just before pupation. It pupates in the soil without any elaborate cocoon formation. The pupal period varies from 12 to 15 days. Thus, the whole life-cycle from egg to adult takes 33 to 37 days.

Egg:

The egg is circular in shape, greenish in colour and measures 0.577 mm. (Fig. 1*b*). The egg period varies from 3 to 4 days.

Larva: *1st Stage: (2a)*

Newly hatched larva about 2 mm. long, with prominent head, brownish black in colour; body slender and blackish; the interseg-mental area blackish white. Prolegs confined to 5th, 6th and 10th segments of the abdomen, the anterior ones being inconspicuous. The larva moves actively in a looping fashion.

2nd Stage:

Length about 6 mm. Body orange coloured with a number of white spots; second and third thoracic segments with a smoky black patch on the dorsal side and the last anal segment with two distinct white spots. Each segment provided with four black tubercles; the anal segment raised in the form of a hump and provided with 2 orange-coloured tubercles on the summit. Paired prolegs three in number, and orange coloured with black crochets; thoracic legs whitish yellow in colour.

3rd Stage:

Length about 1.6 cm. Body including head, thorax, abdomen and prolegs chocolate brown with number of black and white spots, some of the black spots on the thoracic and abdominal region being located on raised tubercles; hairs on tubercles black; two whitish patches seen prominently abutting the dorso-median line on the third

LIFE HISTORY STAGES OF TARACHE NITIDULA F. ON COTTON



EXPLANATION TO THE PLATE.

1 & EGG MAGNIFIED
2 a YOUNG CATERPILLAR
2 & FULL GROWN CATERPILLAR
3 PUPA
4 ADULT

thoracic, 1st abdominal and anal segments. Spiracles distinct as black oval patches.

4th Stage:

Larva pink coloured and about 2 cm. long. Body smooth and provided with brick red spots, a pair of them each on the head, on the thoracic segments as well as 1st, 2nd, 3rd and 8th abdominal segments.

5th (Final) Stage: (Fig. 2b)

Length about 2.4 cm., body very stout, smooth and ashy grey, greenish, yellow and green; head-shield mottled in appearance. Thoracic segments show progressive increase in size with prominent swellings on the first and second. Second, third and fourth abdominal segments smaller in size with a prominent hump situated dorsally on the eighth segment. The total larval period varies during July to August from 20 to 22 days.

Pupa:

Pupa naked dark brown, oval and measures 5 cm. in length. Pupal period during late July to August varies from 10 to 12 days (Fig.3).

Alternative Host Plants

This caterpillar has a number of alternative host plants namely, *Calotropis gigantea, Hibiscus esculentus* and *Abutilon indicum* besides being specific to cotton crop.

Remedial Measures

Since this larva, of late, appeared in a virulent pest form sporadically, a small scale insecticidal trial was conducted in the Central Farm area. Four treatments, namely, sprays of BHC 0.1%, DDT 0.1%, Aldrin 0.1% and Dieldrin 0.1% were tried on the infested plants. Four heavily infested plants were selected for each treatment and the population of caterpillars on 5 leaves per plant was counted before and after treatment. The following results were obtained (Table I).

Table 1

Treatments	*Tarache nitidula* F.		Treatment and population counts.		
	Number of leaves examined per plant	Population before treatment	Population after treatment in		Percentage of reduction in population.
			24 Hrs.	48 Hrs.	
1. BHC 0·1% ...	5	12	4	0	100%
2. DDT 1% ...	5	14	9	7	55%
3. Aldrin 0·1% ..	5	10	6	4	60%
4. Dieldrin 0·1% ...	5	16	8	6	63%
5. Control ...	5	12	10	10	Nil.

From the trials it is evident that BHC 0.1% can effect a complete mortality of the caterpillars within 48 hours after treatment. Next in order of efficacy are Aldrin and Dieldrin respectively. In the trials conducted, spraying was adopted in preference to dusting as the former alone was found practicable for dealing with the caterpillars which usually remain on the underside of the leaves.

ACKNOWLEDGEMENT

The author is deeply indebted to Sri K. P. Ananthanarayanan B.A. (Hons.), Government Entomologist, for his kindness in going through the paper and making valuable suggestions.

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30. PARTIAL EMERGENCE OF THE IMAGINES OF DRAGONFLIES (ODONATA) DUE TO THE ABSENCE OF A HOLDING PLACE

(With two figures)

While engaged in a study of the Biology of Dragonflies of Ramanathapuram District (South India) in an attempt to elucidate the conditions attending the emergence of the imago, I came across interesting cases of partial emergence of the imagines and subsequent drowning of the latter, due to the absence of a holding place in the laboratory experimental jars, where several dragonfly nymphs were kept for observation and study. Since there is no record of a similar observation, it was felt that this interesting case is worthy of recording. In view of the importance of the dragonflies in the biological control of mosquitos (adults and larvae), the present observation at this critical stage in the life-history comprising of a shifting over from aquatic to aerial mode of life will be of considerable interest.

Thirtyseven nymphs belonging to the genera *Pantala*, *Tholymis*, *Tramea*, *Orthetrum* and *Anax* were kept in a glass jar of $2' \times 1' \times 1\frac{1}{2}'$. The jar was half filled with clear pond water free from reeds, weeds and other usual resting structures for the nymphs, to note whether the nymphs could metamorphose into adults without a suitable object

for gripping and if the emergence could be postponed even after the completion of the metamorphosis. The smooth inner surface of the glass jar did not permit a firm hold for the legs of the nymphs. It was noticed that, whereas, in the control bowls which contained partially submerged reeds, normal metamorphosis took place and the adults emerged out of the nymphal cases leaving behind the exuviae above the level of water, in the present instance the emergence of the imago was partial. In case No. 1, (nymph of *Pantala*) it will be seen that only a part of the head and thorax of the imago

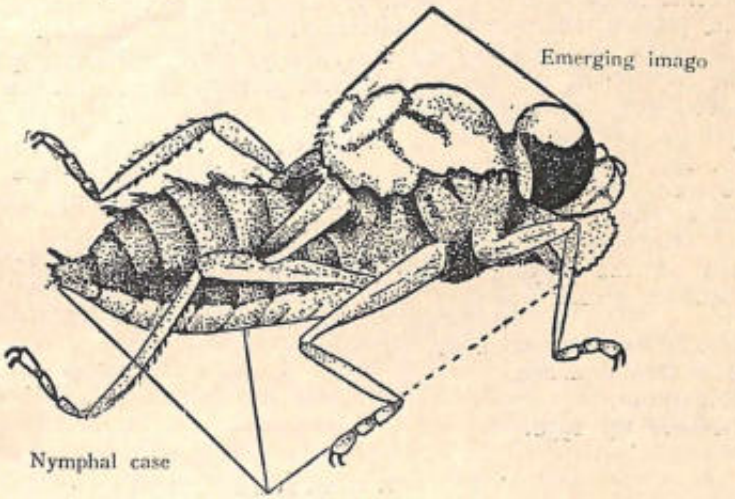


Fig. 1. showing the partial emergence of the imago of *Pantala*.

emerged through the 'crack' in the nymphal case while the rest of the body could not be pulled out which remained within the case. In the second case (nymph of *Tramea*) the emergence was found to be still more advanced but incomplete. The entire head, thorax

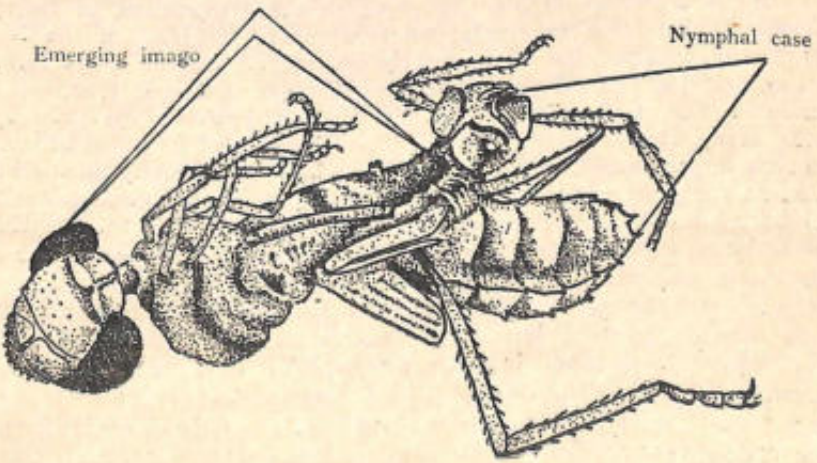


Fig. 2. showing the unsuccessful emergence of the imago of *Tramea*.

and the three pairs of legs emerged out of the nymphal case, but the wings and the abdomen could not be pulled out by the emerging insect, obviously due to the absence of a firm substratum, on which the nymph could firmly hold, to pull the wings and the abdomen. It will be of interest to note the statement of Corbet (1955), in the light of the present observation. He states, 'It is worthy of mention that, after metamorphosis has been completed, it is probable that emergence can be postponed for a considerable time. . . . . This ability to postpone emergence for a considerable period until conditions become favourable might well be of adaptive significance.' However, the present observations indicate that (1) the duration of nymph cannot be extended beyond a certain period. Instead of postponing the emergence, the imago while still partially encased in the nymphal cover, gets drowned, in the attempt to emerge, and that (2) it fails to emerge successfully in the absence of a suitable foot-hold. The present observation, therefore, suggests that one of the essential requisites for the successful emergence is the availability of a suitable substratum on which the nymph could hold fast.

Thanks are due to Dr. N. Balakrishnan Nair for suggestions and help in the preparation of this note, and Prof. Samuel Raj for facilities given.

DEPARTMENT OF ZOOLOGY,
ALAGAPPA COLLEGE,
KARAIKUDI,
October 14, 1956.

D. R. KRISHNAN

REFERENCE

Corbet, Philip (1955): *Proc. R. ent. Soc. of Lond.*, (A) **30**: 115-126.

31. HESPERIIDAE OF THE KHASI AND JAINTIA HILLS

Brigadier Evans in his Catalogue of the Hesperiidae of Europe, Asia and Australia frequently mentions the Khasi Hills or the Naga Hills and Manipur but often merely records Assam, so a list for the Khasi and Jaintia Hills is just worth making. The collectors working under Tytler in the Naga Hills and Manipur between 1911 and 1913 took many Hesperiids now in the British Museum (Natural History), but those procured by others from the Khasi Hills, nearly all from the Cherra area, were evidently only a small part of the general takings of butterflies, as one finds many species represented from the Khasi Hills by only one or two examples in the British Museum. One can therefore conjecture that a few more species do occur but have not been taken, though I have only one such in my collection. This was meagre when I left India; subsequent procurement from the Shillong dealer resulted in large numbers but most of them of a few common species. The obtaining of a few species not known to exist is not worth heavy and expensive slaughter. The list is made binomial for compression; trinomials indicating the Assam subspecies can be found in Evans's book. Abundance or rarity can be judged by the

numbers recorded for Assam generally, and of the Khasi Hills particularly, in Evans, but I have noted VC, C or NR for some species which I have got in numbers sufficient for such recording.

The male of any unknown species can be identified by dissecting it under a dissecting microscope and going through the pages of drawings of genitalia at the end of Evans's book. When genitalia are very similar in allied species, the key will generally show differences in the imago. In very few cases is the amateur left in doubt. Brigadier Evans does all his dissections by moistening the end of the abdomen with wood naptha. The body is held in the fingers or by a forceps with a clip and the skin removed by a needle and forceps. The left clasp is detached and stuck, inner side upwards, on a card by an adhesive, such as seccotine. The rest of the genitalia are detached all together and stuck on the card which is placed below the insect on the pin. Much practice is needed as at first one breaks off portions. If the novice has only one or two specimens of a species and fears failure he can cut off the tip of the abdomen and soak overnight in, or boil for two minutes in a test tube in, a ten per cent solution of potassium hydroxide, wash and dissect in methylated spirit in a watch glass. The left clasp is detached and put alongside the rest of the genitalia on a card when the spirit will at once soak away into the card and the genitalia can be moved into a spot of adhesive on the card. This latter method is not a good scientific one as curling may ensue on the card and small differences in clasps of nearly allied species may become unrecognisable by distortion, but it allows the amateur to identify species by an easy dissection. By both methods the laborious art of slide making is avoided. If at the time of capture the genitalia are extruded by pinching the abdomen, they can be seen subsequently at any time without dissection. Also dissection is not necessary if the genus is known or can be guessed by a collector with some experience. He will then know what to look for and can merely brush away the scales by a small brush with its hairs cut very short and expose a clasp. If a view of the inner side of the clasp or of the ventral aspect of the uncus is required the end of the abdomen can be moistened with wood naptha and a needle used to open the clasps. For such inspection removal of the abdomen from the thorax may not be necessary.

Females are often a difficulty and sometimes an impossibility unless the corresponding male has a distinctive locality and I have to thank Brigadier Evans for his never failing help in such cases.

Bibasis oedipodea, joina, harisa, vasutana NR, *amara, gomata sena.*

Hasora anura, chromus, taminatus, badra.

Badamia exclamationis.

Choaspes plateni, benjaminii, xanthopogon, hemixanthus.

Capila phanaeus, pennicillatum, pieridoides, jayadeva.

Lobocla liliana.

Celaenorrhinus pyrrha, ratna, plagifera, platula, leucocera (the commonest), *putra, munda, nigricans, badia, asmara, zea, dhanada aurivittata.*

Darpa hanria.

Coladenia dan festa, dan fatua NR, *fabia* NR, *indrani, agni.*

Sarangesa dasahara VC.
Satarupa gopala.
Seseria sambara.
Chamunda chamunda.
Daimio sinica C., *phisara* C.
Tagiades japetus NR, *gana*, *parra*, *litigiosa* C, *menaka* NR, *cohaerens.*
Mooreana trichoneura.
Ctenoptilum vasava.
Odontoptilum angulata.
Caprona agama.
Spialia galba.
Asticopterus jama C.
Arnetta atkinsoni.
Ochus subvittatus.
Barachus vittatus.
Aeromachus stigmata, jhora.
Sebastonyma dolopia.
Sovia grahami, one in B.M., *lucasii magna*, one in my coll.
Thoressa cerata, fusca debilis, only the type male and female.
Halpe zema, kumara, knyvetti, sikkima, porus, homolea NR, *arcuata, wantona.*
Pithauria stramineipennis NR, *murdava* NR.
Iambrix salsala VC.
Koruthaialos rubecula, butleri.
Stimula swinhoei.
Ancistroides nigrita.
Notocrypta paralysos NR, *curvifascia* C, *feisthelhami* NR.
Udaspes folus.
Scobura phiditia, isota.
Suastus gremius, minuta.
Copitha purreea.
Zographetus satwa.
Hyarotis microstictum.
Plastingia callineura, one in B.M., one in my coll., *naga*, one in B.M.
Lotongus sarala.
Gangara thyrsis.
Zela zeus, only the type.
Erionota torus, thrax, acroleucus.
Matapa aria, druna, savisarna, cresta, purpurascens.
Ochlodes subhyalina, siva, brahma.
Oriens gola C, *goloides* C.
Potanthus rectifasciata, one in B.M., *trachala, pallida*, one in B.M, *pseudomaesa, juno*, one in B.M., *sita*, one in B.M., *confucius, lydia, ganda*, one in B.M., *nesta*, one in B.M., *palnia.* On dissection the species found is usually *palnia.*
Telicota colon, linna, ohara. (*ancilla* may occur but dissections hitherto have shown only *linna*).
Cephrenes chrysozoa.
Parnara guttatus C, *ganga, naso.*
Borbo bevani C.
Pelopidas sinensis, agna, assamensis NR, *conjuncta.*

Polytremis lubricans C, *discreta* NR, *eltola* NR.
Baoris farri, penicillata.
Calloris sirius, one in B.M., *cahira*, *bromus*, *cormasa*, *kumar tulsi.*

June 14, 1956. SIR KEITH CANTLIE, I.C.S. (Ret

32. FURTHER NOTES AND ADDITIONS TO THE LIST OF BUTTERFLIES FROM BOMBAY AND SALSETTE

With reference to the list of butterflies from the above area published in Vol. 50, No. 2 of your journal, and the further list in Vol. 5 of December 1955, I have recently spent a further five months in Bomb from early February to the end of June 1956. During this time I w able to spend most week-ends collecting, and have to record the followi additions to the list :

1. **Pantoporia perius**. This is fairly common along the stream whi runs from Tulsi Lake through the Kanheri National Park, and also Powai Lake.

2. **Neptis jumbah.** A single male was taken near Tulsi Lake a another on the path between Tulsi and Vihar Lakes. This is a r insect on the Island.

3. **Amblypodia centaurus.** Two males and one female were taken the stream between Tulsi Lake and Kanheri, and another male on t stream between Tulsi Lake and Powai Lake.

4. **Pratapa deva.** Two males taken on the hilltop to the north-east Powai Lake, and several others were seen in the same place.

5. **Rapala schistacea.** Several males on a hilltop where the Ghodbund Road attains its highest point between Ghodbunder and Thana.

6. **Gangara thyrsis**. A male flew into my flat at 9 p.m. at Hill Pa Malabar Hill, and settled on a lamp, where it was taken by hand. Oth were seen in the late evenings in the garden.

During the hot weather the stream running from Tulsi Lake throu Kanheri National Park is practically dry, but there are several pa where butterflies are to be found, and at the lake end there is always trickle of water. This is one of the best areas on the Island.

This year was a good one for *Kallima Phillarctus Horsfieldii* a there was not a single day without seeing at least three or four. was even seen in the City immediately outside the Society's Office, a another in the garden of Hill Park, Malabar Hill.

Another butterfly much commoner than usual was *Graphium nom nomius* of which there were literally hundreds at wet patches on stream mentioned above at the end of May.

Other butterflies seen this year, of which I had previously only ta a single specimen, were :

Appias albina
Euploea crassa

Apatura camiba
Euthalia lubentina
Rapala melampus
Syntarucus plinius
Spindasis lohita
Sarangesa dasahara

P. O. Box 150,
RANGOON, BURMA,
August 25, 1956.

A. E. G. BEST

33. ON THE PHENOMENON OF DRUMMING IN EGG-LAYING FEMALE BUTTERFLIES

Dr. Ilse's note about the 'Behaviour of Butterflies before Oviposition' [*JBNHS*, 1956, 53 (3)] very lucidly reviews the present state of our knowledge of the 'drumming' behaviour—quick alternate tapping on the leaves with forelegs—by female butterflies immediately before the deposition of each egg. The reference made by her to my observation on the behaviour of the egg-laying female of the Lemon Butterfly, *Papilio demoleus*, encourages me to write the following few lines on this subject.

While working on the colour and form perception in some butterflies, I had occasion of observing their way of life very closely. To study the normal behaviour of these butterflies, natural surroundings were imitated as nearly as possible in a special part of a large cage. Here, I was able to observe 'drumming' in *Papilio demoleus*, *Papilio polytes*, *Polydorus aristolochia* and *Graphium agamemnon*. I actually used this behaviour in the female of *Papilio demoleus* as a basis for a series of experiments on colour vision (Vaidya, 1956).

There is still a lot of doubt about the exact purpose served by such tapping on the leaf by female butterflies before oviposition. The explanation offered by Bell (1909)—that it helps in driving away the spiders and micro-ichneumons from the leaf which would otherwise destroy the eggs and the larva—seems to me also too fragile to be acceptable. Dr. Ilse (l.c.) maintains that this behaviour allows the female butterfly to select the exact plant (larval host plant) for egg-laying by testing the chemical properties of the leaf, and then to select such a leaf as is not too turgid or too dry by testing its physical properties. This explanation, which comes of a long standing experience of nature study, seems to be very near the truth.

Some of my recent observations, however, stand in apparent contradiction to the above hypothesis. They are as follows:

(*a*) During my experiments on the responses to colours by the egg-laying females of the Lemon Butterfly, *Papilio demoleus*, I observed that an egg was laid on an artificial paper leaf (a saturated blue-green paper of the standardized Ostwald series). In view of the fact that this paper was not even remotely identical with a leaf of the citrus (the larval host plant) in physical properties like texture, turgidity, etc., nor in its chemical nature, it is difficult to explain this behaviour by Dr. Ilse's hypothesis. It seemed that the actual

response to coloured papers by the egg-laying females was directed by the odour of the citrus plant kept outside the cage but not very far away from the experimental arrangement.

(*b*) In the presence of a strong odour of crushed citrus leaves a number of females of *Papilio demoleus* in my cage actually laid *after drumming*, a large number of eggs on wet soil, on white mosquito-netting, on wire-netting, on an empty tin (which I sometimes used to store water), on my white dress and even on my fingers. This observation shows that even where drumming is performed, eggs may be laid, under certain conditions, on objects in no way comparable to a citrus leaf.

(*c*) Recently, I was watching in the Citrus Nursery attached to the Government Fruit Experimental Station at Kirkee, a female of *Papilio demoleus* laying eggs. On two occasions, I found that *after performing the usual drumming* this female laid eggs on two different weedy plants growing in the citrus beds. One of them belonged to the Compositae and the other to the Graminae. These are surely quite unlike in chemical composition to Rutaceae, to which all citrus plants belong. Moreover, it must be remembered that the plants belonging to Compositae and Graminae can never support the larval development of *Papilio demoleus*.

In the light of these observations, I feel, it is necessary to re-consider the whole problem of 'drumming behaviour' in egg-laying butterflies.

In *Papilio demoleus*, I have observed that the drumming is accompanied by the simultaneous fluttering of the wings. At the moment of the actual deposition of an egg, the drumming stops abruptly but the fluttering of wings continues. It seems that drumming and fluttering of wings are effects of some common cause.

As an egg rapidly makes its way through the oviduct to the female genital opening as a result of contraction of muscles in the wall of the oviduct, the female is probably under the influence of 'pangs of labour' of considerable intensity. May I suggest that drumming with forelegs and fluttering of wings are probably nothing but external manifestations of a momentary uneasiness arising from pain?

A detailed discussion on this subject will be included in a paper on the observations and experiments on the behaviour of the egg-laying female of *Papilio demoleus*.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF POONA,
POONA-7,
August 22, 1956.

VIDYADHAR G. VAIDYA

LITERATURE

Bell, T. R. (1909): Common Butterflies of the Plains of India, *JBNHS*, **19** (3).
Ilse, Dora (1956): Behaviour of Butterflies before Oviposition, *JBNHS*, **59** (3).
Vaidya, V. G. (1956): Observations and Experiments on the Behaviour of the egg-laying Female of *Papilio demoleus* L., (Unpublished).

34. THE POISONOUS QUALITIES OF *CALOTROPIS GIGANTEA* R. BR.

Recently I came across the following reference on the subject in the *J. Ceylon Br. Asiat. Soc.* 4: 157-159, 1865-1866: 'A few remarks on the poisonous properties of the *Calotropis Gigantea*, the Mudar of Bengal, the Yercum of the Tamils, and the Warra of the Sinhalese', by W. C. Ondaatje, Esq. Asst. Col.-Surgeon.

The author of the paper writes: 'From the effects which the milk of *Calotropis gigantea* has thus been ascertained to produce, it appears to me to belong to the class of Narcotic-Irritant poisons . . .' And further down: 'The milk of the Mudar may be placed on the list of the most deadly vegetable poisons in Ceylon and India . . .'

It is generally accepted that the sap of *Calotropis gigantea* and other species of the same genus is poisonous; but the following observations may show the contrary. Whilst engaged in the botanical survey of Saurashtra, on many occasions I did notice that shrubs of *C. procera* and *C. gigantea* seemed to be much damaged as if browsed upon by some animals—cattle and goats? But I did not see any of these animals eating the plants. Both species are common in Saurashtra, and during the dry season one often sees bushes of *Calotropis* with nothing but the bare stems.

In October last year I did in fact see goats actually eating *Calotropis gigantea* leaves. I had climbed to the top of the ghat road at Khandala, when I met a large flock of goats being driven towards Bombay. The goats were marching along and stopping occasionally for a bite on herbs or shrubs near the road. Several goats stopped near a shrub of *C. gigantea* and proceeded to eat its leaves with apparent relish and plenty of haste; when they had finished every leaf on the shrub, they continued their march along the road. Their lips, nostrils and in fact most of their heads were covered with the white milky sap of the plant. It was further noticed that although there was plenty of grass on the ground, goats did not pay any attention to, it, and went straight for *Calotropis*.

From this observation, two points seem to be clear: the first is that the plant is not such a violent poison as the quotation given above would suggest; the second is that goats, and possibly other ruminants, may develop a particular taste for some plant that in itself may be rather unpalatable.

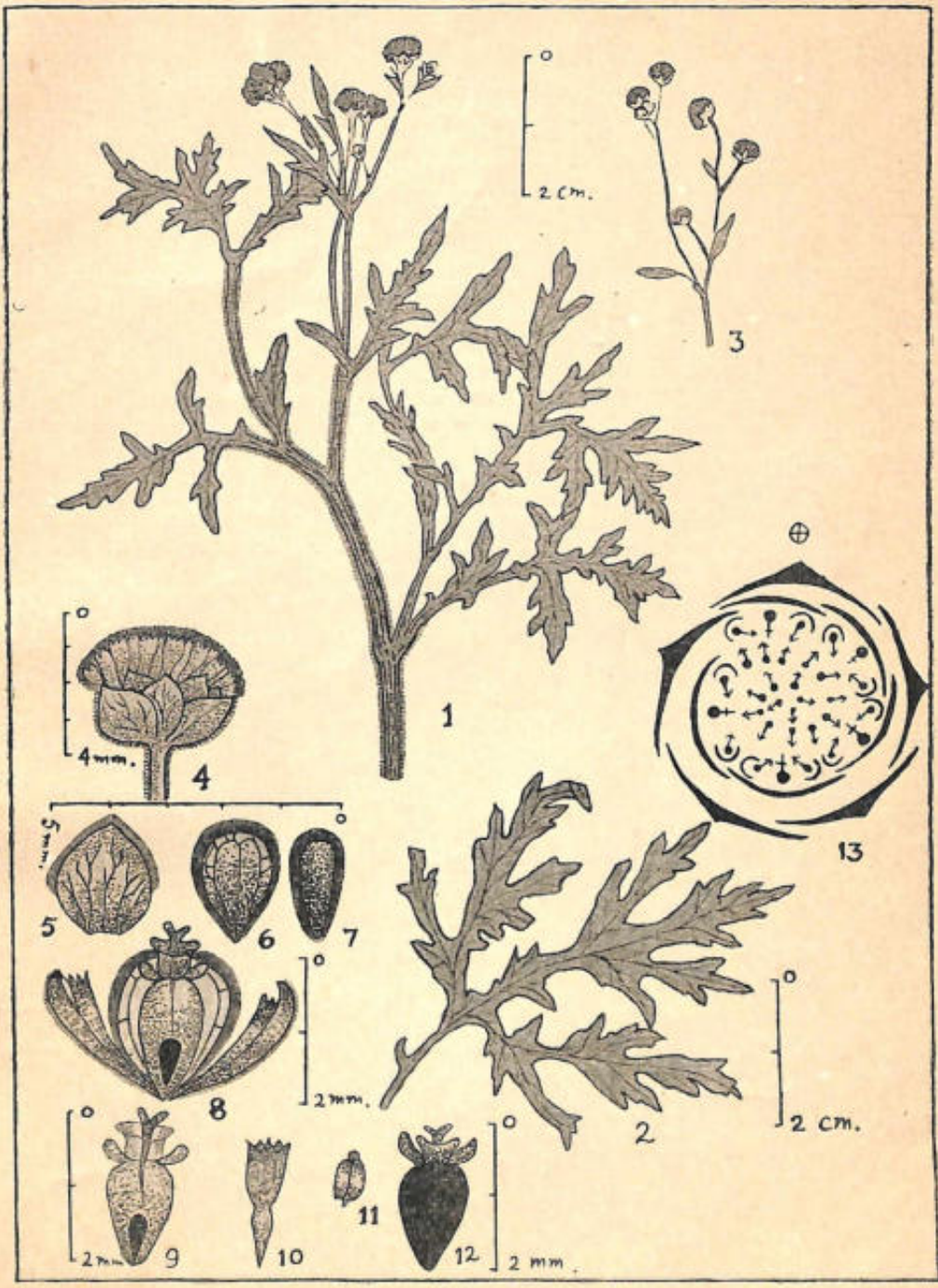
St. Xavier's College,
Bombay,
August 27, 1956.

H. SANTAPAU, S.J.

35. *PARTHENIUM HYSTEROPHORUS* LINN., A NEW RECORD FOR INDIA

(With a plate)

During my stay at Poona in January 1956, Shri H. Paranjape, Retired Horticulturist, Government of Bombay, gave me a specimen for identification, saying that he had found it growing as a stray



Parthenium hysterophorus Linn.

Fig. 1. Twig. 2. Leaf. 3. Apical part with inflorescence. 4. Inflorescence. 5. Outer bract. 6. Bract of female flower. 7. Bract of male flower. 8. Female flower with bract and with a pair of male flowers with bracts. 9. Female flower. 10. Male flower. 11. Stamen. 12. Fresh fruit. 13. Diagrammatic representation of floral arrangement in inflorescence.

plant in his compound. The same species was later found to be growing in abundance as a weed near the river bank and in a scattered state along the dry fields surrounding Poona Agricultural College. The plant has been identified as *Parthenium hysterophorus* Linn. There seems to be no record of this plant from India or even from Bombay State in particular. As it may be of interest for other botanists, a detailed description (prepared by the writer as no description could be procured from the literature available with him) together with the diagrams of various parts of the plant, is given along with this note.

Plant: herbaceous growing to a height of about 1-1.2 metres (3.5-4 ft.), the diameter of upper part upto 45-60 cm. (1.5-2 ft.), *Stem*: whitish hairy, angular, longitudinally grooved, profusely branched. *Leaves*: alternate, simple but pinnately and irregularly much dissected, dissected tips acute, margin entire, pubescent on both sides but more so on upper surface, hairs whitish, thin texture, venation more prominent on lower surface, length varying from 2-8 cm. breadth upto 5 cm. *Inflorescence*: terminal or axillary, peduncled, peduncle upto 1 cm., slightly hairy, head with an involucre of usually 5 outer bracts followed by 5 very thin bracts each subtending a female flower with two male flowers one on either side, each male flower in turn enclosed in a bract of its own and then finally followed by male flowers only, probably without bracts or bracts insignificant or represented by hairy structures, all bracts and floral arrangement spiral (vide fig. 13), head upto 4 mm. long, 4-5 mm. in diameter, outer bracts ovate, acute, upper two-thirds of margin lined by fine hairs, venation prominent, upto 2.5 mm. long, upto 1.5 mm. broad. *Female flowers* usually five, bracteate, bract obovate, thin, transparent, margin lined by irregular filmy layers, venation distinct, upto 2 mm. long or slightly more, upto 1 mm. broad or slightly more, flower jug-shaped with ovary as distinct lower part, corolla as cup-shaped upper part, lobes indistinct, enclosing style, stigma bifurcated, slightly exerted, stylar canal faintly visible through transparent ovary, two appendages one on either side at the junction of the upper and lower parts, ovule single, basal, dark, distinct, flower upto 2.5 mm. long. *Male flowers* developed in pairs along with five female flowers and after that developed singly; flowers developing with female flowers bracteate, bracts oblanceolate, thin, transparent, margin lined by irregular filmy layers, somewhat boat-shaped in young stage enclosing male flowers, upto 2 mm. long or slightly more, upto 0.5 mm. broad or slightly more, male flower in general more or less infundibuliform with a slight constriction demarcating lower abortive ovary and upper transparent corolla, lobes five, distinct, acute, stamens five, syngenecious, anthers with small knob-like prolonged connective, filament very short, flower upto 1.5 mm. long or slightly more. *Fruit*: in fresh stage ellipsoid, obovate, dark, brittle with remnants of cup-shaped corolla, appendages and style persistent, 2 mm. long, 1 mm. broad.

The plant is said to be a native of the West Indies, Central and Northern America. Collections from West Indies, United States of America and South Africa only are available in the Herbarium of the Indian Botanic Garden, Calcutta. There are however, no collections

from India in that Herbarium. This is possibly an exotic weed and has probably got acclimatised in the Western part of India. Further exploration in the various parts of India, particularly Western India, may reveal its occurrence in other localities. It would be interesting to gather details of its economic importance if any.

BOTANICAL SURVEY OF INDIA,
EASTERN CIRCLE,
NIRALA,
SHILLONG,
August 3, 1956.

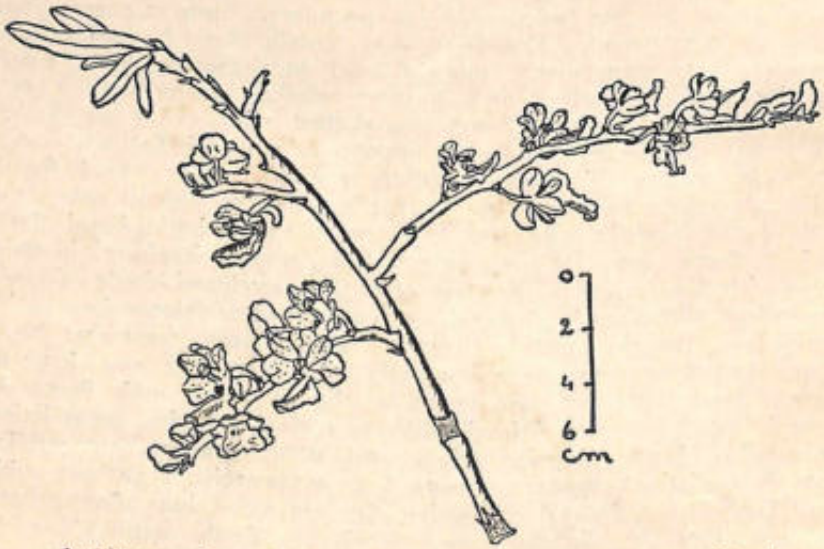
R. SESHAGIRI RAO
Regional Botanist

36. NOTES ON *AERIDES MACULOSUM* LINDL.

(With a text figure)

This is one of the most beautiful of our Bombay orchids; and until a few years ago, it was one of the most common of the wild orchids indigenous in the State; its beauty has been its undoing, for many visitors to our hill stations plundered the countryside and removed whatever specimen was easily available.

Recently we found a specimen in the cemetery of Purandhar Fort, Poona District, that was noteworthy for its very large size; total length 28 cm., leaves 8 pairs, each up to 32 × 5 cm. This plant has been under cultivation in Bombay, and has come into flower in April of this year.



Aerides maculosum Lindl. showing flowers and vegetative proliferation

Many orchids seem to have a rest period during which flowers are not produced; this apparent inability to flower has caused many collectors to throw away otherwise valuable specimens. We have kept our plant under observation since October 1954; for the period

October 1954 to June 1955, the plant was watered regularly every day, but it did not flower; after the monsoon rains of of 1955, the plant was left unwatered until this year's monsoon supervened. During the period when the plant was regularly watered, its vegetative growth was fast; during the dry season, when it was left unwatered, growth was slow, but this seems to have induced profuse flowering. At the end of April of this year we noticed the first signs of the coming flowers; by the middle of May 1956 it showed a large bunch of flowers (a central rachis with four lateral branches).

Towards the end of May of this year the flowering spike gave rise to a vegetative proliferation at its end; gradually 4-6 fleshy leaves, much smaller in size than those at the base of the plant, appeared beyond the flowers; these terminal leaves gradually fell off, but new leaves appeared in their place, so that 4-6 were always present on the plant.

Unfortunately we had only one specimen, and so could not carry out experiments with proper controls, on the effect of the profuse watering during the dry season. It is quite possible that the early flowering of the plant and its vegetative proliferation may be due to the abnormal watering it received. The plant in its wild state is known to flower only between the end of May and the middle of June.

The diagram herewith appended was drawn by one of us from the living specimen. At present the preserved plant is kept in Blatter Herbarium of our College.

H. SANTAPAU, S.J.
Z. KAPADIA, B.SC. (Hons.)

ST. XAVIER'S COLLEGE,
BOMBAY,
July 5, 1956.

37. SOME NEW PLANTS FOR THE DANGS FOREST, BOMBAY STATE

(*With two plates*)

Under the auspices of the Gujerat Research Society, the senior author has been conducting intensive botanical surveys in the Dangs Forest; some of his research students have joined in many of his outings. The results of the survey of the Dangs Forest have been published in the *Jour. of the Gujerat Res. Society;* the work is still continuing. The present paper gives details of two striking plants that have been found to be rather common all over the Dangs. The junior author has been working on the Papilionaceae of Bombay State and has accompanied the senior author on several excursions to the Dangs.

Indigofera oreophila spec. nov.

Accedit ad *Indigoferam tritam* Linn. charactere generali florum, foliorum et habitus; ab ea tamen differt praesertim sequentibus notis:

foliorum magnitudine et forma, inflorescentia aeque longa ac folia vel hisce duplo longiore, fructibus tenuioribus.

Suffrutex valde ramosus, 150-180 cm. altus; *culmi* teretes et sublignosi ad maturitatem, tenues et paulo angulati in juvenili conditione, adpresse albo-pilosi. *Folia* trifoliata, alterna, petiolata, stipulata; petiolus 20-27 mm. longus, productus 10-13 mm. ultra foliola lateralia, adpresse pubescens, supra late et tenuiter canaliculatus. *Foliola* 3, membranacea, 22-45 × 12-15 mm., elliptico-oblonga, rotundato-apiculata ad apicem, obtusa ad basim, integra, paulo adpresse pubescentia in superiore pagina, in inferiore vero plus pubescentia et pallide viridia; nervi laterales 4-5-jugi, alterni, indistincti; petioluli 1-2 mm. longi, aliquantum tumescentes, pubescentes; stipulae 3 mm. longae, subulatae, ciliatae, persistentes; stipellae minutae, lineares, persistentes. *Inflorescentia* axillaris, racemosa; inflorescentiae rachis 5-20 cm. longa, angulosa, pubescens, tenuissima, saepe ad apicem curvata, fructifera evadens aliquanto robustior. *Flores* 20-40, laxe dispositi, pedicellati, bracteati, pediculo 1 mm. longo, erecto sub alabastro, reflexo sub flore et fructu, bracteis singulis sub unoquoque pediculo, 2-2.5 mm. longis, subulatis, pubescentibus, caducis. *Calyx* 3-4 mm. longus, fere ad basim usque divisus, dense et adpresse pubescens, sub fructibus persistens; dentes 5, inter se aequales, lineari-lanceolati, ciliati. *Corolla* rubra, exserta; vexillum 5 × 4 mm., suborbiculare, sessile, fastigatum ad basim, tenuiter pubescens in parte dorsali; alae 5 × 1.5 mm.; carina 5 × 1 mm., calcarata ad basim, ungue 2 mm. longo ornata. *Stamina* 9 + 1; filamenta 5 mm. longa, sub apice libera per 1 mm., alterna quidem breviora; antherae uniformes, basifixae, apiculatae. *Ovarium* 3 mm. longum, lineare, tenuissime pubescens; stylus 1 mm. longus, angulum rectum cum ovario efformans; stigma capitatum, terminale. *Legumen* 25-30 × 1 mm., tetragonum, lineare, apiculatum, adpresse pilosum, reflexum, intus septatum. *Semina* 7-8, singula 2 × 1 mm., ovoidea, levia, ochracea colore.

Typus lectus in Dangs Forest, in loco Waghai, die 23 mensis octobris, anni 1955 a D. P. Panthaki, et repositus in Blatter Herbario, Bombay, sub numero 2,350; paratypi *Santapau* 19,985, 20,081 et 20,281 lecti eodem in loco et positi in Blatter Herbario et in herbario Hortus Regii Kewensis, in Anglia, paratypus alius, *Panthaki* 2,415, positus in Blatter Herbario.

Indigofera oreophila spec. nov.

This new species approaches in many respects *Indigofera trita* Linn.; the general character of the plants is the same, the shape and structure of flowers is rather closely similar. The main differences are the following: the leaves are much large, the leaflets broader, the inflorescence much longer, at times even twice as long as the leaves, the fruits somewhat more slender in the new species.

Undershrub, much branched, 150-180 cm. tall. *Stem* terete and subwoody when old, slender and slightly angled when young, appressedly white-pubescent. Leaves trifoliate, alternate, petiolate, stipulate; petiole 20-27 mm. long, produced 10-13 mm. beyond the attachment of the lateral leaflets, appressedly pubescent, with a broad shallow groove. *Leaflets* 3, membranous, 22-45 × 12-15 mm., elliptic

—oblong, apex rounded-apiculate, entire, base obtuse, upper side appressedly slightly pubescent, the lower one more so and pale green; lateral nerves 4-5 pairs, alternate, rather faint; petiolules 1-2 mm. long, slightly tumid, pubescent; stipules 3 mm. long, subulate, ciliate, persistent; stipels minute, linear, persistent. *Inflorescence* axillary, racemose; rachis 5-20 cm. long, angled, pubescent, very slender, often curved at the apex, becoming somewhat stouter in fruit. *Flowers* 20-40, laxly arranged, pedicellate, bracteate; pedicels 1 mm. long, straight in bud, reflexed in flower and fruit; bracts one at the base of each pedicel, 2-2.5 mm. long, subulate, pubescent, caducous. *Calyx* 3-4 mm. long, divided nearly to the base, strongly and appressedly hairy, persistent in fruit; teeth 5, equal, linear-lanceolate, ciliate. *Corolla* red, exserted; standard 5 × 4 mm., suborbicular, sessile, tapering at the base, downy on the dorsal side; wings 5 × 1.5 mm.; keel 5 × 1 mm., connate dorsally except for the claw, bearing a short spur before tapering into a 2 mm. long claw. *Stamens* 9+1; filaments 5 mm. long, free for less than 1 mm. from the apex, every alternate one slightly shorter; anthers uniform, basifixed, apiculate. *Ovary* 3 mm. long, linear, puberulous; style 1 mm. long, bent at right angles to the ovary; stigma capitate, terminal. *Fruits* 25-30 × 1 mm., tetragonous, linear, apiculate, appressedly hairy, reflexed, septate within. *Seeds* 7-8, each 2 × 1 mm., ovoid, smooth, yellow ochre.

The type of this new species has been collected at Waghai, in the Dangs Forest, on the 23rd October, 1955 by Miss D. P. Panthaki, and has been deposited in the Blatter Herbarium, Bombay, under the number *Panthaki* 2,350; the paratypes, *Santapau* 19,985, 20,081 and 20,281, collected from the same locality, have been placed in Blatter Herbarium and in the Herbarium of the Royal Botanic Gardens, Kew, in England; another paratype, *Panthaki* 2,415, has also been deposited in Blatter Herbarium.

This new species is quite a striking plant. It grows gregariously in dense clumps usually in the undergrowth of tall forest, the clumps at times being over 5 m. in diameter; the usual or average height of the clumps is well over one metre, and some individual plants reach nearly to 2 metres. Another noteworthy feature of the plant is the size of the inflorescence, which often is at least twice as long as the full-grown leaves. In general appearance the plant is decidedly a shrub or undershrub, as against *Indigofera trita* L., which is only a more or less robust herb.

Our new species has been found in flower in October-November, in fruit from November to January. Examination of the species of *Indigofera* from Bombay State, in Blatter Herbarium, has revealed that our new species is fairly widely distributed in Bombay State; we have seen specimens from various parts of the Dangs Forest, from Purandhar Hill, Poona Dt., and from Borivli; in every case the plant grows in the undergrowth of the forest, or where no forest is present, in the undergrowth of tall shrubs. We have named it *oreophila* to commemorate the fact that the new species seems to be restricted to the hills in Bombay State; we have seen no specimen from the low parts of the Konkan proper.

The main differences between our new species and *Indigofera trit* Linn. can be given in tabular form as follows:

	Ind. trita L.	*Ind. orrophila.*
Stems ...	60-120 cm. high	150-180 cm. high.
Leaves ...	8-22 × 5-13 mm.	22-45 × 12-15 mm.
Leaflets ...	Obovate-oblong or sub-orbicular.	Elliptic-oblong.
	Petiole 4-13 mm. prolongued 1-6 mm.	Petiole 20-27 mm. prolongued 10-13 mm
	Petiolule less than 1 mm. long.	Petiolule 1-2 mm.
Racemes ...	0·6-4 cm. long.	5-20 cm. long.
	Flowers close.	Flowers lax.
	6-12	20-40.
Fruit ...	Woody, 2 mm. thick.	Slender, 1 mm. thick.

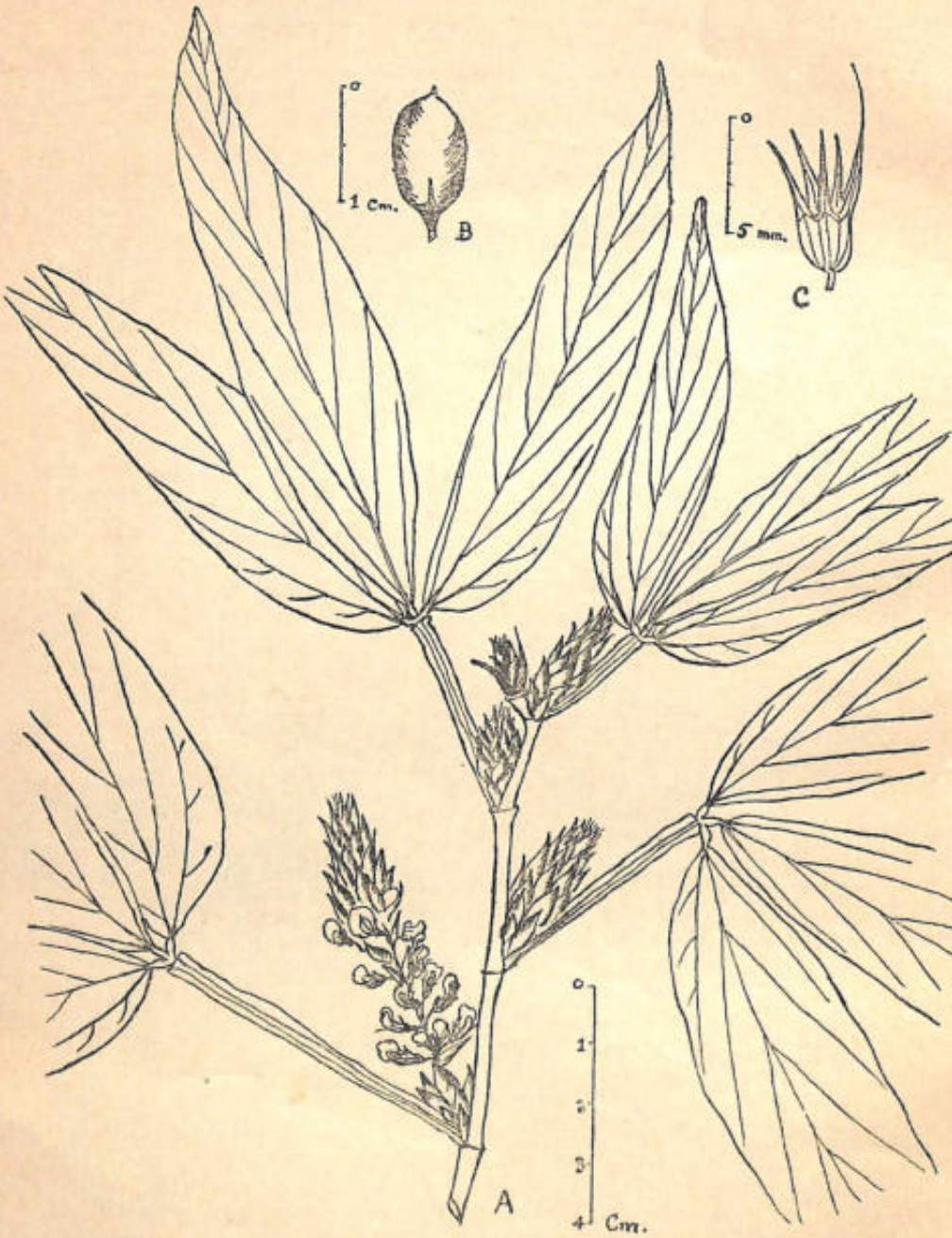
Moghania praecox H.L.Li., var. **robusta** Mukerjee in Bull. Bot. Soc. Bengal 6: 19, 1953.

An erect undershrub, 120-210 cm. high, much branched; *stem* woody, terete, younger parts somewhat triquetrous, faintly striate, glabrous. *Leaves* trifoliate, alternate, petiolate, stipulate; leaflets 11-25 × 2-6.8 cm., subcoriaceous, oblong-ovate, or lanceolate, obscurely repand, acuminate, base of central leaflet cuneate, that of lateral ones oblique and rounded, upper surface glabrous, lower one dotted with minute golden brown glands, and puberulous especially about the veins; nerves three strong ones from the base with in addition 6 or 7 pairs higher up; petioles 4.5-8.5 cm. long, slightly winged, smooth on the dorsal side, deeply fluted on the upper or ventral side, puberulous, the base expanded into a slight pulvinus; stipules 10-13 mm. long, scarious, ovate, acuminate, ciliate, striate, conduplicate, caducous; stipels absent. *Inflorescence* axillary, racemose; rachis 2.5-8 cm. long, angled, glabrous. *Flowers* 30-50 in each raceme, close, each supported by a bract and pedicellate; bracts 6-8 × 2-4 mm., the basal ones ovate to broadly-ovate, the higher ones elliptic, all striate, ciliate, caducous; pedicels 1-2 mm. long, slender, glabrous. *Calyx* 6-9 mm. long glabrous, persistent in fruit; tube 2 mm. long, campanulate; teeth 5, free, ovate- acuminate 4 mm. long, the lower ones the longer, nearly 7 mm. long. *Corolla* dark purple, exserted; standard 8 × 6 mm., greenish with dark purple veins, suborbicular, acute, with two short spurs before tapering into a claw, which is 2 mm. long, wings 6 × 1 mm., white or green with a few purple veins, each with a spur just above the 2 mm. long claw; keel 8 × 3 mm., almost purple black at the tip, the colour gradually becoming lighter towards the base, connate on the dorsal side up to the claw, which is 2 mm. long. *Stamens* 9+1, filaments 8 mm. long, united together except for about 1 mm. near the apex; anthers uniform, minute. *Ovary* 2 × 1 mm., straight on the dorsal side, rounded on the ventral, glabrous; style 7 mm. long, slender, inflexed; stigma hairy. *Fruit* 10 × 6 mm., turgid, oblong, slightly apiculate, glabrous, brown. *Seeds* 2, black, smooth, truncate, each 2 × 2 mm.



Indigofera oreophila Santapau and Panthaki

A. Upper branch in flower and fruit; B. Calyx in fruit.



Moghania praecox var. *robusta* Mukerjee

A. Flowering branch; B. Fruit; C. Flowering calyx

This plant is very noticeable on account of its size and its gregarious habit; it grows in dense clumps at the edges of forest; it is also found in the undergrowth of some of our more dense forests. It comes into flower in January-March, and into fruit in March. The records of this species which we have been able to examine are the following:

T. R. D. Bell 3634/II, from North Konkan, February 1918.
Santapau 19227, from Waghai, in the Dangs Forest, September 1954.
N. A. Irani 1688-1689, from Waghai, February 1956.
D. P. Panthaki 2571-2573, Waghai, February 11, 1956; *Panthaki* 2591 from Waghai, 12 February 1956.

Distribution: *Moghania praecox* proper has been recorded only from Chittagong in East Pakistan (*C. B. Clarke* 19916 A, B, C); the present variety has been recorded from Yenkatapur, in Chanda Dt. of C.P., Thana and Dangs Forests in Bombay.

H. SANTAPAU,
S.J., F.N.I.,
D. P. PANTHAKI,
B.SC. (Hons.)

38. CHINA'S BOOK-LIKE ROCK FORMATION WITH 25-MILLION YEAR OLD PLANT FOSSILS

Numerous plant fossils of the Upper Miocene Age some 25-million years old can still be seen today near Shanwang Village in the Linchu district of northern Shantung Province. They are imbedded in a peculiar rock formation locally called the 'Ten Thousand Volumes'.

The district in which Shanwang Village is located lies twenty kilometres south of the Tanchiafang station on the Tsingtao-Tsinan Railway which cuts across the peninsula. At a place called Hsiehchiachuang, in a valley which faces the northeast, outcrops of volcanic sediments one and a half kilometres long are covered with basalt of the Pliocene epoch. In the shale rockbeds are found large quantities of volcanic ash intermingled with which are numerous thin layers of diatomaceus earth. With only the help of a pen-knife, these thin layers can be easily pried loose. And there, lying among these layers, are leaves, flowers and fruits of ancient plants. The peasants here call them 'Ten-thousand-volume' rockbeds because these thin layers of white volcanic ash resemble the pages of an enormous book. This is a very significant and descriptive name indeed.

By 'opening' this 'heavenly book' as it is otherwise called, scientists are able to know the various kinds of plants in this 25-million year old area as well as the difference between plants of that time and now. They can also find out what changes have happened during the past 25-million years and the causes that have brought about these changes.

The plants hidden in the rock beds of the 'Ten-thousand-volumes', covering a wide range of varieties, are so well preserved that they

look like herbarium specimens. Even the chlorophyl is still preserved in them. Most of them are leaves, though flowers and fruits are also found among them. Two kinds of monocotylae (plants with only one seed leaf) and eighty-four kinds of dicotyledonea (plants with two seed leaves) have been determined. No gymnospermae (plants having naked seeds such as pines, cedars) have been found. The dicotyledonea consist of fifteen orders, thirty families and sixty-one genera. There are seven kinds each of genus *Acer* and genus *Carpinus*, three kinds each of genus *Filia* and genus *Ulmus*, the remainder being of only one or two species.

Most of the plant fossils belong to the flora of eastern Asia. *Eriobotrya, Firmiana, Kalopanax* and *Platycarya* are genera found only in eastern Asia. The genera of *Carya, Gladitsia, Hamamelis* and *Liquidambar* do not exist in northern China now-a-days. In general, two-thirds of these genera now grow in the valley of the Yangtze River. Thirty-nine kinds of the plant fossils are similar to present-day Japanese plants and eighty-five kinds belong to the same present-day Japanese plants of as many genera. They are also similar to Korean plants. The leaves of the plants are bigger and softer than those plants now found in North China.

Animal fossils such as those of insects, fishes, frogs, turtles and mammals have been collected and studied, and a series of papers have been published by Dr. C. C. Young and his associates. But the primary interest is focussed on the large collection of plant fossils.

On the basis of geological data, geologists judge that these rock formations were generated by the lake deposits which were accumulated during an age in which volcanic activities were very active. The leaves, flowers and fruits which frequently fell into the water were interlayered with frequent deposits of volcanic ash, which makes it possible to preserve beautifully these plant materials, the study of which enables the paleobotanists not only to identify those preserved plants, but also to understand the change of climate and floral elements of North China during these long geological times.

Much material has been collected and studied. But by further collection and research from those 'heavenly books' new discoveries will be made, and further knowledge of those remote times obtained.

INSTITUTE OF BOTANY,
ACADEMIA SINICA,
September 11, 1956.

PROF. HSEN-HSU HU

39. WILD LIFE PRESERVATION IN INDIA

DANDELI AND THE DANGS

All Indians who are interested in the protection of Nature are grateful to the Society for the sustained effort it is making to foster public interest in the preservation of the fauna and flora of our country. The Governments are more or less converted to this view and are moving gradually in the right direction. The creation of the Indian

Board for Wild Life and special legislation in some States are steps in that direction. Yet, in spite of the above legislative and organisational efforts, wild life is decreasing from day to day.

2. In 1942-43, when I was Divisional Forest Officer, Kanara Northern Division, I selected an area of approximately 100 square miles suitable for a wild life sanctuary in that Division. The site selected has natural boundaries, rivers with deep gorges on three sides and well demarcated P.W.D. road and Forest block boundaries on the fourth side. It contained a representative stock of wild life and has several perennial springs and nullahs. By an executive action, sign-boards were put up at all road entrances and exits, prohibiting shooting within the area and the Conservator of Forests, Southern Circle, declined to issue shooting block permits for the shooting blocks included in the proposed sanctuary. Later, when I was the Conservator of Forests in charge of this Circle, I closed all shooting in this area by a notification under Indian Forest Act and submitted detailed proposals to Government to constitute this area into a National Park. For this purpose, it was necessary to remove 2 or 3 hamlets within the area affecting about 500 persons (about 100 families). For the rehabilitation of these persons, the proposals included the creation of a model village near Dandeli, cost of which would be met from selling the forest crop on the proposed site for this village. Here the displaced persons will have more land for cultivation than they had in the midst of the forest and better and safer grazing for their cattle. This arrangement would be to the all-round benefit of the displaced persons as they would be, at the rail head at Dandeli, enabled to obtain better prices for their agricultural and garden produce and also get the benefit of all modern social services like sanitation, medical aid, education and later on electricity from Jog etc., which was denied them due to their habitation in the forests. The following extract from the diary of Fr. H. Santapau, printed on page 26 of the *Journal*, Vol. 53, would appear to show that no effective action has been taken so far.

'30 May, 1954, Sunday. The animal sanctuary is just across the river; all we saw were crowds of monkeys, some domesticated buffaloes and heard jungle-fowl and an occasional woodpecker.'

From the above it should be realized how difficult it is for a State Government to give effect to any proposals when local interests are not sympathetic. This explains the progressive diminution of wild life all over India in spite of protective laws of the Governments.

3. Wild life preservation to be effective should be a Central responsibility away from pressure of local interests. For this purpose, the National Parks should be large enough to be self-supporting financially. Dandeli sanctuary is one such site.

Another good site for a National Park in Bombay State is Dangs. Dangs was formerly a confederation of 19 Bhil States. The forests were leased to the Forest Department of Bombay Province and the rest of the area was administered by the Political Department. With the merger, Dangs has been constituted into a District of Bombay State. The area of Dangs is about 700 square miles, hardly the area of a taluka, but for political considerations, it is administered as a district. The whole of Dangs should be constituted into a National

Park under the Union Government. I have served as a Forest Officer in Dangs. The Dangi is a good woodsman, but, rather a poor cultivator. If Dangs is taken over by the Central Government as a National Park, it will benefit both the Wild Life and Dangies. Wild life is almost eliminated from Dangs, but, it can be nursed back to normal for the locality. The objects of management of this park should be:

(*a*) Preservation of wild life;

(*b*) Preservation and improvement of environmental conditions;

(*c*) Consistent with (*a*) and (*b*), exploitation of forest resources for the benefit of Dangies.

(*d*) Social benefits and improvement in the housing conditions of Dangies.

To achieve this, some of the prescriptions of Forest Working Plans would need revision in view of the changed objects of management. The forest revenue resources of the area are more than ample to meet all the needs of Dangies in the matter of cheap food and social services like education, sanitation, medical aid, cottage industries based on forest produce, and full employment on game preservation and forest works. In fact the Dangies will be better off by the constitution of National Park than they are at present, when the forests are under commercial exploitation.

5, Modibag,
Ganeshkhind Road,
Poona 5,
October 26, 1955.

TOLARAM K. MIRCHANDANI

GLEANINGS

Falconry Revived in Germany

The 4,000-year old art of falconry received new impetus when a training centre for hawks and other raptorial birds was opened near Waldorf, in the district of Calw in Württemberg. The new training centre, which it is claimed has no match in Europe, will replace the Reichsfalkenhof in Brunswick which was destroyed in the war.

The sponsor of the new establishment is the 'Deutsche Falkenorden' which has its counterparts in the British Falconers' Club and in the Falconers' Association of North America. The 'Falkenorden', founded in 1923, held its last exhibition in Düsseldorf in 1937. England, France, Italy, Egypt, Japan, Yugoslavia, and Arabia were represented.

The task the new establishment has set itself is the training, theoretically and practically, of falcons, hawks, and other raptorial birds which can be used for hunting. All birds of prey, including the owl, can be trained to the basic art of falconry, which is to kill the quarry and remain upon it until the falconer picks up the bird or calls it to his fist. The Chinese Golden Eagle, it is said, can even be trained to retrieve its kill. History has it that falconry was known in China as early as 2,000 B.C. India, Arabia and Iran also look back

on a very old tradition in this field. In Europe, the quarry at which hawks are flown consists of grouse, pheasants, partridges, ducks, woodcocks, snipe, heron, crows, gulls, magpies, hares and rabbits. In Asia, vultures and gazelles are captured by trained hawks.

[From the Bulletin of the Press and Information Service of the German Federal Republic, Bonn, June 28, 1956.]

Electrical Field set up by Lamprey

Some experiments are being made at McMaster University in Hamilton, Ontario, on the parasitic lamprey which has been destroying large numbers of trout and whitefish in the Great Lakes. It has been found that the lamprey can set up an electrical field around its head and, when this field is amplified, can light a flash bulb and trigger a camera shutter, thus taking a photograph of itself.

The research board say that these early observations are of great biological interest because the electrical field is limited to regions around the animal's head. At the moment it appears there is no resemblance between the phenomenon and that peculiar to the electric eel, which is not found in the fresh waters of Canada.

Method of Generation: It is not clear which organs of the lamprey generate the electrical field, but it is known that the field is closely synchronized with its breathing movements. The potentials could be produced by either nerve or muscle tissues, or a combination of both. A number of experiments to determine this are in progress, involving drugs and surgical techniques.

Properly described, the field is one of electrical potentials, recurring rhythmically, from 200 to 300 millionths of a volt at a distance of about four-fifths of an inch from the head of a normal lamprey in fresh water. These potentials occur every four-tenths of a second, and the duration of each is one twenty-thousandth of a second. They are called 'spike' potentials because of the shape they make on a recording machine, and they have been measured at a distance of several inches from the head. How far these electrical inpulses are valuable to the lamprey is still a matter of speculation. They can hardly be used as radar, as the impulses do not occur sufficiently often.

Signals by African Fish

The first case of fish which send out weak electrical signals, and apparently use these signals to gain information about their surroundings, was reported by Dr. H. W. Lissman of the Department of Zoology, Cambridge University, in 1951. The one which he first observed was an African freshwater fish, *Gymnarchus niloticus*, which is roughly one foot in length. It sends out continuous signals at a rate between 258 and 318 pulses a second. The rate is affected by the temperature of the water but not by the degree of activity shown by the fish. The greatest observed strength of the signals was about 30 millivolts.

Dr. Lissman found that the fish responded by their behaviour to changes in the electric field which they set up about them, and also to pulses similar to their own. Soon after he found that signals of

the same general type but differing in detail were produced by two other species of fish. He pointed out that the production of these weak signals was of interest in relation to the origin of organs of electric discharge, notably in the electric eel, which give a high enough voltage to be of obvious value to the fish.

Later the electric eel itself was found by Dr. R. D. Keynes to produce smaller pulses which it appeared to use, like these other fish, to obtain information about its surroundings. These pulses, normally at the rate of about one a second and of some few volts (?) strength, are sent out by the eel only when it is moving. Their rate is increased sometimes to as much as 20 a second, when the eel is showing interest in any object near by. The case of the electric eel seems to prove that pulses sent out at comparatively long intervals can be of value to the fish.

—*The Times*, March 29, 1956.

(Government of India, Ministry of Natural Resources and Scientific Research, Science Newsletter No. 225, dated July 3, 1956.)

Atom v. *Death Watch Beetle*

Atomic scientists in the United Kingdom are planning to use the atom to outwit the death watch, beetle which each year causes considerable damage to the woodwork of ancient buildings. Physicists at the atomic energy research establishment at Harwell, collaborating with timber experts, have found that small doses of radio active cobalt can halt the reproductive instinct in the beetle and make its eggs infertile. The method they have developed will be used to protect historic buildings and furniture, the principal victims of this destructive.

—*The Chemical Age*, June 16, 1956.
(ibid., No. 265, dated September 14, 1956.)

Bee-eaters' Dust Bath

'One morning, as I was walking along the banks (of Mutha Canal, a short distance out of Poona) I saw, some hundred yards in front of me on the brown earth path what looked exactly like a heap of grass newly cut by a lawn mower which the gardener has emptied from the box of the machine. But the whole green heap seemed to be in movement. Warily I approached nearer until with my field-glasses I solved the mystery. What I had taken to be a heaving mound of grass proved to be a mass of emerald green bee-eaters, which were lying close together, higgledy-piggledy, enjoying a dust bath. Some were lying on their bellies, others on their sides, and all were flapping their wings with vigour. There must have been thirty or more birds together on one small patch of ground.'

[From 'Memoirs of a Camp-Follower' by Philip Gosse. Published 1934.]

Extracts from the Report of the Director, Royal National Parks, Kenya, 1952

Barriers and Fences

'I am convinced that the only successful method of constructing such a barrier is not only to make it formidable, but also to make it impossible for the animals to see through or over to the other side of it. Few animals will charge or jump a fence when they do not know what lies beyond. . . . The growing hedge is undoubtedly the ideal but by some strange dint of nature suitable plants when grown in rows seem to attract the attention of various creatures that normally would not attempt to feed on this type of vegetation. The stretch of euphorbia along a portion of the Nairobi National Park, for example, was very quickly devoured and uprooted by zebra, although similar isolated plants growing in the same area survived for years unscathed. . . .'

Observations

'The lions in the Nairobi Royal National Park appear to circle an area in an anti-clockwise movement, and over a period of about a week they generally complete the circuit.'

'Several families of cheetah have been born and reared within the Park, and the number of cubs seems to be in each case five.'

'A few leopards are occasionally seen in this Park, and I like to hope that they are increasing. The unfortunate trapping and persecution of leopards in the past few years has reduced these animals to a point where they are below the number required by nature's plan. This is evident from the vast increase of baboons, pigs and suchlike, upon which the leopards normally prey.'

'The remarkable thing about wild Africa is the silence—or noise—of the night. There are moments when there is absolutely no sound whatever. Then there is a rustle in the dom palms; a lonely cricket chirps; an owl hoots; and a gentle breeze glides through. For no obvious reason there is then a sudden chorus of the most diabolical noises and every creature that has any means of screeching, snorting, blowing, scraping or croaking, joins in to ensure the greatest possible disturbance of the peace, and one wonders how the same cold moonlight ever appeared so lifeless.'

Artificial Lighting

Artificial lighting has been introduced at the famous observation point 'Treetops': 'Power is provided from an engine situated at the forest edge and by means of a diffused floodlight the whole arena can be illuminated up to much the same brightness as by the full moon. The key to the introduction of this system of artificial lighting lay in bringing the light up from darkness to full strength very slowly, as any sudden flood of light caused a minor stampede. In a very short time, however, most of the regular habitues of 'Treetops' learned to accept the light as part of the natural scene, and most animals, even

including the normally timid rhino, continued to scuffle for salt or to take their fill of water in full view of the floodlight.

'The provision of artificial lighting in a National Park was a subject that exercised the minds of the Trustees, since it could clearly be argued that this was interference with the natural scene, and was not the kind of system one would expect in a wild life sanctuary. Since "Treetops", however, had been in operation for many years before the area had been proclaimed as a National Park, and since artificial lighting made it possible for so many more people to visit this famous place and see the animals clearly, it was considered to be a justifiable concession. Since the Royal visit in February, 1952, artificial lighting has been in use on all dark nights, and appears to have had no adverse effect on the habits of the animals.'

Salt-licks

'It has been the practice for many years to sprinkle common salt on the fringes of the pool beneath "Treetops", but this to my mind is not the entire requirement of the forest dwellers. On analysis it was found that the natural salt-lick contained an unusually high percentage of ferric oxide, and when any of this mineralised soil was placed at "Treetops" or nearby it was at once consumed by almost every kind of animal. This points to a conclusion that common salt by itself will not be sufficient to satisfy the animals at "Treetops" indefinitely, and as time goes on it may be necessary to recreate the attractions of the ridge by moving fairly large quantities of the natural salt-lick up into the forest.

'Natural salt-licks in various other National Parks have been analysed and the reports point to a very great variation in the essential components. This again is a subject for considerable scientific research, but from observations already made it seems perfectly clear that common salt by itself is not the main or only requirement.'

[A series of chemical reports on samples of earth obtained at salt-licks in India was published in the Society's *Journal*, Volumes 36-41. No conclusions were attempted and it may now be worth while re-examining them in the light of experience in other countries.]

Extracts from I.U.P.N. Bulletins. Selected and Annotated by R. W. Burton

The Use of Predators

In the Bulletin is mention of an excellent little brochure, 'Predator Control—Why and How' prepared by the Conservation Commission of the State of Missouri (U.S.A.) contents of which are well worth study by all concerned in the Conservation of Wild Life.

'. . . The important factor to be borne in mind is that the animal, predator though it may be, nevertheless has a definite rôle to play in the chain of natural balance and that every living creature is subject to the implacable law that demands the assimilation of another form of life to assure its own survival.'

Anti Parasites

In its latest Annual Report 'Nature Conservancy' (Great Britain) refers to the conclusions of an inquiry made under its auspices on spraying selective weedkillers on the vegetation of roadside verges and on hedges. Such spraying does not always have the desired effect. Some interesting species of flora have been destroyed, while others, for whom the treatments were intended, survived. . . . The Ministry of Transport has issued advice to highway authorities in a Circular (No. 718) which is to serve as a guide when selective weed-killers are being sprayed on roadside vegetation.

Forests of Yesterday

In the British Nature Conservancy's Annual Report it is shown that:

'over-grazing and over-burning have not only vastly reduced the area of Scottish woodlands but have also radically changed their composition.'

April 1956.

Hydroelectricity

'The columns of this whole Bulletin (May 1956) would not suffice to reproduce all the requests that come to the Union appealing for the preservation of areas threatened by hydroelectric schemes.' . . . 'Of course the economic needs of the country must be satisfied, but other sites that are less precious to both naturalists and to scientific study could surely be used, even although they may be further from the development sites.'

Education

India: 'The Governor of West Bengal has stressed the need for education to impress on the Indian people the great national heritage which their wild life gives them.

In his opinion, wild life on account of its beauty and rarity, is well worthy of government protection.'

May 1956.

NOTES AND NEWS

The Council of Biological and Medical Abstracts Ltd., London, has decided to change the title of their journal *British Abstracts of Medical Sciences* to

International Abstracts of Biological Sciences

(Honorary Editor: C. C. N. VASS, M.SC., PH.D., M.B., CH.B.)

This decision results from two major developments. The first is an extension of coverage to a wider range of biological research subjects published in journals throughout the world, and the second is that the International Abstracts of Biological Sciences, with the co-operation of the specialist editors selected by the Institute of Scientific Information of the Academy of Sciences of the U.S.S.R. will include, as from the January 1957 issue, translations of the important Russian papers abstracted in the *Referativny Zhurnal Biologii* (Soviet Biological Abstracts) and *Referativny Zhurnal Biologischekoi Khimii* (Soviet Abstracts of Biological Chemistry), to be published simultaneously with their appearance in Russian.

International Abstracts of Biological Sciences abstracts the world literature in the following fields: Anatomy, Animal Behaviour, Biochemistry, Biophysics, Cytology, Embryology, Endocrinology, Epidemiology, Experimental Biology, Genetics, Haematology, Histochemistry, Histology, Immunology, Microbiology, Nutrition, Odontology, Parasitology, Pathology, Pharmacology, Physical Anthropology, Physiology, Radiation Effects, Toxicology and Viruses.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER 1955

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Major-General Sir Sahib Singh Sokhey, I.M.S.
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Rev. Fr. H. Santapau, S.J.
Mr. Sálim Ali

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Mr. D. N. Marshall	*Bombay*
Mr. D. J. Panday	*Bombay*
Mr. D. E. Reuben, I.C.S. (Retd.)	*Bombay*
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HONORARY SECRETARY'S REPORT FOR THE YEAR 1955

The Society's Journal

Part 4 of Vol. 52, Parts 1 & 2 of Vol. 53, and the Index to Parts 3 & 4 of Vol. 51 were published during the year under review.

Mammals

Three papers were published under this head.

Prof. Bernhard Rensch and K. W. Harde in their 'Growth-Gradients of Indian Elephants' have, after a thorough investigation of fifteen working elephants in Mysore, confirmed the view that *Elephas maximus* is fully grown at the age of about twenty-five years and that after this a slow growth continues up to a high age.

'Hedgehogs of the Desert of Rajasthan' by Daya Krishna and Ishwar Prakash is the result of their study of the distribution and fossorial habits of the two species *Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth. The study was made under a UNESCO scheme to determine the role of vertebrates in the spreading and preserving of desert conditions.

Dr. Angela Nolte in her 'Field Observations on the Daily Routine and Social Behaviour of Common Indian Monkeys with Special Reference to the Bonnet Monkey (*Macaca radiata* Geoffrey)' gives interesting accounts of the Bonnet Monkey, the Rhesus Monkey

Macaca mulatta Zimmerman, and the Common Langur *Semnopithecus entellus* (Dufresne), based on her personal observations during her study tour in India under the leadership of Prof. B. Rensch. At the end of the paper, the author suggests a number of problems for Indian zoologists, the elucidation of which would throw important light on the natural history and social life of Indian monkeys, which are very little known.

Birds

Seven papers were published under this head.

Sálim Ali concluded his regional paper on 'The Birds of Gujarat' with Part II, in which he lists 162 more species, together with useful notes under each.

Nepal birds came in for special attention, and the following papers were published:

'Some Birds collected in Langtang Khola, Rasua Garhi Dt. (Central Nepal)' by O. Polunin, recording some 100 species.

'Some Birds from North-Western Nepal' by Col. D. G. Lowndes, which lists 92 species including many that were not met with by Polunin in northern central Nepal.

'More Notes on the Birds of Nepal Valley' by Desireé Proud, is a useful list of 112 species supplementing her previous contributions on the same area in Volumes 48 and 49. An appendix gives the status of the various species as summer and winter visitors and passage migrants, together with dates of their arrivals and departures.

Loke Wan-Tho's 'Two Bitterns in a Penang Marsh' in two parts is a detailed and readable account of the nesting habits of the Yellow and Chestnut Bitterns (*Ixobrychus sinensis* and *I. cinnamomeus*). Mr. Loke has, as usual, illustrated his account with some excellent photographs. The two beautiful coloured plates accompanying the article were generously donated by the author.

S. A. Aktar in 'Bird Migration and Fowling in Afghanistan' describes the several crude but ingenious and highly effective methods by which hundreds of passage migrants like Wrynecks, Bluethroats, Pastors, Quails, and Wild Duck are subjected to wholesale slaughter, while passing through Afghanistan during the winter months.

Reptiles & Amphibians

Only two herpetological papers were published.

Under 'A New Form of the Burrowing Snake *Uropeltis macrolepis* (Peters) from Mahableshwar' V. K. Chari describes a new race, *mahableshwarensis*, differentiated on lepidosis.

'*Nyctibatrachus humayuni*, A new Frog from the Western Ghats, Bombay' by J. L. Bhaduri and Miss M. B. Kripalani, is the description of a new species obtained at Khandala supplemented with field notes by Humayun Abdulali, the collector.

Fish & Fisheries

Four papers were published in this section.

S. L. Hora in his 'Tectonic History of India and its Bearing on Fish Geography' explains how tectonic history is helpful in establishing geographical distribution of freshwater fishes, the study of which has been greatly neglected in the past. The mode of dispersal of fishes, Hora states, is dependent on drainage patterns, river captures, flood plains and other phenomena which help in the commingling of waters of different drainage systems. Dr. Hora commends to Indian fish-geographers the use of 'The Structural and Tectonic History of India' published by Dr. M. S. Krishnan, Director of the Geological Survey of India, in a recent memoir in their Piscine Geographical Studies.

P. N. Saranghdhar in his 'Comparative Observations on the Placenta and Foetal Nutrition in Elasmobranchs and Mammals' gives the results of his study of over a dozen elasmobranchs of Bombay in comparison with mammalian placentae. In the light of this comparison an attempt is made to interpret the mechanism of the yolk sac and the yolk sac placenta, the early or late formation of which in this class of fish seems to be influenced by the initial quantity of yolk in the mature ovum.

In 'Notes on a Collection of Fish from the Headwaters of the Bhavani River, South India', S. Rajan lists 48 species of fish from two collections made at different periods in 1953 in the Bhavani and Moyar rivers and some of their tributaries. Detailed taxonomic notes, together with ranges or distribution of 8 species are given.

'Trout Fishing in Kashmir' by Philip K. Crowe is an interesting account of the author's fishing experiences during his 17-day stay in Kashmir. The various localities fished, and the number and weight of fish caught are tabulated, which enhances the value of the paper.

Invertebrates

The following papers were published in this section:

Insects:

'Miscellaneous Notes on Indian Butterflies' by D. F. Sanders.

'A Note on *Apanteles flaviceps* Cam., a Braconid Parasite of the Cholam Stem Borer *Chilo zonellus* Swinh.' by K. C. Chandy.

'Bionomics of *Urentius echinus* Dist. (Hemiptera—Heteroptera: Tingidae), an Important Pest of Brinjal (*Solanum melongena* L.) in North Gujarat' by R. C. Patel and H. L. Kulkarny.

'Some Notes on the Rice Gall-Fly—*Pachidiplosis oryzae* (W.-M.) by M. Q. Khan and D. V. Murthy.

'The "Slug" Caterpillar—*Parasa lepida* Cram. and its Control' by K. P. Ananthanarayanan and E. V. Abraham.

'Biology and Ecology of Oriental Termites (Isoptera) No. 3, Some Observations on *Neotermes gardeneri* (Snyder) [Family Kalotermitidae]' by M. L. Roonwal and P. K. Sen Sarma.

Arachnids:—

'Ixodes kerri, a New Species of Tick from a Flying Squirrel from Southern India (Acarina : Ixodidae)' by T. Ramachandra Rao.

'Habits and Habitat of Some Common Spiders found in Western India' by T. V. Subrahmaniam, which deals with 22 different species of common spiders in Bombay and other districts in Western India, including Cochin and Travancore.

Crustaceans & Molluscs:

R. Altevogt in 'Some Studies on Two Species of Indian Fiddler Crabs *Uca marionis nitidus* (Dana) and *Uca annulipes* (Latr.)' published the results of his study of the behaviour of these fiddler crabs in their habitat on the beach at Bandra, Bombay. The paper, as well as the field study upon which it is based, is a model for investigations of this type.

'Some Indian Land Snails' by Frau Prof. Ilse Rensch reports on 27 species collected during her recent trip to India, in three different localities, namely, the Western Himalayas, the Western Ghats and the hills of South Mysore. The paper describes a new race *Pyramidula rupestris sálimalii,* from the Chakrata-Deoban area of the Western Himalayas on proportional characters of the shell.

In 'Marine Organisms Injurious to Submerged Timber in the Bombay Harbour' V. C. Palekar and D. V. Bal list the species of Shipworms (*Teredo*) and 'Piddocks' (*Bankia*) found in the course of their survey of marine borers conducted during 1953-54.

Botany

Six papers were published.

'A New Species of *Chlorophytum* from Salsette Island' by Fr. Santapau and R. R. Fernandes describes the new species *borivlianum.*

'A Botanical Excursion to North Kanara, Bombay State, in May 1954' is the diary of an excursion undertaken by Fr. Santapau and some of his colleagues with the object of studying and collecting medicinal plants in North Kanara. Species of plants met with in various localities have been listed, adding greatly to the usefulness of the paper.

'The Botanical Exploration of the Krishnagiri Park, Borivli, near Bombay' is a summary of the results of a botanical survey carried out by Fr. Santapau and Miss Aban J. Randeria (who was awarded the Society's natural history grant). It gives a general description of the terrain, climatic data and rainfall, temperature and humidity, and the vegetation of the area. Our thanks are due to the Milk Commissioner of Bombay for donating the cost of the coloured plate which accompanies the paper. Reprints in the form of a brochure are available with the Milk Commissioner, Wakefield House, Ballard Estate, Bombay, and should prove of interest and value to students and visitors to the park.

Parts III & IV of the serial 'New Plant Records for Bombay', by Fr. Santapau and C. Saldanha, record 9 species not hitherto known to occur in our area.

In 'A New *Polygala* from South India' S. K. Mukerjee describes his new species *ramaswamiana*.

Wild Life

Five interesting papers were published on wild life and wild life preservation, a subject which of late has been receiving the special attention of the Society.

R. C. Morris and Sálim Ali, who were delegated by the Society at the request of the Kashmir Government to review the position of wild life in the State and recommend measures to preserve the game animals, particularly the Kashmir Stag, published their report and recommendations—'Game Preservation in Kashmir: Report and Recommendations of the Bombay Natural History Society's Delegation, October 1952'. This report, which was submitted to the Kashmir Government on the completion of the survey tour, contains among other practical suggestions and recommendations one to declare the Black Bear 'vermin' in view of the unwarranted increase in its numbers and its ravages on young deer. The introduction of foreign animals like the Elk and the Red Deer is discouraged in the absence of an adequate knowledge of the ecology of these two animals. It is not known how far the recommendations have been implemented by the Kashmir Government.

Part II of E. P. Gee's 'The Management of India's Wild Life Sanctuaries and National Parks' and another contribution by him on 'The Function of Zoological Gardens in the Preservation of Wild Life' were published. The author, who has been intimately associated with the problem of wild life preservation in our country and has visited almost all the Indian wild life sanctuaries as also many abroad, lays down rational definitions of zoological gardens, zoological parks, municipal parks, wild life sanctuaries, and national parks, so as to remove the prevailing uncertainties and misconceptions regarding the exact character and functions of the various types of parks found in the world. Observations made during his visits to the sanctuaries in Assam, Bengal, Madhya Pradesh, Uttar Pradesh, and Mysore are detailed, and the paper is illustrated by some of his beautiful photographs of wild life. Mr. Gee remarks that India possesses several advantages not enjoyed by other countries in that she has very fine tree forests, mountain scenery, and grand rivers, many of which are wild life centres of first-rate national park potentiality, holding many interesting and beautiful species of mammals and birds not found elsewhere in the world.

In the second article, while discussing the functions and management of zoological gardens and zoological parks, Mr. Gee lists a number of animals on the danger list and suggests that efforts should be made to breed them in zoological parks for subsequent release and boosting of their natural populations in depleted areas.

Two annual reports (1953) of the respective Regional Secretaries on wild life in the Western and Southern Regions were published. In the former, R. S. Dharmakumarsinhji reviews the position in several States in his region and recommends the formation of touring Wild

Life Committees to assess the wild life population from time to time in a given locality. Mr. Y. R. Ghorpade mentions the species of animals in the Eastern Region which are in urgent need of the strictest protection. These include Great Indian Bustard, Hunting Leopard, Nilgiri Tahr, Nilgiri Black Langur, Malabar Squirrel, Four-horned Antelope, Chinkara, and Blackbuck.

Miscellaneous Notes

96 notes covering all branches of natural history were published. This section of the *Journal*, as usual, is very popular with the readers, and contributions of likely interest from members are most welcome.

Scientific Expeditions

No major expeditions were undertaken during the year under report, but several short collecting trips were made to different localities, which resulted in considerable accessions, particularly in specimens of amphibians.

Nature Education Scheme

This scheme, which has completed its ninth year, has become increasingly popular with schools in view of its useful activities in spreading interest in natural history among teachers and children.

In the series 'Glimpses of Nature' the Kannada edition of 'Our Birds' (No. 1) and a second impression of the English edition were published.

It is hoped that the Government of Bombay will be pleased to retain the Society's Nature Education Scheme as a permanent feature of the State's educational programme so that adequate long-term planning can be undertaken. Its present activities include guided tours to places of natural history interest like the Natural History Section of the Prince of Wales Museum, the Taraporevala Aquarium, and the Victoria Gardens, as also field-trips in the environs of the city, the starting of Nature Study Clubs in schools, arranging film shows and talks on nature, and publication of simple illustrated booklets.

Publications

The 5th edition of 'The Book of Indian Birds' by Sálim Ali was published during the year. It now contains 56 plates in colour (depicting 224 species), 3 in line and 22 in half-tone.

'Butterflies of the Indian Region' by M. A. Wynter-Blyth is making satisfactory progress and there is every hope of its publication in the course of 1956.

Revenue Account

Total receipts during the year amounted to Rs. 51,791-4-3, which includes grants from the Government of India, Rs. 8,000, and Government of Bombay, Rs. 4,000, as compared with Rs. 37,593-6-8 during

the previous year. It will be noted that this increase in total revenue is due to our new publications 'The Book of Indian Birds' (5th edition), 'Some Beautiful Indian Trees' (2nd edition) and 'Some Beautiful Indian Climbers and Shrubs'.

Sales of the Society's publications were appreciably higher than last year.

The following is a comparative statement showing the different sources of revenue received in 1954 and 1955:

	Revenue in 1954	Revenue in 1955	Increase in 1955	Decrease in 1955
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A P.
Subscriptions ...	20,418 0 0	20,428 0 0	10 0 0	——
Entrance Fees ...	1,412 0 0	1,372 0 0	——	40 0 0
Publications:				
Books ...	5,691 0 0	10,210 0 0	4,519 0 0	——
Journals ...	1,634 0 0	3,320 0 0	1,686 0 0	——
Sundries, Taxidermy, Advertisement, etc.	346 0 0	352 0 0	6 0 0	——
Interest on Investments	4,092 0 0	4,109 0 0	17 0 0	——
Grants:				
Govt. of India ...	——	8,000 0 0	8,000 0 0	——
Govt. of Bombay ...	4,000 0 0	4,000 0 0	——	——
Total ...	37,593 0 0	51,791 0 0	14,238 0 0	40 0 0

The net increase in 1955 as compared with 1954 was Rs. 14,198.

The total number of members on our books as at 31st December 1955 was 1,152, of whom 233 were life members. Subscriptions for 1955 have so far been received from 665 members. During the year 70 new members joined, 2 life members and 4 ordinary members died, 5 ordinary members became life members, and 22 ordinary members resigned.

Staff

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

Acknowledgements

The Committee's thanks are due to Mr. P. M. D. Sanderson who continues to look after the Society's interests in the U.K.

APPENDIX TO THE HONORARY SECRETARY'S REPORT COVERING THE PERIOD JANUARY TO AUGUST 1956

This report covers the current year and is supplementary to that for the year ended 31st December 1955, copies of which have been handed out to you.

The April *Journal* has already been issued and the August number should soon be available.

Since 1st January, 33 new members have joined against which 4 died and 11 resigned, making a total of 936 ordinary members and 233 life members on our books.

The Society's recent publications, THE BOOK OF INDIAN BIRDS and the two plant books, viz. SOME BEAUTIFUL INDIAN TREES and SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS, are proving popular and selling well, a fair proportion of the orders, particularly for the plant books, coming in from abroad where they have been very favourably reviewed.

We hope to have ready before the end of this year the long-overdue butterfly book and also reprints of the wall chart for the identification of Poisonous Snakes in English, as well as editions in Gujarati and Marathi. This chart has proved of great usefulness in hospitals and dispensaries throughout the country.

We gratefully acknowledge a grant of Rs. 3,000 from the Sir Dorabji Tata Trust to make awards for field work in natural history. Nineteen applications were received and the amount has been divided amongst 8 selected applicants whose studies cover subjects varying from the life cycle and ecology of several branchiopods found on the Panchgani Tableland to a trip into East Nepal for the collection of plants.

It is hoped that the facility will enable the recipients to produce useful results and that these opportunities for field work will help them to cultivate and establish a permanent interest in field biology.

The scientific work of the Society is greatly hampered by the fact that its collections are presently housed in the Prince of Wales Museum while the reference library and offices are a quarter of a mile away. An ambitious plan for the establishment of a National Institute of Natural History in Bombay under the Second Five Year Plan has, unfortunately, failed to find the necessary support from the Government of India, but a more modest scheme for housing the Society's offices and invaluable research collections in a new extension on the Museum's premises is now under negotiation, and we hope that it will be possible to arrive at some suitable arrangement whereby our unique study material will be made more easily accessible to research workers, and at the same time saved from the deterioration which they are now unavoidably incurring.

The following 64 members have joined since the last Annual General Meeting:

FROM 17TH AUGUST TO 31ST DECEMBER 1955

Lt.-Col. S. A. H. Granville, Pachmarhi; Mr. N. A. G. Brooks, Bombay; Mr. S. R. Chowdhuri, Bombay; Dr. Baron von Maydell, Germany; H. E. The Right Hon'ble Mr. Malcolm Macdonald, New

Delhi; Mr. Norman Andrew, Birmitrapur; Rev. L. H. Cramer, Italy; Mr. K. W. H. Adlam, Coorg; Mrs. M. F. Tessier-Yandell, Calcutta; The Chief Forest Officer, North-East Frontier Agency, Tirap (Ledo), Assam; Mr. H. K. Dang, Letekunjan, Assam; Mr. Jan Roger Van Oosten, California; The Librarian, Gujarat University Library, Ahmedabad; Mr. Hamid Wali Mohamad, Nairobi; Mr. Merwan Chamarbagwalla, Bangalore; Shri Chhatrasalji H. H. The Thakore Saheb of Limbdi; Mr. Keser Singh, Jaipur; The Principal, Alagappa College, Karaikudi; Mr. M. Obaidullah, Bettiah; Rev. J. Pallithanam, S.J., Madras; The Principal, Government Arts College, Cuddapah; The Conservator of Forests, Northern Circle, Madhya Bharat; Mr. A H. Paul, Hoogrijan, Upper Assam; Mr. Henry Penn Wenger, Detroit; Brig. S. T. Apcar, Nilgiris; The Superintendent, Delhi Zoological Park, New Delhi; Dr. William H. Moore, California; Mr. Arjan Jairamdas, Shillong; Mr. Sris Banerji, Bhagalpur City; Mr. H. Bradley Martin, New York; Dr. K. K. Tiwari, Calcutta.

From 1st January to 15th August 1956

Major A. N. Weinman, Ceylon; Miss M. T. Leveque, France; The Chief Conservator of Forests, Nagpur; Mr. Goverdhandas Roopchand Kirpalani, Bombay; Miss M. G. York, Pithoragarh; The Dy. Director, Soils & Crops, Damodar Valley Corporation, Hazaribagh; Rev. Richard Lane-Smith, S.J., Jamshedpur; Mrs. H. M. Adcock, Bombay; The Principal, Government College, Chandigarh; Mr. A. R. Crampton, Cachar; The Fisheries Development Officer, M. B. Government, Gwalior; The Librarian, Nagpur University Library, Nagpur; Raja Mohammed Etzad Rasul Khan, Jahangirabad Raj; Mr. I. M. Clyde, Cachar; Mr. Kailash Nath Katiyar, Dehra Dun; Brig. H. G. M. Dunn, New Delhi; Mr. A. Hamish Pirie, Darrang, Assam; Mrs. F. Graham Cooch, Ottawa; Mr. Robert Gordon Peirce, Cochin; Mr. K. R. Sethna, Poona; Mr. J. M. Dalal, Bombay; The Assistant Municipal Commissioner, Poona; Mr. H. V. T. Blackburn, Raipur; Mr. F. H. G. Allen, Penang; Mr. Kishore Jayashankar Gandhi, Bombay; Mr. M. S. Raschid, Rangoon; Mr. H. H. Tyabjee, Bombay; Major J. O. M. Roberts, Gorakhpur; Mr. K. G. Gairdner, Thailand; Mr. J. V. Talcherkar, Jamshedpur; Mr. George F. Townes, South Carolina, U.S.A.; The Principal, St. Joseph's College for Women, Alleppey.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE CONFERENCE HALL OF THE B.E.S. & T. UNDERTAKING, ELECTRIC HOUSE, ORMISTON ROAD, BOMBAY, ON WEDNESDAY THE 22nd AUGUST, 1956 AT 6 p.m. WITH DR. HAREKRUSHNA MAHTAB, GOVERNOR OF BOMBAY, IN THE CHAIR

1. The Honorary Secretary's Report for the year ended 31st December 1955 having been circulated was taken as read. The Honorary Secretary then read a supplementary report for the period January to August 1956. (*See* p. 242.)

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted.

On completion of the formal business, Dr. Harekrushna Mahtab, Governor of Bombay and President of the Society, addressed the gathering. He remarked on the deplorable lack of interest in Nature Study among the Indian public, particularly in the case of young people and school children. This lack of interest and of a lively spirit of scientific inquiry was to be attributed largely to the apathy or indifference of the elders at home and of the teachers at school. He stressed the importance of early guidance, and the rich spiritual enjoyment to be derived from a proper appreciation of Nature. In this connection he commended the work of the Nature Education Scheme conducted by the Bombay Natural History Society with the aid of a special monetary grant from the Government of Bombay, and the active and continuing efforts of the Society to promote a general interest in Nature by the publication of popular, well-illustrated books on Indian animal and plant life, and in other ways. The Governor expressed high appreciation of the Society's activities in popularizing the pursuit of natural history, and promised it his full support for furthering this end.

An exhibition of original paintings of Indian birds, flowers, and butterflies, from the Society's collection as well as others kindly lent by Messrs. Thacker & Co. Ltd. and the Oxford University Press, arranged for the occasion by Mrs. V. Gardner-Lewis, was greatly appreciated by the gathering.

CORRECTIONS

Volume 53 (3), page 487 (April 1956), 4th line from bottom *for* U.G. Vaidya *read* V.G. Vaidya.

Page 690 last line. *For* 'the third longest' *read* 'the longest'.

Page 691 the record for circumference is held by 19¾" (C.R.T. Congreve) item No. 7, and not by No. 11 (Major Goring and C. Theobald) as stated.

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER 1955

FUNDS AND LIABILITIES			Rs A P	Rs A P
Trust fund or Corpus:				
Life Membership Fund.				
Balance as per last Balance Sheet		...	92,793 10 8	
Add: Amount received during the year		...	2,295 15 0	95,089 9 8
Other Earmarked Funds:				
Expedition Fund.				
Balance as per last Balance Sheet	... ...	1,900 0 0		
Less: Expenses during the year	... ...	100 0 0	1,800 0 0	
Field Work Fund.				
Donation for field work in Natural History by Sir Dorabjee Tata Trust	...	3,000 0 0		
Less: Expenses during the year	... ...	43 9 0	2,956 7 0	
Wild Life Fund.				
Donation by Mr. Blickmans	... ...		1,000 0 0	
Mammal Survey Fund.				
Balance as per last Balance Sheet	... ...	2,604 12 7		
Add: Sales to Pakistan Zoological Survey	... ...	1,701 11 0		
		4,306 7 7		
Less: Expenses during the year	... ...	678 15 3	3,627 8 4	
Reserve for future Publications		– ...	18,000 0 0	27,383 15 4
Loans: (Secured or unsecured)				
From Trustees	... ...		Nil	
,, Others	... ...		,,	Nil
Liabilities:				
For Expenses	... ...		73,410 0	
,, Advances (Subscription and Entrance Fees)	... ...		1,455 13 0	
,, Rent and Other Deposits...	...		Nil	
,, Sundry Credit Balances	...		4,702 4 0	79,568 8 0
Carried forward	...			2,02,042 1 0

ASSETS			Rs A P	Rs A P
Immovable Properties:				
Investments:				
Rs. 14,000 4% Bombay Port Trust Bonds			10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds		...	11,400 0 0	
,, 36,000 3% Funding Loan 1966-68		...	35,812 10 9	
,, 25,000 3% Conversion Loan 1946		...	25,000 0 0	
,, 2,000 3% First Development Loan 1970-75		...	1,948 12 0	
,, 92,000			84,941 6 0	
(Market value on 31st December 1955 Rs. 83,921-14-0)				
£460 3½% Defence Bonds		... ...	6,133 5 4	
			91,074 11 4	
Less: Provision for Depreciation		...	1,000 0 0	90,074 11 4
Furniture and Fixtures:				
Balance as per last Balance Sheet		...	2,500 0 0	
Less: Depreciation	... ...	...	312 8 0	2,187 8 0
Loans: (Secured) :	*Good*	*Doubtful*		
Loan Scholarships	– Nil	Nil		
Other Loans (to staff)	– 1,050	,,	1,050 0 0	1,050 0 0
Advances			Nil	
To Trustees	... ...	...	,,	
,, Employees	... ...	...	10,896 6 9	
,, Contractors	... ...	...	Nil	
,, Lawyers	... ...	...	200 0 0	11,096 6 9
,, Others	... ...	...		
Income Outstanding:			Nil	
Rent	... ...	... ...	,,	
Interest	... ...	... ...		
Other Income:				
Supplies and Services	... ...	...	6,028 1 0	
Government of Bombay (Grant)	...	...	4,000 0 0	10,028 1 0
Carried forward	...			1,14,436 11 1

BALANCE SHEET AS AT 31st DECEMBER 1955—(*continued*)

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Brought forward ...		2 02,042 1 0	Brought forward ...		1,14,436 11
Income and Expenditure Account :			*Nature Education Scheme :* (As per statement attached)		2,773 7 9
Balance as per last Balance Sheet ...	51,735 10 6		*Stock of Books on hand :* (At cost or under) as certified by the Honorary Secretary		71,643 9 0
Add : Surplus as per Income and Expenditure Account	613 8 3				
		52,349 2 9	*Cash and Bank Balances :*		
			(*a*) 1. In Current Account with National Bank of India, Ltd., Bombay ...	23,246 7 11	
			2. With National Bank of India, Ltd., London (£320-11-6)	6 ,941 0 0	
			3. Fixed Deposit Account with National Bank of India, Ltd., Bombay ...	35,000 0 0	
			(*b*) With the Trustee	N	
			(*c*) With the Cashier	350 0 0	65,537 7 11
Total ...		2,54,391 3 9	Total ...		2,54,391 3 9

The above Balance Sheet to the best of my belief contains a true account of the Funds and Liabilities and of the Property and Assets of the Trust.

BOMBAY, *20th August 1956.*

For Bombay Natural History Society

(Sd.) M. J. DICKINS,
Honorary Treasurer,
Trustee.

As per our report of even date.

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31st December 1955

Receipts	Rs	A	P	Payments	Rs	A	P
To Grant from Government of Bombay for 1954/55	5,920	0	0	By Balance due to the Society as per last Balance Sheet ...	3,382	14	3
„ Nature Study Pamphlets—Sales	966	13	0	„ Cost of Nature Study Pamphlets	776	10	9
„ Balance being amount due to the Society	2,773	7	9	„ Salary of Nature Education Organiser	5,655	0	0
				„ General Expenses (Stationery, Conveyance, etc.) ...	314	10	3
				„ Postage	131	1	6
Total ...	9,660	4	9	Total ...	9,660	4	9

Bombay, *20th August 1956.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants.

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE IX [RULE 17 (1)]

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1955* *Cr.*

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
To Expenses in respect of Properties:			*By Rent:* Accrued	Nil	
Rates, Taxes, Cesses	Nil		Realised	"	Nil
Repairs and Maintenance	"		*" Interest (Accrued and realised):*		
Salaries	"		On Securities—Realised...	3,252 11 0	
Insurance	"		" Bank Account—Realised	855 14 0	4,108 9 0
Depreciation (by way of provision or adjustments)	"		*" Dividend*		Nil
Other expenses	"		*" Donation in cash or kind*		"
		Nil	*" Grants:*		
" Establishment Expenses:			Government of India	8,000 0 0	
Salaries (including Dearness Allowance)	19,489 0 0		Government of Bombay	4,000 0 0	12,000 0 0
Society's contribution to Staff Provident Fund	949 5 0		*" Income from other sources:*		
Rent	2,400 0 0		Subscriptions	20,428 5 3	
Postage	1,205 2 0		Entrance Fees	1,372 0 0	21,800 5 3
Printing and Stationery...	699 4 9		*" Publications:*		
Editor's Travelling Expenses	1,000 0 0		Journal Sales	3,319 15 0	
		25,753 11 9	*Books etc. Profits:*		
Remuneration to Trustees:		Nil	Book of Indian Birds	2,327 6 6	
" Legal Expenses:		100 0 0	Book of Indian Animals...	2,327 5 6	
" Audit Fees:		250 0 0	Some Beautiful Indian Climbers and Shrubs	2 316 11 0	
" Amounts written off:			Some Beautiful Indian Trees	864 6 6	
Bad Debts	53 6 0		Circumventing the Mahseer and other sporting Fish	361 7 0	
Loan Scholarships	Nil		Calendars	2,222 12 6	
Irrecoverable rents	"		Taxidermy, etc.	78 10 6	
Other Items	"		Other Publications	273 15 0	
		53 6 0		14,142 9 6	
" Miscellaneous Expenses:			*Less:* Loss on: Rs A P		
General Charges	1,236 0 1		Game Birds of India ... 152 11 6		
Fire Insurance	150 0 0		Indian Molluscs 107 8 0	260 3 6	
Provision for Sales-Tax	550 0 0				
		1,936 0 1			
		1,312 8 0			
" Depreciation:					
" Amount transferred to Reserve or Specific Funds:					
Reserve for future publications ...		3,500 0 0			13,882 6 0
Carried forward ...		31,885 9 10	Carried forward ...		51,791 4 3

SCHEDULE IX [RULE 17 (1)]—*(continued)*

Dr. *INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1955—(continued)* *Cr.*

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
Brought forward ...		22,585 9 10	Brought forward ...		51, 91 4 3
To Expenditure on objects of the Trust :					
(a) Religious	Nil				
(b) Educational—Journal expenses ...	16,747 8 8				
Library	1,544 9 6				
Natural History Award ...	Nil				
(c) Medical relief	,,				
(d) Relief of poverty	,,				
(e) Other charitable objects ...	,,	18,292 2 2			
Surplus carried to Balance Sheet ...		613 8 9			
Total ...		51,791 4 3	Total ...		51,791 4 3

BOMBAY, *20th August 1956.*

As per our report of even date
(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

For Bombay Natural History Society
(Sd.) M. J. DICKINS,
Honorary Treasurer
Trustee

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