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Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS. should be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names to be printed in italics should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than $3\frac{1}{4} \times 2\frac{1}{4}$ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text-figures, line drawings, and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

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Prater, S. H. (1948): The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis:* Each scientific paper should be accompanied by a concise, clearly written synopsis, normally not exceeding 200 words.

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EDITORS,
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CONTENTS OF VOLUME 55, NO. 3

This part completes the present volume. In future each volume will consist of the three parts issued during the calendar year.

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Naturally, what is a water birds' paradise is also a happy hunting ground for the duck-shooting man. These particular jheels together with the huge and historic permanent jheel between Gurgaon and Najafgarh formed the core of the plan to control duck shooting in the District on an organised basis when the late F. L. Brayne was Deputy Commissioner of Gurgaon just over thirty years ago. Unfortunately, it was a plan, which, though temporarily successful, did not outlast its originator. More recently, in the years just before and after the last war these jheels still provided all that the naturalist and shooting-man could hope for. They were then but lightly shot-over and for the casual shooting party, without the advantage of elaborate preparation, afforded both exacting and stimulating sport. Here during the course of a winter season one could count on seeing practically all the species of migratory duck and teal which visit India, including the occasional rarity. In addition, both species of wild goose were regular visitors, the Greylag often in hundreds when the conditions for them were right.

The writer's game book, which covers about 16 years of this period shows 14 species of migratory duck and teal, as well as 5 indigenous species. The number of birds which found their way into the bag was of course only an infinitesimal proportion of those seen, for the shooting parties did not exceed 4 guns as a rule and usually shot for the first four or five hours or so of daylight and that only once a week on an average. In fact it was one of the most satisfying features of this type of shooting that while enjoying excellent sport one appeared to make no real impression on the quarry which seemed to exist in just as great numbers at the end of the season as at the beginning. At times the duck and teal were concentrated in almost incredible numbers and the concerted roar of their wings when they rose to the first shot of the day was a sound that will not easily be forgotten. The greatest concentrations were usually to be seen during the migration assemblies at each end of the season. But between times there was a remarkable change in the appearance of the birds, for by the end of February in the New Year the dowdy eclipse plumage of the previous autumn had given place to immaculate and colourful breeding dress.

Most interesting were the fluctuations in numbers of the various species from time to time over the years. For example in the late 1930's this area seemed to be only on the fringe of the Mallard's range: they were seldom seen and even less seldom bagged. Ten years later the position was very different and Mallard were not only

seen regularly in appreciable numbers but quite often formed a sizeable part of the bag. It is difficult to account for this. Similarly, the commonest of the four pochards was formerly the White-eye: more recently their abundance has definitely declined and there has been a noticeable increase in the once rare Tufted Pochard. Most pleasing of all has been the recent increase in the numbers of Spotbill, once rather uncommon in these parts. But where they breed is something of a puzzle in view of the vast increase in human population, cultivation and land reclamation all over this area in the last 10 years or so. One hopes they will continue to keep it a secret.

The proportion of species one to another in the bag by no means reflected their relative abundance at large. One of the commonest duck to be seen on the big jheels, and one of the most conspicuous, was the Pintail, but their wariness makes them difficult to circumvent and they figure sparsely in the records. Similarly Wigeon were nearly always to be seen in fair numbers but are so well able to look after themselves that their appearance in the bag was only occasional. With such an abundance and variety one could always hope for making contact with a real rarity. Twice during this period the occurrence of Bronzecapped Teal was definitely established by birds in the hand. A little more often Marbled Duck were obtained, but their status is difficult to assess accurately owing to their retiring habits. Most prized quarry of all were, as ever, the geese, particularly the Greylag, whose wiliness in the face of pursuit is proverbial, as also should be their excellence as table birds. But a careful study of them reveals that they too are creatures of fixed habits. If careful note were taken of them, a keen and experienced shooting man could reckon on bringing one or two of them to bag in a day with fair regularity during the season. Each such occasion makes an indelible mark on the memory for no one can get too old or sophisticated to experience a thrill on bagging a Greylag Goose by his own efforts.

Today the course of the non-stop air service from Bombay to Delhi lies right over this stretch of country. The eye that knows it intimately from the ground can trace the lay-out with ease from the air and see that all of these Mewat jheels are in a normal year now drained and put under the plough. From the standpoint of the national economy this is a good thing and in step with the march of time. No one, except the ultra-reactionary, can complain if the shooting man's loss is the farmer's gain. But from the aspect of wild life conservation one has to consider what adjustments may be necessary in the face of such developments. For this is not a local trend. With the continual demand for progressive expansion in food production it is likely to be country-wide. This means that with the

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Small Game Shooting and Conservation in Northern India—with some Observations on the Bombay Wild Animals and Wild Birds Protection Act 1951[1]

BY

O. H. DE ST. CROIX

Until quite recently there existed on either side of the Delhi-Alwar road, between Sohna and Firozpur Jhirka, a series of large jheels which provided a winter home for scores of thousands of all sorts of waterfowl. This is the land of the Meos in the Gurgaon District of the Punjab and is overlooked throughout its length by the Kala Pahar, one of the northward-thrusting spurs of the Aravali Range. In a good monsoon this stony ridge drains itself in profusion on to the plain below. To control this capricious flow of water in the interests of cultivation Government constructed a system of long, low bunds over a wide area and after the monsoon the result was a chain of large, shallow jheels, sprouting with vegetation and teeming with aquatic life which formed a paradise for all sorts of water birds. Here one could see at one time or another during a winter season practically the whole range of Indian waders from the several kinds of Stork, and even occasionally a flight of Flamingoes, to diminutive Stints and Sandpipers. Swimming birds of course were also fully

[1] The comments of Mr. Humayun Abdulali, the Society's representative on the Indian Board for Wild Life and on the State Wild Life Board, who is also an Honorary Game Warden for Bombay State, are given in square brackets in the body of the article.

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draining of marsh lands the best feeding grounds for waterfowl will be obliterated and the vast numbers of migratory and indigenous waterfowl, both game birds and otherwise, will have a much restricted choice of winter feeding grounds. They will not often be able to select the safest and most remote as hitherto. They will, assuming that the migratory birds continue to come to this country in the same numbers as before, have to exist in denser concentration than ever if they are to live on their feeding grounds. They will consequently be more vuinerable, especially now that firearms seem to be licensed more freely and widely than hitherto and shooting or netting appears to be practised incessantly, ubiquitously, and with little restraint. Already one hears reports of the growing scarcity of waterfowl in their former haunts. This may be due in part to migrants going elsewhere in which case they are lost to this country all together. Or in part it may be due to a change of habits in that they are only visiting their feeding grounds, where they are most vulnerable, during the hours of darkness. In that case, to the extent that they are game birds, there is a loss to sport and to the supplementary food supply. In either case the situation gives the sportsman naturalist, who cannot but be a conservationist at heart, serious cause for thought. For while it is true that vast areas are being inundated by the new dam projects under the Five Year Plan, the water of these is for the most part too deep to provide a living for large numbers of surface feeding waterfowl.

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The country within a radius of about 60 miles from Delhi lying within the Gurgaon and Rohtak Districts of the Punjab and the Meerut and Bulandshahr Districts of the U.P. provides an admirably suitable habitat for partridges both Black and Grey. It provides an ideal blend of intensely cultivated, well irrigated farm land with scrub-covered, lightly forested wastes or tracts of thick reeds and pampas grass of the Jamuna Kadir country. This combines the abundant and varied food supply afforded by intensive agriculture and the requisite amount of permanent shelter for safety and nesting purposes provided by the waste land. Country like this can support a very large, though not necessarily evenly distributed, partridge population, which undisturbed by man can maintain itself despite losses from weather conditions and natural enemies. But when there is unrestrained interference from man, the balance is very soon upset even under favourable conditions of habitat such as those described above. The fluctuating effects spread over a long period of years make an interesting and instructive study.

Our predecessors tell us that in the 1920's and before a good partridge shoot was to be had within sight of the Kutub Minar or almost anywhere in the adjoining districts of the U.P. or Punjab within a short tonga drive of Delhi. The march of time has put its foot firmly on that and no wonder, when the growth of New Delhi provided a large market for the professional trapper and the development of motor car travel increased the mobility of the shooting man. Inroads on the partridge population were heavy and not always with respect to seasons or a sporting sense of restraint.

The Black Partridge, being somewhat of a fool so far as self preservation is concerned and also the better eating bird, suffered most and by the early 1930's its status had sunk so low that its killing or capture was totally prohibited in the Gurgaon District. The Grey Partridge, though by nature better able to look after itself, was also heavily reduced in numbers and became scarce even in some of its favourite haunts. Since it has the additional disadvantages of being a popular cage bird and of announcing its presence with irrepressible regularity, it is far from being proof against the wiles of professional netters.

With the outbreak of war things changed for the better fortuitously. Petrol was rationed reducing mobility, the cost of cartridges increased in inverse proportion to their availability, shooting men were preoccupied with grimmer things. It was surprising how quickly the partridge population reacted to these favourable conditions reinforced by wise administrative action on the part of the Punjab Government. In the early 1940's it was possible, within sight of a large town and just off a trunk road not 40 miles from Delhi, to see both species as numerous as they must have been 20 years or so before.

By the time the war ended proper protective legislation had been enforced in the Punjab, which with continued petrol rationing and cartridge scarcity sustained the position for a few years. But as soon as war-time conditions receded into the background and with the population of greater Delhi increasing by leaps and bounds, there was a progressive worsening. Lax administration of the law did not help matters. But more recently the law has been tightened up, particularly as regards netting, and the early 1950's onwards have seen a definite though patchy improvement. Now it is understood that the offering of partridges for sale in Delhi has been made illegal at all times and if this is so a still further improvement is assured, for this checks by far the biggest drain on the stock.

All this should provide some useful lessons for shooting men, for shooting undoubtedly played a part in depleting the partridge stock over the years under review in this area. Partridge shooting in this

sort of country is done almost entirely on cultivated land when the birds are in search of food in the growing Rabi crops and are not difficult to flush. In well irrigated tracts, which goes for most of this area, the sugar cane patches are the favourite resort. These are relatively small in extent and can be easily covered by two guns: if well beaten out and with reasonable marksmanship a high proportion of birds seen is brought to bag. A mustard crop is a greater magnet still, especially when running to seed. Here again the patches are small, the concentration of birds sometimes surprisingly large, and the shooting easier.

Seeing that there is no artificial replenishment of stock it seems fairly clear that if the stock level is to be properly maintained some special self-imposed restraint should be practised over and above strict observation of the law, which in this case now imposes a limit per gun daily. There are certain self-imposed rules which can achieve the object in view as the writer can vouch from actual experience. The experience in question is drawn from a week's shooting from camp over a certain tract of well favoured partridge grounds twice, two seasons apart, each time with the same number of guns. On the first occasion observing the law and the self-imposed rules a very satisfactory bag was obtained in four outings. On the second occasion with the same methods and the same number of outings over exactly the same ground there was as good, if not a better, showing of birds and a bag obtained up to the legal limit. On each occasion sufficient birds were left behind to replenish the stock in the normal way.

The self-imposed rules referred to were as follows:

(1) The same ground was not shot over twice in a season,

(2) The number of guns was never more than 3 and they were spaced in such a way that no bird which went straight away could come under fire from more than 1 gun,

(3) The line of draw was pre-determined and any bird which flew out of the area to be drawn (unless known to be wounded) was allowed to go unmolested.

In addition it is felt that, in view of the nesting habits of the three commonest Indian partridges of the plains, the open season should be confined to the four months from November to February inclusive, regardless of what the law may say.

[In the Bombay Act a comprehensive Close Season from 1st April to 31st September is laid down for all small game, partly because of lack of exact information regarding the breeding seasons of the different species but mainly to simplify administration. As very few

of the officers concerned would be able to tell the different species apart, it was thought that this differentiation on paper would be useless.

The overall close season is, however, not altogether satisfactory. A little beyond Poona we shot Grey and Painted Partridge on the same day (15th February) when the former had unshelled eggs in the oviduct and the latter showed no signs of breeding. Sandgrouse shot on the same day were also in breeding condition. It is evident that the Close Season for the Grey Partridge and Sandgrouse should commence about the 15th of February if not earlier.]

The foregoing gives an idea of how the interference of man, whether deliberate or not, can affect quickly and drastically the status of birds, mainly game birds, of widely differing habits and environment, both indigenous and migratory. It emphasises the need for intelligent conservation both by law and by the voluntary self-restraint of shooting men. In the Bombay State we are fortunate in that comprehensive legislation has been enacted through the Wild Animals and Wild Birds Protection Act (No. XXIV) of 1951 and its rules. But legislation, however well drafted, by itself is not enough. Its effective implementation is of course essential if it is going to get anywhere near the achievement of its objects. For effective implementation it must have been framed with a due regard for the severely practical aspects of the problem. It is, therefore, highly pertinent to consider how the Act stands in this respect.

In the first place it is as well to be quite clear on the precise object which the Act should set out to achieve. The preamble merely states this as 'to make adequate provision for the protection of wild animals and birds . . .'. Why is it found necessary to provide special protection? To answer this the statement of objects might be expanded as follows to explain the need for protection of fauna as:

(1) to conserve a National Asset but with due regard to the safeguarding of farm crops and livestock, and

(2) to conserve wild life classed as game for shooting by way of sport in a properly conducted manner or for capture as part of the food supply by humane methods.

[The Bill when first published was accompanied by a Statement of Objects and Reasons and most of these matters were referred to in great detail (*JBNHS* 49: 817). The sentiments expressed of course cannot now affect the interpretation or administration of the Act. But since the Act has to be read by everybody taking out a

licence under it, it is as well that they should have a clear idea of its basic objects and it may be worthwhile publishing the Objects and Reasons along with the Act.]

To reconcile the interests of the farmer with the need for conservation of a national asset is one of the most difficult aspects of the whole problem. The fact has to be faced that herbivorous wild animals cannot be tolerated where crops are grown and carnivorous wild animals must be kept severely in check where livestock is raised. This is provided for in the Act (Section 50) by enabling the 'occupier' (whatever that may mean) of land to protect his agricultural property freely. But is the administration of this Section being conducted properly or is it courting abuse as it can easily do?

[In old Bombay State (1948) the total number of arms licences was 70,000 of which 50,000 were for sport and 20,000 for crop protection. Before the expansion of the State the total number of licences had increased to 1,20,000 of which those for sport remained at 50,000, the rest being for crop protection!

It is the general consensus of opinion that the only manner in which wild life can be properly protected from the depredations of the farmers is to arrange to recall or seal the guns as soon as the crop is harvested. Sketches showing how all types of guns can be sealed have been circulated, but no action has yet been taken by any State.

It may be worthwhile drawing attention to an unfortunate anomaly whereby Section 38 of the Act, requiring the surrender of animals shot in defence of property, does not cover *female* deer and antelope which are neither 'game' nor 'trophy'.]

There is also provision for classification of certain animals and birds as vermin. Is this really necessary when the interests of cultivators are already safeguarded as above? If it is at all necessary, the list should be a very short one indeed. There are certain inclusions in the existing vermin list which call for immediate comment.

By including all birds of prey and bats there is an invitation to kill some of the best rodent and insect destroyers known to man. Then again it should be remembered that an animal (wild pig for example) may be definitely harmful in a cultivated area and yet not so in a forest area.

[The inclusion of birds of prey and insectivorous bats in the list of 'Vermin' was an unfortunate error, and though nothing has yet been done, the Advisory Board decided on 21st September 1954 that

the wild pig should be removed from this category and be included in both Big and Small game.

Actually, in view of Section 50 of the Act there does not appear to be any need of a separate class of animals to be termed 'Vermin' and its inclusion allows for a lot of poaching in many different forms.]

This latter point raises the question of how the Act under reference ties in with the Forest Act and its Rules (which is understood to have its own provision) for regulating shooting and the capture of birds and animals in the Reserved Forest Areas.

[The Forest Act and its Rules still operate, but the Wild Life Act is comprehensive and refers to both forest and non-forest lands. The shooting of 'Vermin' in forest land without a permit from the Forest Department is now prohibited. For the correct administration of any game laws under Indian conditions it is I think necessary that no distinction be made between forest and non-forest land. Before the Act came into operation it was not possible to take any action against a person driving into town with a Cheetal doe in his car unless it could be proved that it had been shot inside a Reserved Forest! The Forest Rules have not been rescinded and there is a certain amount of duplication of rules with respect to the forest areas.]

There is ample provision in the Act (Chapter IV) for the formation and conduct of 'sanctuaries' for wild life. But what steps have been taken to form any in the seven years since the Act was passed? The only ones that come to mind are those at Taroba in Chanda District (inherited from M.P.), Gir in Kathiawar (inherited from Saurashtra), and the Krishnagiri National Park in Salsette: the last named has little or nothing to offer as at present constituted, though it has distinct possibilities. Surely there are other areas in the Reserved Forests of the new Bombay State which could be made sanctuaries, for cannot the creation of a sanctuary be reconciled with the requirements of forestry?

[The Krishnagiri National Park is admittedly very small (about 12 sq. miles) and its administration has now passed to the Director of the Aarey Milk Colony. A preliminary attempt at the introduction of deer into the Krishnagiri National Park has not been very successful, but Grey Junglefowl released in 1952 have now established themselves and can be heard on any morning. With the closure of shooting on the whole of Salsette Island and with the opening of the new road from the Aarey Milk Colony to Kanheri it is possible that another attempt at the introduction of Sambar and Cheetal may be more successful.

The Dandeli Game Reserve in North Kanara, which was never a national park, covers an area of about 100 sq. miles and did hold a few Bison, Deer, and Elephants. This has now unfortunately gone to Mysore and it is certainly essential that Bombay should look for suitable areas to turn into national parks. Sanctuaries are really not enough as they can be demolished by a stroke of the pen. National parks should be controlled by Acts of Parliament which render them more inviolable.]

A sanctuary in India (Taroba for instance) need not be of anything like the size of its African counterpart for the type and variety of animals, which have to be protected and which incidentally are almost all forest dwellers, differ so widely from those in Africa that the proposition is basically different. A sanctuary where killing or capture is totally prohibited, surrounded by Reserved Forest where there is proper regulation of both should be ideal for the purpose in view. It should not only be easily accessible to the public but properly administered as well, and here is where the provisions of the Act or the implementation of them seem to be lamentably inadequate. For how many officers or servants of the right calibre and training have been appointed to enforce the Act?

[The lack of suitable personnel for the administration of the Act is one of the most difficult problems before us. The number of people who can identify game birds and animals is negligible and so far no attempt appears to have been made to remove this deficiency.

Soon after the Act came into operation there was a report of a man being fined Rs. 5 for shooting an 'Opossum' during the Close Season. As this animal is not known to occur in India, the Society asked for the skin which proved to be that of a Civet Cat and which is listed as Vermin and does not require any licence! In the same area another person shot a Green Pigeon and was apparently able to prove to the Court that it was a bird of prey because it had claws!]

It seems that too much is expected of a single Wild Life Preservation Officer and honorary appointees. It also seems fairly clear that it is in the Reserved Forest areas that almost all India's species of four-footed fauna can and should be conserved. This places the onus on the Forest Department for carrying out the work required and they will obviously need a reinforcement of staff at the right level to do it. Why cannot there be an entirely separate set of rules (administered by the Forest Department) governing shooting and capture in those areas of Reserved Forest which are large enough to be divided into blocks? It is on the border line between Reserved

Forest and cultivated areas that the real clash of interests occurs, so far as big game is concerned, between the interests of cultivators and conservationists. The handling of this situation to maintain a proper balance calls for skilful and authoritative administration for which an adequate executive staff is essential.

[The preamble to the Act referred to earlier reads in part:

'Recently, so many States have merged in the State of Bombay. This has increased the State-forest area considerably. In view of this it is proposed to appoint an independent officer for seeing that the provisions of the Bill are properly implemented. Forest Officers are fully engaged with their normal work and cannot find time for effectively undertaking this duty.'

In spite of these sentiments the Wild Life Officer works departmentally under the Chief Conservator of Forests and there is very little evidence of his securing any assistance, at least from the junior members of the Forest Department few of whom really understand the details of the Act and its administration.]

There remains the administration of conservation and shooting of small game (birds almost entirely) which applies outside the Reserved Forest for the most part. While the Act provides fairly comprehensively for this on paper it can hardly be said that anything like adequate provision has been made for implementation.

[Within shooting distance of Bombay, the activities of trappers appear to have been controlled, but there is little or no evidence of increase in the number of game birds like partridge and quail. I think an important factor is one to which very little attention has been given in this country, namely Cover. The denudation of the hillsides and the continued cutting of bushes and shrubs around villages has left no cover which is essential to these birds. Where some years ago two or three guns could make a satisfactory bag of partridge, no birds are now seen. It is apparent as one walks along that the cover which existed is now gone and the small islands of scrub which produced the birds which had run the whole line of the beat no longer exist. Below the Ghats we have only the Painted Partridge which seldom goes out into the open, and the removal of its natural habitat has either reduced its numbers sadly or forced it to live in new places still unlocated.]

There also appears much room for improvement of the classification in the Act under Schedule II (Small Game): for example what are 'water-birds' and what water-birds should really be treated as game

birds? What in fact is a game bird or animal? Some attempt at definition seems indicated and the following is suggested:

'A game bird or animal is one which possesses the first and at least one other of the following three attributes:

(1) It should have adequate means of protecting itself by powers (or combination of powers) such as those of swift movement or concealment or detection or retaliation and the intelligence to use those powers, which make it difficult to circumvent and call for skill, patience and/or endurance in bringing it to bag;
(2) It should be notably edible;
(3) It should carry a trophy which is a worthy memento of the chase.'

[The term 'Water-Birds' was used after due consideration to include the 100 odd species of Sandpipers, Stints, Plovers, Curlews, Coot, Moorhens etc., etc., which are all shot at sometime or the other in the best shooting circles. It was thought that this general term with the specific exclusion of Egrets, Herons, and Storks would be sufficient, though it now seems necessary to add a few more like Flamingoes, Ibises, and Cormorants to the list of prohibited species. I do not think that it would be worthwhile attempting to make a list of the water-birds which can or cannot be shot.]

Finally, if people are to be allowed to shoot or capture game lawfully and have to pay for a licence or licences to do so (in addition to an arms licence) they should be given a fair money's worth. They should not be subjected to a complexity of rules, for example forest rules superimposed on Protection Act rules. In short they should be treated with some consideration.

[In spite of several efforts, I have still been unable to persuade Government to arrange to have the game licences issued against payment at the counter. It is true that some persons may be black-listed and licences not issued to them, but no such action has yet been taken and the problem has not yet arisen.

There has been considerable discontent among shikaris over the necessity of obtaining permission to beat in Reserved Forests, particularly as most of the shooting is arranged at short notice when there is no time to obtain permission from the District Forest Officer. At a meeting of the Advisory Board held on 22nd February 1955 it was agreed that permission should be available from the Range Forest Officer and a list of these officers would be attached to game licences. It was also recommended that if the officer was not available, the

applicant had only to make an entry in a book to be retained on the premises and proceed with the beating, though it was open to any forest officer to stop this should he think that this interfered with the work of his department. Unfortunately, there is yet no evidence of any action having been taken in this respect.]

On this basis (to take one instance) the necessity for Section 10, Chapter III of the Protection Act is not clear when it seems that the object of this provision could quite easily be achieved by the arms licensing authority notifying the Wild Life Preservation Officer direct of all licences granted or renewed under the Arms Act. Also both for convenience and information, could not a handy-sized copy of the Protection Act of 1951 (in the appropriate language) be issued automatically along with any licence granted initially under Section 11 of the Act? Licencees have to sign for having read it. [The Act and the Rules thereunder have been published in a handy booklet priced at 5 as.]

The above is mostly concerned with the proper implementation of what is an admirably intentioned piece of legislation. But no amount of effort towards implementation will be really successful unless there is an adequate amount of popular support. To enlist popular support, widespread education (starting with the young) and dissemination of information by every possible publicity medium is indicated. Also, most importantly, it is necessary to allay suspicions, which undoubtedly exist, of wild life conservation and hence game preservation being really designed in the interests of the well-to-do. These aspects of the matter will undoubtedly have to be tackled by private agency. But those who are public spirited enough to make the effort can surely expect to receive adequate Government support.

Nest construction technique of the Purple Sunbird

BY

JOSEPH GEORGE

New Forest, Dehra Dun

The nest of the Purple Sunbird (*Nectarinia asiatica*), one of the most wonderful examples of bird architecture, has been described by many ornithologists. Hume (1890) has given the following exhaustive account: 'The nest is pendent, and composed of all kinds of materials beautifully woven together with the silkiest fibres and cobwebs; hair, fine grass, pieces of decayed wood, lichens, rags, thorns, etc., are all pressed into service. The body of the nest is oval, generally, with all sorts of little pendent pieces of wood, etc., hanging below as ornaments, apparently, while the apex of the oval is prolonged into a cone meeting the point of support. A little above the centre of the oval, a small circular aperture is worked, and just above it a projecting cornice, 1 to 1½ inches wide, is extended; then on opposite side of the oval, the wall of the nest, which is ready some days before the eggs are laid, is pushed out or bulged out a little so as to give room for the sitting bird's tail. The bulging out of the back of the nest is one of the last portions of the work, and the female may be seen going in and out trying the fit, over and over again.'

Hutton, a correspondent of Hume (1890), observed that the materials of construction are not interwoven, but held together by cobwebs and seed down sparingly plastered over the other materials, and most abundant at the point of attachment to the twig from which the nest is suspended.

Adam, another correspondent of Hume (1890), found that on the second day after beginning of a new nest, it had the upper portion well formed, on the third day the nest was well blocked out, but had no inner lining, and from the fourth day to the seventh, the bird was occupied in ornamenting the outside of the nest with all sorts of stray feathers and other odds and ends. During these days it also filled in the inner lining. On the ninth day Adam found the bird sitting in the nest, presumably on eggs.

Gill (1924) has briefly described the different stages in the construction of the nest as observed in the plains of U.P. From the point of suspension, he states, the nest is gradually extended and widened till the place where the aperture should be is reached, the nest having acquired by this time the shape of a more or less solid cone with the apex on top. Now comes the aperture with the little projecting cornice above it. Next, the bird extends the body of the nest and finally the soft and cosy egg-compartment. Then follows a short period of activity during which the female may be seen going in and out of the nest, twisting her little body about inside it in order to get the pliable materials to conform to the shape of her body; and, as she sits in the nest with her bill protruding from the aperture, it acquires a distinct bulge behind in order to accommodate her tail in comfort. Gill found that the nest took about 10 days to complete.

Bates has recorded the different stages in the construction of two nests. The first nest (Bates, 1926, 1931) in a Madras garden, the construction of which he saw from its commencement, took a full three weeks to build. On the fifth day the nest had progressed to the extent of being in shape not unlike the upper half of a crinkled paper bag suspended from the branch or a small edition of an unfinished weaver-bird's nest without the cross bar. On the twelfth day this outer shell was almost completed and reminded him of nothing so much as of a deflated penny balloon, the entrance hole appearing like a rent in its side.

The next step appeared to be the construction of the porch, and by the sixteenth day this and the outer shell were altogether finished, even down to the ragged little bits hanging down an inch or so below the nest on loose strands of web. After this no further work was done on the outside. During the next week the 'balloon' was quickly inflated, the bottom presenting a more or less rounded appearance on the afternoon of the seventeenth day.

The second nest, observed by Bates (1927, 1931) in Pachmarhi, was completed within six days. The first day's work resulted in a stalk some 3 inches long which just showed signs of a division in its lower portion from which, Bates thought, the sides were eventually to be formed. On the second day great progress was made, as the entrance and porch were completed and also the sides, front, and half the back, leaving as the third day's task but the bottom and lower half of the back premises to be added. By the afternoon of the third day the female had actually commenced the filling. Three days more and the nest was finished.

The method of construction of the second nest was, according to Bates, virtually the same as that of the first nest he described. The

outside was completed in every detail before the filling and lining was put in hand. The so-called decorations, he remarks, are component parts of the outer case and, far from being additions which might easily be dispensed with, are, or rather those not merely suspended from the structure are, important solid portions—foundations—of the main framework.

Later in the same year, Bates (1931) observed the construction of a nest by the Purplerumped Sunbird (*Nectarinia zeylonica*). The female Sunbird wrapped building materials round a drooping twig causing the loose ends to project on either side of it. These projections were gradually increased, bent round, and brought together, so that the shell was thus formed of two more or less separate halves joined together from below the entrance hole.

If the second Purple Sunbird observed by Bates had adopted such a technique, that is, if it had lengthened the two halves of the stalk and joined them together from below the entrance hole, its method of construction would have been different from that of the first bird which had initially built a small edition of an unfinished weaver-bird's nest without the cross-bar, or in other words, a bell shaped structure.

Lowther (1949) saw a female Purple Sunbird flying from one bush to another one morning prospecting for a nesting site. As soon as a site was decided upon she busied herself with nest building. The following morning Lowther found the bird making 40 visits to the nest in 40.5 minutes and 50 in 60.5 minutes. At 8.15 a.m. the visits to the nest slowed down appreciably and from midday till 2.30 p.m. she did not go near the nest. On the evening of the second day the pendent home was found to have been roughly fashioned, even down to the entrance hole. The nest held the first egg on the sixth day after construction began.

It has been the experience of different observers that the nest of the Purple Sunbird is the work of the female alone. (Sálim Ali, 1955). Lowther (1949) has, however, come across three instances of the male assisting in the task 'at nests each 200 miles apart'. In one case the male bird's contribution was about 25 per cent, in the second about 50 per cent, while in the third only the male proceeded with the construction during the two days following a great fright which the female received as she left the nest.

Hutson (1954) saw 3 female sunbirds at work on their nests. At the time of observation one bird which was reducing the size of the entrance, which was too large, was never at the nest longer than 10 seconds and was often away for over a minute. The second bird was at the nest 5 to 8 seconds at a time and away for 20 to 25 seconds,

while the third one merely stayed long enough to poke in what she had brought before flying back for more.

The writer (1957) had a rare opportunity to observe the construction of a nest by the Purple Sunbird in his bungalow. This was followed by observations on the construction of a few other nests during the nesting seasons of 1957 and 1958 in New Forest, Dehra Dun, U.P. It is possible from these observations to form a complete picture of the operations involved in nest building. It would be interesting to find out, especially in view of Bates's observations, whether the technique followed by the birds in Dehra Dun is the same as that followed elsewhere. Lowther's observations on the participation of male sunbirds in nest construction also show the possibility of variation in nest construction habits.

Method of Nest Construction

The observations in Dehra Dun show that while all the birds followed the same technique of nest construction, there was a certain amount of variation in the timing of the different operations involved, as also in the number of times a particular operation was carried out. Extracts from the field notes on the construction of three nests are given at the end of this paper. These notes show the similarity in technique of construction, and at the same time serve to bring out the differences referred to above.

First day's work: Nest construction always began in the morning. On the morning of the first day, male and female birds together examined different sites and chose one. Prospecting for a nesting site appeared to begin on the day previous to this or even earlier. Bates (1931) found a pair of Purplerumped Sunbirds becoming interested in their nesting site 10 days before construction began. The female Purple Sunbird was often observed to wind cobweb at more than one site before the pair made the final decision about the nesting site. The female, who alone was found to build the nest, alighted on the chosen twig to fix the material she brought. Later on, she alighted on the nest stalk as it took shape. Some material was also fixed while hovering. The female bird was never seen coming to the nest without building material except during the first visit or first few visits in the mornings.

When nest construction began, one bird confused between two sites that were similar in appearance and close to each other on the same twig. Work proceeded simultaneously at the two sites for some time before the bird mastered the situation and built at one site alone. In one instance two strands were built close to each other at a site to

support the nest. When the nest was suspended from a sloping twig, a considerable length of the latter was usually built over. One nest built on an almost vertical stem of a climber was attached to it for a length of about 6 cm. The nest was loosely attached to the stem for a further distance of 12 cm. Bates (1931) found a Purple-rumped Sunbird wrapping building materials to a distance of 5 to 7.5 cm. on a twig drooping at an angle of about 60°. In the case of the nest built on a pendent chain (George, 1957) about 13 cm. of the latter was built into the nest. Another nest was loosely attached throughout its whole length to a vertical stem of a climber.

The next development in nest construction was to poke the nest stalk with the beak at a point about 3 cm. to 7 cm. below the point of suspension. The poking was done during several visits to the nest, but usually only once per visit. Occasionally, material brought to the nest was pushed in at this point with a vigorous thrust. In one nest the fibres around this point showed a circular orientation by 11 a.m.; in some other nests orientation was visible by the evening; in yet others, especially where leaves were used in abundance, no orientation was observed. At the end of the first day the nest stalks were found to be from 5 cm. to 15 cm. in length with a tail up to 15 cm. in length. The stalk was often shaped like a gently tapering cone with the apex at the top.

Second day's work: On the second day more material was added to the nest stalk. Poking was continued, but the head itself was now pushed into the mass of materials. Eventually a depression appeared at this point if the nest stalk was very bulky or a hole appeared if the nest stalk was fibrous and thin. Starting from the same point, the direction of the push was now changed up to about 75° to the left and right. The material at the back of the stalk got spread out and the beak of the bird and, later on, its head came out on the sides and back of the nest. The spreading out of the materials at the back and sides of the nest stalk was the first step in the formation of the pouch. The wall so formed was very flimsy at this stage with a big hole in the middle, opposite the point at which the bird started pushing, and many other smaller holes and gaps. The hole in front at the point of pushing became the entrance hole to the nest.

The addition of material to the nest went on, but much of it was now pushed in through the entrance hole. The bird continued to enter forward into the entrance hole, but it now also pushed upwards with partly lifted wings. It then backed out. The hole was enlarged by this operation. Standing on the lower rim of the opening,

the bird also pushed up the top rim with its crown. As a result of these pushing operations the hole assumed an oval shape and was larger than the entrance hole of the finished nest in length. When the bird pushed up with partly opened wings, it stretched its legs apart on the lower rim. The whole mouth of the nest was in tension during this operation and elongation of the hole took place both upwards and downwards.

The pushing in of material into the hole continued and the material was further pushed back by the head as described earlier. The wall of the nest got strengthened and the hole at the back was nearly closed in some nests. At this stage the bird carried out a very interesting operation to smoothen the sides of the entrance hole. It lifted its hind parts up to one side and pressed the material on that side of the opening with its tail, using the underside of the tail for the purpose. The operation was carried out on both sides, now on one side, now on the other. The tail was sometimes lifted well above the head for this operation.

A move to force down the bottom of the nest to enlarge and lengthen it into a pouch also began at this stage. The bird entered the nest and with a vigorous shaking movement of its body, sank into the material at the bottom.

Another interesting move was made to smoothen the lower rim of the entrance hole. The bird entered the nest, turned about and put its head outside the nest. The head was then bobbed up and down so that the throat pressed the rim. The bird moved left and right to cover the whole rim. If some point of the rim was misshapen this head bobbing was sometimes restricted to that point only.

Third day's work: On the third day the bird continued to push the top of the opening with its crown and partly lifted wings. Pressing the rim of the opening with the tail and throat, and forcing the bottom down to lengthen the pouch were also continued. In those nests where the back wall of the nest was slow to form, these operations were begun only on the third day.

The construction of the cornice and the lining of the pouch were taken in hand on the third day. The former was completed on the fourth day, while the latter was continued till the bird was ready to lay. Most of the lining work was, however, done on the third and fourth days.

A move to consolidate the materials of the wall and to bulge it out further was begun on the third day and continued on subsequent days. The bird entered the nest, remained inside in various directions and pushed the wall backwards with the underside of its tail. The

point that was pushed could be seen shaking and bulging out on the outside. The wall of the nest is very pliable, so that when the bird stopped pushing, the bulge disappeared. The directions in which the bird pushed with its tail were the same as those in which it pushed with its beak and head earlier on the second and third days. In addition, the bird took up positions at right angles to the direction it occupies while incubating and pushed out the wall on the left and right of the entrance hole.

It is interesting to compare these actions of the Purple Sunbird with the corresponding actions of the Yellowbreasted Sunbird (*Nectarinia jugularis*), so vividly described by Loke (1954) who observed the bird at work in his garden in Singapore. Every so often, the female Yellowbreasted Sunbird would sit inside the nest and turn in a circle with the object of rounding out the lower half of the nest chamber. Sometimes she would sit with her beak projecting out of the entrance and with wings slightly opened would move vigorously from side to side pushing out the walls of the nest.

The hole in the back wall sometimes became larger as a result of the tail movements of the Purple Sunbird. Material added subsequently usually closed the hole again.

Very little material was added to the exterior of the nest on the third day. On the fourth day it was done only once or twice. On subsequent days there was no addition at all.

Fourth day's work: Work on the cornice and the lining of the pouch continued on the fourth day. The lining material was smoothed down by the shaking and sinking movement. The wall was pushed on all sides with the tail. The bird also pressed against the sides of the wall with its body. Hume's expression 'trying the fit' may be taken to mean all these operations together.

The wall of the nest sometimes developed holes even on the fourth day when the bird was trying the fit. These holes were usually closed with material added later, but small holes remained in the finished nest sometimes.

The upper end of the oval opening was built over in making the cornice. The sides received on very rare occasions some material to strengthen them. The lower rim became thickened by the material added on the inside of the nest and by the ends of fibres pulled in from the outside of the nest by the bird. The result of all this was that the entrance hole became more or less circular in shape.

Fifth and subsequent days' work: Lining of the nest continued on the fifth day. No other material was added to the pouch but fibres sticking out in front were pulled in through the entrance hole and

the entrance smoothed out by the tail if found necessary. The front side of the nest was sometimes further tidied up by pushing loose projecting ends of fibres into the body of the nest.

A certain amount of work was done on subsequent mornings till the first egg was laid. This consisted in adding more lining material and trying the fit. The first egg was laid on the eighth or ninth morning after commencement of construction. The second egg followed on the next morning and the third egg, if laid, the morning after.

The 'tail' of the nest: The tail seen hanging below many nests was partly built by the bird and partly accidental. Loose strands of cobweb brought by the bird or already existing at the site 'collected' material falling off the nest. The bird sometimes also fixed material quite low down on these strands of web. There appeared to be a tendency for the bird to 'dump' large size material in the tail region. In one instance the tail was contiguous with cobweb already existing below the site so that the tail appeared to have been joined to a bush lower down. However, this connection was not as conspicuous as the one photographed by Bates (1927, 1931). It is interesting to recall Jerdon's (1877) observation of two nests being built at sites where cobweb already existed.

Collecting material for the nest: For gathering cobweb for the nest, the bird was observed to take hold of one strand after another while hovering, and fly off. For bark, the bird alighted on a suitable stem and tore off piece after piece, some pieces dropping off during the process. Most of the material was collected after alighting at suitable places. Sometimes the bird also tried with little success to snap off grass stems, etc., while hovering.

Orientation of nests: At a very early stage in the construction, it became clear that the bird invariably made the approach to the nest from the same direction. This was the direction in which the opening of the nest eventually faced. The bird did all the work on the nest from the entrance hole side. For fixing material at the back, she stretched her body out over the side or even the top of the nest. It may be worthwhile recording that out of 24 nests observed in 1957 and 1958, 13 nests faced west while only 7 faced north and 2 each faced east and south.

ACKNOWLEDGEMENT

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Observations on the Vegetation of the Rampa and Gudem Agency Tracts of the Eastern Ghats*

BY

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(*With two maps and five text figures*)

The Rampa and Gudem Agencies, as they were formerly known, are located along the Eastern Ghat ranges of the Godavari East and the Visakhapatnam districts of Andhra Pradesh (long. 81° 30′—82° 15′E. and lat. 17° 15′—18°N.). The forests of these tracts which are occupied by the hill tribes, 'Konda Dora' (or 'Koya') and 'Konda Reddi', have been very little explored. A part of the Gudem Agency tract which now lies in the Visakhapatnam district near the boundary of the Godavari East district was first visited by Col. R. H. Beddome of the Madras Forest Department in 1840. Later in 1883 and 1884 J. S. Gamble of the Madras Forest Department explored the forests along the Godavari River which include the Rampa Agency. In 1902 C. A. Barber of the Madras Forest Department again visited the Rampa Agency and other surrounding parts of the lower Godavari. Afterwards, in 1914, M. S. Ramaswami of the Botanical Survey of India collected a few specimens from the Rampa area only. A. W. Lushington visited a part of the Gudem area of the Visakhapatnam district during his collection tours in the early part of this century. The same area and the surrounding tract were next visited by V. Narayanaswami of the Botanical Survey of India in 1920. Again, in 1947, a general survey of the parts of the Rampa and Gudem areas and also the wide area in between the two zones was undertaken by V. Narayanaswami and the research party of the Botanical Survey of India including the writer. Afterwards, in 1949, the writer had the opportunity of studying the Rampa and Addatigala Agency forests in further detail.

The Rampa and Gudem Agency tracts occupy hilly regions adjoining the plains of Godavari East district and the south-west border of the Visakhapatnam district with the boundaries of the Godavari River on the west, the Sileru River on the north, the major portion of the

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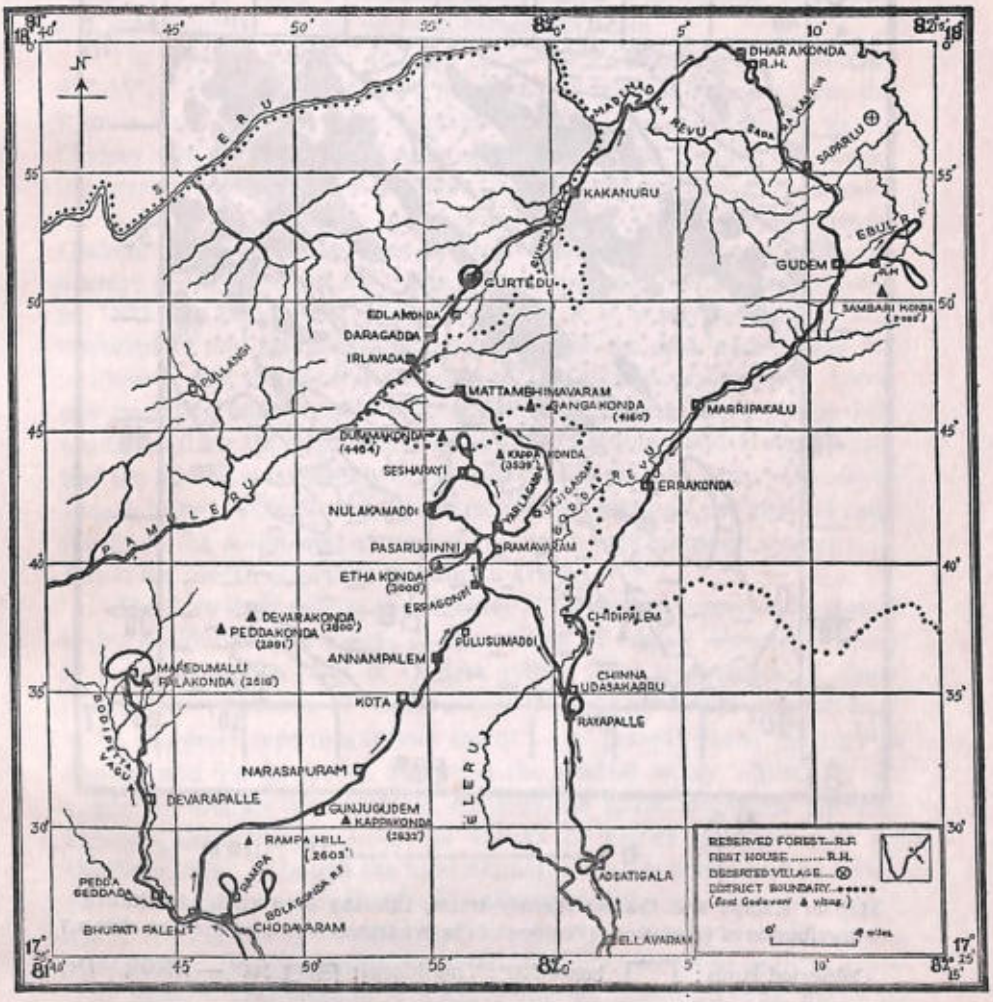
*The paper was written when the author was working at the Calcutta Herbarium and was read at the symposium on 'Vegetation Types of India' held during the 42nd session of the Indian Science Congress at Baroda in Jan. 1955.

Chintapalli taluq of Visakhapatnam district on the east, and the plains of the Godavari East district on the south. It covers an area of about 3000 sq. miles ranging from long. 81° 30′ to 82° 15′ E. and lat. 17° 15′—18°N. The ghats in this area rise by gentle gradations with an average altitude varying from 500 ft. to 4000 ft. The elevation of the Rampa country adjoining the Godavari River gradually increases from Chodavaram (30 miles north-east of Rajahmundry) and the general altitude of the area is about 1500-2000 ft. (450-600 m.). The highest point in this region is Bison Hill with an altitude of 2708 ft. (825 m.). The hills are highly dissected. The elevation from the bank of the Godavari gradually increases towards the north-east with an average altitude of about 2500-3000 ft. (750-900 m.). The highest peak in this part of the Rampa region is Dummakonda with an altitude of 4466 ft. (1361 m.). Further north-east in the Gudem area of Chintapalli taluq, Visakhapatnam district, the highest point is Sambar hill with an elevation of 5009 ft. (1527 m.). This north-eastern part of the Rampa and Gudem areas contain moist valleys with dense primeval forests and small tributaries of the rivers Sileru and Eleru running along the various gorges and valleys. The hills throughout the region under study are covered with dense forests along the slopes and present characteristic barren tops where mostly grasses and a few herbs grow. (Map 1).

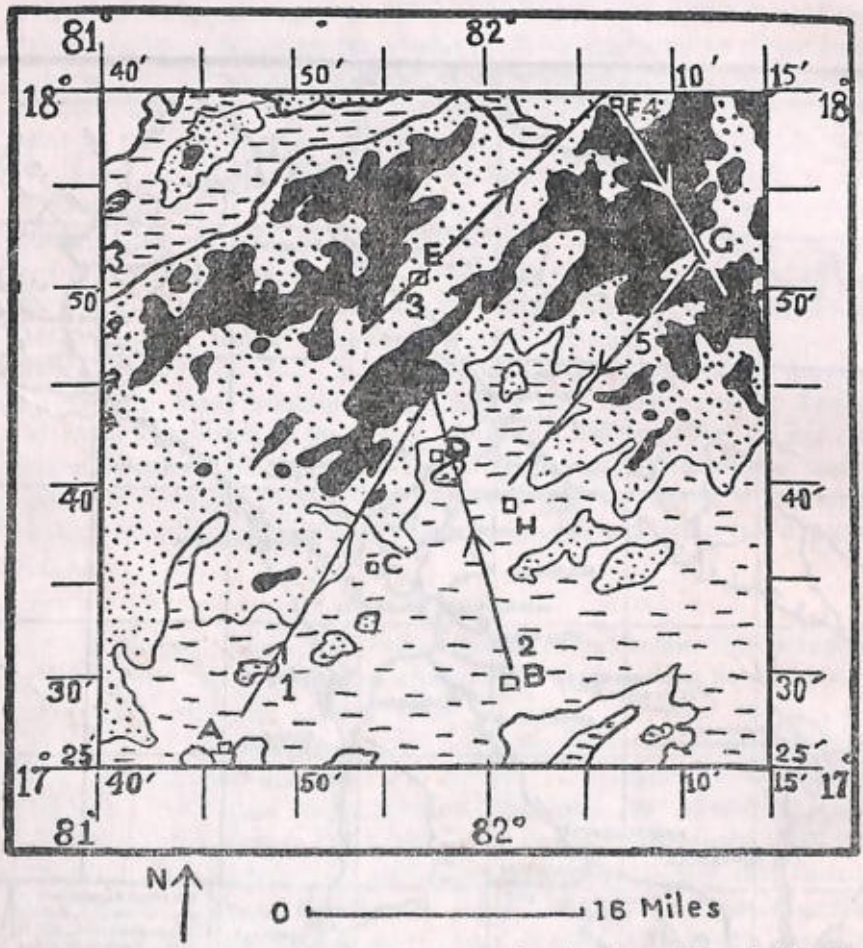
Geology

The Eastern Ghats, consisting chiefly of crystalline metamorphic rocks, have a strike north-east—south-west with various parallel structural ridges running in the same direction. Young valleys are opened up by subsequent tributaries like the Pamuleru of the Godavari River and the Maddieru of the Eleru. The region is an uplifted peneplain. The chief rock types of the area are khondalites and charnockites, the former group including garnet-biotite-gneiss (Musurumilli and near Addatigala), garnetiferous gneiss (widely distributed), garnetiferous quartzites (Seethapalli hills), and garnet-sillimanite-gneiss.

The area from Rampa to Gudem consists of different types of soils. Lateritic soil is the common type along the deciduous forests of the area. But along the plains and valleys adjoining the rivers Pamuleru and the tributaries of Eleru there is a certain amount of black cotton soil partly mixed with coarse sandy loams. At certain places the hill-sides are usually covered by stony and gravelly soil which is sometimes highly leached. The hill-tops on Bison Hill, Dummakonda, Sesharayi, Dharakonda, and others, which are almost barren with grasses and other minor herbs, usually present huge boulders and highly denuded rocky surface. Hot springs with a few sulphur deposits along the huge cut-end portion of a hill-slope near Sesharayi have been observed.



Map of Rampa and Gudem Agency tracts, showing the route followed and regions surveyed.



Map of Rampa and Gudem Agency tracts, showing the variation in altitude and distribution of vegetation. (Position of the five transects studied are also shown.)

Cultivated lands: ☐ below 500′; Transitional: ▤ 500′ — 1,500′; Dry Deciduous: ▦ 1,500′ — 3,000′; Moist Deciduous: ■ 3,000′ — 5,000′.

A. Chodavaram; B. Addatigala; C. Kota; D. Ramavaram; E. Gurtedu; F. Dharakonda; G. Gudem; H. Chidipalem.

1. Rampa to Dummakonda. 2. Addatigala to Dummakonda. 3. Daragedda to Dharakonda. 4. Dharakonda to Gudem. 5. Gudem to Chidipalem.

Climate

The climate on the hills of Rampa and Gudem is mild in summer and in some of the interior valleys of Gudem the winters are very chilly. The maximum shade temperature rarely exceeds 100°F. even in May. The valleys of Rampa and Dummakonda areas are quite hot and less humid, but the valley in between Dharakonda and Gudem is cooler and more humid. Frosts occur at higher elevations.

The general rainfall for the area as a whole ranges between 45″-55″. The rainfall shows a tendency of gradual increase from the Rampa area (south-western portion of the region under study) to the Gudem area. In places like Chodavaram, Addatigala, and the neighbouring areas with an altitude of about 1000 ft. (300 m.), the average rainfall is 45″. This average gradually increases towards Dharakonda, Gudem, and Jeypore Agencies of the Visakhapatnam district where the average rainfall is about 55″. The highest rainfall of 86.02″ was recorded in 1893 at Chodavaram (about 1000′). It is a pity that no data of temperature and rainfall from the hill-tops of the area under study are available. But the general averages of the various places given above can be safely considered as appropriate as they are based on the data available from the adjoining regions of the Rampa and Gudem areas. But the rainfall is not evenly distributed throughout the year. Usually in June-July and in October and November these areas get the heaviest rainfall from the south-west monsoon and north-east monsoon respectively. July is the month of maximum rainfall (10″).

The flora itself reflects the climate. The general vegetation is mostly a dry deciduous type except in the valleys of higher elevation where it is more moist. But in Gudem valley, there are patches of dense forest with a network of small streams which indicate the formation of moist evergreen type to a certain extent. In general, ferns are rare in number and few in species except in the Gudem valley. Similarly the epiphytic orchids are scarce in most of the lower elevations but they appear quite common along the valleys of higher elevation and the Gudem valley. Though the total annual rainfall is considered as moderate, it is noted that its distribution throughout the year is very uneven. Thus, the climate of the area under study is almost dry from December to May, the average monthly rainfall during these seven months being very little. This absence of a heavy rainfall combined with moderate temperature and rather prolonged cold season from November to March tends to favour a flora of not very moist type, a fact which is evident from the list of plants given at the end. The effect of frost is probably not very severe in the plants growing on the plateaux and other open areas. But usually it kills the saplings and other secondary growth and this causes delay in the recolonisation of the grass-lands and forest-cleared

areas by trees and shrubs. As the frost is not so severe as to inhibit growth completely, young seedlings become slowly established under the protection afforded by the larger trees along the fringe of the closed forest, thus gradually extending their range.

Another factor, which cannot be entirely overlooked and which also adversely affects the process of recolonisation, is the high winds that sweep across the plateau lands and the barren hill-tops at certain periods of the year, particularly during the months of March and April and also during the cyclonic months October and November. The high winds that blow during the hot season, with their dessicating effect on the vegetation that grows on the hill-tops with only thin soil-covering and little soil moisture, give no chance at all for the plant growth and are thus responsible to some extent for the development of barren hill-tops along the Dummakonda and other neighbouring ranges.

Biotic Factors

The people inhabiting these Agency areas are mostly 'Konda-Reddis' and 'Konda Doras' (Koyas), the two hill tribes found on either side of Godavari from the point where the Indravathi joins it down to the borders of the plains and extending as far as Jeypore Agency towards the north-east. These tribes have settled down in these areas and taken to cultivation for many years. During former times, before the reservation of forests, they indulged extensively in shifting cultivation called *podu* by clearing and burning the forests. The two methods of cultivation followed by them are the ordinary (or *chalaka*) *podu* and the hill (or *konda*) *podu*. The former consists in cultivating certain cleared areas for a year or two, then allowing the forest to grow again for a few years and again burning and cultivating those areas. Under the latter, the clearing is not returned to for a much longer period, and is sometimes deserted for ever. By this method of making clearings in the heart of the forest by felling and burning the trees, cultivating them for a year or two until their first fertility was exhausted and then moving on to new ground, and also by the fires lit for burning these patches spreading over surrounding areas, extensive tracts of the forests were ruthlessly destroyed. Many deserted villages were observed along the track followed by the Botanical Survey of India's field party. It is only after the strict enforcement of forest rules and reservations that this destructive method of raising crops has been controlled to some extent. Due to the conflict between the interests of the tribes and those of forest conservation, and also due to the violent rebellion in Rampa and Gudem Agencies, some of the well-recognised *podus* and certain cultivable areas were excluded from reservation and handed over to the people for rotation and extension of cultivation.

But there are certain zones in the Gudem valley appearing to be practically uninhabited and also unreserved and thus remaining as primeval forests uninterfered with by the human agency.

Another important factor with a considerable influence on the vegetation of the area is the grazing of cattle brought by professional graziers, particularly during the summer and monsoon months, in the Rampa area adjoining the plains. Such grazing is less common in the interior.

The effect of these two main factors, namely *podu* cultivation and seasonal grazing on the original vegetation coupled with denudation of the soil by heavy rains on certain cleared hill slopes, has been sufficient to reduce a great part of the forest to mere grass-lands or to an open dry deciduous jungle. Some of the plateaux and uplands in between the plains and the actual hilly tracts which were once subjected to destructive methods of raising crops and which are now seasonally attacked by grazing cattle or by fires created by graziers present a deserted appearance with dry eroded soil, huge weathered rocky boulders, and a few spiny bushes and stunted trees here and there.

The villages of 'Doras' (Koyas) and 'Reddis' are mostly situated in the valleys or on the uplands adjoining the hills. The rice cultivation in flood plains and other areas with black cotton soil occurring along the tributaries of Pamuleru and Eleru Rivers, mostly depends on rains. A few pulses, like arhar (*Cajanus cajan*), mung (*Phaseolus radiatus*), green gram (*Phaseolus angularis*), are also cultivated on and along the rice fields as a second crop. In other areas with laterite soils where only dry cultivation is possible, small millet (*Panicum miliare*), ragi (*Eleusine coracana*), jonna (*Andropogon sorghum*), ganti (*Pennisetum typhoideum*), are mostly grown. In the villages a few climbers of Papilionaceae and Cucurbitaceae such as 'bean' (*Dolichos lablab*), dosa (*Cucumis sativus*), and other allied species are grown. Tobacco is cultivated on the dry patches near about the rice fields of Yarlagadda village. Tamarind (*Tamarindus indica*) and mango (*Mangifera indica*) trees are very commonly grown in and around the villages. Particularly in regions near Ramavaram and Yarlagadda, there is abundant growth of tamarind trees which yield quite a good revenue to the villagers. Jak trees (*Artocarpus integra*) are also grown in this area. At Gujjumamidivalasa and the neighbouring areas, 'kamala' (*Citrus reticulata* Blanco) and musambi (*Citrus sinensis* (L.) Osbeck) are well grown. As early as 1898, one Mr. Brodie tried to introduce coffee (*Coffea arabica*) plantations in the middle Pamuleru valley and supplied seeds to the local people, but the results were not favourable. There are a few plantations still near Pullangi which are only of subsistence type. Similarly near Gudem in the Visakhapatnam district, coffee plants are grown on a small scale

round about the villages. Sago palms (*Caryota urens*) were once very abundant in the Rampa and Ramavaram areas, but most of them were cut down for removing the soft delicious pith which was used as the main food by the hill tribes during the famine years.

Sugary sap extracted from these palms is usually fermented and used as an intoxicating drink. Such drinks are also prepared from ragi (*Eleusine coracana*) and sometimes from rice. Higher up in the Bhadhrachalam area and towards the north-east, in the Jeypore Agency, 'ippa' (*Madhuca latifolia*) grows in abundance and the sweet fruit is used mainly for the preparation of a delicious intoxicating drink.

A Brief Note on Vegetable Resources of the Area

Various species of *Terminalia*, *Xylia*, *Dalbergia*, *Anogeissus*, *Pterocarpus*, *Lagerstroemia*, *Adina*, and a few others yield a useful type of timber, and there is some possibility of cultivation of *Tectona grandis* in certain localities of the region. A few minor forest products, such as fibre from leaves of *Caryota*, *Agave*, *Sanseviera*, *Sterculia*, *Helicteres*, *Bauhinia*, and a few others, floss from *Salmalia* and *Cochlospermum*, tans and dies from *Cassia* and *Terminalia* species, gums from *Pterocarpus* ('Gum kino') and *Cochlospermum* ('Katira gum'), and a few drug plants including seeds of *Strychnos* have been of considerable utility. Along the edges of streams and the surroundings of Rampa hill, aromatic grasses, such as *Cymbopogon coloratus* with a characteristic smell of Citronella oil, and *Vetiveria zizanoides* producing the well-known khus-khus roots, are available, and these can be economically exploited for the development of essential oil industry in that area. Further, experiments to cultivate other grasses, such as *Cymbopogon nardus* the typical 'Citronella oil grass', and other allied species yielding different essential oils, in order to find out the suitability of the area for extensive cultivation of such species are worth trying. Besides these grasses, wild growth of *Nyctanthes arbor-tristis* in the Rampa area and also in different areas towards the north-east (between Yarlagadda and Gurtedu), whose deliciously scented flowers are well known for their essential oil contents, is an important feature worth study in connection with the development of the essential oil industry in this area.

It appears that the excellent resources of dense growth of bamboos particularly *Dendrocalamus strictus* all along this region have not been so far utilised in the best interests of paper manufacture, which is being carried out by the paper mill at Rajahmundry the nearest city to this area. A general survey of the distribution of different species of bamboos in this region should be carried out and the introduction of better types of bamboos best suited for good paper production should be tried on the various hill slopes of this region. The means of trans-

port by land and by water can be worked out when this area becomes a suitable land for such large-scale cultivation of better varieties.

An interesting item of cottage industries can be developed among the women folk of the hill tribes by utilising the commonly growing grasses such as *Saccharum spontaneum* and *Pollinidium binatum* for making attractive mats, baskets, chiks, and other similar articles which will have a good market in neighbouring towns.

Further, introduction and systematic cultivation of Cape Gooseberry (*Physalis peruviana* Linn.), a promising bush-fruit which has already been found to be very successful and profitable in Araku valley (3000 ft.) adjacent to the Gudem Agency, and also other hill fruits and beverage crops like coffee and cocoa, spices like pepper and ginger in the hilly tracts, and mango, citrus, banana, jak, guava, sapota, and cashewnut on the surrounding plains, and several medicinal plants indigenous to this hill country, and also planning for the exploitation of other horticultural resources of Agency areas should form the important aspects of the economic programme envisaged by the Government of Andhra for the uplift of the tribal people of the Rampa and Gudem Agency tracts.

VEGETATION

The vegetation of the region under study, i.e. the region starting from the dry cultivated laterite plains to the hills extending up to the Sileru River as the northern boundary, can be divided on the basis of climate, topography, and soil into two major vegetational zones : (*i*) the transitional zone with a mixture of thorny-scrub and dry deciduous forest types of vegetation, and (*ii*) the deciduous forest zone. (Map 2).

(*i*) The Transitional Zone : This zone comprises the transitional vegetation, showing a mixture of the thorny-scrub type and the dry deciduous forest type with, however, a few laterite fields here and there which are under dry cultivation. In this zone, there is a gradual development of different species of shrubs and trees which at the beginning form into a thorny-scrub jungle consisting of xerophytic species, such as *Zizyphus mauritiana, Z. xylopyra, Alangium salvifolium, Randia brandisii, Dodonea viscosa, Maba buxifolia, Cassia occidentalis, C. auriculata, Acacia sundra, Jatropha curcas, Annona reticulata,* and grasses like *Aristida setacea, Eragrostis unioloides, Themeda triandra,* and climbers like *Derris scandens, Acacia caesia,* and a few others. Subsequently, the thorny species are replaced by plants which are bushy and stunted thus giving an appearance of the formation of an open dry deciduous forest here and there. This zone occupies a considerably small region beyond Tunnuru Reserve Forest, Musurumilli Reserve Forest, Chodavaram, and Addatigala to Kota and Ramavaram. The vegetation exhibits a sparse growth of scattered bushes of *Dendrocalamus strictus, Diospyros pere-*

grina, Strychnos nux-vomica, Cochlospermum religiosum, Garuga pinnata, Grewia tiliifolia, Euphorbia neriifolia, Casearia tomentosa, Holarrhena antidysenterica, Morinda tinctoria, Semecarpus anacardium, Webera corymbosa, Woodfordia fruticosa, climbers such as *Capparis zeylanica, Atylosia scarabaeoides, Bauhinia racemosa, B. purpurea*, and grasses like *Aristida setacea, Themeda tremula, T. trianda*, and such others. The soil in this region is mostly laterite mixed with gravel and sand and the rainfall is about 45". Approximately the 1500-foot-contour can be considered as the northern boundary of this zone.

(*ii*) The Deciduous Forest Zone: This zone can be conveniently divided into (*a*) dry deciduous forest which covers the various hilly tracts ranging between 1500 feet to nearly 3000 feet, and (*b*) moist deciduous forest which occurs here and there as pockets in the northernmost part of the region under study where the altitude increases beyond 3000 feet with warm moist valleys.

Dry deciduous forest: The region starts from Peddagaddada, Maredumalli, Palakonda, and Devarakonda through Rampa and Bolagonda Reserve Forests and proceeds towards the north-east covering the villages Gunjagudem, Kota, Ramavaram, Yarlagadda (1072 ft.), Sesharayi (2000 ft.), Mattam-Bhimavaram (2000 ft.), Gurtedu (1840 ft.), to as far as Dharakonda (1500 ft.), with various hill-tops such as Palakonda (2518 ft.), Peddakonda (2991 ft.), Devarakonda (2800 ft.), Kappakonda (2832 ft.), Ethakonda (3000 ft.), and Dharakonda Falls (2500 ft.), none of which exceed 3000 ft. (except Dummakonda hill-tops and a few others). It comprises dry deciduous forest with a variety of trees, shrubs, climbers, and epiphytes, among which the *Xylia-Terminalia-Anogeissus-Dendrocalamus* association predominates.

The region starting from Chodavaram (560 ft.) and proceeding northwards through Pedda-gaddada (750 ft.), Devarapalli (1000 ft.), Maredumalli (1285 ft.), and Etukuru (1467 ft.), along the river Bodipettavagu, flanked on either side by various hill-tops such as Palakonda (2518 ft.), Peddakonda (2991 ft.), and Devarakonda (2800 ft.), consists of dense mixed jungle with various bamboo bushes scattered all over. Rainfall is comparatively less and evaporation is great in this region, and hence the vegetation in general presents a dry appearance excepting at few points where a collection of small streams along the narrow valleys creates a humid atmosphere allowing a few ferns to grow like *Adiantum lunulatum, Drynaria quercifolia, Lastrea filix-mas, Hemionites arifolia*, and others. Generally speaking, the whole vegetation presents a dry bushy appearance with *Dendrocalamus strictus* as the prominent species. Trees such as *Pterocarpus marsupium, Aglaia roxburghiana, Strychnos*

potatorum, *Dalbergia* and *Terminalia* species, *Tectona grandis* (often cultivated), and shrubs such as *Polyalthia suberosa*, *Grewia abutilifolia*, *Olax scandens*, *Zizyphus rugosa*, *Desmodium triangulare*, which are covered by various climbers, *Bauhinia vahlii*, *Ampelocissus tomentosa*, *Thunbergia fragrans*, *Cissampelos pareira*, and others, and Orchids like *Cymbidium aloefolium*, *Vanda parviflora*, and others comprise the upper canopy of the vegetation. The lower canopy comprises the various grasses such as *Paspalum scrobiculatum*, *Hackelochloa granularis*, *Cymbopogon nardus*, *Chloris incompleta*, and herbs like *Hibiscus urcatus*, *Indigofera linifolia*, *Desmodium* and *Moghania* species, etc. Similarly, there is not much difference in the vegetation of the region from Rampa to Bolagonda Reserved Forest and from there to Ramavaram through Gunjugudem, Narasapuram, Kota, Annampalem, Pulusumamidi, and Erragondi which comprises trees such as *Terminalia* species, *Dillenia pentagyna*, *Pterospermum heyneanum*, *Chloroxylon swietenia*, *Anogeissus latifolia*, *Garuga pinnata* mixed with huge bushes of *Dendrocalamus strictus* and *Bambusa bambos*, and shrubs like *Grewia hirsuta*, *Woodfordia fruticosa*, *Erythroxylon monogynum*, and *Nyctanthes arbor-tristis*, the last named shrub growing wild covering wide tracts of the hilly slopes. (Transect Fig. 1.)

The various climbers commonly observed are *Celastrus paniculata*, *Ventilago calyculata*, *Cayratia auriculata*, *Cissampelos pareira*, *Argyreia nervosa*, and others. The lower region is covered by various grasses, *Isachne miliacea*, *Paspalidium flavidum*, *Cymbopogon coloratus* (covering large areas on Rampa hill slopes), and other cultivated millet species and herbs such as *Hybanthus suffruticosus*, *Hibiscus vitifolius*, *Canavalia virosa*, *Galactia longifolia*, and others. From some of the humid corners and rocky edges near the streams a few species of ferns, such as *Adiantum caudatum*, *Cheilanthes tenuifolia*, *Pteris pellucida*, *Lygodium pinnatifidum*, *Selaginella barbata*, and a few more, have been collected.

In the Rampa hill country various food grains, such as *Panicum crusgalli* var. *frumentaceum*, the staple food of the hill tribes (Tel. name —shama), *Pennisetum glaucum*, and *Eleusine coracana*, are commonly cultivated at the foot of the hills.

Now coming to further north-east, the hilly region surrounding the villages Ramavaram and Yarlagadda, with a considerable area of cultivated land around, shows typical deciduous forest. The common weeds in the surrounding dry and wet fields with jonna (*Sorghum vulgare*), rice (*Oryza sativa*), and tobacco (*Nicotiana tobaccum*) under cultivation are *Leucas linifolia*, *Caesulia axillaris*, *Eriocaulon quinqueangulare* (near swamp), *Melochia corchorifolia*, *Siegesbeckia orientalis*, *Sphaeranthus indicus*, and *Heteropogon contortus*. Proceeding towards Ethakonda, which was visited twice first in 1920 and again in 1947, on

the way to Pasaruginni (1250 ft.) and Chintalapudi (1500 ft.), plants such as *Justicia betonica*, *Woodfordia fruticosa*, *Acacia concinna*, *Argyreia nervosa*, *Flacourtia jangomas*, *Aganosma caryophyllata*, *Hemidesmus indicus*, *Pupalia atropurpurea*, *Casearia tomentosa*, *Andrographis ovata*, and *Phaulopsis dorsiflora* are common. At the base of Ethankonda, a tangled undergrowth with huge lianes of *Acacia*, *Caesalpinia*, and others intertwining each other, and trees such as *Strychnos potatorum*, *Pongamia pinnata*, *Terminalia belerica*, and others. Higher up beyond 2000 ft. *Xylia xylocarpa* is comparatively a more common tree and the vegetation becomes more dense with humid atmosphere, giving a chance for the lichens to grow well. But epiphytic orchids and mosses are not common, though dried up specimens of *Funaria* were observed on tree trunks and in moist corners of rocky boulders. The forest becomes more tangled with a variety of climbers like *Bauhinia vahlii*, *Mucuna florida*, *Caesalpinia crista*, *Dioscorea alata*, *Asparagus racemosus*, twining among the various trees and shrubs, such as *Xylia xylocarpa*, *Kydia calycina*, *Garuga pinnata*, *Polyalthia cerasoides*, *Helicteres isora*, *Murraya koenigii*, *Mangifera indica*, *Pterospermum acerifolium*, *Moghania strobilifera*, *Colebrookea oppositifolia*, and herbs and grasses, like *Dicliptera roxburghiana* (very common all along the way), *Pimpinella heyneana*, *Blumea virens*, *Rubia cordifolia*, *Apluda varia*, *Thysanolaena procera*, *Heteropogon contortus*, *Oryza meyeriana* (wild paddy), *Cyrtococcum oxyphyllum*, and *Brachiaria kurzii*. Interestingly enough, near the humid, shady corners and along the small hill streams at an altitude of about 2000 ft. to 3000 ft., rare specimens of a few Himalayan plants(*), tree ferns, and other members of Polypodiaceae such as **Drymaria cordata*, **Vitex peduncularis* var. *roxburghiana*, **Linociera malabarica*, *Cinnamomum zeylanicum*, *Cyathea spinulosa*, *Angiopteris erecta*, *Lygodium flexuosum*, *Gymnopteris variabilis*, *Trichomanes bipunctatum*, and several others.

The region on the northern side of Ramavaram and Yarlagadda, extending towards Sesharayi (2000—2500 ft.) and Dumma Konda (4464 ft.) is mostly covered by open deciduous forest with occasional dense humid patches near about ravines and shady corners along the narrow stream, allowing profuse growth of ferns and other plants and giving an appearance of almost semi-evergreen forest of the humid regions. Throughout the deciduous forest of this region, having an altitude of 2000—2500 ft., *Xylia xylocarpa*, *Anogeissus latifolia*, and *Terminalia tomentosa* form the dominant species of the vegetation with huge bushes of *Dendrocalamus strictus* covering wide areas at certain places near about Sesharayi after crossing Viswanatha Swami Temple on the way. Occasionally pure associations of either *Xylia* or *Anogeissus* have also been observed along the hill slopes on the way. Near about the temple,

one of the mountain slopes which is exposed to direct sun for a greater part of the day presents a very dry appearance with *Euphorbia neriifolia* and *Dendrocalamus strictus* growing prominently. *Gnetum ula*, the common robust climber of Gymnosperms, makes its first appearance in this region beyond 2000 ft. altitude. The vegetation in general comprises, apart from the common species above mentioned, huge trees of *Ficus tomentosa*, *F. mooniana*, *Garuga pinnata*, *Mangifera indica*, with climbers such as *Aristolochia roxburghiana*, *Clematis smilacifolia*, *Tetrastigma lanceolarium*, *Smilax macrophylla*, and other plants, such as *Diospyros sylvatica*, *Pogostemon plectranthoides*, *Macaranga indica*, *Grewia tiliifolia*, and many other species. Grasses are few and they are *Panicum brevifolium*, *Cyrtococcum trigonum*, *Eragrostis unioloides*, *Thysanolaena procera*, *Centotheca lappacea*, etc. Similarly the orchids, which are all epiphytic, are very poorly represented by *Aerides multiflorum*, *Vanda tessellata*, *Dendrobium aqueum*, and a few others. (Transect Fig. 2.) Very interesting plants which are recorded for the first time from this area, namely *Spilanthes acmella*, *Linociera malabarica*, *Glochidion assamicum*, *Begonia malabarica*, *Abelmoschus manihot* var. *pungens*, and other plants such as *Rubia cordifolia*, *Phyllanthus urinaria*, *Pleomele terniflora*, *Cyclophorus adnascens*, and ferns like *Dryopteris urophylla*, *Pteris pellucida*, *Hemionitis arifolia*, and others are some of the common species growing along the small hill streams.

Round about Sesharayi and the hill slopes on the way to Gurumanda, the forest is dominated mostly by *Xylia xylocarpa* mixed with *Terminalia* species, *Anogeissus latifolia*, *Kydia calycina*, *Adina cordifolia*, *Sterculia villosa*, *Tamarindus indica*, and a few others. Climbers like *Bauhinia vahlii* and *Flagellaria indica*, which is the first record of this area, and ferns such as *Lygodium flexuosum*, *Pteris pellucida*, *Nephrolepis cordifolia*, *Dryopteris urophylla* were observed and collected. Of these, a few plants of this area such as *Grewia* species, *Musa rosacea*, huge plants of *Costus speciosus*, *Dysophylla quadrifolia*, and *Vitex peduncularis* var. *roxburghiana*, a rare medicinal plant recorded for the first time from this area, need special mention.

The vegetation of the area observed while returning from Sesharayi to Yarlagadda via Nulakamaddi and Pasaruginni is almost similar to that of the region mentioned above and mostly consists of the mixed association of *Anogeissus* and *Terminalia* with various plants like *Hibiscus vitifolius*, *Peperomia dindigulensis*, *Phyllanthus debilis*, *Tylophora dalzellii*, *Jussiea suffruticosa* (a new record), and many others, climbers such as *Zehneria hookeriana*, *Clematis gouriana*, and others, epiphytic orchids such as *Cymbidium aloifolium*, *Aerides multiflorum*, and a few others, grasses such as *Oplismenus compositus*, *Eragrostis unioloides*, and a few

more, and ferns such as *Adiantum lunulatum*, *Hemionitis arifolia*, and a few others.

The area between Sesharayi and one of the hill-tops of the Dummakonda Range covering an altitude of 2500 ft.-4000 ft., comprises mostly secondary forest zone along various hill slopes where paddy cultivation was once very prevalent. The most dominant and robust species among the forest trees is *Xylia xylocarpa*, which on certain slopes forms into pure association covering an extensive area. Similarly *Dendrocalamus* species also cover a wide area, forming at certain places into pure association. Members of Podostomaceae growing on the stones in the bed of torrential mountain streams have been collected. The forest all along the way comprises various other trees such as *Emblica officinalis*, *Pterocarpus marsupium*, *Dalbergia odoratissima*, *Terminalia bellerica*, *Chloroxylon swietinia*, *Diospyros tomentosa*, *Gardenia latifolia*, *Casearia tomentosa*, *Glochidion velutinum*, with huge climbers like *Tinospora cordifolia*, *Argyreia nervosa*, *Bauhinia vahlii*, and grasses like *Oplismenus compositus*, a very common undergrowth, *Cyrtococcum oxyphyllum*, *Apluda varia*, and *Thysanolaena procera*, which are very adaptable in covering quickly the open areas of the forest zone. As already mentioned in the earlier pages, the vigorous tree-growth, which is prominent along the slopes, stops at about 4000 ft. and only very few stunted trees with bushy appearance and a few herbs grow along the weathered rocky boulders as a result of which all the hill-tops on this range present a characteristic bald appearance. While climbing to the top, it is felt as though one emerges all of a sudden from a dense forest into an open area from where all the surrounding hill-tops and even the Bay of Bengal are visible. The stunted trees on this hill top are *Phoenix palludosa*, *Emblica officinalis*, *Ptercocarpus marsupium*, and herbs such as *Phyllanthus narayanaswami*, *Osyris arborea*, *Tephrosia roxburghiana*, *Pogostemon plectranthoides*, *Dysophylla myosuroides*, *Vicoa indica*, *Hamiltonia suaveolens*, and the grasses *Apluda varia* and *Thysanolaena procera* are extremely common covering the whole barren top. Strangely enough, epiphytic orchids and ferns are not so common as in the lower ranges.

The track from Yarlagadda to Gurtedu passes along Kakulumamidi River and Yeleru Vagu, covering the valley in between the two hills Ganga-konda (4160 ft.) and Kappa-konda (3539 ft.). Many villages such as Chintakaripalem, Jajigadda, Marakota, and Mattambhimavaram of Gudem Taluk and, crossing the river Pamuleru, other villages like Irlavada, Daragadda, Edlakonda are situated on the way. Most of the forests round about these villages are replaced by the *podu* cultivation and there are many deserted villages (*padu*) on the way where mostly forests of secondary type are gradually developing. The forest of the region after Jajigadda and near about the deserted village of Degalakota

is dominated by mostly bamboo bushes of which *Dendrocalamus strictus* is the most common species. Beyond Marakota along the deep valley in between Kappa-konda and Ganga-konda, the place of ups and downs with seven turnings commonly called Edu Vampula Ghat, some of the typical deciduous forests of the area with *Cochlospermum religiosum* as the most common tree have been observed. After Mattambhimavaram, proceeding towards Pamuleru River the dark valley known as Bhusi Gandi with its very humid atmosphere develops a dense original forest with a variety of plants like *Musa rosacea, Caryota urens, Costus speciosus,* and many other species along the stream. A few specimens of *Hydrobryum* have been collected from the bed of the Pamuleru River. The rest of the area up to Gurtedu (1840 ft.) consists of scattered jungles with species *Anogeissus, Terminalia, Lagerstroemia, Woodfordia,* and several others. Some of the common species collected on the way are *Casearia tomentosa, Lagerstroemia parviflora, Gardenia turgida, Eriolaena hookeriana, Machilus macrantha, Schrebera swietenioides, Grewia hirsuta, G. glabra, Nyctanthes arbor-tristis, Abutilon polyandrum, A. indicum, Floscopa scandens, Dioscorea oppositifolia, Teramnus labialis* and also a new record of *Abelmoschus cancellatus.*

The region between Gurtedu (1840 ft.) and Dharakonda (1599 ft.) is covered by some of the best original forests of the area most of which are not under reservation by the Forest Department. The track followed is along the dense valleys watered by the chief tributary of the Gumma Revu stream and the other streams, Manipa Revu and Madimadlu Revu and its tributaries, covering an altitude between 1400 to 2000 ft. Though the area surrounding the various villages on the way is under normal and also *podu* cultivation, most of the original forest appears to be undisturbed. The vegetation comprises the tall trees of *Anogeissus latifolia, Terminalia tomentosa, T. arjuna, Emblica officinalis, Dolichandrone falcata, Schrebera wallichii,* and *Diospyros peregrina,* mixed with shrubby and herbaceous species of *Woodfordia, Grewia, Clerodendrum, Nyctanthes, Wendlandia, Desmodium, Triumfetta, Randia, Flacourtia, Gnaphalium,* and huge climbing species of *Bauhinia, Gnetum,* and *Dioscorea.* Bamboo bushes are very commonly mixed up all along the forest and at certain places along the Madimadlu River, bamboo growth is so dense that it covers the entire area forming the most dominant species among the other tree species of *Terminalia,* and *Anogeissus.* Near about the higher elevations of the valley *Xylia xylocarpa* makes its appearance here and there mixed up with the species of *Anogeissus* and *Terminalia,* the most dominant species of this valley forest (Transect Fig. 3). While crossing Madimadlu River, which was flowing with considerable force with knee-deep water, a few specimens of *Hydrobryum* and other members of Podostomaceae growing on the rocky boulders

lying at the bottom of the stream, were collected. The moist banks of the stream are well suited for the profuse growth of *Adiantum* and a few other members of the Polypodiaceae. An epiphytic orchid *Cymbidium aloifolium* growing on a mango tree was also collected. The region at the foot of the hills on either side of the track just before crossing Madimadlu Revu is quite open and though well suited both for dry and wet cultivation, has not been properly cultivated and is desert-like. The open region on either side of the path after crossing Madimadlu Revu covered by tall grasses and scattered bamboo bushes develops, interestingly enough, a large number of small trees of *Nyctanthes arbor-tristis* growing extensively in wild form.

Most of the hill-slopes round about Dharakonda are under *podu* cultivation. Some of the common trees on the neighbouring hill-slopes are *Terminalia tomentosa*, *Anogeissus latifolia*, *Mitragyna parvifolia*, *Xylia xylocarpa*, *Bischofia javanica*, *Kydia calycina*, *Machilus macrantha*, and others, covered with climbers such as *Milletia*, *Acacia*, *Dolichos*, *Bauhinia*, and *Gnetum*. The common herbs are *Trichodesma zeylanicum*, *Crotalaria albida*, *Laggera pterodonta*, *Lepidagathis hyalina*, *Dysophylla myosuroides*, and others. *Nyctanthes arbor-tristis* is also quite common in this area. The wild awnless paddy *Oryza meyeriana* has also been collected. Near the waterfall on the southern side of the village the atmosphere is quite humid and mosses have been observed growing on tree trunks and rocky boulders as distinct green patches.

The track from Dharakonda to Gudem passes through one of the most dense primeval unreserved forests of this area covering an altitude between 1500-3500 ft. The gradual ascent from Dharakonda (1500 ft.) leads to high hill slopes and mountain tops with an altitude ranging between 3000-3500 ft. which continues for a considerably long distance. At certain spots on such altitudes, where there is a network of small streams making the atmosphere highly humid, the vegetation appears to be changing from deciduous to almost semi-evergreen type, producing suitable habitat for the development of very interesting subtropical and temperate species. In this humid and dark valley with an altitude of about 3000 ft. plants such as *Pygeum acuminatum*, *Peperomia reflexa*, *Curculigo recurvata*, *Ophiopogon intermedius*, *Wendlandia gamblei*, *Smilax orolifera*, and ferns such as *Lycopodium cernuum*, *Gleichenia linearis*, *Botrychium daucifolium*, *Blechnum orientale*, *Cheilanthes farinosa*, *Dryopteris cochleata*, *Stenoloma chusanum*, and tree ferns *Cyathea spinulosa*, and *Alsophila glabra*, and many others, all of them typical species of subtropical and temperate regions, have been collected. Due to the favourable humid surroundings, epiphytic orchids are very common in this area. To mention a few, *Dendrobium pierardi*, *Eria bambusifolia*, *Luisia teretifolia*, *Oberonia ensiformis*, *Pholidota imbricata*

DISTRIBUTION OF DOMINANT SPECIES ALONG THE TRANSECTS

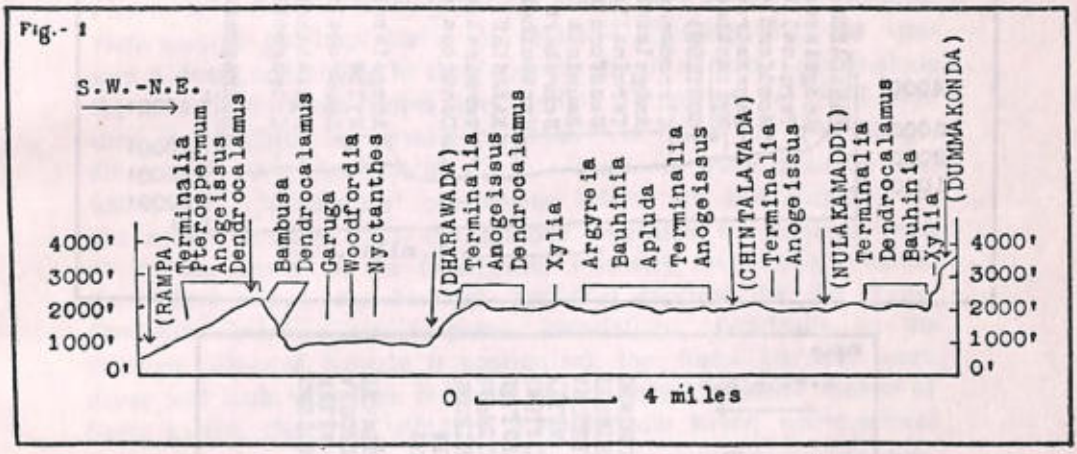


Fig. 1. From Rampa to Dummakonda top.

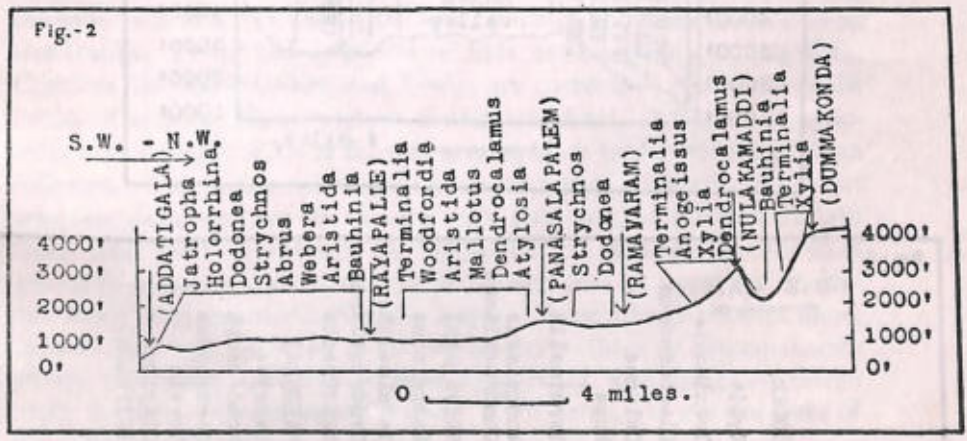
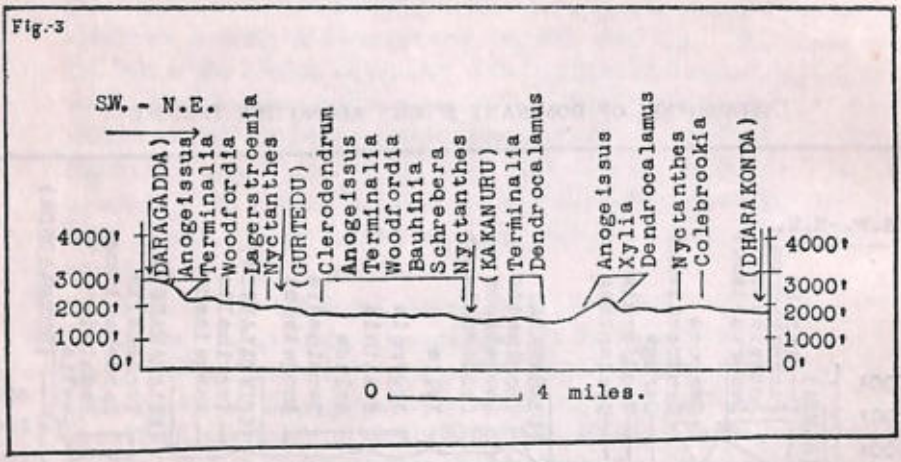
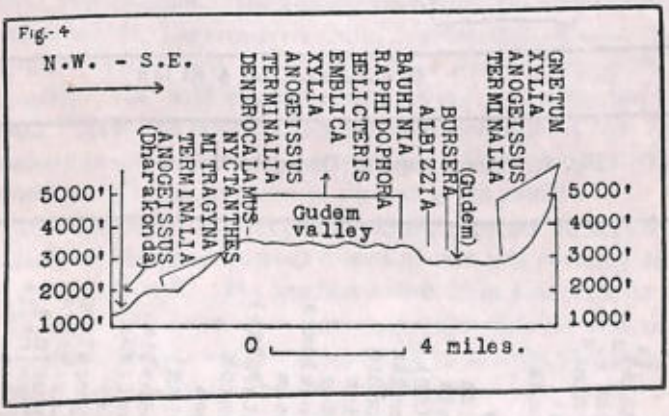


Fig. 2. From Addatigala to Dummakonda top.

DISTRIBUTION OF DOMINANT SPECIES ALONG THE TRANSECTS





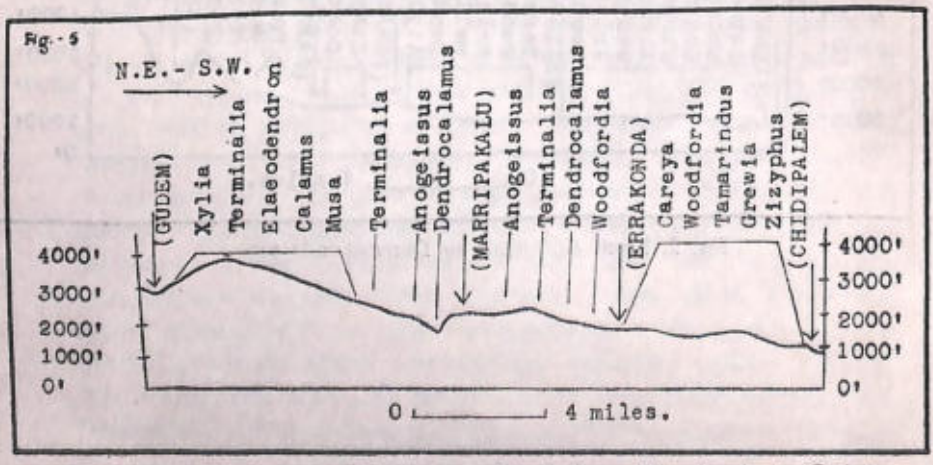


Fig. 3. From Datepadu to Dharakonda. Fig. 4. From Dharakonda to Gudem.
Fig. 5. From Gudem to Chidipalem.

may be quoted. During the ascent from Dharakonda from 2000-2500 ft., bamboo forest mixed with *Terminalia*, *Anogeissus*, and *Xylia*, and with the undergrowth of *Triumfetta*, *Dicliptera*, *Sida*, *Desmodium*, and *Nyctanthes* is the common sight. On certain slopes *Xylia* is the most common tree mixed up with a dominant growth of *Dendrocalamus* and *Bambusa* species. Shrubby growth of *Zizyphus*, *Helicteres*, *Nyctanthes*, *Flacourtia*, and a tall bushy growth of grasses such as *Apluda*, *Themeda*, *Heteropogon*, and huge leaves of *Bauhinia* climbing over the trees give a dense appearance to the deciduous forests at certain places along the path. On some slopes the bamboo forests are so dense that they may rightly be termed primeval. As there are no villages along this valley, the trees of *Caryota urens* are quite common and undisturbed. Mosses and crustaceous lichens are also common on wet rocky boulders. As the altitude increases to 3000 ft. and above, the density of the forest also increases, presenting a humid atmosphere where the bamboo forest is replaced by the *Xylia-Terminalia-Emblica-Cassia-Anogeissus* association. Gradually, as the deserted village of Saparlu is approached, the forest becomes more dense and dark with high humidity and a network of small streams of Sapar kalava, the main tributary of Madimadlu River, where several interesting plants of subtropical and temperate climates, already mentioned, have been collected. Liverworts and mosses with male and female 'flowers' are very well developed and quite common, covering the moist soil and rocks along the small puddles and streams and also on tree trunks. Ferns and epiphytic orchids are numerous in this area. Climbers like *Raphidophora* and *Smilax* are common. Along the moist banks of streams *Musa rosacea*, *Costus*, tree ferns, *Cyathea*, and *Alsophila* with a height of 15-20 ft., and several other tender herbs have been collected. The valley with such a dense forest, appearing almost of semi-evergreen type, covers a very wide area and, as the altitude falls from 3000–2800 ft. towards the approach of Gudem, the humidity gradually decreases and the narrow path enters into an open dry deciduous forest with exposed mountain slopes. Some of the hill-tops along the way have been observed to be very similar so those of Dummakonda group, presenting a barren, rugged appearance with huge weathered rocky boulders, covered by tall grasses, a few herbs, and stunted trees of *Phoenix*.

Round about Gudem, the country is very picturesque with huge mountain peaks around. Of these, the Sambarikonda with its peak reaching an altitude of 5009 ft. is the highest in the region under study and is also one of the highest peaks in the Eastern Ghats range. The region towards the deserted village of Nilavaram and the Ebul Reserved Forest with an elevation of about 2500 ft. is covered by the common

species characteristic of these forests namely *Terminalia* and *Anogeissus* with other trees such as *Albizzia odoratissima, A. marginata, Eriolaena hookeriana, Bursera serrata,* and *Casearia graveolens,* shrubs such as *Gymnosporia bailadillana, Grewia tiliifolia,* and *G. abutilifolia,* and the herbs of *Commelina salicifolia,* a few members of *Cyperaceae* near the watery edges, *Alysicarpus, Rhynchosia, Laggera, Leucas,* and others. The common climbers covering the trees are *Zizyphus xylopyra, Gnetum ula, Thunbergia fragrans,* and *Cryptolepis buchanani.* The orchids particularly species of *Saccolabium* are very common, epiphytic on the forest trees. An interesting terrestrial orchid *Satyrium nepalense* from moist soil and a member of Charales (algae) *Nitella furcata* from the bed of a small tank have also been collected. Several grasses, some of them growing profusely to nearly 6-8 ft., covering the lower regions of the Ebul forest have been collected, e.g. *Cyrtococcum oxyphyllum, Apocopsis wightii, Themeda triandra, T. tremula, Cymbopogon martini,* and many others. *Carex stramentitia,* a member of the family Cyperaceae, collected from a few places of this region is the first record for south India.

The hilly region towards south-east Gudem along the route to Sambarikonda with an altitude starting from 2700 ft. is covered with typical deciduous forest with species of *Terminalia, Anogeissus,* and *Albizzia,* mixed up with trees such as *Macaranga peltata, Litsaea polyantha, Embelia tsjariam-cottam,* and others, covered by climbers such as *Aganosma dichotoma, Clematis smilacifolia, Dioscorea glabra,* and also *Gnetum ula,* which is the most common and robust climber in this region (Transect Fig. 4). Shrubs like *Memecylon gracile, Paramignya scandens* (new record for peninsular India), *Grewia glabra,* and others, and herbs such as *Plectranthus, Anisomeles, Begonia, Phrynium, Boehmeria,* and many ferns species of *Asplenium, Diplazium, Leptochilus,* and grasses such as *Microstegium monanthum, Apluda, Oplismenus,* and several others cover the lower regions of the forest. Interesting collections of *Balanophora indica* with male and female inflorescences, and rhizomes and pinnae from the small trees of *Angiopteris evecta* were made at an altitude of about 4000 ft. The region above 4000 ft. in Sambar Hill (Sambarikonda) could not be explored as the upper part is so steep and rugged that it could not be climbed ordinarily without any special arrangements.

The region from Gudem to Marripakalu along Gangadevi Ghat proceeding down from an altitude of about 3700 ft. to 1500 ft. comprises one of the richest vegetation of the area similar to Gudem valley, unreserved by the Forest Department and undisturbed by the hill people. The track runs along the main tributary of Bodda Revu River flowing down from the Sambar Hill range, and hence the area is watered well by a network of small streams. At certain spots as

in the Gudem valley, the forest is so dense with a dark and humid atmosphere that it appears to present a primeval almost semi-evergreen type of vegetation with abundant growth of ferns, including tree ferns such as *Alsophila glabra* and *A. latebrosa*, and orchids, and with profuse undergrowth of shrubs and herbs and closely developed huge tall trees covered by lianes and climbers. Besides the common species of *Xylia*, *Terminalia*, and others, which form the dominant plants of the forest, the other interesting plants observed and collected are *Elaeodendron glaucum*, *Glochidion malabaricum*, *Canthium dicoccum*, *Pouteria tomentosa*, *Zizyphus glabra*, *Pimpinella monoica*, huge bushes of *Calamus viminalis*, *Musa rosacea*, tufted grasses like *Pennisetum hohenackeri*, *Setaria palmifolia*, and many others.

Proceeding down from Marripakalu (1324 ft.) to Rayapalle through Errakonda (1086 ft.) and Chidipalem (906 ft.) typical open deciduous forest with the common species of *Anogeissus*, *Terminalia*, *Careya*, *Woodfordia*, and others covering almost plain region with low hills on either side has been observed (Transect Fig. 5).

Frequency of Families

Although the collections made in this region are not so exhaustive as to offer any conclusive remarks, a very fair indication of the numerical strength of the most important families can be obtained from an analysis of the collections comprising about 800 species including cryptogams. The eleven families of Angiosperms with a fairly good representation of species are listed below, together with the corresponding sequences of families for the Madras province and for Bihar and Orissa (the surrounding regions of the area under study) as given in Gamble's FLORA OF MADRAS and in Haines's BOTANY OF BIHAR AND ORISSA and also for the whole of India as given in Hooker's SKETCH OF THE FLORA OF BRITISH INDIA for the sake of comparative study :

Sequence for Rampa and Gudem Area.		*Sequence for Madras Province.*	*Sequence for Bihar and Orissa Provinces.*	*Sequence for India.*
Families	*No. of species.*			
I. Leguminosae	85	— Leguminosae	— Leguminosae	— Orchidaceae
II. Gramineae	72	— Gramineae	— Gramineae	— Leguminosae
III. Euphorbiaceae	38	— Rubiaceae	— Cyperaceae	— Gramineae
IV. Acanthaceae	30	— Acanthaceae	— Compositae	— Rubiaceae
V. Compositae	30	— Euphorbiaceae	— Euphorbiaceae	— Euphorbiaceae
VI. Rubiaceae	26	— Orchidaceae	— Acanthaceae	— Acanthaceae
VII. Orchidaceae	26	— Compositae	— Orchidaceae	— Compositae
VIII. Malvaceae	21	— Cyperaceae	— Rubiaceae	— Cyperaceae
IX. Labiatae	20	— Labiatae	— Labiatae	— Labiatae
X. Cyperaceae	19	— Asclepiadaceae	— Scrophulariaceae	— Urticaceae
XI. Urticaceae	19	— XIV	— ..	— ..

Convolvulaceae (XII) with 17 species, Commelinaceae (XIII) with 14, Scrophulariaceae (XIV) with 13, and Tiliaceae (XV) with 11 follow the above sequence. The number of Dicotyledons is almost three times that of the Monocotyledons, and there is only one species of Gymnosperm. Comparing the sequence of families for the Rampa and Gudem Area and for the Madras Province, the most noticeable changes are the fall of Rubiaceae from third to sixth place, the advance of Euphorbiaceae from fifth to third, and the securing of the eighth place by Malvaceae which has no place at all in the sequences given for the other three regions.

There is quite a good number of plants, which have been collected for the first time from the Rampa and Gudem Agency tracts and which were not recorded by Gamble in FLORA OF MADRAS for these areas. Besides these, there are a few interesting collections given below which are new records: (I) for the Northern Circars, (II) for the Eastern Ghats running along the east coast, (III) for the whole of peninsular India, and (IV) for India.

I. New Records for the Northern Circars

Note : Previous records are given after the name of the plant and its family.

1. **Gymnosporia bailadillana** Narayanswamy & Mooney. Celastraceae.
   Bailadila Hill, Bastar & Kalahandi (Mooney).
2. **Galactia longifolia** Bth. Papilionaceae.
   W. Ghats (Gamble); Orissa Ghats (Mooney).
3. **Jussiea suffruticosa** Linn. Onagraceae.
   W. Ghats and West Coast (Gamble); Orissa (Haines).
4. **Flagellaria indica** Linn. Flagellariaceae.
   Deltaic forests of Mahanadi (Haines).
5. **Curculigo recurvata** Dryand. Hypoxydaceae.
   Forests of Singbhum and Puri (Haines).
6. **Bupleurum mucronatum** Wt. & Arn. Umbelliferae.
   Western Ghats and Nilgiris (Gamble); South Kalahandi (Mooney).
7. **Drymaria cordata** Willd. Caryophyllaceae.
   W. Ghats from S. Kanara, Mysore (Gamble); Parasnath (Haines); Kalahandi, etc. (Mooney).
8. **Abelmoschus cancellatus** Wall. Malvaceae.
   Chota Nagpur, Santal Parganas, Sambalpur (Haines).

II. New Records for the Eastern Ghats

1. **Abelmoschus manihot** var. **pungens** Hochr. Malvaceae.
   Orissa hills (Mooney).

2. **Begonia malabarica** Lam. Begoniaceae.
   Nilgiris, Annamalai, and Pulney hills up to 6000 ft. (Gamble).
3. **Ludwigia prostrata** Roxb. Onagraceae.
   W. Ghats, Annamalais at 2000 ft. in swamps (Gamble); supposed to be in Orissa but not collected (Haines).
4. **Schefflera stellata** Haines. Araliaceae.
   Nilgiris and Pulneys up to 6000 ft. (Gamble).
5. **Balanophora indica** Wall. Balanophoraceae.
   Nilgiris—Travancore hills up to 5000 ft. (Gamble); Mahableshwar and Khandala (Cooke).

III. Records for Peninsular India

1. **Nervilia crispata** Schltr. Orchidaceae.
   Sikkim. First collected by Pantling in 1895 from Lachung valley (7000 ft.), Sikkim and there is only one sheet in Calcutta Herbarium. Subsequently Narayanaswamy collected it from Devarakonda (2000 ft.) on 7 October 1920.

IV. New Records for India

1. **Alocasia decipiens** Schott. Araceae.
   Burma and the Andamans. This plant was first collected by Ramaswamy on 8 July 1914 from Rampa hill slopes and was wrongly identified by Fischer as *A. macrorhiza* and recorded as such in the FLORA OF MADRAS.

Summary

The forests of the Rampa and Gudem Agencies located along the Eastern Ghat ranges of Godavari East and Visakhapatnam districts of Andhra State (long. 81° 30′–82° 15′ E. and lat. 17°.15′–18° N.) have been very little explored. The vegetation of this area with an average rainfall of 45–55 inches can be divided into two major zones: (i) the Transitional Zone with a mixture of thorny-scrub and dry deciduous forest types of vegetation (from the 500-foot contour to the 1500-foot contour), and (ii) the Deciduous Forest Zone (from 1500-foot contour upwards). The first zone comprises mostly arid, scattered, thorny, scrub jungle with many xerophytic species. The Deciduous Forest Zone comprises the dry deciduous forest ranging between 1500–3000 ft. (450–910 m.) altitude, and the moist-deciduous forest from 3,000 ft. (910 m.) upwards. *Xylia-Terminalia - Anogeissus - Dendrocalamus* association predominates in various parts of the region under study. Most of the hill-tops of the various ranges present, beyond 4000 ft. (1220 m.) altitude, a characteristic bald appearance with no tree-growth and are covered by dry weathered rocky boulders, allowing stunted

growth of a few shrubs and herbs. The Gudem Valley at an altitude of about 3000-3600 ft. (910-1070 m.) develops one of the most dense primeval, unreserved forests of the area with a few pockets of highly humid, dark corners, presenting almost semi-evergreen type of vegetation where several Himalayan species of *Lycopodium*, *Gleichenia*, *Botrychium*, *Alsophila*, *Peperomia*, *Pygeum*, *Curculigo*, and a few other sub-tropical and temperate species have been collected. The region along the Ganga-Devi Ghat also presents similar primeval forests, with patches of almost semi-evergreen type of vegetation. Occurrence of *Nyctanthes arbor-tristis* and essential oil grass species of *Cymbopogon* in wild condition, covering large tracts of the hill-slopes, is one of the interesting features of the vegetation worth studying in detail. Further, there is great possibility for the development of fruit-growing and other allied industries and also for the exploitation of various other horticultural resources of these Agency tracts.

Several species belonging to such distant regions as the Himalayas, Assam, Burma, and the Andamans have been newly recorded from this area and this indicates the necessity of exploring vast tracts of India for the many unknown species and their newer localities. Various aspects of the region and its vegetation, such as Geology, Climate, Biotic factors, Vegetable resources of the area, types of forests and their floristic composition and frequency of families are given in the paper along with lists of new records collected.

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Some Biometrical Observations on the Common Rats of Bombay

BY
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The study of rats in relation to plague epidemiology has been made for the last many years[1],[2]. Bombay rats have been studied in the past by the Indian Plague Commission and other workers. Recently, it has been observed in Bombay that the erstwhile carriers of plague, namely *Rattus rattus* and *Rattus norvegicus*, are becoming immune to plague while the Lesser Bandicoot or Indian Mole-Rat *bandicota bengalensis*, normally an inhabitant of fields, is becoming more susceptible to the disease. Some significant changes in the percentages of the different species of Bombay rats collected are also noticeable in recent years.

Considering the present state of affairs an attempt was made in 1954 and 1955 to study the common Bombay rats with special reference to certain biometrical measurements, breeding seasons, and some morphological characters which would help in increasing existing knowledge regarding the general classification of these rodents of Bombay.

A large number of rats (both alive and dead) are received at the Haffkine Institute daily from different parts of the City for examination. From this central pool of rats about a dozen (whenever available) were taken every day for the present investigation. The rats were etherised before measuring. Body measurements were taken with a measuring tape. Rings on the tail and vibrissae were actually counted.

For studying the pads and the rings on the paws the specimens were placed under the binocular microscope. Actual counting of hairs was done for the density of fur in the particular measured area. The number of rats used are given in Table I.

Each form of rat in Bombay has its own characteristic percentage in the rat population. During recent years, a definite shift has been observed in the percentage of the different forms. Table II gives the percentage of different rats brought to this Institute during different years. It will be seen that the percentage of *R. norvegicus* is more or less constant, while that of *R. rattus* shows a definite decrease during

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[1] Hossack, W.C. (1907) : An account of Rats of Calcutta. *Mem. Ind. Mus.* 1 : 1-80.
[2] Reports of Haffkine Institute, 1947 to 1955.

TABLE I:

SHOWING THE NUMBER OF RATS USED FOR BIOMETRICAL OBSERVATIONS DURING THE PERIOD OF STUDY

	No. of rats received at the Institute both alive and dead		No. of rats measured		Sex-wise distribution of the rats used for biometrical observations					
					1954		1955		Total	
	1954	1955	1954	1955	Male	Female	Male	Female	Male	Female
R. rattus	2,31,861	2,40,765	898	931	414	484	471	460	885	944
R. norvegicus	1,67,450	1,80,135	500	617	254	246	228	289	582	535
B. bengalensis	3,56,433	4,51,446	624	736	274	350	423	313	697	663
B. indica	8,139	7,551	18	24	12	6	13	11	25	17
M. musculus	52,568	44,709	13	27	9	4	12	15	21	19
S. murinus	1,22,367	1,04,887	81	98	41	40	52	44	93	84

TABLE II:

SHOWING THE PERCENTAGES OF DIFFERENT RATS RECORDED IN THE RAT CATCHES BROUGHT TO THE INSTITUTE

Year	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
1947	38.0	16.2	34.7	0.2	8.0	2.9
1948	36.6	18.8	31.8	0.4	8.5	3.9
1949	23.3	20.0	42.2	0.4	9.1	5.0
1950	23.9	17.6	39.3	0.7	11.0	7.5
1951	21.1	16.5	36.7	0.8	13.1	11.8
1952	22.6	17.7	38.1	1.0	13.0	7.6
1953	22.3	16.7	39.9	1.0	14.3	5.8
1954	24.7	17.8	38.0	0.9	13.0	5.6
1955	23.4	17.5	43.9	0.7	10.2	4.3

recent years[1]. *Bandicota bengalensis* shows a greater increase as compared with *R. rattus*. This form, originally to be found in fields, is now coming nearer human habitation. The percentage of *B. indica* is very low in the total population. *Mus musculus* and *Suncus murinus* show a slightly increased percentage in recent years.

Table III summarises the observations made on the weight, length of body, length of tail, head, ear, number and characteristics of rings on tail, number of vibrissae, nature of fur on the body, number of mammary glands, structure of paws, droppings, and other characteristics. It is intended to serve the general public as a handy guide for identifying Bombay rats; therefore, details are omitted. Biometrical observations help in giving definite information as regards the measurements of different body parts in the various species. Study of fur is important from the point of host specificity. Ectoparasites, especially fleas, like a fur of thick density and of a texture that will suit their movements on the host's body. *R. rattus*, which carries the largest number of fleas, has fur of thick density and of smooth texture. But the fur is comparatively thin in the case of *R. norvegicus* which carries a smaller number of fleas. Fur of *B. bengalensis* is of harsh texture and thick density; *B. bengalensis* carries more *Xenopsylla astia* than *X. cheopis*.[2] It appears that *X. astia* likes fur of thick density and harsh texture while *X. cheopis*

[1] Report of Haffkine Institute, 1947 to 1955.
[2] Deoras, P. J. and Tonpi, K. V. (1956): *The Journal of Bombay University* **25** (3): 13.

TABLE III

SOME DIAGNOSTIC CHARACTERS FOR THE IDENTIFICATION OF THE COMMON RATS OF BOMBAY

No.	Character	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
1.	Common name.	House Rat	Brown Rat	Indian Mole-Rat	Bandicoot Rat	House Mouse	Grey Musk Shrew
2.	Habit ..	In and near houses	Away from houses; in drains	In fields and in open spaces	Only in fields	In houses near man	Insectivorous, near man
3.	Body ..	Medium slender animal	More fleshy than *R. rattus*	Heavy build, piglike face	Very big, ferocious	Looks like a miniature of *R. rattus*	Small, slender, with short snout
4.	Weight*	120–125 gm.	142–146 gm.	234–237 gm.	370–414 gm.	23–26 gm.	60–65 gm.
5.	Total Length	35–38 cm.	35–41 cm.	36–41 cm.	38–45 cm.	15–20 cm.	20–24 cm.
6.	Length of Tail	20–22 cm. Always greater than length of head and body together, uniformly tapering from base to tip.	17–19 cm. Always less than head and body together. Not uniform and tapering. Tuft of hairs at tip.	18–20 cm. Less than or sometimes equal to length of head and body together.	19–23 cm. Equal to length of head and body. Not uniformly tapering.	6–7 cm. Less than length of head and body.	6–8 cm. Less than length of head and body.

* Females are heavier than males.

TABLE III—(*contd.*)

SOME DIAGNOSTIC CHARACTERS FOR THE IDENTIFICATION OF THE COMMON RATS OF BOMBAY

No.	Character	*R. rattus*	*R. norvegicus*	*B. bengalensis*	*B. indica*	*M. musculus*	*S. murinus*
7.	Head and snout ..	3.5–4 cm. Short, long and sharp	4–4.2 cm. Wide and sharp	4.5–4.7 cm. Short, stumpy, pig-like	5–5.4 cm. Broad, slightly longish	2–2.3 cm. Small in size	3–3.4 cm. Less broad. Pointed snout
8.	Rings on tail ..	225—240 rings, well marked	165–170 rings, faintly marked	160–170 rings, clearly seen. Scaly tail	230–240 rings, not clear	35–40 rings, not very clear.	No rings. Small, very fine hairs.
9.	Ears ..	2.4–2.5 cm. Translucent. No hairs. Ears reach the eye when stretched forward	2.0–2.2 cm. Opaque and thick. Ears do not reach the eyes	2.5–2.6 cm. Thick and opaque	2.5–2.8 cm. Short and opaque. Ears do not reach the eyes.	1.1–1.3 cm. Small and translucent	0.5 cm. Very small and of a rounded shape like a human ear
10.	Mammary glands ..	5 pairs,	6 pairs,	9 pairs,	10 pairs,	4 pairs,	3 pairs,
		2 pectoral,	2 pectoral,	2 pectoral,	3 pectoral,	1 pectoral,	0 pectoral,
		3 inguinal	4 inguinal	7 inguinal	7 inguinal	3 inguinal	3 inguinal

11.	Fur ..	Soft blackish brown	Soft, brownish, white on belly	Thick, round, blackish brown, prominent spines present	Very thick, coarse, dark brown, long spines	Fine short hairs, smooth in texture	Smooth grey, faint on belly
	Between fore legs ..	379.8 per sq. cm.	348.2 per sq. cm.	412.5 per sq. cm.	436 per sq. cm.	159.1 per sq. cm.	127.7 per sq.cm.
	Between hind legs ..	343.3 do.	332.6 do.	396.2 do.	420.5 do.	141.2 do.	113.3 do.
	Anterior dorsal ..	388.4 do.	367.6 do.	431.3 do.	443.5 do.	172.7 do.	146.3 do.
	Posterior dorsal ..	366.3 do.	367.6 do.	406.4 do.	415.1 do.	146.3 do.	124.6 do.
12.	No. of pads on forepaws ..	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 3 interdigital, 1 hypothenar, 1 thenar	5 on tips of digits, 4 interdigital, 1 hypothenar, 1 thenar
13.	Shape and average weight of faecal pellets ..	Scattered, sausage-shaped, 0.0521 gm.	In groups, spindle-shaped, 0.0808 gm.	Scattered, oval, 0.0417 gm.	Scattered, big spindles, 0.064 gm.	Fine spindles, 0.0212 gm.	Scattered, small, longish, 0.0258 gm.
14.	Noise ..	*Chew-Chew*	Squeaks	Grunts	*Khur-Khur*	*Chur-chur*	Long note *sheer-sheer*
15.	The month when more pregnant females were received.	June to August	July to August	July to August	—	—	—

TABLE IV

FREQUENCY DISTRIBUTION OF THE VIBRISSAE OF THE RATS EXAMINED

Species	*R. rattus*		*R. norvegicus*		*B. bengalensis*		*B. indica*		*M. musculus*		*S. murinus*	
Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Average of	442	472	241	267	348	331	12	15	10	12	46	42
No. of Vibrissae	48.2 ±6.0	48.0 ±6.1	47.4 ±5.7	47.4 ±6.2	49.3 ±6.3	49.6 ±5.7	49	48.8	26.7	26.3	26.3	26.4

TABLE V

AVERAGE NO. OF EMBRYOS PER LITTER

(Average of 45 rats)

Species	No. of Embryos (Average)	No. of Embryos (Maximum)
R. rattus	6	8
R. norvegicus	6	8
B. bengalensis	8	10
B. indica	10	12
M. musculus	2	4
S. murinus	2	4

prefers fur of thick density and smooth texture such as is found on *R. rattus*. Fleas are seen more in the region between the limbs. It may be that in this region they can conceal themselves more effectively, and or the skin is more suitable for making an incision.

Burrowing habits differ with different rats. *B. bengalensis* and *B. indica* are the most important burrowers. The House Rat, *R. rattus*, if left in an enclosed place, tries all ways and means of escape and, if it fails, then only does it take to burrowing. Field rats, or bandicoots on the other hand, start burrowing as soon as they are let loose. Burrows made by them are generally 'W' shaped. The breeding season varies from place to place, depending upon the climate. Bombay rats breed more during the months July to September. A proper study of the habits of rats tells us when they breed at their maximum during the year, knowledge that helps in drawing up a control programme.

The following are some general observations on the different rats found in the local collections.*

Rattus rattus (Linnaeus) : The House Rat

A very common rodent in Bombay. A clean, neat-living creature. It is a small and slender animal of elegant build. Muzzle sharp ; ears almost naked and translucent and so large as to cover the eyes completely when turned forwards ; tail slender, often considerably longer than the head and body together. Head more long than broad. Fur brownish, paler on the belly ; spines not present in the fur.

* The nomenclature is according to Ellerman, J. R. and Morrison-Scott, T.C.S. (1951) : CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS 1758 to 1946 Brit. Mus. (Nat. Hist.)

In Bombay this is essentially a house rat. It is so confiding that it may almost be said to be domesticated. It takes up its abode in human dwellings and even breeds in living rooms amongst little disturbed accumulations of rubbish. Although typically a climbing rat, it is also able to burrow. *R. rattus* appears to be more particular in its choice of food than the other forms. The proportion of *R. rattus* trapped increases in grain and seed godowns, and diminishes in non-food godowns.

Rattus norvegicus (Berkenhout) : The Brown or Drain Rat

This rat lacks the elegant build of *Rattus rattus*. It has a longer and sharper snout, small ears, less bristly fur, and a more hairy bi-coloured tail. The tail is shorter than the head and body together. Colour of the fur brownish grey on the back and lighter grey on the belly. Feet large, heavy, and flesh-coloured.

As is well known, this is a rat which lives for the most part outside houses. It is found in Bombay City where drains and sewage exist, but it has also been noticed in houses to a certain extent. It feeds on garbage of any kind. *R. norvegicus* is shy and timid in manner, shunning the society of man but living upon the refuse he leaves. This rat shows a remarkable power of burrowing, gnawing through such hard material as bricks and cement ; it is also a good climber.

Bandicota bengalensis (Gray & Hardwicke) : The Lesser Bandicoot or Indian Mole-Rat

This is the third form which adds to the rat population of Bombay. In the past its occurrence was overlooked owing to its superficial resemblance to *R. norvegicus*. *Bandicota bengalensis* is an animal of heavy build, with a short, stumpy, pig-like face, broad forehead, large ears, rough bristly fur, and a short, comparatively hairless tail. The tail is shorter than the head and body together, having well marked rings.

Bandicota indica (Bechstein) : The Large Bandicoot Rat

Another member of Bombay's rat population, but rather scarce. This rat is a very heavily built and ferocious-looking animal. The muzzle is similar to that of *Rattus norvegicus*, but stouter in size. The tail is shorter or nearly equal to the head and body together. The fur is greyish brown in general, but light grey on the sides. There are long spines on the body which stand out when the animal is enraged.

The damage caused to agriculture godowns due to this rat is considerable. It has big powerful teeth and is a good burrower.

Mus musculus Linnaeus : The House Mouse

The fifth common rat of Bombay, is a small animal looking like a miniature *R. rattus* with a notch on its upper incisors. Its body is

clothed with fine fur having a brownish colour. The tail is almost as long as the combined length of head and body. The percentage of this form is not large in the collections, but it is destructive to household material.

Suncus murinus (Linnaeus) : The Grey Musk Shrew

Actually this is a rat-like insectivore, not a rodent at all, found near human habitation. It is an ugly looking, grey, soft-furred creature, with a pointed snout, and tiny eyes. The tail is short and pointed, ears small and of a very peculiar rounded shape rather like human ears. It eats baby rats, mice, frogs, and insects. It is often found inside houses and is never affected by plague.

The Biology of the Weevil *Alcidodes mysticus* Faust (Coleoptera: Curculionidae)[1]

BY

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(*With two plates*)

INTRODUCTION

The weevil *Alcidodes mysticus* Faust was first noticed by the author attacking a variety of cotton known as Sea-island cotton (*Gossypium barbadense*) at Pattambi (south Malabar) early in October 1951. This variety, cultivated on a few islands in the West Indies, is considered to be the world's finest and costliest cotton. It was then newly introduced on the west coast of Madras State by the Madras Agricultural Department for experimental purposes. The occurrence of this weevil was noted immediately after the introduction of this cotton in the locality. It was unrecorded here previously. The grubs of the weevil were found to bore the stem, making the plants stunted in growth and reducing their yield considerably. The flowers dropped off in large numbers during the flowering period as a result of the damage done by this insect. Literature shows no reference to the biology or occurrence of this weevil in a pest form previously in India or elsewhere and this appears to be the first record of such. In view of this circumstance and of the seriousness of the pest on the newly introduced cotton, a detailed study of its biology was made by the author, and the results are presented in this paper.

HISTORY AND SYSTEMATIC POSITION

Alcidodes mysticus Faust belongs to the subfamily Alcidodinae of the family Curculionidae. The species was first described by Faust in 1894 from specimens collected in Burma. Later Heller (1911) gave a short description of the same species. As far as the author is aware, there appears to be no other reference to this species until 1953 when Tirumal Rao mentioned its discovery by the author

[1] Part of thesis submitted for the M.Sc. degree of Madras University.

in a pest form on cotton at Pattambi. The author (1957) has given a short account of its occurrence at Pattambi.

Distribution

The weevil has been collected previously from Pusa and Chapra (Bihar) and from Saidapet (Madras) as seen from the labels of specimens in the National Pusa collections. At present its distribution in south India is known to be only south Malabar, where for the first time it has been found as a pest. In his original description Faust mentions the place of collection as Burma.

Host Plants

On the specimens in the National Pusa collections the host mentioned is cotton. At Pattambi the weevil was noted attacking the varieties of cotton known as Sea-island (*Gossypium barbadense*), Cambodia CO2 (*Gossypium hirsutum*), and also the hybrid of these two cottons. A vigorous search was made for alternate hosts of this weevil in the surrounding places near Pattambi. Although it was not found breeding on any other plant, a few adults were collected on *Urena lobata* L., *Urena sinuata* L., and *Malvastrum coromandelianum* G.

Nature and Symptoms of Damage

The adult weevils feed on leaf buds, petioles, and tender terminal portions. They make small pits during the process of feeding and egg-laying on tender shoots. The damage done by the adults is very insignificant. It is the grubs that do serious damage to the crop by boring the stem and petioles. The adult weevils lay eggs in petioles of leaves and at the terminal portions. The grubs that hatch out bore into the petiole and gradually reach the main stem, and from there they bore downwards. At frequent intervals the grubs make exit holes at the sides of the stem and petiole to send out the frass. A large number of grubs bore the stem and feed on the contents, causing a stunted growth of the crop. In the early stages of the crop the attack can be made out by the wilting of tender leaves which in course of time gradually dry and fall off. In an infested field during the earlier stages of the crop a large number of plants with such wilted and drooping leaves can be seen. In a later stage the attack can be easily made out by the presence of small exit holes in the stem and petioles plugged with brownish powdery frass. Attacked plants look stunted and sickly. At the flowering stage, a number of flowers drop off reducing the yield considerably. A single attacked plant may harbour as many as 16

grubs. In one single plant about 27 grubs were collected in November 1952. In severe attack more than 80% of the plants were found infested with the insect. A loss to the extent of 12 to 15% in the yield was noted due to the damage of this weevil at Pattambi.

Life History and Descriptions of Various Stages

There is no literature on the biology and life-history of this weevil. Hence the detailed life-history was studied for the first time in the years 1951 and 1952 by the author.

The entire life-history is completed on the plant itself.

Copulation. The weevil is very rarely seen in copulation in the field. However, they were found freely copulating under laboratory conditions. The copulation in several cases was found to last for 20 to 30 minutes. The time from emergence to copulation varied with individuals and the minimum period was noted to be three days and the maximum six days. Several males were observed to copulate with the same female during the course of the day.

Pre-oviposition period, period of oviposition and fecundity. The pre-oviposition period was found to vary from 8 days to 14 days with an average of 10.4 days for 25 individuals. The weevils were found to lay very few eggs in captivity. The maximum of eggs laid was 38 in the course of 33 days. The daily range was found to be 1 to 3 eggs. The period of oviposition was noted to be very short in the laboratory, the maximum period being only 33 days. The total number of eggs laid varied from 9 to 38 with an average of 20. Under field conditions probably the rate of egg laying may be higher.

Place and method of oviposition. Eggs are usually laid at the tender terminal portions of the plant and under the leaf petioles; sometimes also on the thick veins of big leaves. The weevil makes excavations, the depth of which is as long as the rostrum, and lays eggs in them. In very many cases it was found that three such excavations were made close to each other at a particular place, and that in all cases only the centre one contained the eggs. As a rule only one egg is laid in an excavation, and in no case were two eggs noticed in a single hole. After finishing egg-laying the hole was covered with the material that was scooped out by the weevil. The time taken for laying a single egg was noted, in several cases, to range from 15 to 18 minutes.

Egg

Pale white, chorion smooth, glossy, broadly oval. A freshly laid egg measures on an average 0.99 mm. in length and 0.59 mm. in

ALCIDODES MYSTICUS Fst.

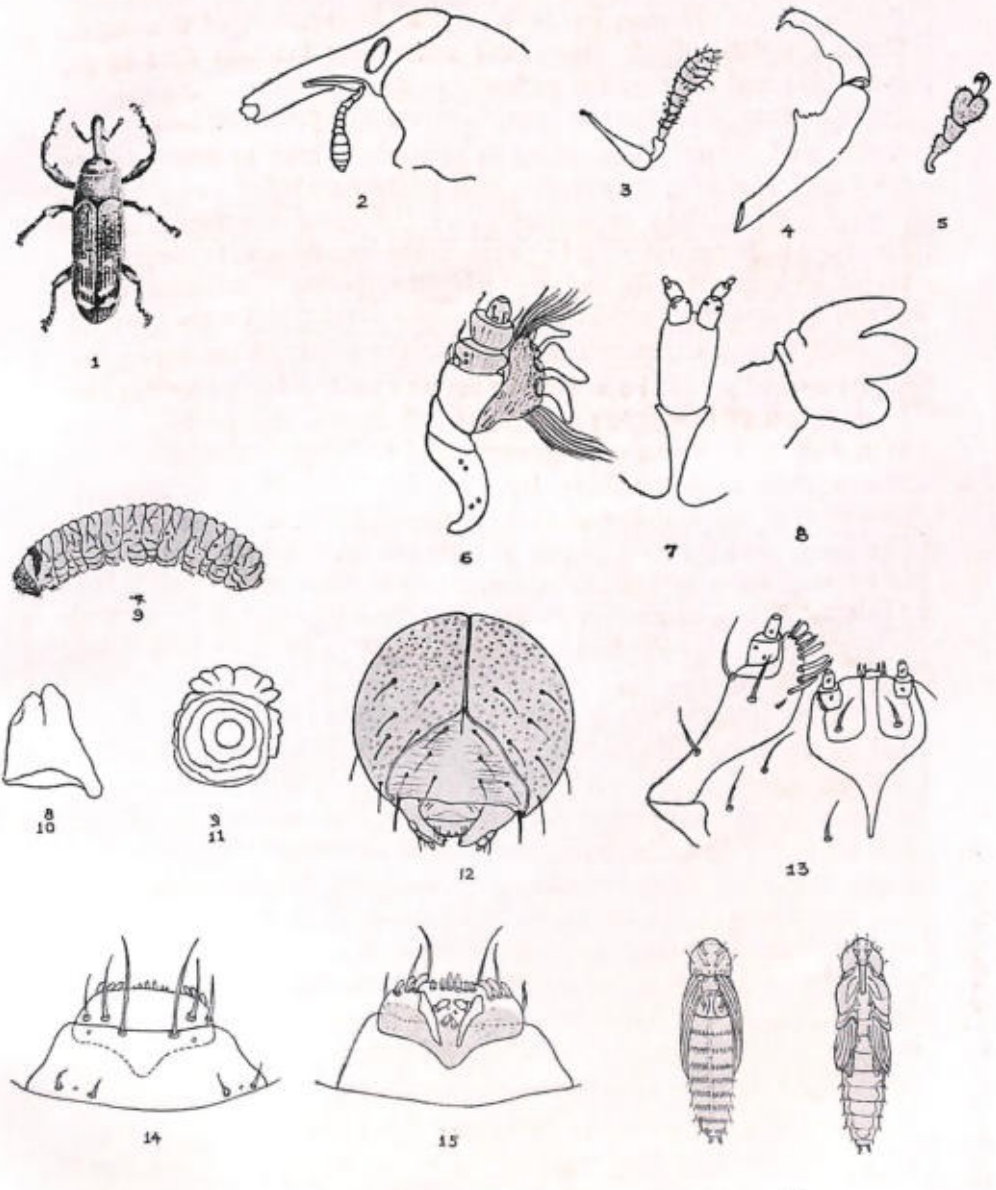

Fig. 1. Adult ; 2. Side view of head ; 3. Antenna ; 4. Front femur and tibia ; 5. Tarsus ; 6. Maxilla (adult) ; 7. Labium (adult) ; 8. Mandible; 9. Grub ; 10. Mandible (grub) ; 11. Spiracle (grub) ; 12. Head capsule (grub) ; 13. Maxilla and Labium (grub) ; 14. Labrum (grub) ; 15. Epipharynx (grub) ; 16. Pupa (dorsal and ventral views).

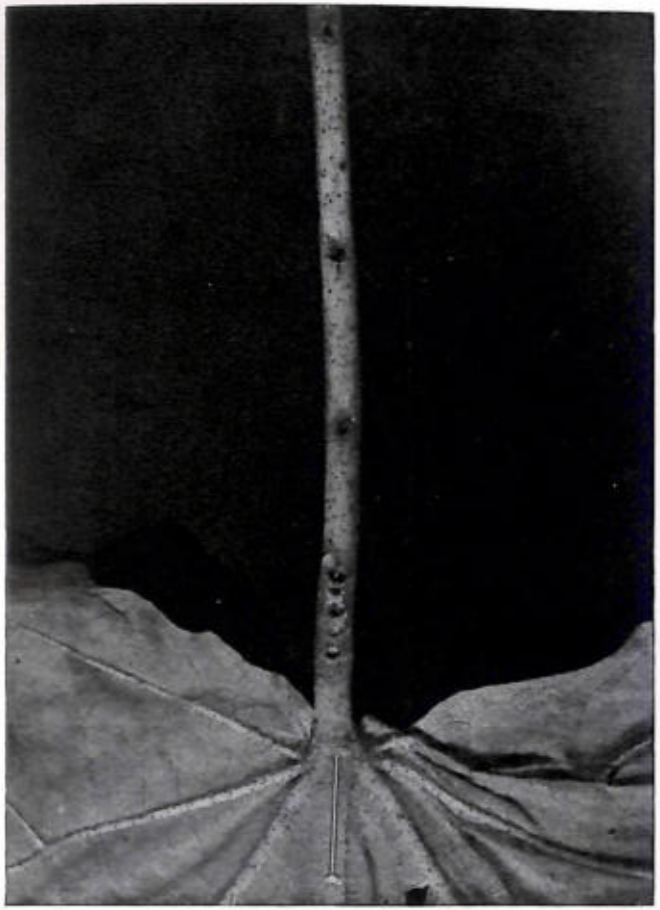

Fig. 1. Leaf petiole of Sea-island cotton showing the weevil attack

Fig. 2. Infested Stems

width, the length ranging from 0.96 to 1.1 mm. and width from 0.56 to 0.61 mm. Newly laid eggs are white, fragile, while older eggs are harder with brittle chorion. As it develops the egg swells up slightly and the brown mandibles of the embryo become visible after three days. No change in colour is noted until hatching.

Incubation period. Under laboratory conditions when the average maximum and minimum temperatures and humidity were 87.2° F., 78.1° F., and 77.6% respectively, the incubation period of 50 eggs was found to vary from 6 to 7 days, with an average of 6.5 days.

GRUB

The number of the larval instars, the moulting activities, and the duration of each instar were studied in detail. The grub was noted to pass through eight instars in the laboratory. The description and duration of each instar with reference to 25 individuals are given below. There is not much difference in general characters between these instars, except in the measurements of the body and head which vary, and also a slight change in the coloration of the head capsule.

First instar: Length of body 1 to 1.5 mm.; width 0.55 mm.; length of head 0.45 mm.; width 0.45 mm.

Colour pale yellow. *Body* curved and sparsely baset with hairs; slightly broader anteriorly. Apodous. *Head* pale brown, smooth; frons with a small median dark line on the posterior end; mandibles dark brown and prominent and bifid.

The duration of the first instar was found to be six days for all the individuals.

Second instar: Length of body 1.8 to 2.2 mm.; width 0.75 mm.; length of the head 0.58 mm.; width 0.53 mm. Characters similar to previous instar.

The duration of the second instar varied from 6 to 7 days with an average of 6.1 days.

Third instar: Length of body 2.5 to 3.2 mm.; width 0.8 mm.; length of head 0.72 mm.; width 0.63 mm. *Head* light brown, smooth. *Pronotum* pale testaceous. Other characters similar to the previous instar.

The duration of this instar varied from 6 to 7 days with an average of 6.1 days.

Fourth instar: Length of body 3.5 to 4.5 mm.; width 0.8 mm.; length of head 0.84 mm.; width 0.78 mm. *Colour* pale yellow as in previous instars. *Head* deep brown and finely punctate.

Prothorax testaceous brown. Other characters similar to the previous instar.

Fifth instar: Length of body 4.5 to 5.0 mm.; width 1.2 mm.; length of head 1.1 mm.; width 0.92 mm. General characters similar to fourth instar.

The duration of the fourth and fifth instars varied from 6 to 7 days with an average of 6.3 days.

Sixth instar: Length of the body 5.0 to 5.5 mm.; width 2.0 mm.; length of head 1.26 mm.; width 1.15 mm. *Colour* as in previous instars. *Head* dark castaneous and coarsely pitted. The testaceous colour of the prothorax is very distinct.

The duration of this instar varied from 6 to 7 days with an average of 6.4 days.

Seventh instar: Length of body 5.5 to 7.0 mm.; width 2.0 mm.; length of head 1.4 mm.; width 1.34 mm. *Colour* creamy yellow. *Head* dark castaneous, coarsely pitted. The testaceous colour of pronotum very prominent. Other characters similar to previous instars.

The duration of this instar varied from 6 to 8 days with an average of 6.9 days.

Eighth instar: (Full-grown grub).

Length of body 7.5 to 10 mm.; width 2.4 mm.; length of head 2.1 mm.; width 1.50 mm.

Larva apodous. *Colour* creamy yellow. *Body* stout, cylindrical, moderately curved and wrinkled. Head capsule chitinised, dark castaneous, entire mouth frame and mandibles much darker, subcircular, length slightly exceeding width, surface deeply pitted; cheeks broadly rounded. *Epicranial suture* distinct, slightly exceeding half cranial length. *Frontal sutures* distinct, each arm slightly exceeding epicranial suture in length, sinuate; each side of epicranium provided with seven setae. *Frons* sub-triangular with some transverse sculpture on the surface and a dark streak on the posterior end which extends forward to about one-fourth length of frons, one and one-fourth times as broad as long, length equal to epicranial suture; provided with five pairs of setae. *Ocellus* one pair on each side along with a smaller posterior spot. *Antenna* small, two jointed, apical segment conical and longer than wide. *Clypeus* about twice as wide as long with two pairs of setae on the posterior margin. *Labrum* transverse, length about half of width and three-fourths of clypeus, posterior margin prolonged into clypeal zone, upper surface carrying three pairs of setae, the median pair longest. *Epipharynx* with a pair of slender and slightly converging rods which extend into the clypeal zone, the anterior margin with six median setae and three lateral

setae on each side; between the rods are two pairs of small setae, the anterior pair much stouter and more widely separated than the posterior pair; in addition a pair of tripartite pores are found between the rods. *Mandibles* strong, subtriangular, bluntly bidentate, shorter than basal width and dark brown in colour. *Maxillae* elongate, terminated by a two jointed palpus and a setose lacinia; *Cardo* smooth; stipes longer than broad with a basal latero-ventral setae and two setae in the palpiferous region; palpus two jointed, basal joint as long as wide and twice as long as the apical joint with a pair of sensory pores. The apical joint is one and a half times longer than wide and provided with one small sensory pore at the base and small sensory pegs at the tip; mala simple, with 9 to 10 long dagger-like setae and another small seta at the posterior end. *Labium* as long as wide, posteriorly limited by a Y-shaped chitinised band and with one pair of long setae on each labial stipe; palpus two jointed each with one small sensory pore, basal joint slightly wider than long, apical one equal in length to the basal joint and one and half times longer than broad and provided with sensory pegs; ligula with two pairs of setae anteriorly; subfascial area entire with three setae on each side.

Thorax. *Prothorax* strongly transverse, dorsally not divided but the two areas prescutal and scutal are roughly indicated by rows of setae; pronotum testaceous brown. *Meso- and meta-thoracic* region divisible into two distinct areas dorsally, namely prescutum and scuto-scutellum; the prescutum provided with two small setae and scuto-scutellum with four setae in a straight line. Pedal lobes prominent and provided with four or five hairs.

Abdomen. Ten-segmented, segments 1 to 8 similar in shape and size with three distinct transverse folds namely prescutum, scutum, and scutellum; a weakly formed inter-segmental fold is also visible. The prescutum is provided with one pair of setae, scutum with one tiny seta, scutellum with four setae in a row; alar area provided with two setae. Each epipleural lobe of abdomen is provided with a single seta and each hypopleural lobe with two setae; the last two abdominal segments simple with a number of setae. *Spiracles* present, one between pro- and meso-thorax and eight in the abdominal segments 1 to 8 on each lateral side, size moderate, circular, air tubes irregular and short and do not project far beyond peritreme, posterior spiracles placed more dorsally.

The duration of the eighth instar varied from 6 to 8 days with an average of 6.9 days.

The total larval period for the 25 individuals varied from 48 days to 52 days with an average of 50.5 days in the laboratory.

Larval habits. Soon after hatching the grub starts feeding on the tissue immediately around the hole in which the egg was laid. Then it starts boring downwards in the case of the main stem, whereas if the egg is laid in petioles, the grub starts boring the petiole and gradually reaches the nodal region from where it travels downwards into the main stem. It makes, at intervals, small exit holes on the petiole and stem as it advances. The distance varies between each hole, usually being shorter at the beginning and gradually increasing as the grub advances in growth. Through these holes it throws out the frass. By nature the grub is very sluggish. Before pupation it prepares a small cavity inside the stem, just bigger than the length of the pupa.

Prepupa

This stage is characterised by the shortening of the grub in length, and the slight swelling in the thoracic region. The length of this stage is about 8.9 mm., and the period lasts for about 48 hours.

Pupa

Average length of the body 8.9 mm.; width 2.5 mm.

General colour creamy yellow, but turns still darker before its transformation into adult. *Body* soft, beset with moderately long hairs which are concolorous with the body. *Head* as long as broad and provided with five pairs of setae originating from minute tubercle as follows: one pair near the base, two pairs immediately behind the eyes, and two tiny pairs between the eyes. *Rostrum* about one-fourth total length of body and three times as long as its greatest width, pressed against thoracic sterna, bears two pairs of setae in small tubercles, the posterior pair close to the eyes, and the anterior pair between the position where the scape is inserted. *Antennae* geniculate, concolorous with the body, with indistinct segments, inserted in the middle of the snout.

Prothorax occupies one-fifth total length of the body, about one and a half times as wide as long, provided with nine pairs of setae raised on tubercles consisting of two anterior pairs, three median pairs, and four posterior pairs. *Mesothorax* half as long as prothorax; width about twice its length; bears two pairs of setae. *Metathorax* one and a half times as long as broad, and provided with three pairs of small setae.

Abdomen twice longer than broad, nine segmented; segments 1-8 have dorsally a transverse row of six pairs of setae on small tubercles on the posterior margin which consists of two median pairs, four lateral pairs; in addition one pair on the pleural region. The ninth

segment is provided with a pair of slender, pointed, curved pleural process.

Pupation takes place inside the larval burrow in the stem. The duration of the pupal stage varied from 9 to 11 days with an average of 10.4 days for 25 individuals.

The total life cycle from egg to adult for this weevil varied from 64 to 70 days with an average of 68.4 days.

ADULT

The original description of the adult by Faust (1894) is as follows:

'Elongatus, subcylindricus niger; fronte rostro parum angustiori, medio foveola abbreviata impressa, antice carinulato rostro subrecto, basi densius fortiterque punctato; prothorace latitudine nonnihil breviore, basi profunde bisinuato, apice subtruncato, lobis ocularibus rotundato-productis, basin versus subparallelo; antice sinuato angustato, supralongitudinaliter convexo, minute granulato; elytris prothorace haud latioribus, fasciis duabus transversis abbreviatis cinereosquamosis, a basi usque ad fasciam secundam striato-fovego latis, interstitiis angustis irregulariter punctatis pectore rugosepunctato hinc inde granulis parvis immixtis. Long 7-10, lat 2-2.6 mm. Bhamo.'

Since Faust's original description is brief, and based on only a very few specimens, the species is redescribed here in greater detail based on a larger number of male and female specimens collected.

Female

Form subcylindrical, integument piceous, not very densely clothed with small pale scales, more or less dusted with rust red powder. *Elytra* with pale markings formed of small short greyish white plumose scales, one small patch just beyond the middle extending from stria 3; another narrow oblique and extending from the suture to the lateral margin just above the apical region and in addition an indefinite preapical band which is broadly interrupted on the suture.

Head closely punctate, a little broader than long; forehead with a shallow median fovea, and with an impressed line round the upper edge of each eye. *Rostrum* elongate, subcylindrical, shorter than front femur, longer and slender, slightly widened at the insertion of the antennae and again at the apex; coarsely punctate at the basal half, but much finner apically. *Mandibles* dark brown, tridentate, as long as broad. *Maxillae* elongated, freely exposed; palpus three segmented, segment 1 twice as broad as long, 2 about twice as broad as long, apical segment half as long as basal segments and as long as broad, small and bluntly conical; palpifer stout, longer than broad, as long,

as the first two segments of palpus; stipes as long as first segment of palpus; cardo stout and curved posteriorly, as long as all the three segments of palpus put together; lacinia with prominent bristles and lacinial teeth. *Labium* with three segmented palpi, segment 1 longer than broad, 2 about twice longer than broad, 3 very small, length half of segment 2 and twice longer than broad. *Mentum* stout, twice longer than broad. *Submentum* pedunculate. *Antennae* inserted in the middle; the scape as long as funicle which is 7 jointed, joint 1 as long as 2 plus 3, 3 to 6 bead like and transverse, 7 as long as the first two segments of club; club conical, twice as long as broad, 4 segmented and covered with grey hairs.

Prothorax broader than long, widest at the base, subconical, parallel sided from the base to the middle, roundly narrowed and broadly constricted at the apex; the post ocular lobes rather feeble, the dorsal outline slightly convex, the whole prothorax being tilted upwards anteriorly; dorsum set throughout with separated and much flattened granules except the apical area which is closely and shallowly punctate; *Scutellum* small not enclosed in front, pyriform, broadest behind, bare and with a shallow median impression. *Elytra* cylindrical, not broader at the shoulders than the prothorax, with a broad shallow transverse impression at the base behind scutellum; about three and half times longer than broad, apices separately rounded; striae containing large deep punctures each containing a seta but most of them more or less filled up with scaling or powdering, which are reduced behind the narrow pale band, intervals rather narrower than striae, rugosely punctate with small setiform scales. *Hindwings* about four times as long as broad, hyaline with light brown veins. *Legs* dark piceous with coarse shallow punctures each of which contains a scale; the front femora with an elongated vertical tooth in the middle and three indistinct denticulations in front of it, that on the posterior ones having only one simple tooth; the front tibiae gently curved externally and with an obtuse-angled tooth behind the middle and a sharp prominent tooth at the apex, the posterior ones with a tooth only at the apex, tarsi four segmented, joint 3 bilobed, 4 curved and ends in four small spines; the hind pair of legs distinctly smaller than the other two. *Sternum* with front intercoxal space narrower than median one, the sculpturing of the metasternum concealed by the scaling. *Abdomen* about one and half times longer than broad, surface reticulate and covered with minute hairs.

Measurements (in millimetres): Length of body with rostrum 9.2, width 2.2, rostrum 2.1, antenna 1.8; prothorax 1.9, width 2.2; elytra 5.1, width 1.5; hind wing 6.8, width 1.8; abdomen 2.7, width 1.8 (average of 25 specimens).

Male

The male is similar in general characters to female. Differences are found only in the following: the rostrum of male is short and more stout, and further coarsely punctate throughout; average size of male is shorter than female.

Measurements (in millimetres): Length of body 8.8, width 1.9; rostrum 1.8; antennae 1.5; prothorax 1.6, width 1.9; elytra 3.5, width 1.2; hind wing 5.2, width 1.4; abdomen 2.1, width 1.4 (average of 25).

Emergence

The adults emerge through the holes made by the full-grown grubs on the stem before pupation. As soon as they emerge they are very soft and delicate but get hardened in one or two days.

Habits

The adults are generally less active. They are often found clinging to the terminal branches, especially at the axils of leaves in the fields. If approached they try to hide beneath the leaves and a slight disturbance makes them fall down and feign death and in this posture they remain for about 20 to 30 minutes. They are rarely seen in the field in copulation. They feed on tender portions of the stem. Though provided with fully developed wings they are not often found to fly from place to place.

Longevity

The length of life of adults of both males and females were studied under laboratory conditions with and without food taking 25 individuals under each sex. The length of life of both the sexes was short under captivity. Unlike in the case of a number of other weevils this weevil was found to die soon under captivity. The duration of life with food varied from 8 to 37 days with an average of 23.2 days in the case of males, and 15 to 38 days with an average of 23.0 days in the case of females. Without food it varied from 4 to 12 days with an average of 6.6 days for females, and 3 to 13 days with an average of 6.3 days for males.

Sex Ratio

The exact sex ratio has not been ascertained but throughout the period of the investigation individuals of both sexes were available in large numbers and males were roughly as numerous as the females.

Natural Enemies

During the course of this study a few grubs were found to be parasitised by the Braconid *Bracon greeni* Ash. in the field. The parasitism was, however, very low. This was the only parasite noted during the study. Apart from this, the small red ants *Solenopsis* sp. were found to enter through the exit holes on the stem and destroy the grubs in a few plants.

Seasonal History

The seasonal history of this weevil was studied at Pattambi. The Sea-island cotton is sown in mid-June at the break of monsoon, and removed by the end of December. Only one generation of the weevil was noted during this period. The egg laying commences by the end of July and continues up to October (maximum in August and September). The adults emerge towards the end of November and in December. The small and medium sized grubs are seen from the middle of August to the end of October, and the full-grown grubs and pupae in November. Most of the adults emerge by the middle of December. The weevils continue to feed as long as the twigs are green but when the crop is pulled out, they enter into hibernation and remain in that condition up to the end of June. They have been found hibernating in all sorts of locations—beneath debris, under bark of trees and on shoots of other wild plants like *Urena lobata* and *Urena sinuata*. Mortality during hibernation is high. Early in July the weevils emerge from hibernation, and start egg laying and feeding during the middle of July on the cotton.

In 1951 the crop was left in the field after picking was over in December as a ratoon crop. In this case a second generation of the weevil was noted from May to August 1952 affecting the ratoon crop. Egg laying was noted in fresh shoots which developed in May after the receipt of summer showers. The second generation adults emerged in the middle of July and early in August, which in turn attacked the newly raised main season crop.

Intensity of Attack on different Varieties of Cotton at Pattambi

Observations were made on the intensity of damage done to four varieties of cotton, namely Sea-island, Cambodia CO2, Hybrid of Sea-island × Cambodia, and Moco, in the year 1952. Under each variety a plot of equal area was marked out in the field and the number of infested and healthy plants were recorded in each month from September to December. The details are furnished in the following table:

Infestation of *Alcidodes mysticus* F. on different varieties of cotton at Pattambi during the year 1952

Name of the variety	No. of plants in the plot	Total number of plants infested during				% Infestation
		Sept.	Oct.	Nov.	Dec.	
1. Sea-island	212	68	94	167	182	85.8
2. Hybrid of CO2 and Sea-island	216	63	87	142	160	74.1
3. Cambodia CO2	232	31	52	98	134	57.7
4. Moco	178	—	8	24	32	18.0

It was found that the infestation was more on Sea-island and the hybrid Sea-island×CO2 cottons the percentage of attack being 85.8 and 74.1 respectively. The next variety that showed high infestation was Cambodia CO2, the percentage being 57.7. Moco showed the least incidence the percentage being only 18.0. This indicates that Sea-island cotton is more susceptible to the attack of this weevil than other varieties.

SUMMARY

The weevil *Alcidodes mysticus* Faust is recorded for the first time as a pest in India. It attacks a variety of cotton known as Sea-island cotton at Pattambi (south Malabar) where the crop has been recently introduced by the Madras Agricultural Department. The grubs of the weevil bore the stem of the plant with the result the crop becomes stunted in growth and the yield is also considerably affected.

The detailed life history and various aspects of its biology were studied. The weevil lays eggs in excavations made on terminal shoots and leaf petioles. Eggs are laid in 8 to 13 days after emergence. The period of different stages of the weevil are found to be 6 to 7 days for egg, 48 to 52 days for larva, and 9 to 11 days for pupa. The duration of adult life in captivity varies from 8 to 37 days for males and from 15 to 38 days for females. This weevil has a very poor egg laying capacity in captivity, the maximum eggs laid being only 38. The period of oviposition is also very short being only 33 days. The grubs have the peculiar habit of making exit holes at the sides of the stem to throw out the frass.

The weevil attacks apart from Sea-island cotton, other varieties of cotton also, namely Cambodia CO2, and hybrid Sea-island×

Cambodia CO2, though Sea-island is the more susceptible. Adults have been collected on other plants like *Urena lobata, Urena sinuata,* and *Malvastrum coromandelianum.*

The grubs are parasitised by a Braconid *Bracon greeni* Ash, the parasitism being very low in fields. The seasonal history has been fully described; there is only one generation in the crop of Sea-island cotton at Pattambi.

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Catla Fishing in Powai Lake, Greater Bombay

BY

F. R. GOLDSCHMIDT

(With five text figures)

To anglers, who would like to specialise in Catla fishing, I am giving my views for what they are worth. They are based on personal experience over 12 years, but restricted to Powai. The reader will soon find that the subject on which I am elaborating is quite controversial. But it is the object of these lines to interest others in trying out new and better methods in circumventing the Catla.

The fry of catla were first introduced into Powai Lake along with rohu, mrighil, and calboos in 1937. Today there are many more of these fine fish in the Lake than is commonly believed. When the water is calm like a millpond one can watch them rising. A pair of binoculars is useful. They can be identified easily by their dark grey-green back breaking the surface like a porpoise, and splashing the water with their colossal tail rudder as they dive.

It is said that catla never take the baited hook and that all of them are foul-hooked. This is not true because I have landed them with one or both hooks in the mouth. This, to be sure, happens rarely. Usually he is foul-hooked either outside the lips, under the 'chin', or in the fins or tail. Because of such foul-hooking 9 out of 10 fish are lost at Powai. Most disappointing indeed; but it leads to one conclusion: our method of catla fishing is wrong. Either the type of bait is not attractive enough or the tackle is wrong, or both. I shall revert to this later.

Let me however at this stage say that, contrary to general opinion, I consider this fish is a very cunning, moody, and unpredictable customer. There is very little information available in piscatorial literature on its ecology and feeding habits, from which the angler could draw conclusions.

It is mentioned [Chacko and Kuriyan (1950): The Bionomics of the Carp *Catla catla* (Cuv. and Val.) in the South Indian Waters, *Proc. Zool. Soc. London* **120**: 38-42] that catla is mainly a surface and mid-water feeder; that his food consists of vegetable matter and plankton.

Examination of the stomach contents also revealed presence of crustacea. Reference is also made in their paper to Mookerjee, H. K. (1945): Life-Histories of some major Carps of Bengal (*Sc. and Cult.* **10**: 400-402) reporting that 'crustaceans formed the major portion of its diet, but sometimes, though rarely, it browses along the marginal substances and feeds on molluscan shell'. Chacko and Kuriyan further report that catla swims with its mouth wide open, straining the water through the gill opening and retaining micro-plankton in its buccal cavity.

I think catla is a pure vegetarian and feeds mainly on the algae suspended in the water, or on the 'moss' which grows on submerged rocks. He is built for this, the disproportionately large mouth with the lower lip protruding like a spoon.

Catlas have quite a different diet as compared with our other game fish at Powai, i.e. rohu, mrighil, and calboos. This is borne out by the fact that the weight of catla has increased year by year, while the other major carp have not grown satisfactorily during the last eight years no doubt due to lack of food. I have observed a catla grazing on moss from the rocks and the body was at an angle of about 45 degrees. The sloping position probably assists in scraping the moss off the rocks with the lower jaw working like a dredger bucket.

The catla does not or cannot pick up the baited hook from the bottom without difficulty because of the structure of his mouth. This difficulty increases if the bottom is not completely clean. Stones will prevent him from getting at the bait with his bulky lips. He therefore has to suck in the bait along with the water. The conclusion to be drawn is that the bait, in addition to being acceptable, should be as small and light as possible to be easily sucked up with the inhaled water. He may succeed on occasions, but usually he does not because the bait is too heavy. He will then leave the bait or try to shift it by pressing against the line with his head or body.

The question arises: Why then should the bait rest on the bottom? Why can it not be suspended an inch or more higher? I have tried this and fixed one hook 3 inches above the other and arranged it as shown in fig. 1. I have hooked—and lost—catla this way but the only fish I brought to gaff in this manner was caught on the *lower* hook. There it is! It may have been by chance, but I have not entirely given up fishing this way. I would also say: in years past, when I fished mainly for rohu and mrighil, I used a single small hook (Mustad No. 4) on 8 lb. Monofil. Nylon, never any lead. Whenever I hooked a catla that way, I am quite sure that he was hooked in the mouth because I played him for a long time and did

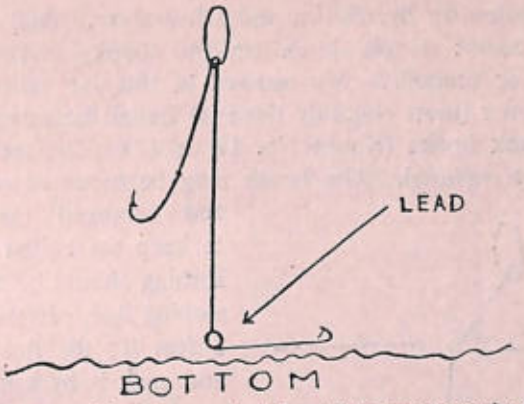


Fig. 1. Second hook suspended about 3 inches above the first which is shown lying on bottom.

not lose him because of foul-hooking. I lost him nevertheless. Either the small hook opened out or the leader broke after some time. So, there is food for thought!

Now let us go to the practical side and try to explain failure or success in the light of what I have theorised above. I have hooked catla in most parts of the Lake, though I have never had a bite in the 'Pipe Line Bay' and to my knowledge only one catla of 12 lb. was ever caught there. I have had bites at all times of the year: in December, January and September in the Lobo Bay, from February up to the beginning of July between the Dams (old raft sites) and in the Clubhouse Bay and below the Powai Club, and during and after the rains in Brighton Beach and Everglades.

The most suitable depth is 5-7 feet, but I hooked a catla in January 1958 in Brighton Beach in less than 3 feet of water and this was a good fish of over 50 lb., which broke around a tree after 55 minutes. The most important factor in my selecting a site has always been to fish over a clean bottom, free of large stones; a little slope is an additional advantage.

Now to the tackle: I have already warned my readers that I do not consider the tackle which others and myself are using at the Lake as the ideal outfit. In any case, some of my gear is correct. The first item is a stiff rod of about 8 feet, a reel with adjustable brake (Windex are unbeatable) and at least 350 yards line.

A home-made peacock float (bazar floats are clumsy and useless) is of course a MUST. But now the trouble starts: lead or no lead? Fishing without lead is a great advantage. Not only is the bite more pronounced, but the bait can be taken by the fish more readily. The problem however is how to get the bait down without a lead

before it is eaten up by Chilwa and Olive Carp. And there is more trouble to come: single hook or two hooks? And the trace? Mugga silk or monofil? My answer to this is: unless I learn of something better (most certainly there is) I shall be using two medium size long-shank hooks (Kantu No. 17 or 18). The testing of hooks with pliers is essential. The hooks may be mounted on mugga silk and arranged (as in fig. 2) to keep the baited hooks apart: Fishing should be with a slightly sloping line. If the depth is say 5 feet fix the float 6 feet high and cock it by taking up line.

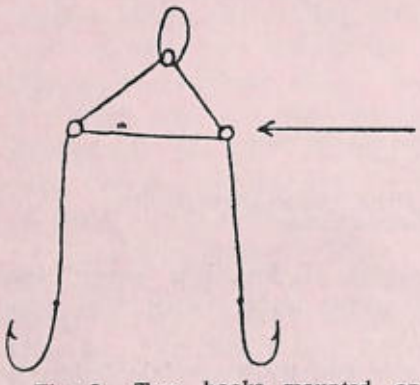


Fig. 2. Two hooks mounted on Mugga silk and arranged as in figure to keep the baited hooks apart. The arrow points to the copper wire of about 1 mm. thickness.

And now we are coming to the all important point of ground-baiting. As I have attracted catla regularly to my swim I think my groundbait is good. It has been changed, experimented with and improved upon over the years, and now consists of three types, all of them being used together:

(*a*) MUD BALLS: Two parts earth (mutti); one part mustard oil cake (fried in Dalda) powdered; one part boiled rice; a pinch of hingh (asafoetida) and huldi (turmeric); $\frac{1}{8}$ part of roasted and powdered methi seed. Mix with a little water into a dough. Then add a little ghee and form into balls of about golf ball size. If the mixture is correct it smells like Italian Salami Sausage.

(*b*) SWEET MEAT: One part boiled rice; one part mustard oil cake, as above, $\frac{1}{4}$ part ghee. Knead and make balls of walnut size. Ten balls should last for eight hours fishing.

(*c*) PEBBLES: Collect a dozen small porous lava stones from the lake-side. Soak them in ghee and keep them in the sun for some time, so that the ghee can properly penetrate into the stone. (The idea is that the Olive Carp cannot eat stones though, otherwise, they consume anything.) This completes the ground bait.

The preparation of hookbait is simpler: fresh white breadloaf is kneaded into a dough together with a little ghee. It is then kept in a glass jar for three to four days when it develops a sweetish smell. Just *before* commencing fishing mix with a little boiled rice. I add a little dry bread, ata, or milkpowder, if the paste has become too soft. If it has become dry a little ghee should be added. That's all. This of course is not the catla's natural food, but I have still to come

across a better bait. I have mentioned already that the bait should be light and small. It is quite sufficient if the lower part of the hook is covered. Lumps of walnut size are absurd! Fig. 3 will illustrate the required actual size.

And now, at last, we commence fishing: The boat is tied securely so that I am not bothered with the poles again after an hour. Get

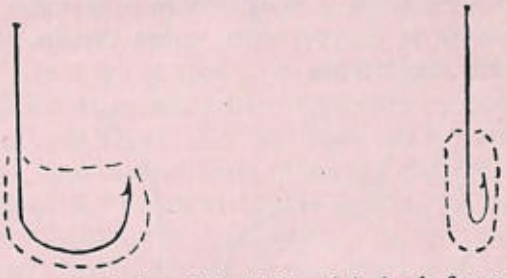


Fig. 3. Actual size of ideal bait and the hook for catla.

the correct depth and put the unbaited hooks at the place where you intend groundbaiting. An unbaited pair of hooks is good for investigating the bottom for stones and other obstacles. If the place is clean, commence groundbaiting and throw in a couple of 'mudballs'. Only a few to begin with. If Olive Carp are there in strength they will clear the place in 15 minutes even if you throw in a whole bucketful. Groundbaiting therefore has to be continued by throwing in 2 to 3 balls every half an hour till the carp biting stops. In addition the place has also to be baited with 'pebbles' as they cannot be consumed and therefore keep the ghee scent for some time. In between a ball of 'sweetmeat' is thrown in. As soon as the Olive Carp are gone I throw in 4 to 5 'sweetmeat' balls.

One has to sit it out till Olive Carp and other small fish leave. If my paste is not touched any more, I keep the rod in my hands all the time. The bite of a catla lasts only a second or two. By the time you snatch your rod and strike it's all over! It happens occasionally that one has a catla bite between carps. But as a rule the sudden disappearance of carp is a sure indication that there is something 'fishy' about. One has to be ready for a strike then though it may only be a rohu who has driven off the small fish.

Quite often the catla gives his presence away. He may be rolling in front of you; the Chilwa may jump to all sides; he may be making a swirl below the water causing a circular movement; or he may let off that famous huge 'bubble'. All these signs are warnings to be on guard. But there is no guarantee that a bite will follow 'in due course'. Anyhow, once he is around you, the first thing is dead quietness. I have on many occasion observed that

anglers strike at the slightest movement of the float, even if it is a clear carp bite. I consider this definitely wrong if there is a real customer around. The strike produces a noise and movement which may scare away the fish you are after. I strike only if I am reasonably sure that it is not a carp, even at the risk of not striking if a catla imitates a carp (which also happens).

To identify a catla bite is quite easy in calm water. But it is not always recognizable in choppy water, unless the float is pulled. But then it is usually too late.

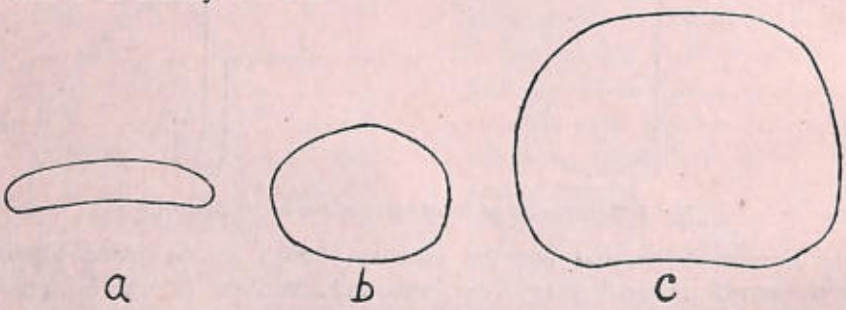


Fig. 4. *a*, *b*, and *c*. Outline drawings of the gape of mouth of mrighil, rohu, and catla respectively.

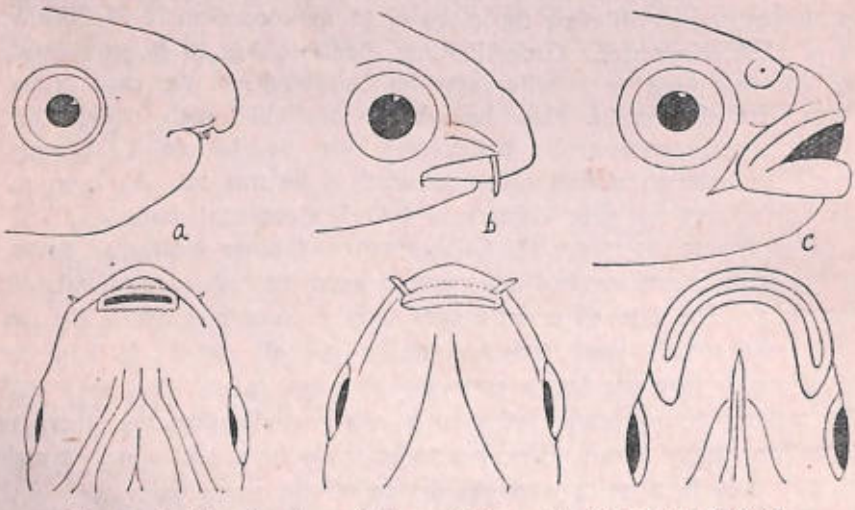


Fig. 5. Outline drawings of the anterior part of the head (lateral and ventral views) of: (*a*) rohu; (*b*) mrighil; (*c*) catla, showing the position and nature of the mouth opening.

There are five typical catla bites:

(*a*) float, without perceptible warning, is slowly going down. This is the most common bite and the chances are you hook him foul and he is off immediately or after his first run.

(*b*) float makes one or two slow bobs. I strike to the first bob if I am quick enough.

(*c*) float moves from the tilting into the perpendicular position or vice versa, several times. This is the best bite. Strike immediately.

(*d*) float begins to quiver. It is a sort of trembling, not to be mistaken with the bobbing of a rohu, which is much more pronounced and slower. When you observe this quiver, don't wait for further development but strike.

(*e*) float is taken down in stages. It starts with a slight depression. After a few seconds there is a further depression by perhaps an inch. You feel the next pull will take the float under water. I do not strike to that. I have done it many times but did not connect. But when the depressed float, without further pull, moves like a crab-bite a few inches to one side, you must strike.

These are the 'standard' bites. Strike always with a resolute kick with both hands and *not* with a half-hearted long pull. Never mind if it was a crab or catfish which fooled you. There are several other variations in a catla bite, such as raising the float like a rohu, or jerking it like a carp. But such bites are rare and quite exceptional.

As already mentioned, to observe a bite in windy water is very difficult. Without fear of contradiction I would say that in disturbed water most catla bites are never noticed.

If you hook a catla you usually know immediately what you are in to. For a second you feel you have hooked a wooden log or gunny bag. But then there will be water swirl and off he moves gaining speed. It is just the opposite of a rohu run. Rohu goes off in top gear, slows down and comes to the surface or he jumps. The catla moves of in first gear before he goes into top gear. He will always keep to the bottom unless he is forced to the surface.

Playing a well-hooked catla is grand sport and to land him I follow this golden rule: he will tire himself out as long as he *runs*. He will make a first long run of 100 to 200 yards, often more. Reel in with pressure on the line the moment the run is over or follow up in a boat. He will make his second and third run. Now comes the critical point: The moment he refuses to run again, sulks on the bottom, jerks the line by hitting it with his tail, or 'walks' slowly along, you have to force him to the surface at the risk of breaking him. He cannot run at full speed for more than fifteen minutes without losing his breath. But he can 'walk' for ten hours and will go on doing that once he has got his second wind! The finest fish in Powai Lake have been lost by not observing this rule. (On one occasion I played a fish from 9.45 a.m. till 3 p.m. and finally lost him). Once the fish is on the surface, one has to keep him there under

full pressure on the line. One has to move the boat to where he is on the surface or bring him alongside the raft or boat. But he must not be allowed again to 'walk' along on the bottom. The main point of course is that he is properly hooked. If not, you will lose him anyhow.

Once on the surface, he puts up little fight. One can easily gaff or net him. The safest way is to put the gaff into his mouth and hook him through the lower jaw. A landing net will do as well if big enough to take the head and part of the body. He does not splash about or turn when seeing the net as a rohu does.

Looks quite simple and will work alright but for the three big IFs: as I have just said, he must be securely hooked; secondly, there should be no trees, sunken logs, or other obstacles around, where he is sure to go in order to break the line; and thirdly, the tackle must be all sound. A breaking strength of 15 lb. for line or trace is quite sufficient and it is anyhow more than a normal rod can stand. A 15 lb. pull can force to the surface a fish which has lost his wind after a couple of fast, big runs. But anglers seem to believe that a line or trace remain sound and intact for an indefinite period. This is not so. Mugga silk traces in particular should not be used more than once or twice. They lose most of their strength if they have been in the water for a day and break then easily at the knot. Monofil has a tendency of getting damaged upon severe stress. One can detect the minute transverse cracks in the structure with a magnifying glass. Such cracks, which look like a thin white ring around the the line, reduce the breaking strength by about 50%. By the way a foolproof knot for monofil has still to be invented. The best to my knowledge is the sailors' sling knot. One has to test the gear regularly, at least the first 30 to 40 yards of the line complete with trace and hooks. The weakest part of your outfit is usually the rod. Hence if you lift a played out catla of 50 lb. and over to the surface and the line snaps but the rod remains intact, your line was damaged and had a strength of less than 15 lb.

And now I wish my reader to hook and successfully land one of the granddaddy catla of 100 lb. and over of which there are quite a few at Powai. Tight Lines!

New Plant Records for Bombay–V

BY

H. SANTAPAU, S.J., F.N.I., R. R. FERNANDES, M.SC., AND
Z. KAPADIA, B.SC.

(*With five plates*)

(*Continued from Vol.* **53**: 216)

In the course of our intensive studies on the flora of Bombay, we have come across several plants that, though not new to science, have never previously been recorded for Bombay State. We present several of our new finds here in this series, with the hope that the descriptions and illustrations will be of help to other Bombay botanists.

Family ALISMATACEAE

Alisma oligococcum F. Muell. Frag. Phyt. Austr. **1**: 23, 1859; Hook. f. Fl. Brit. Ind. **6**: 560, 1895.

A water plant, growing in fairly shallow water, the roots attached to the ground, the leaves and inflorescence above the water surface. *Leaves* simple, radical, petiolate, up to 13 in number; petiole up to 30 cm. long, trigonous; lamina 15-20×7-15 cm., at first submerged, then floating, acute, entire, in the lower leaves elliptic, in the higher ones ovate-oblong, base cordate, the sides overlapping; main nerves about 7, convergent. *Inflorescence* paniculate, pyramidal, much branched, 20×30 cm., branched in whorls of three, becoming shorter upwards, bracteate; the whole scape up to 60 cm. long, erect, strongly ribbed; bracts linear-lanceolate to ovate, acute or acuminate, clearly parallel-veined, green, 1-8×0.4-0.8 cm., becoming smaller upwards. *Flowers* white, 8 mm. diam., hermaphrodite, pedicellate, bracteolate, in whorls of three; pedicels up to 4 cm. long. *Sepals* orbicular-ovate, green, hooded, persistent, marked with 6 brown lines, 3 mm. long. *Petals* obovate, deciduous, 5×4 mm. *Stamens* 6, free; filaments as long as the petals; anthers dark. Ovary 6-carpellary, carpels green, ovoid, 1-ovulate; style slightly lateral, shorter than the ovary; stigma indistinct. Fruit an etaerio of achenes, which are more or less reniform, muriculate, 4 mm. long; embryo horseshoe shaped. (Plate I).

Flowers and Fruits: September-October.

Occurrence in Bombay: We have only seen this plant in the National Park, Borivli, near Bombay; it is still a rare plant in the district. (*Fernandes* 1566-1572).

Family SCROPHULARIACEAE

Lindernia multiflora (Roxb.) Mukerjee in *J. Indian Bot. Soc.* **24**: 131, 1945.

Torenia multiflora Roxb. Fl. Ind. **3**: 96, 1832.

Vandellia multiflora G. Don, Gen. Syst. **4**: 549, 1838; Hook. f. Fl. Brit. Ind. **4**: 280, 1884.

Annual, erect *herb*, 8-15 cm. high, glabrous, profusely and regularly branching from near the base. *Leaves* simple, opposite and decussate, glabrous; the lower ones larger, ovate, obovate, or oblanceolate, tapering into a short petiole; higher leaves broadly ovate, sessile or nearly so, the margins of all the leaves crenate or serrate; larger leaves 2.5-4.5×1.2-1.7 cm., the smaller ones 1.2-2×1-1.3 cm. *Inflorescence* racemose, often corymb-like, terminal, occasionally branched. *Flowers* small, bracteate, pedicellate, bluish purple in colour; bracts minute, triangular, persistent, herbaceous; pedicels slender, 5 mm. long, enlarging to twice this length in fruit. *Calyx* green, 2 mm. long enlarging to 3-4 mm. in fruit, divided almost to the base into 5 subequal, linear acute lobes. *Corolla* 4 mm. long, 2-lipped to a little below the middle; upper lip short and narrow, shallowly divided at the apex into two lobes; lower lip 3-lobed. *Stamens* 4, all fertile, didynamous, included; anther cells somewhat divaricate. *Ovary* ovoid, glabrous; style 2 mm. long; stigmas 2. *Capsule* glabrous, green, ovoid, apiculate, slightly exserted beyond the calyx. *Seeds* minute, yellow, oblong or cylindrical, sparsely granulate. (Plate II).

Flowers and Fruits: Monsoon period until October.

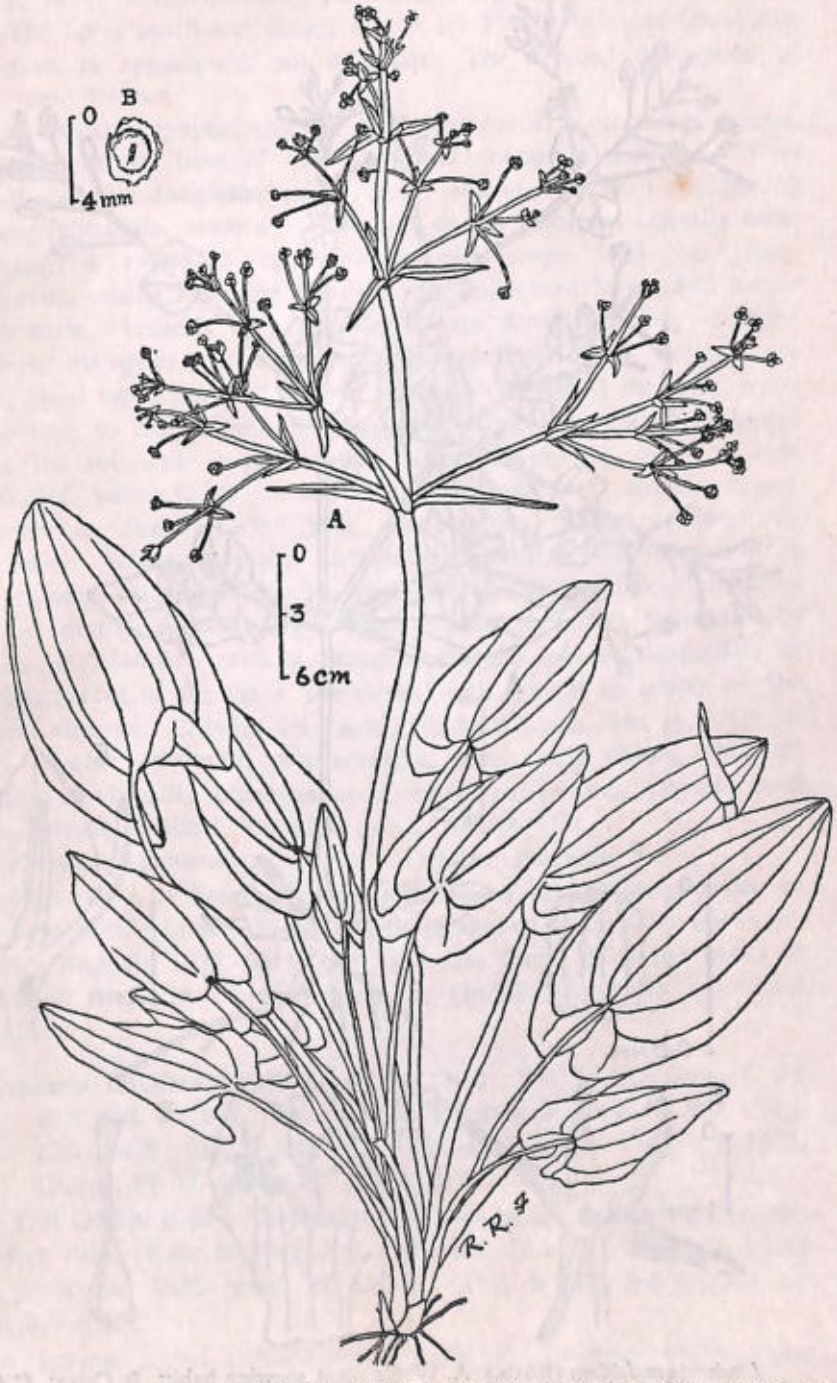
Occurrence in Bombay State: We have found this plant as a weed in Victoria Gardens, Bombay (*Saldanha* 1301); also at Waghai in the Dangs Forest, along forest paths, where it was abundant (*Santapau* 19988; *Saldanha* 1930).

Family ORCHIDACEAE

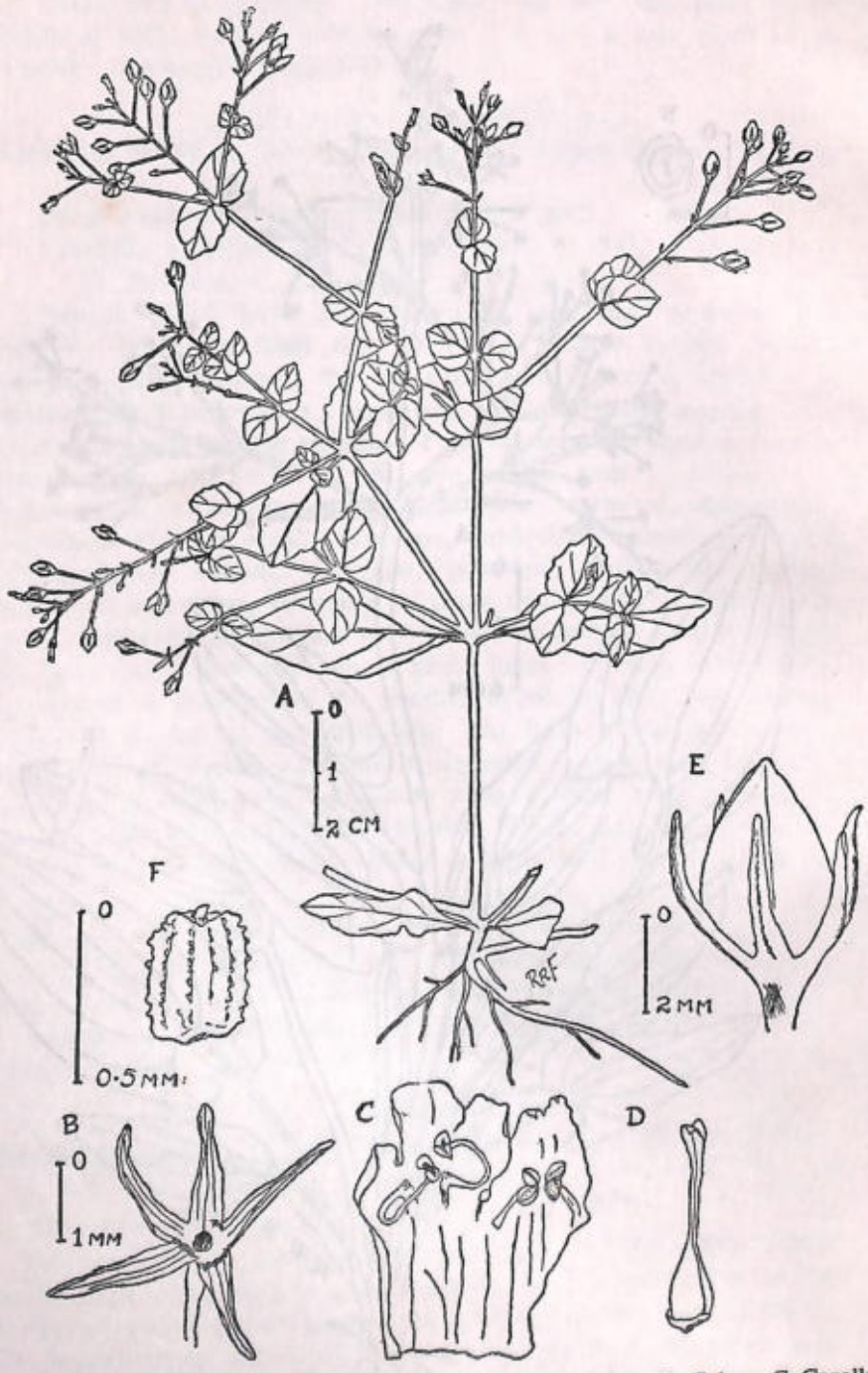
Oberonia iridifolia Lindl. var. **denticulata** Hook. f. in Fl. Brit. Ind. **5**: 675, 1885; Fischer in Gamble, Fl. Madr. 1404, 1928.

Oberonia denticulata Wight, Icon. t. 1625, 1851.

This species seems to be widely distributed in India, from Sikkim and Bhootan to Assam and southwards to the Nilgiris; so far neither the typical species nor its varieties have been reported from Bombay. The present variety differs from the typical plant, as illustrated and described by King & Pantling (in *Ann. Roy. Bot. Gard. Calcutta*



Alisma oligococcum F. Muell. A. Whole plant to show the habit; B. Achene.



Lindernia multiflora (Roxb.) A. Whole plant showing habit; B. Calyx; C. Corolla; D. Pistil; E. Capsule; F. Seed.

8: 8, 1898) in the following particulars: (*a*) The scape is bracteate; (*b*) The lip is much less deeply lobed; (*c*) The lip is more triangular-quadrate in appearence, not orbicular. The detailed description of our plant follows.

Perennial, epiphytic, erect or pendulous *herbs*; roots small, slender, clustered at the base of the plant and spreading outwards. *Stem* small. *Leaves* distichous, sessile, fleshy and broadly ensiform; lamina oblong-lanceolate, acute or acuminate, entire, glabrous, laterally compressed, 4-14×1.5-2.5 cm. *Inflorescence scape* 7-24 cm. long, decurved, arising from the centre of the uppermost leaves and longer than them. Pedicels very short or 0, the flowers densely crowded towards the upper part of the scape; bracts on the lower part of scape few; floral bracts up to 2×1 mm., slightly reflexed at the apex, ovate or oblong to elliptic, subacute, irregularly crenate or toothed, longer than the subsessile ovary. *Sepals* subequal, broadly ovate to sub-orbicular, subacute or obtuse and even sometimes slightly retuse, one-nerved. *Petals* 1×0.6 mm. ovate-oblong, obtuse, occasionally somewhat retuse, margins irregularly toothed, one-nerved. *Lip* 1.5×2 mm., broader than long, triangular to quadrate in outline, more or less deeply 3-lobed; lateral lobes pectinately erose; terminal lobe entire or 2-lobulate with a broad sinus, the lobules denticulate or entire; nerves of the lip 3, the central one straight or nearly so, the lateral sinuous. *Column* very small, 0.25×0.5 mm., but stout for its size. *Anther* opercular, greenishwhite, transversely oblong-orbicular; pollinia 4, broadly comma-shaped, brownish yellow. *Capsule* 5×2 mm., shortly stalked, broadly ovoid. (Plate III).

Flowers: September. *Fruits*: October onwards.

Occurrence in Bombay: We have found this plant epiphytic on *Tectona grandis* Linn. f. in the neighbourhood of Tansa Lake (*Santapau* 16030; *Kapadia* 1638, 1711); we have also found it on the banks of the Kali Nadi in North Kanara at Gundh, about 45 km. from Dandeli.

Habenaria furcifera Lindl. Gen. Sp. Orch. 319, 1835; Hook. f. Fl. Brit. Ind. **6**: 149, 1890; King & Pantling in *Ann. R. Bot. Gard. Calcutta* **8**: 313, t. 410, 1898; Haines, Bot. Bih. Or. 1157, 1922; Duthie, Fl. U. Gang. Pl. **3**: 225, 1925.

This Orchid is of widespread occurrence in the northern and north-eastern parts of the country; but until recently it had not been found in peninsular India south of Orissa. This is the first record for Bombay State.

A ground orchid perennating through one or more underground tubers, which are ovate or ellipsoid, up to 3×1.5 cm. *Stem* stout,

up to 40-46 cm. high, glabrous, with several sheaths below the leaves. *Leaves* 13-17×3-6 cm., clustered together below the middle, gradually passing into bracts above, sessile or subsessile and somewhat narrowed at the base, glabrous, broadly ovate or obovate or oblanceolate or elliptical, entire at the margins or minutely denticulate, acute at the apex. *Inflorescence* stout, lax, racemose, many-flowered, 25-40 cm. long; scape bracteate, glabrous, occasionally longitudinally ribbed; lower bracts 6-7×3-6 cm., ovate-lanceolate, acute, gradually becoming smaller upwards. *Flowers* small, green, subsessile; bracts 1.3×0.3 cm., ovate-lanceolate, acuminate, about as long as the ovary, margins entire or minutely denticulate. *Sepals* unequal; the dorsal one 4.5×3 mm., concave, ovate oblong, obtuse, entire; the lateral sepals narrower, oblong-lanceolate, 3-nerved, somewhat falcate, subacute to acute, gland-dotted. *Petals* 4×2.5 mm., broadly oblong, obtuse or slightly retuse and forming a hood over the column with the dorsal sepal. *Lip* 6×6 mm., trilobed to the base; lateral lobes filiform, divergent, much longer than the stout blunt mid-lobe. Spur slightly longer than the ovary, laterally compressed and involute at the base. *Anther* cells 2, touching, rather short, caudicles slightly curved; glands small and narrowly oblong. *Staminodes* 2, elliptic, blunt, stalked, one on each side of the entrance to the spur. *Rostellum* a thickened, horny rim just above the orifice, from the centre of which a small, ligulate projection is given out, which forms a flap over the mouth of the spur. *Capsule* 1.5-0.55 cm., fusiform, turgid, decurved, with strong, broad ribs; beak of capsule short, about ¼ as long as the body of the capsule. (Plate IV).

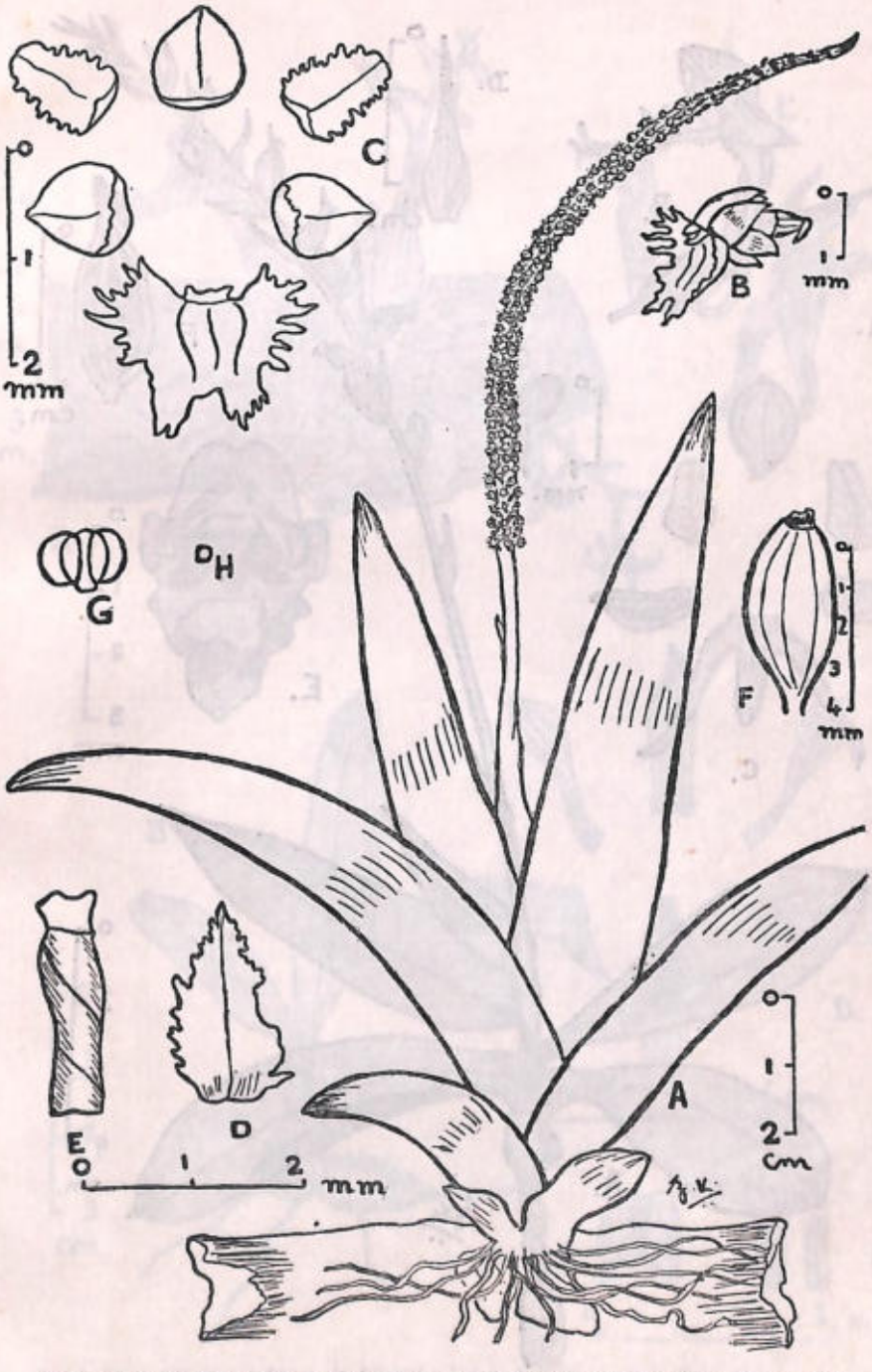
Flowers: August and September. *Fruits*: October.

Occurrence in Bombay: We have found this plant to be common in the undergrowth at Waghai and Ahwa in the Dangs Forest (*Santapau* 19204, 19143, 19343; *Kapadia* 681, 1438).

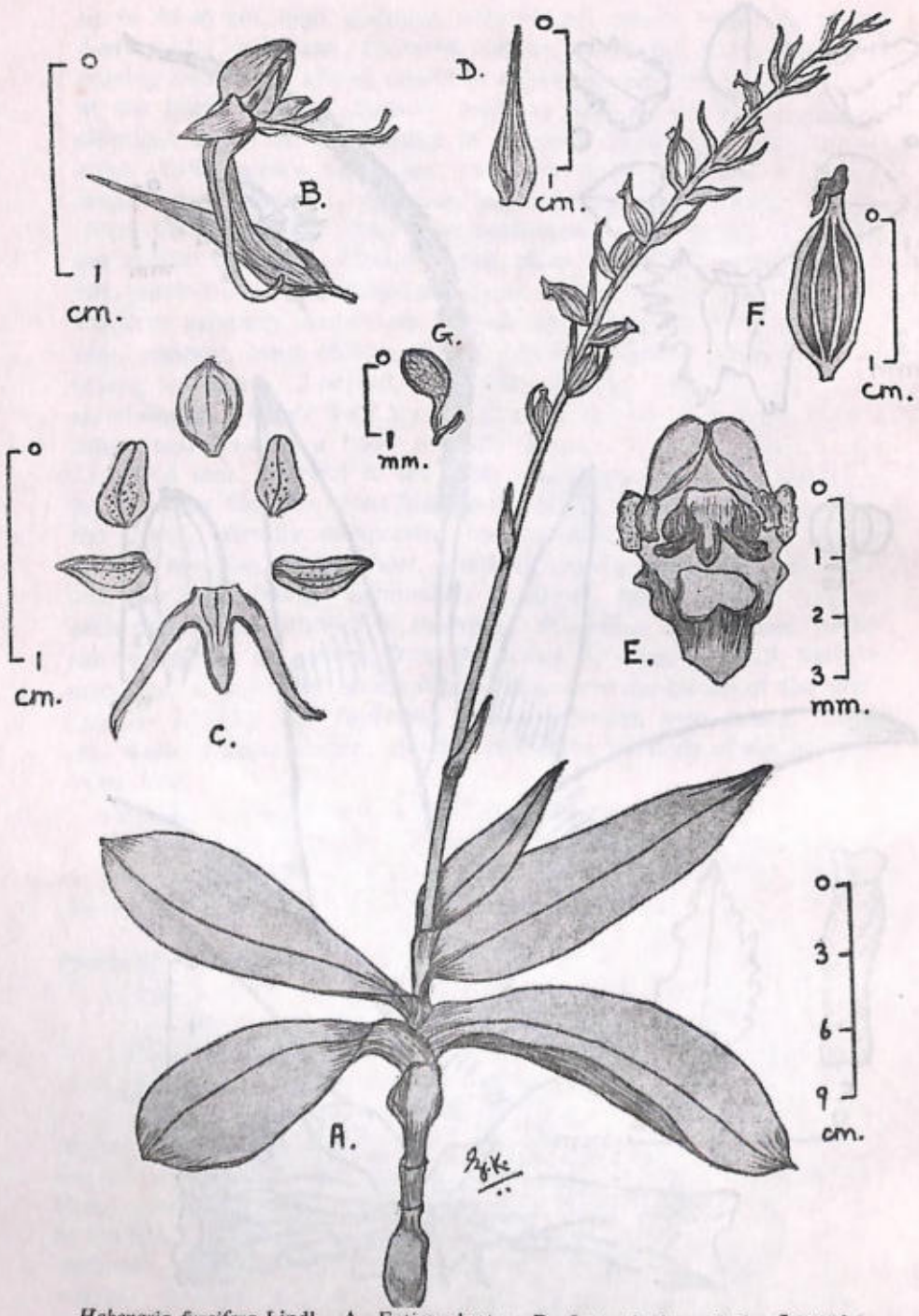
Dendrobium peguanum Linn. in *J. Linn. Soc.* **3**: 19, 1853.

D. pygmaeum Lindl. in Wall. Cat. no. 1999, 1829, nom. nud. et Gen. Sp. Orch. 25; King & Pantling, loc. cit. 43, t. 58, 1898; Kranzl. in Pfreich. 45: 83, t. 3 L-O, 1910; Hook. f. Fl. Brit. Ind. **5**: 717, 1890 (non Smith ex Rees, 1808).

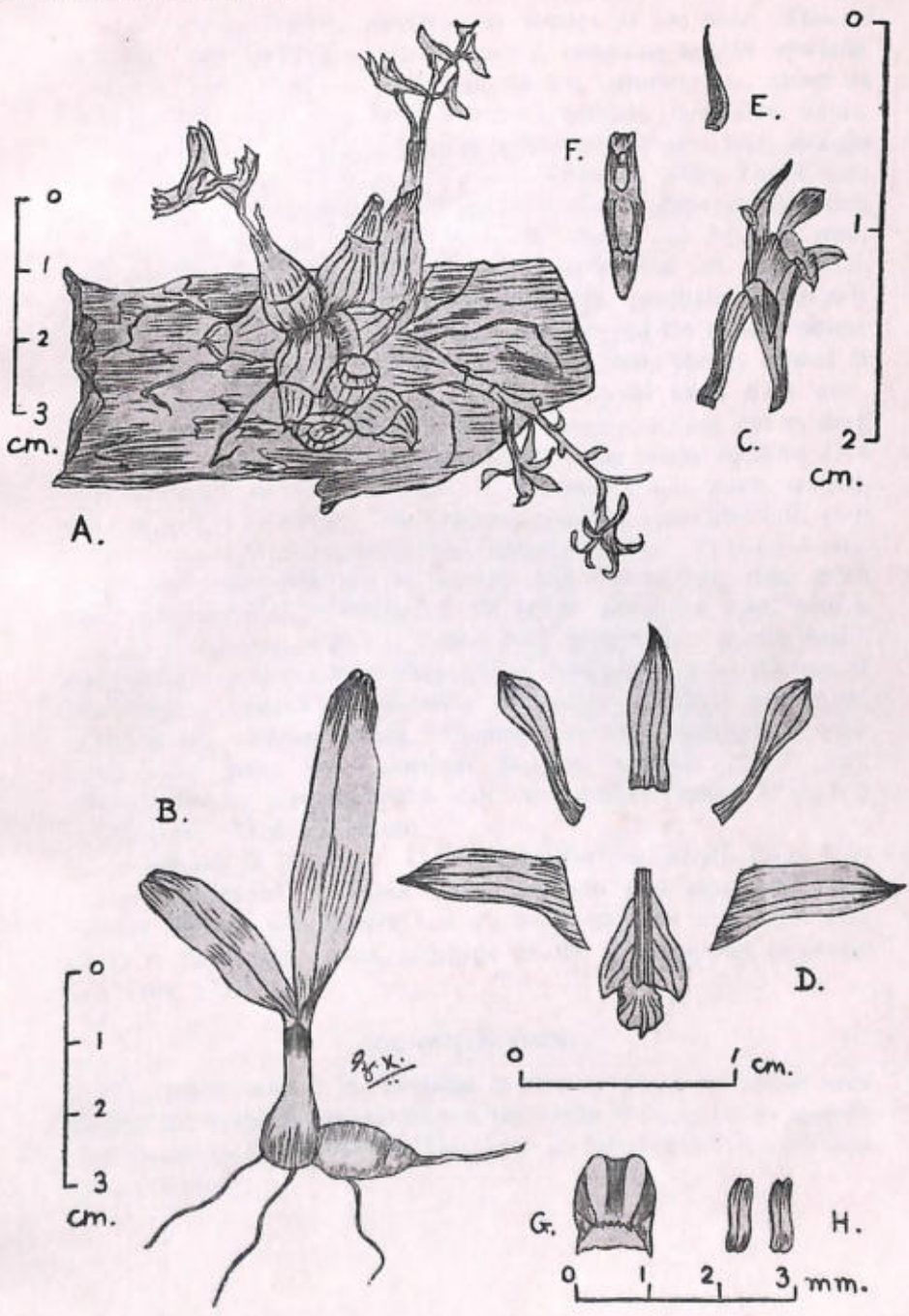
Perennial, epiphytic *herbs*. *Pseudobulbs* 1-7×0.9-2 cm., pear-shaped, ovoid or subglobular, sheathed, generally one- or two-, occasionally three-noded. *Leaves* 2-4, caducous, rarely persistent, fleshy, coriaceous, alternate and distichous, 1.5-6×0.8-2 cm., sheathing at the base, sessile, linear-oblong or oblong, subacute or obtuse, entire; midnerve depressed above, prominent below, with 4-6 faint lateral nerves. *Racemes* 1-13-flowered, apical or subapical, up to 5 cm. long; peduncle short, terete, 1-1.5 mm. in diam., purplish green with



Oberonia iridifolia Lindl. A. Entire plant ; B. Lateral view of flower ; C. Calyx and corolla dissected ; D. Floral bract; E. Ovary and column ; F. Fruit ; G. Anther ; H. Pollinia (G and H highly magnified).



Habenaria furcifera Lindl. A. Entire plant ; B. Lateral view of the flower ; C. Calyx and corolla ; D. Floral bract ; E. Front view of column ; F. Fruit ; G. Pollinium.



Dendrobium peguanum Linn. A. Clump of pseudobulbs with inflorescence ; B. Leafy shoot ; C. Flower ; D. Calyx and corolla ; E. Floral bract ; F. Column showing anther, stigmatic surface, and foot with nectary ; G. Anther ; H. Pollinia.

a few oblong-lanceolate membranous sheaths at the base. *Flowers* bracteate and pedicellate; bracts unequal, becoming smaller upwards, 4-6 mm. long, 2 mm. broad, pale brown, membranous, about as long as the ovary or a little shorter, acuminate, lanceolate, entire, glabrous, 1-nerved; pedicels together with ovary 5-6 mm. long, straight or slightly curved, deep green. *Sepals* subequal, white tinged with green or purplish towards the base, acute, entire, glabrous, 1-nerved; the two lateral sepals 7-9×1-2 mm., the dorsal one 7-9×1-3 mm., oblanceolate. *Mentum* 3-5 mm. long, cylindrical or subconical, obtuse. *Petals* 7-9×1-2 mm., white, falcate, spathulate, narrowly linear at the base, suddenly dilating a little beyond the middle, obtuse or subacute, glabrous, 3-nerved. *Lip* 8-10×5 mm., shortly clawed at the base, dilating cuneately and 3-lobed; lateral lobes 6×1 mm., erect, parallel with the column, narrowly oblong, obtuse, entire, deep green with slightly swollen reddish nerves on the inside; midlobe 3×4 mm., deflexed, broadly triangular or triangular ovate, acute, crisped, deep amethyst in colour. *Disc* ridged, 3-nerved, greenish-white, ending in a truncate or slightly retuse, upturned callus. *Column* 2 mm. long, green, deep amethyst at the top; foot 6 mm. long, deep green with deep amethyst markings on the inner subconcave side, with a nectary at the base, which is 2 mm. long, pouch-like. *Anther* small, deep mauve or amethyst, oblong-conical, firmly affixed on the top of the column; anterior lip minutely denticulate. Pollinia 4, minute, golden-yellow, narrow-oblong. Stigmatic surfaces quadrately orbicular, deep green with amethyst margins. *Capsule* 15×7 mm., obovate-globular, greenish brown with broad maroon bands. (Plate V.)

Flowers: Monsoon season.

Occurrence in Bombay: Common on *Tectona grandis* Linn. f. in the neighbourhood of Tansa Lake; common also along the road between Kasara and Igatpuri on *Tectona;* common at Pimpri and Ahwa in the Dangs Forest, epiphytic on the same support (*Kapadia* 897, 1104, 1375, 1600).

ACKNOWLEDGEMENT

The junior author, Z. Kapadia, wishes to place on record that some of the work here presented was done with the help of the subsidy given to him by the Sir Dorabji Tata Trust through the Bombay Natural History Society.

Some Observations on the Fauna of the Maldive Islands

PART V—FISHES

BY

G. PALMER

Dept. of Zoology, British Museum (Natural History)

(With a plate)

[*Continued from Vol.* 55 (2) : 220]

The small collection of fishes made by Major W. W. A. Phillips from the Maldive Islands is of some interest as, with the exception of Deraniyagala's publication in 1956, little has been published on the fishes of this area for almost fifty years.

121 species had previously been recorded from these Islands and this figure is now increased to 128, seven of the eleven species here reported on being new records for this area.

In this paper, Major Phillips's notes are placed in square parentheses at the end of the systematic matter and are initialed 'W.W.A.P.' All the specimens were taken in North Malé Atoll.

APODES

MURAENIDAE

Gymnothorax meleagris (Shaw & Nodder) : Moray Eel

Shaw & Nodder 1795 Nat. Miscell. 7 ; A2 pl.220.

1 specimen, 235 mm. total length.

Widely distributed throughout the Indo-Pacific including the Red Sea. Attains a length of about four feet. New record.

[Common on the southern reef of Malé Island ; the principal food of the Eastern Grey Heron (*Ardea cinerea rectirostris*).—W.W.A.P.]

Gymnothorax pictus (Ahl) : Painted Moray Eel

Ahl 1789 Spec. ichtyol. de Mur. et Ophich. Inaug. Dissert. Uppsala : 6.

1 specimen, 350 mm. total length.

Widely distributed throughout the Indo-Pacific and has been recorded from the Red Sea. Reaches a length of two to three feet .

[Caught on the southern reef of Malé Island at low tide.—W.W.A.P.]

Gymnothorax brummeri (Blkr.) : Brummer's Moray Eel

Bleeker 1858 Nat. Tijdschr. Ned. Indie **17** : 137.

1 specimen, 535 mm. total length.

Indo-Pacific. This species is apparently quite rare in the Maldives. Attains a length of two to three feet. New record.

[The only specimen seen ; caught while fishing in the Fishery Harbour. Reported by the Maldivians to be a rare species.—W.W.A.P.]

Gymnothorax boschi (Blkr.) : Bosch's Moray Eel

Bleeker 1853 Verh. Bat. Gen. **25** : 52.

1 specimen, 330 mm. total length.

Occurring generally throughout the Indo-Pacific and reaching a length of over two feet. New record.

[Taken on the southern reef of Malé Island, at low tide.—W.W.A.P.]

OPHICHTHIDAE

Myrichthys colubrinus (Boddaert) : Serpent Eel

Boddaert 1781 Neue Nord. Beitrage **2** : 56 pl.2 fig. 3.

1 specimen, 460 mm. in total length.

This species is widely distributed in the tropical Indo-Pacific, including the Red Sea. The striking colour pattern of the alternate light and dark vertical bands is subject to considerable variation. Attains a length of three feet.

[Caught inside the reef of Hululé Island, North Malé Atoll ; not so common as the following species.—W.W.A.P.]

Leiuranus semicinctus (Lay & Bennett) : Half-banded Serpent Eel

Lay & Bennett 1839 in Beechey's Voyage ; 66 pl. 20 fig. 4.

7 specimens ranging in length from 236-480 mm.

Widely distributed throughout the Indo-Pacific. This is an agile fish, which frequently burrows in the sand. Reaches a length of one to two feet. New record.

[Moderately plentiful on the southern reef of Malé Island. Seen moving slowly amongst the low-growing sea-weed, in pools left by the receding tide.—W.W.A.P.]

SOLENICHTHYES

SYNGNATHIDAE

Corythoichthys fasciatus (Gray) : Banded Pipe-fish

Gray 1830-32 Illustr. Indian Zool. **1** : 89 figs. 2 and 2a.

4 specimens, ranging in length from 68-99 mm.

This is a small species, reaching a length of six to seven inches, found generally throughout the Indo-Pacific. Has been recorded from the Red Sea. New record.

[Plentiful in small pools, with sandy bottoms, on the southern reef of Malé Island, at low tide.—W.W.A.P.]

PERCOMORPHI

SCOMBROIDEA

ISTIOPHORIDAE

Istiophorus gladius Bloch : Sail fish

Bloch 1793 Nat. ausl. Fische 7 : 81 pl. 345

Maldivian Name : Fung Hibar

Recorded from photographs of specimens, taken by W.W.A.P. Open water fishes, found in most warm seas. Attains a length of about 12 feet.

[Plentiful in the seas around Malé ; frequently brought to the fish market for sale.—W.W.A.P.]

Makaira marlina Jordan & Evermann : Black Marlin

Jordan & Evermann 1926 Occ. Pap. Acad. Sci. Calif. No. 12 : 59 17.

Maldivian Name : Hibar

Recorded from photographs of specimens, taken by W.W.A.P.

Open water fishes, widely distributed in most warm seas. Attains a length of about 14 feet.

[Plentiful in the seas around Malé ; frequently brought in to the fish market.—W.W.A.P.]

BLENNIOIDEA

CARAPIDAE

Encheliophis (Jordanicus) gracilis (Blkr.) : Fierasfer

Bleeker 1856 Nat.Tijdschr. Ned. Inde. **11** : 105.

2 specimens.

Distributed throughout the Indo-Pacific and has also been recorded from the Red Sea. These interesting fishes normally live in the body cavity of a host, usually a holothurian. This particular species has been reported as inhabiting the body cavity of a starfish. It reaches a length of about nine inches. New record.

Sail-fish in the Fish-market, Malé

Bonito (*Enthynnus* sp.) caught in the lagoon of North Malé Atoll

Photos : W. W. A. Phillips

SCLEROPAREI

SCORPAENIDAE

Dendrochirus brachyptera (C.V.) : Scorpion Fish

Cuvier & Valenciennes 1829 Hist. nat. Poissons **4** : 368

4 specimens, 91–120 mm. in total length.

Widespread in tropical Indo-Pacific waters. These fishes are brightly coloured and should be handled with care, as a wound from one of the sharp spines can be extremely painful. Attains a length of about seven inches. New record.

[Caught on the reef of Malé Island by fishermen, who regard them as very poisonous.—W. W. A. P.]

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PART VI — INSECTS

BY

W. W. A. PHILLIPS

I am greatly indebted to the various specialists at the British Museum (Natural History), who have worked out the collections that I brought back from the Maldive Islands and have identified the material. Also to Dr. W. E. China, M.A., SC.D., the Keeper of Entomology, for all his assistance in connection with them. The collections themselves have been donated to the British Museum (Natural History).

MOTHS — LEPIDOPTERA NOCTUA

All the Moths, listed in the following pages, were taken on islands within the North Malé Atoll; the majority of them were collected on Malé Island, the seat of the Maldivian Government. For a description of the locality and the Maldivian Archipelago reference should be made to *JBNHS* Vol. 55 (1) : 1-3. Against each species is given the name of the island, upon which it was taken.

Most of the specimens were captured amongst low vegetation and the lower branches of trees, by the beating method. Some were, however, taken by night. Sugaring was tried on the trunks of large trees growing in the Guest-house compound, at Malé, but without success.

The whole of the collection was made between the end of November 1956 and the middle of February 1957. As many species as possible were collected but a few species were seen, especially amongst the Sphingidae, that evaded capture.

The insect fauna as a whole, and the Lepidoptera in particular, of the Maldives, appear to be very similar to the corresponding fauna of the Indian peninsula and Ceylon but the known ranges of many species will be extended by this paper.

The following is a list of the specimens collected :

	Name of Species	Sex ♂	Sex ♀	
Arctiidae				
Utetheisa	*pulchelloides* Hampson subsp. .. The Maldive subspecies is closely related to *U. p. pulchelloides* occurring in the Seychelles Is. and the Chagos Archipelago.	14	20	Fujoadee I.
Utetheisa	*l. lotrix* Cramer ..	19	17	Malé I.
Hypsidae				
Deilemera	*lacticinea* Cramer ..	1		Hululay I.
Noctuidae				
Leucania	*albistigma* Moore ..	1		At sea, near Kuda Boudos I.
,,	,, ,, ..		1	Malé I.
Calogramma	*festiva* Donovan ..	5		Malé I.
Chasmina	*candida* Walker ..	1	1	Malé I.
,,	,, ,, ..	1		Gardu I.
Amyna	*punctum* Fabricius ..	1		Gardu I.
,,	,, ,, ..	1		Hululay I.
Bombotelia	*jocosatrix* Guenée ..	1	1	Malé I.
Xanthodes	*graellsii* Feisthamel ..	1		Malé I.
Grammodes	*hyppasia* Cramer ..		1	Malé I.
Euclidisema	*mygdon* Cramer ..		7	Malé I.
,,	,, ,, ..		1	Hululay I.
,,	,, ,, ..		1	Hulule I.
,,	,, ,, *pertendens* Walker ..		1	Malé I.
Ericeia	*obeditalis* Walker ..	1		Malé I.
Gesonia	*flava* Fabricius ..	1		Malé I.
Cosmophila	*sabulifera* Guenée ..		6	Malé I.
Cosmophila	*ignotalis* Walker ..	1		Malé I.
Hypena				
Hyblaeidae				
Hyblaea	*puera* Cramer ..	7	4	Hulule I.
Sphingidae				
Macroglossum	*gyrans* Walker ..	4		Hulule I.
,,	,, ,, ..	3		Malé I.

	Name of Species	Sex ♂	Sex ♀	
Geometridae.				
Thalassodes	*immissaria* Walker ..	4	1	Malé I.
Scopula	*caesaria* Walker ..	1		Malé I.
,,	,, ,,	1		Hulule I.
Hyperythra	*lutea* Stoll ..		1	Willinggillie I.
Limacodidae.				
Macroplectra	*nararia* Moore ..	1		Malé I.
Thyrididae.				
Striglina	*scitaria* Walker ..		4	Hululay I.
Pyralidae.				
Bradina	*admixtalis* Walker ..	1		Malé I.
Bradina	*acrospila* Meyrick ..	14	6	Malé I.
,,	,, ,,	1		Lankcumfurri I.
Nymphula	*stagnalis* Zeller ..	2		Malé I.
Earrhyparodes	*tricoloralis* Fabricius ..	1		Malé I.
Sylepta	*derogata* Fabricius ..	8	7	Hululay I.
,,	,, ,,	6	4	Hulule I.
,,	,, ,,	1		Gardu I.
,,	,, ,,	30	17	Malé I.
Dichocrocis	*punctiferalis* Guenèe ..	1	2	Malé I.
Margaronia	*suralis* Lederer ..	3	2	Gardu I.
,,	,, ,,	1		Hulule I.
,,	,, ,,		2	Hululay I.
,,	,, ,,		2	Lankcumfurri I.
,,	,, ,,		1	Malé I.
Margaronia	*caesalis* Walker ..	1		Malé I.
Tortricidae				
Argyroploce	*aprobola* Meyrick (det. *J. D. Bradley*) ..	3	3	Malé I.

Three Pyralidae (Phycitinae) remain indeterminable.

Hemiptera

All the species, given in the attached list were taken in Malé Island or on the islands close by, in the North Malé Atoll.

I am greatly indebted to Miss G. M. Day for making the identifications.

Suborder Heteroptera

Pentatomidae

Piezodorus rubrofasciatus Fabr.

(India, SW. China, Philippine Is., Japan, Society Is., Samoan Is.)

Plautia fimbriata Fabr.
(Indo-China, China, India, Malaya)

Acrosternum graminea Fabr.
(India and Ceylon)

PYRRHOCORIDAE

Dysdercus cingulatus Fabr.
(India, Burma, Malaysia, Australia)

REDUVIIDAE

Triatoma rubrofasciatus de Geer
(S. China, Siam, W. Indies, Burma, India, Ceylon, Borneo, Philippine Is.)

MIRIDAE

Creontiades pallidifer Walk.
(Ceylon, China, India, Malaya, Christmas Is.)

Eurystylus bellevoyei Reut.
(Africa, India, and Ceylon)

Suborder HOMOPTERA

FLATIDAE

Melicharia obtusangula Dist.
(India and Ceylon)

CICADELLIDAE

Parabolocratus arcuatus Motsch
(India, Ceylon and Queensland)

Freshwater Diatoms from Kolhapur and its immediate Environs[1]

BY

H. P. GANDHI

M. N. College, Visnagar, N. Gujarat

(With fifty-one figures)

INTRODUCTION

There are no records available of the freshwater diatom flora of Kolhapur, except for one on soil diatoms by the present author (1956). It is, therefore, considered desirable to survey the freshwater flora of the said area. This account is based on extensive collections made by the author during 1951-56, from many permanent, temporary, and ephemeral bodies of water in and around the city.

Kolhapur is a prosperous city and a vital hub of commerce to many towns and villages extending far beyond the Western Ghats. It lies on latitude 16° 42′ N. and longitude 74° 16′ E. at the terminus of the Miraj-Kolhapur section of the Southern Railway, on a plateau approximately of 1500 feet elevation. The annual average rainfall is 35 inches, the bulk of which is received during the monsoon. The climate is moderate. The geology is essentially of the Deccan Trap.

Material collected practically from all possible wet situations in and around the city was examined at the Rajaram College, Kolhapur, during 1953-56. While examining the material, it became evident that many forms found here are also recorded from Bombay and Salsette (Gonzalves and Gandhi, 1952-54), some of them widely distributed.

The classification and indentification of the forms has been done according to Hustedt's (1930) and Cleve-Euler's (1951-55) monographs. Besides these major works, Van Heurck's TREATISE ON DIATOMACEAE and several other works and papers have been referred to in preparation of this paper.

The dimensions given for the individual forms are those actually recorded. At the end of this paper a table is given suggesting the distribution of these diatoms in the said area and elsewhere in India as recorded by previous workers.

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[1] [Article 35 of the *International Code of Botanical Nomenclature*, 1956 edition, reads as follows : ' Publication on or after 1 Jan. 1958 of the name of new taxon of recent plants of the rank of order or below is valid only when the nomenclatural type is indicated (see Arts. 7—10).' Accordingly the various new forms published in this paper, even when the Latin description is supplied, must be considered as not validly published.—EDS.]

Family COSCINODISCACEAE

1. **Melosira granulata** (Ehr.) Ralfs (Figs. 1-2)

Van Heurck, Treat. Diat. 444, t. 19, f. 621 ; Hustedt, Bacil. 87, f. 44 : Cleve-Euler, A., Diat. Schwed. Finn.—I : 25, f. 15 a-b (= *M. granulata* v. *typica* A. Cl.).

Frustules 6-10 μ in diameter, semi-cell 12-14 μ high, cylindrical, united in short or long chains. End cell with spines and furrows, and straight rows of areoles, 8-10 in 10 μ ; other cells have 9-11 rows in 10 μ, spirally disposed.

2. **Melosira granulata** v. **muzzanensis** Meister (Fig. 3)

Hustedt, Bacil. 88, f. 47 ; Cleve-Euler, A., Diat. Schwed. Finn.—I : 25, f. 15 f.

Frustules 14-16 μ in diameter, semi-cell 10-11 μ high, short-cylindrical or discoid, otherwise like the type. Rows of areoles 9-10 in 10 μ.

3. **Cyclotella meneghiniana** Kütz. f. **binotata** Grun. (Fig. 4)

Cleve-Euler, A., Diat. Schwed. Finn.—I : 48, f. 63 c (= C. *meneghiniana* v. *genuina* A. Cl. f. *binotata* Grun.).

Valves 13-16 μ in diameter, discoidal. Central field inconspicuously punctate with two distinct dots. Striae 8-9 in 10 μ, thick and radial.

The varietal epithet ' v. *genuina* ' which refers to the type proper is eliminated since it is out of vogue.

Family FRAGILARIACEAE

4. **Fragilaria rumpens** (Kütz.) Carlson v. **familiaris** (Kütz.) A. Cl. (Figs. 5-6)

Cleve-Euler, A., Diat. Schwed. Finn.—II : 42, f. 352 c-e ; Hustedt, Bacil. 156, f. 176 [= *Synedra rumpens* Kütz. v. *familiaris* (Kütz.) Grun.].

Valves 69-96 μ long and 2.7-3 μ broad, narrowly lanceolate, walls twice constricted in the middle with ends produced and somewhat capitate. Pseudoraphe narrow. Central area present. Striae 17-19 in 10 μ, fine.

The form agrees well with the type except that some forms found in this region were definitely longer than those recorded in the literature.

5. **Synedra ulna** (Nitz.) Ehr. v. **subaequalis** Grun. (Fig. 17)

Cleve-Euler, A., Diat. Schwed. Finn.—II : 61, f. 382 f-i.

Valves 300-495 μ long and 6.5-8 μ broad, linear, slightly bent with narrowed, constricted, produced broadly subcapitate ends. Pseudoraphe narrow, linear ; central area present or absent. Striae 8-9 in 10 μ, coarse,

FIGURES 1-16

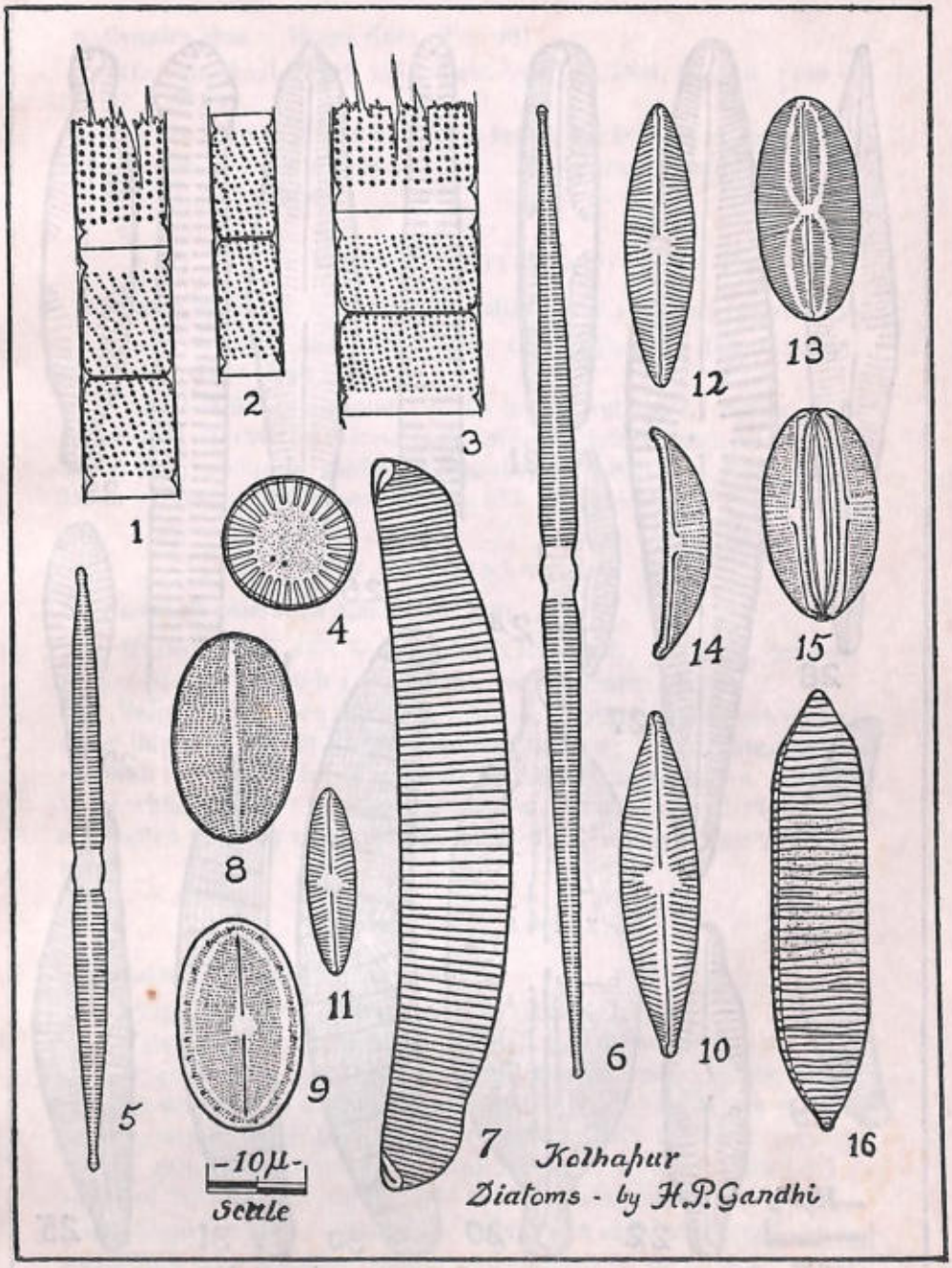

Fig. 1-2. *Melosira granulata* (Ehr.) Ralfs ; 3. *M. granulata* v. *muzzanensis* Meister ; 4. *Cyclotella meneghiniana* Kütz. f. *binotata* Grun. ; 5-6. *Fragilaria rumpens* (Kütz.) Carl. v. *familiaris* (Kütz.) A. Cl. ; 7. *Eunotia major* (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg ; 8-9. *Cocconeis placentula* Ehr. ; 10. *Navicula cryptocephala* Kütz. ; 11-12. *N. cayptocephala* v. *subsalina* Hustedt ; 13. *N. pygmaea* Kütz. ; 14-15. *Amphora veneta* Kütz. ; 16. *Nitzschia tryblionella* Hantz. v. *levidensis* (W. Sm.) Grun.

FIGURES 17-31

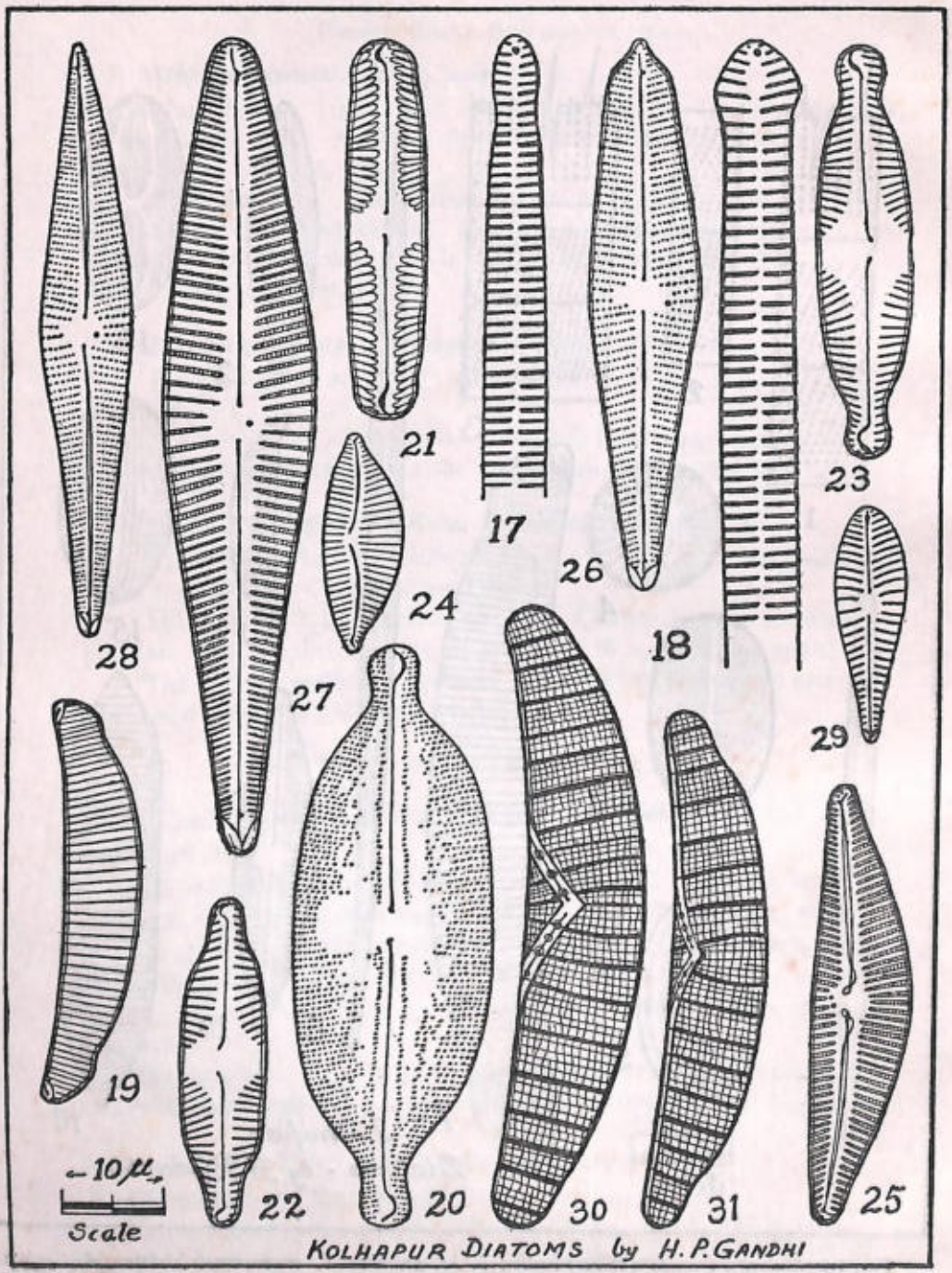

Fig. 17. *Synedra ulna* (Nitz.) Ehr. v. *subaequalis* Grun.; 18. *S. ulna* v. *biceps* Kütz.; 19. *Eunotia major* (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg; 20. *Anomoeoneis sphaerophora* (Kütz.) Pfit.; 21. *Pinnularia kolhapurensis* sp. nov.; 22. *P. notata* (Perag. & Hèr.) A. Cl. v. *rostrata* A. Cl.; 23. *P. biceps* Greg. v. *amphicephala* (May.) A. Cl.; 24. *Cymbella kerkevarensis* A. Cl.; 25. *C. tumidula* Grun.; 26. *Gomphonema subapicatum* Fritsch & Rich.; 27. *G. lanceolatum* Ehr.; 28. *G. spicula* sp. nov.; 29. *G. olivaceum* (Lyng.) Kütz.; 30. *Epithemia zebra* (Ehr.) Kütz.; 31. *E. zebra* v. *proboscidea* (Kütz.) Grun.

6. **Synedra ulna** v. **biceps** Kütz. (Fig. 18)

Hustedt, Bacil. 154, f. 166 ; Cleve-Euler, A., Diat. Schwed. Finn.—II : 62, f. 382 1.

Valves 250-425 μ long and 6-7 μ broad, linear, bent in the middle, with swollen, broadly subcapitate ends. Pseudoraphe narrow. Striae 7-8 in 10 μ, very coarse.

Family EUNOTIACEAE

7. **Eunotia major** (W. Sm.) Rabh. v. **indica** (Grun.) Å. Berg (Figs. 7, 19)

Berg. Å., *Bot. Not.* 1939 : 452 ; Cleve-Euler, A., Diat. Schwed. Finn.—II : 120, f. 456 r.

Valves 38-68 μ long and 7.7- 10μ broad, sublinear, arcuate with ventral side concave and dorsal side convex, ends constricted on the dorsal side, obliquely capitate-wedge-shaped. Polar nodules small. Striae 9-10 in the middle and 12-14 in 10 μ, at the ends.

Family ACHNANTHACEAE

8. **Cocconeis placentula** Ehr. (Figs. 8-9)

Hustedt, Bacil. 189, f. 260 a-b ; Cleve-Euler, A., Diat. Schwed. Finn.—III : 8, f. 492 a-b (= *C. placentula* v. *genuina* Mayer).

Valves 15-30 μ long and 10-16 μ broad, elliptical. Valve with raphe : raphe thin and straight ; axial area very narrow ; central area small, roundish ; striae 27 in 10 μ, finely punctate, marginal rim distinct. Valve without raphe : pseudoraphe narrow, linear ; striae 23-25 in 10 μ, interrupted by many closely placed longitudinal, somewhat wavy hyaline bands.

Family NAVICULACEAE

9. **Mastogloia recta** Hustedt (Fig. 32)

Voigt, M., *J. roy. microsc. Soc.* 75 : 191, t. 2, f. 3.

Valves 41-47 μ long and 13-13.5 μ broad, linear-elliptical with slightly constricted, produced obtusely rounded ends. Raphe thick, complex with slightly unilaterally bent central pores. Axial area narrow, linear ; central area fairly large, roundish. Belt of loculi arcuate, slightly away from the margins ; loculi 9-10 in 10 μ, each loculus 1-1.3 μ long and 2-3 μ broad. Striae 12-14 in 10 μ, radial throughout or sometimes inconspicuously convergent at the extreme ends, coarse and clearly punctate, 1-2 median striae smaller or deformed.

This form agrees well with the type (photomicrograph) given by Voigt, except that the margins are feebly convex and the ends slightly produced.

10. **Mastogloia recta** v. **pulchella** Voigt (Figs. 33-35)

Voigt, M., *J. roy. microsc. Soc.*, 75 : 191, t. 2, f. 4.

Frustules epiphytic on *Chara*, united in short ribbons, broadly rectangular in girdle view with two longitudinal belts of loculi. Valves 24-35 μ long and 11-13 μ broad, broadly lanceolate with slightly constricted, produced obtuse ends. Raphe, central and axial areas as in the type. Loculi 8-9 in 10 μ, each loculus except the end ones, 1-1.2 μ long and 2-3 μ broad. Striae 13-14 in 10 μ radial throughout or at the extreme ends 2-3 striae either perpendicular or convergent, coarse and clearly punctate, punctae 22-23 in 10 μ, 1-2 median striae smaller or somewhat deformed.

11. **Anomoeoneis sphaerophora** (Kütz.) Pfitzer (Fig. 20)

Hustedt, Bacil. 262, f. 422 ; Cleve-Euler, A., Diat. Schwed. Finn.—III : 202, f. 928 a (=*A. sphaerophora* v. *genuina* A. Cl.).

Valves 50-55 μ long and 17-18.5 μ broad, sub-elliptical to elliptical lanceolate with narrowed, produced, slightly capitate ends. Raphe thin with curved central pores. Axial area very narrow ; central area large, unilaterally widened. Striae 16-18 in 10 μ, coarsely punctate, towards the axial part interrupted by broad, irregular, longitudinal wavy hyaline bands.

12. **Navicula cuspidata** Kütz. f. **brevirostrata** f. nov. (Fig. 36)

Valvae 58.8-68 μ longae atque 18-20 μ latae, elliptico-lanceolatae, apicibus constrictis ac brevi-rostrato-subtruncatis. Raphe tenuis et recta, poris centralibus hamo-similibus. Area axialis angustissima, linearis ; area centralis vix evoluta. Striae transversales 14-16 in 10 μ, plerumque perpendiculares ad lineam mediam, striae longitudinales tenuissimae, indistinctae, circa 26-28 in 10 μ.

Valves 58.8-68 μ long and 18-20 μ broad, elliptic-lanceolate with constricted, shortly rostrate subtruncate ends. Raphe thin and straight with central pores hook-like. Axial area very narrow, linear ; central area scarcely formed. Striae transverse 14-16 in 10 μ, mostly perpendicular to the middle line, longitudinal striae very fine, almost indistinct, about 26-28 in 10 μ.

A few frustules observed in the collection, differed from the type in being more elliptical-lanceolate with constricted, shortly rostrate-subtruncate ends. Hence, such specimens have been tentatively regarded as a new form.

13. **Navicula cuspidata** v. **ambigua** (Ehr.) Cl. (Fig. 37)

Hustedt, Bacil. 268, f. 434 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 18, f. 1353 g (=*N. cuspidata* Kütz. v. *ambigua* (Ehr.) Cl. f. *crati-*

cularis A. Cl.); Van Heurck, Treat. Diat. 214, t. 4, f. 193 (=*N. ambigua* Ehr. f. *craticula* V. H.).

Valves 81-91 μ long and 17-18 μ broad, narrowly rhombic-lanceolate with constricted, produced feebly capitate ends. Craticular plates sometimes present. Raphe thin and straight with central pores hook-like. Axial area very narrow, linear; central area scarcely formed. Striae transverse 16-17 in 10 μ, almost perpendicular to the middle line, longitudinal striae fine, almost indistinct, about 28 in 10 μ.

This form appears to be slender as compared to Hustedt's form but agrees well with others. In some forms craticular plates were also observed as indicated by Van Heurck and Cleve-Euler in their illustrations and such forms they have regarded as forma *craticula* and f. *craticularis*, respectively. Here, these forms have been included under *N. cuspidata* v. *ambigua* (Ehr.) Cl., since craticular stages are immobile stages induced under unfavourable conditions of the environment. (Smith, G. M., Cryptogamic Botany, II : 207).

14. **Navicula minuta** (Cleve) A. Cl. (Fig. 38)

Cleve-Euler, A., Diat. Schwed. Finn.—III : 142, f. 791 a (=*N. minuta* v. *genuina* A. Cl.).

Valves 19-20 μ long and 7 μ broad, broadly lanceolate with constricted, shortly capitate ends. Raphe thin and straight with central pores closely set. Axial area very narrow; central area small, roundish. Striae 22-24 in 10 μ, radial and fine.

This diatom agrees well with the type, except that it is somewhat smaller in dimensions. It also compares well with *N. carassius* Ehr., as described by Donkin (Donkin, Brit. Diat. 20, t. 3, f. 7), in the outline. But as the dimensions are not indicated, the comparison is difficult. Moreover, the ends are described to be produced which are here capitate, hence it differs.

15. **Navicula cryptocephala** Kütz. (Fig. 10)

Hustedt, Bacil. 295, f. 496; Cleve-Euler, A., Diat. Schwed. Finn.—III : 154, f. 813 a-e (= *N. cryptocephala* v. *genuina* A. Cl.).

Valves 27-44 μ long and 6-7 μ broad, lanceolate with somewhat constricted produced ends. Striae 14-17 in 10 μ, lineate, radial in the middle and convergent at the ends.

16. **Navicula cryptocephala** v. **subsalina** Hust. (Figs. 11-12)

Cleve-Euler, A., Diat. Schwed. Finn.—III : 154, f. 813 i-j, n.

Valves 18-27 μ long and 5-6.6 μ broad, lanceolate with rounded ends. Raphe thin and straight. Axial area very narrow, linear; central area small, elliptical. Striae 14-17 in 10 μ, radial in the middle and convergent at the ends, lineate.

17. **Navicula pygmaea** Kütz. (Fig. 13)

Hustedt, Bacil, 312, f. 561; Cleve-Euler, A., Diat. Schwed. Finn.—III: 105, f. 708.

Valves 18-25 μ long and 9-10 μ broad, elliptical. Raphe thin and straight with central pores closely set and distinct. Axial area very narrow; central area small, rectangular. Striae 26-28 in 10 μ, radial, interrupted in the axial region by a H-shaped hyaline area.

18. **Pinnularia kolhapurensis** sp. nov. (Fig. 21).

Valvae 36-40 μ longae atque 8.5 μ latae, sublineares, apicibus aliquantum constrictis, productis atque truncato-rotundatis. Raphe tenuis et recta, ornata poris centralibus unilateraliter inclinatis, fissuris terminalibus aliquantum curvatis. Area axialis angusta ; area centralis lata, rhomboidea ad latera perveniens. Striae 11-13 in 10 μ, crassae, proximae positae, radiales in medio ac convergentes in utroque apice.

Valves 36-40 μ long and 8.5 μ broad, sublinear with slightly constricted, produced, truncate rounded ends. Raphe thin and straight with unilaterally bent central pores and slightly curved terminal fissures. Axial area narrow ; central area wide, rhomboid, reaching the sides. Striae 11-13 in 10 μ, thick, closely set, radial in the middle and convergent at the ends.

This form remotely resembles *P. subcapitata* Greg. (Hustedt, Bacil. 317, f. 571; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 64, f. 1090 a-b) (=*P. subcapitata* v. *genuina* A. Cl.); Lund, J. W. G., *New Phytol.* 45: 90, f. 10 T-V), in the outline and somewhat in ends. However, the present form appears to be distinctive, as it is proportionately much broader than *P. subcapitata*, besides having closely set striae and rhomboidal central area. Hence it is tentatively considered to be a new species.

19. **Pinnularia notata** (Perag. & Hér.) A. Cl. v. **rostrata** A. Cl. (Fig. 22)

Cleve-Euler, A., Diat. Schwed. Finn.—IV : 56, f. 1075 e-f, k.

Valves 27-35 μ long and 8-8.5 μ broad, linear with somewhat abruptly constricted, produced rounded ends. Raphe thin and straight. Axial area narrow, linear ; central area very large reaching the sides. Striae 10-12 in 10 μ, coarse, radial in the middle and convergent at the ends.

This diatom agrees well with the type, except that some smaller forms were also recorded in the area.

20. **Pinnularia biceps** Greg. v. **amphicephala** (May.) A. Cl. (Fig. 23)

Cleve-Euler, A., Diat. Schwed. Finn.—IV : 63, f. 1088 i; Hustedt, Bacil. 319, f. 578 [= *P. braunii* (Grun.) Cl. v. *amphicephala* (A. Mayer) Hustedt].

Valves 42-45 μ long and 8.5-9 μ broad, sublinear with slightly convex sides and constricted capitate ends. Raphe thin and straight with central pores unilaterally bent and closely set; terminal fissures curved. Axial area narrow; central area very large, rhomboid, reaching the sides. Striae 10-12 in 10 μ, coarse, radial in the middle and convergent at the ends.

The form recorded from this area agrees well with the type, except that they are slightly broader.

21. **Amphora veneta** Kütz. (Figs. 14-15)

Hustedt, Bacil. 345, f. 631 ; Cleve-Euler, A., Diat. Schwed. Finn.—III : 96, f. 682,

Frustules 13-24 μ long and 8-10 μ broad, broadly elliptical with somewhat subtruncate ends in the girdle view. Valves 4-4.5 μ broad, strongly convex on the dorsal side and slightly concave on the ventral margin with inwardly bent rounded ends. Raphe thin, very close to the ventral margin with central pores dorsally directed. Striae 16-20 in 10 μ, in the middle and up to 27 at the ends, median striae clearly punctate, end striae very finely punctate and rather indistinct, radial throughout. Ventral margin very shortly punctate.

This form is described by Krishnamurthy (1954) where he indicates that the frustules have constriction in the middle zone. However, the present author observed no such constrictions in any of his forms collected from several places, and he finds no such point mentioned either by Hustedt (1930) or Cleve-Euler (1953).

22. **Cymbella kerkevarensis** A. Cl. (Fig. 24)

Cleve-Euler, A., Diat. Schwed. Finn.—IV: 146, f. 1215.

Valves 22-25 μ long and 7.7-8 μ broad, asymmetrical with strongly convex dorsal side and slightly convex ventral side, ends slightly constricted and rostrate. Raphe thin, slightly arcuate or apparently straight, excentric and strongly marked. Axial area very narrow; central area very small. Striae 11-13 in 10 μ, throughout radial and finely punctate.

This form agrees well with the type, except that it is somewhat smaller in dimensions.

23. **Cymbella tumidula** Grun. (Fig. 25)

Hustedt, Bacil. 361, f. 669; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 157, f. 1239 a-b (= *C. tumidula* v. *genuina* A. Cl.)

Valves 35-40 μ long and 8.8-9 μ broad, asymmetrical, lanceolate with strongly convex dorsal side and slightly convex ventral side ; ends constricted and produced, rounded. Raphe thick, excentric. Axial area very narrow ; central area slightly widened towards the dorsal side, ventral side with two distinct puncta. Striae 12-14 in 10 μ, radial, indistinctly punctate and somewhat closer at the ends.

24. **Gomphonema subapicatum** Fritsch & Rich. (Fig. 26)

Gandhi, H. P., *J. Indian bot. Soc.* 35 : 205, f. 22.

Valves 55-60 μ and 10-11 μ broad, lanceolate-clavate with constricted, subapiculate apex and attenuated base. Raphe thin and straight. Central area with an isolated stigma on one side. Striae 10-13 in 10 μ, radial and distinctly punctate.

25. **Gomphonema lacus-rankala** sp. nov. (Fig. 39)

Valvae 69-90 μ longae atque 18.5-20 μ latae, late lanceolato-clavatae, apice constricto, late rostrato-rotundato, ad basim concavo, attenuato-rotundato. Raphe crassa, cum portione centrali unilateraliter inclinata. Area axialis angustissima, lanceolata; area centralis aliquantum unilateralis cum unico stigmate in latere opposito. Striae 8-9 in 10 μ, radiales, crassae atque distincte punctatae, punctis 16-17 in 10 μ.

Valves 69-90 μ long and 18.5-20 μ broad, broadly lanceolate-clavate with constricted, broadly rostrate rounded apex and somewhat concave attenuated rounded base. Raphe thick with central portion unilaterally bent. Axial area narrowly lanceolate ; central area slightly unilateral with a stigma on the opposite side. Striae 8-9 in 10 μ, radial, coarse and distinctly punctate, puncta 16-17 in 10 μ.

This form bears some resemblance with *G. subapicatum* Frit. & Rich. described above, in the outline and constricted apex. However, it differs from it in having thick raphe with unilaterally bent central part, conspicuously rostrate apex, very coarsely punctate striae and some other details. It, therefore, appears to be a distinctive form, hence it is considered to be a new species.

26. **Gomphonema lacus-rankala** v. **robusta** v. nov. (Fig. 40)

Valvae 90-101 μ longae atque 18.7 μ latae, robustae, longo-lanceolato-clavatae, apice aliquantum constricto, rostrato-rotundato, ad basim attenuato, rotundato. Striae 8-10 in 10 μ, crasse punctatae, ac aliquantum radiales. In coeteris ut typus.

Valves 90-101 μ long and 18.7 μ broad, robust, long-lanceolate-clavate with slightly constricted, rostrate-rounded apex and attenuated rounded base. Striae 8-10 in 10 μ, coarsely punctate and slightly radial. In other details like the above type.

This form differs from the above type in being elongated, more lanceolate-clavate, robust with somewhat prominently rostrate apex. It is, therefore, regarded as a new variety of *G. lacus-rankala*, with which it occurred in a good number.

27. **Gomphonema lacus-rankala** v. **gracilis** v. nov. (Fig. 41)

Valvae 100-112 μ longae atque 15 μ latae, angustissime-lanceolato-clavatae, apice aliquantum constricto, tenuissime producto, ad basim

FIGURES 32-51

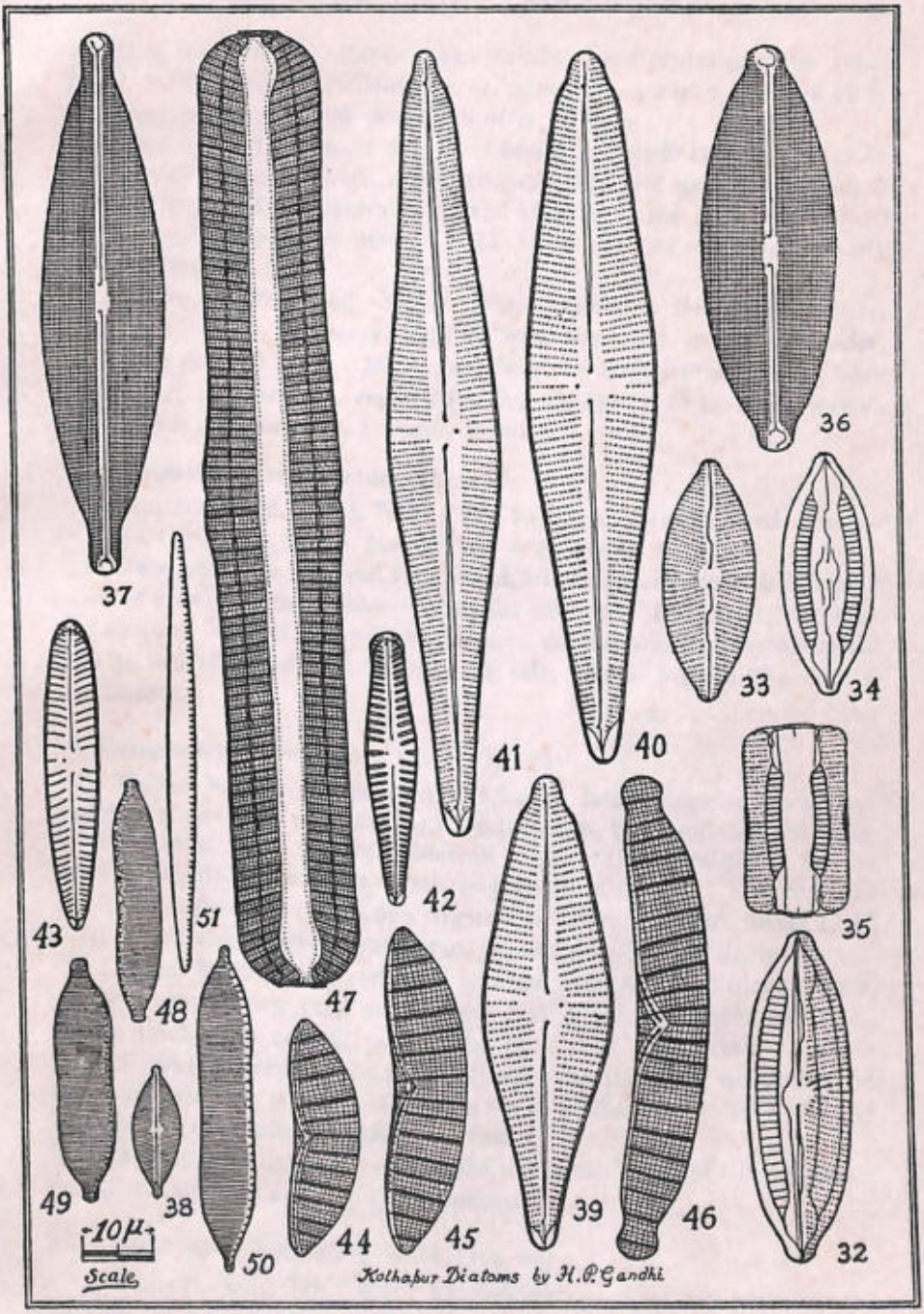

Fig. 32. *Mastogloia recta* Hustedt ; 33-35. *M. recta* v. *pulchella* Voigt ; 36. *Navicula cuspidata* Kütz. f. *brevirostrata* f. nov. ; 37. *N. cuspidata* v. *ambigua* (Ehr.) Cl. ; 38. *N. minuta* (Cleve) A. Cl. ; 39. *Gomphonema lacus-rankala* sp. nov. ; 40. *G. lacus-rankala* v. *robusta* v. nov. ; 41. *G. lacus-rankala* v. *gracilis* v. nov. ; 42. *G. intricatum* Kütz. ; 43. *G. intricatum* v. *bohemicum* (Reichelt & Fricke) A. Cl. ; 44-45. *Epithemia zebra* (Ehr.) Kütz. v. *frickei* A. Cl. ; 46. *E. zebra* v. *porcellus* (Kütz.) Grun. ; 47. *Rhopalodia gibba* (Ehr.) O. Müll. ; 48. *Hantzschia amphioxys* (Ehr.) Grun. v. *densestriata* (Font.) A. Cl. ; 49. *Nitzschia thermalis* Kütz. v. *minor* Hilse ; 50. *N. commutata* Grun. v. *pamirensis* (Hust.) A. Cl. ; 51. *N. gandersheimiensis* Krasske.

attenuato rotundato. Raphe, area axialis atque centralis ut in typo. Striae 8-10 in 10 μ, radiales atque punctatae, punctis 20-22 in 10 μ, striae aliquantum proxime positae in utroque apice.

Valves 100-112 μ long and 15 μ broad, narrowly-lanceolate-clavate with very slightly constricted, much produced narrower apex and attenuated rounded base. Raphe, central and axial areas as in the type. Striae 8-10 in 10 μ, radial, punctate, puncta 20-22 in 10 μ, striae somewhat closely set at the apices.

This form agrees well with *G. lacus-rankala*, in the outline, apex, raphe and striae. However, it differs from the same in being slender, with more pointed apex. Moreover, the striae have comparatively finer puncta. It is, therefore, regarded as a new variety of *G. lacus-rankala* with which it occurred in a smaller number.

28. **Gomphonema lanceolatum** Ehr. (Fig. 27)

Hustedt, Bacil. 376, f. 700 ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 184, f. 1280 a-e (= *G. lanceolatum* v. *genuinum* A. Cl.).

Valves 60-70 μ long and 12 μ broad, lanceolate-clavate with distinctly rounded apex and base, base somewhat narrower. Raphe slightly thick and straight. Axial area narrow, linear ; central area slightly unilateral with an isolated stigma on the opposite side. Striae 8-13 in 10 μ, radial and lineate.

29. **Gomphonema spicula** sp. nov. (Fig. 28)

Valvae 38-58 μ longae atque 5.5-8 μ latae, anguste lanceolato-clavatae, aliquantum arcuatae, apice acutissimo, basi gradatim fastigata. Raphe crassa, cum portione centrali unilateraliter inclinata, fissuris terminalibus distinctis. Area axialis angustissima, linearis ; area centralis quadrata, unilateralis cum unico stigmate in latere opposito. Striae 12-15 in 10 μ, radiales, distincte punctatae, punctis tenuibus sed distinctis.

Valves 38-58 μ long and 5.5-8 μ broad, narrowly lanceolate-clavate, slightly curved with very acute apex and gradually attenuated base. Raphe thick with central part unilaterally bent and terminal fissures distinct. Axial area very narrow, linear ; central area quadrate and unilateral with an isolated stigma on the opposite side. Striae 12-15 in 10 μ, radial, distinctly punctate, but fine.

This form does not agree with any of the known types of *Gomphonema*, hence, it is considered to be a new species.

30. **Gomphonema intricatum** Kütz. (Fig. 42)

Hustedt, Bacil. 375, f. 697 ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 187, f. 1283 a-d (= *G. intricatum* v. *genuinum* Mayer).

Valves 39-42 μ long and 5.5-6.7 μ broad, subclavate with constricted slightly swollen broadly rounded apex and attenuated rounded base.

Raphe slightly thick. Axial area narrow, linear ; central area unilateral with an isolated stigma on the opposite side. Striae 8-9 in 10 μ, in the middle up to 12 at the apices, radial, coarse, punctate, median striae very small and widely set.

31. **Gomphonema intricatum** v. **bohemicum** (Reich. & Fricke) A. Cl. (Fig. 43)

Cleve-Euler, A., Diat. Schwed. Finn. IV : 189, f. 2183 v-w ; Hustedt, Bacil. 377, f. 718 a-c (= *G. bohemicum* Reich. & Fricke).

Valves 40-45 μ long and 7-7.5 μ broad, linear-clavate with broadly rounded, somewhat thickened apex and acutely rounded base. Raphe thin and straight. Axial area linear ; central area unilaterally reaching the side, large with an isolated stigma on the opposite side. Striae 6-8 in 10 μ in the middle and up to 11 at the ends, slightly radial and curved, indistinctly punctate.

32. **Gomphonema olivaceum** (Lyng.) Kütz. (Fig. 29)

Hustedt, Bacil. 378, f. 719 a-c ; Cleve-Euler, A., Diat. Schwed. Finn.—IV : 192, f. 1291 f-g (= *G. olivaceum* v. *genuinum* Mayer)

Valves 20-24 μ long and 6-6.5 μ broad, clavate with broadly rounded apex and attenuated base. Raphe thin and straight. Axial area somewhat narrow ; central area moderate without an isolated stigma. Striae 8-11 in 10 μ, radial and curved.

Family EPITHEMIACEAE

33. **Epithemia zebra** (Ehr.) Kütz. (Fig. 30)

Van Heurck, Treat. Diat. 296, t. 9, f. 357 ; Hustedt, Bacil. 384, f. 729 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 37, f. 1409 a-f (= *E. zebra* v. *genuina* Grun.).

Frustules free or were found as epiphyte on *Hydrilla* and *Chara*, rectangular in girdle view. Valves 40-50 μ long and 8-9 μ broad, arcuate with dorsal side convex and ventral side concave, ends very slightly or not at all constricted, narrow to obtusely rounded. Raphe in the raphe-canal reaching $\frac{1}{3}$-$\frac{1}{2}$ the breadth of the valve. Costae 3-4 in 10 μ, strong and radial, alternating with 3-5 rows rarely 2 rows of alveoli, rows of alveoli 12-13 in 10 μ.

34. **Epithemia zebra** v. **frickei** A. Cl. (Figs. 44-45)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 37, f. 1409 h ; Hustedt, Bacil. 387, f. 732 (= *E. intermedia* Fricke).

Frustules were found epiphytic on *Chara* and *Hydrilla*, rectangular in girdle view. Valves 36-49 μ long and 9.7-10 μ broad, slightly arcuate ; dorsal side convex or in larger forms somewhat straight in the middle

part; ventral side more less concave; ends slightly depressed, backwardly oriented and rounded. Raphe in the raphe-canal very close to the ventral margin, slightly curved in the middle or sometimes reaching ¼ the breadth of the valve. Costae 3-4 in 10 μ, almost parallel with one another, alternating with 3-5 rows of alveoli, rows of alveoli 12-13 in 10 μ, fairly well developed.

This form is treated according to Cleve-Euler's diagnosis, since it does not show any appreciable difference with *E. zebra*, in its general organisation. Here, therefore, Hustedt's *E. intermedia* Fricke is considered to be the variety of *E. zebra*.

35. **Epithemia zebra** v. **proboscidea** (Kütz.) Grun. (Fig. 31)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 38, f. 1409 m-n.

Frustules were found epiphytic on *Chara* or *Hydrilla*, sometimes isolated rectangular in girdle view. Valves 50-53 μ long and 8-8 μ, broad, linear, arcuate with strongly constricted, produced rounded ends. Raphe in the raphe-canal reaching ⅓ the breadth of the valve. Costae 3-3.5 in 10 μ, alternating with 3-5 rows of alveoli; rows of alveoli 12-13 in 10 μ, quite distinct.

A few forms observed in the collection, none showed capitate ends as indicated by Van Heurck for his specimen (Van Heurck, Treat. Diat. 297, t. 9, f. 358). However, the present form agrees well with figure '1409 m', given by Cleve-Euler, hence it is so treated.

36. **Epithemia zebra** v. **porcellus** (Kütz.) Grun. (Fig. 46)

Skvortzow, B. W., *Philipp. J. Sci.*, 65 : 416, t. 2, f. 3; Cleve-Euler, A., Diat. Schwed. Finn.—V : 38, f. 1409 q.

Frustules were found epiphytic on *Chara* and *Ceratophyllum* along with the type, rectangular in girdle view. Valves 60-71.5 μ long and 8.8-10 μ broad, slightly arcuate, linear with conspicuously constricted, broadly capitate rounded ends, sometimes ends slightly backwardly bent. Raphe in the raphe-canal reaching the centre. Costae 3-3.5 in 10 μ, radial, alternating with 3-4 rows of alveoli, rarely 5, rows of alveoli 12-13 in 10 μ.

Hustedt's *E. zebra* v. *porcellus* (Kütz.) Grun. (Hustedt, Bacil. 385, f. 731) is treated as *E. zebra* v. *proboscidea* (Kütz.) Grun., by Cleve-Euler, since its ends are neither strongly constricted-capitate nor backwardly bent.

37. **Rhopalodia gibba** (Ehr.) O. Müll. (Fig. 47)

Hustedt, Bacil. 390, f. 740; Cleve-Euler, A., Diat. Schwed. Finn.—V : 44, fig. 1416 a, e (=*R. gibba* v. *genuina* Grun.); Van Heurck, Treat. Diat. 296, t. 9, f. 352 (=*Epithemia gibba* Kütz.).

Frustules free or found epiphytic on *Chara* and *Ceratophyllum*, 80-124 μ long and 18-20 μ broad, elongated, linear with slightly notched inflations in the middle ; ends subtruncate, slightly swollen with rounded corners. Valves 7-9 μ broad, dorsal side slightly bulged in the middle with a notch, ventral side straight with a slight depression at the ends which are acutely rounded. Costae 6-7 in 10 μ, becoming strongly radial towards the ends, alternating with 2-3 rows of alveoli, rows of alveoli 12-14 in 10 μ, fine but distinct, crossed by a hazy longitudinal band or fold.

This specimen agrees very well with illustrations given by Cleve-Euler and Van Heurck, but differs from that of Hustedt's which shows ends to be gradually narrowed in girdle view, as in *R. gibba* v. *ventricosa* (Ehr.) Grun. (Hustedt, Bacil. 391, f. 741 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 44, f. 1416 c-d).

Family NITZSCIACEAE

38. **Hantzschia amphioxys** (Ehr.) Grun. v. **densestriata** (Font.) A. Cl. (Fig. 48)

Cleve-Euler, A., Diat. Schwed. Finn.—V : 49, f. 1419 n-p.

Valves 35-38 μ long and 5-5.5 μ broad, slightly arcuate, linear with constricted, rostrate obtuse ends. Keel excentric with keel puncta 9-10 in 10 μ, distinct. Striae 23-24 in 10 μ, fine but distinct.

39. **Nitzschia tryblionella** Hantz. v. **levidensis** (W. Sm.) Grun. (Fig. 16)

Hustedt, Bacil. 399, f. 760 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 51, f. 1430 i-l.

Valves 31-50 μ long and 8.7-10.5 μ broad, linear with constricted, slightly produced ends. Keel excentric, notched in the middle, keel puncta 10-11 in 10 μ. Striae 11-13 in 10 μ, coarse and undulate.

40. **Nitzschia thermalis** Kütz. v. **minor** Hilse (Fig. 49)

Hustedt, Bacil. 403, f. 772 ; Cleve-Euler, A., Diat. Schwed. Finn.—V. 6, 4f. 1445 g-h.

Valves 30-35 μ long and 7-7.5 μ broad, linear, concave in the middle with wedge-shaped, constricted rostrate ends. Keel excentric, keel puncta 10-12 in 10 μ. Striae over 30 in 10 μ, fine and seen with difficulty.

41. **Nitzschia commutata** Grun. v. **pamirensis** (Hust.) A. Cl. (Fig. 50)

Cleve-Euler, A. Diat. Schwed. Finn.—V : 64, f. 1443 c.

Valves 45-47 μ long and 7.7 μ broad, linear, concave in the middle with wedge-shaped, constricted, shortly capitate ends. Keel excentric, keel puncta 8-9 in 10 μ, distinct. Striae about 24 in 10 μ, fine.

42. **Nitzschia gandersheimiensis** Krasske (Fig. 51)

Hustedt, Bacil. 417, f. 804 ; Cleve-Euler, A., Diat. Schwed. Finn.—V : 86, f. 1495 b.

Valves 46-63 μ long and 3.4-4.4 μ broad, narrowly linear-lanceolate or lanceolate with somewhat constricted, produced rounded ends. Keel excentric, keel puncta distinct, somewhat irregularly disposed, 8-11 in 10 μ. Striae very fine, indistinct probably over 35 in 10 μ.

In the following table, in addition to the above named diatoms, others are also included which occurred in the said area. Since these are being described and illustrated from other places by the author and as they do not show any special feature of interest, it is therefore considered sufficient merely to list them and indicate their distribution in this region and other places in India.

TABLE SHOWING THE DISTRIBUTION OF DIATOMS COLLECTED FROM KOLHAPUR AND ITS IMMEDIATE VICINITY

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author[1]
Achnanthes minutissima Kütz. ..	Rankala, Kalamba, and other tanks; common.	17, 28.
Amphora ovalis Kütz. v. *pediculus* Kütz. ..	Widely distributed in pools and tanks; frequent.	5, 16, 19.
A. veneta (Kütz.) Hustedt	Widely distributed; very common.	17, 18, 28, 43.
Anomoeoneis sphaerophora (Kütz.) Pfit. ..	Rankala and Kalamba tanks and pools; occasional.	1, 5, 23, 42.
Caloneis silicula (Ehr.) Cl.	Rankala and Kalamba tanks; not common.	16, 17.
Cocconeis placentula Ehr.	do.	1, 5, 14, 23, 33, 46.
C. — v. *euglypta* (Ehr.) Cl. ..	Widely distributed; very common.	1, 16, 17, 19, 22, 42.
Cyclotella meneghiniana Kütz. ..	Widely distributed, particularly in slimy matrix; frequent.	1, 5, 16, 17, 19, 22, 39, 42.
C. — f. *binotata* Grun. ..	Rankala tank, pools, and filter-house drainage; rare.	17, 18.

[1] Numbers in this column refer to the bibliography at the end of this paper.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
Cymbella kerkevarensis A. Cl. ..	Pools, puddles, and tanks; not common. Also collected from Sagar and Jog Falls.	A new record for India.
C. tumidula Grun. ..	Rankala tank; rare.	do.
C. turgida (Gerg.) Cl. ..	Pools, puddles, and tanks; frequent but never abundant.	5, 16, 17, 21, 25, 42.
C. ventricosa Kütz. ..	Pools, puddles, and tanks; common.	4, 5, 16, 17, 28.
Diploneis puella (Schum.) Cl. ..	Stagnant water of drainage, pools, and puddles; not common.	1, 21, 28, 34, 39.
Epithemia zebra (Ehr.) Kütz. ..	Widely distributed in tanks; common.	1, 4, 5, 27.
E. — v. *frickei* A. Cl. ..	Rankala tank; occasional.	A new record for India.
E. — v. *porcellus* (Kütz.) Grun. ..	Rankala tank; common.	do.
E. — v. *proboscidea* (Kütz.) Grun. ..	Rankala tank; not common. Also in Kalamba tank.	do.
Eunotia lunaris (Ehr.) Grun. ..	Marginal slime of tanks; occasional.	1, 4, 5, 12, 23, 28, 47.
E. major (W. Sm.) Rabh. v. *indica* (Grun.) A. Berg ..	Rankala and Kalamba tanks and puddles; not common.	5, 25 (= *E. indica* Grun.).
Fragilaria intermedia Grun.	Pools, puddles, and tanks; common.	21, 22, 42.
F. rumpens (Kütz.) Carl. v. *familiaris* (Kütz.) A. Cl. ..	Rankala, Kalamba, and other tanks; common.	22 (= *Synedra rumpens* v. *familiaris* Kütz.).
Gomphonema augur Ehr. ..	Pools and tanks; not common.	5, 17, 43.
G. gracile Ehr. ..	Pools, tanks, and ditches; common.	5, 6, 14, 15, 21, 28, 33, 46.
G. intricatum Kütz. ..	Rankala and Kalamba tanks; rare.	1, 5, 28, 33, 47.
G. — v. *bohemicum* (Reich. & Fricke) A.Cl. ..	Rankala tank and paddy fields; not common.	A new record for India.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
G. lacus-rankala sp. nov. ..	Rankala tank; common.	A new record.
G. — v. *gracilis* v. nov. ..	Rankala tank; rare.	do.
G. — v. *robusta* v. nov. ..	Rankala tank; less common.	do.
G. montanum Schum. v. *acuminatum* May. ..	Rankala tank and pools; not common.	17.
G. olivaceum (Lyng.) Kütz.	Rankala and temple tanks, and paddy fields; fairly common.	4, 5, 28.
G. parvulum (Kütz.) Grun.	Widely distributed; common.	5, 16, 17, 21, 25, 34, 42.
G. sphaerophorum Ehr. ..	Rankala and Kalamba tanks, pools; fairly common.	21, 28.
G. spicula sp. nov. ..	do. Also recorded from Bombay.	A new record.
G. subapicatum Fritsch & Rich. ..	Tanks, ponds, pools; common	1, 5, 17.
Hantzschia amphioxys (Ehr.) Grun. v. *densestriata* (Font.) A. Cl. ..	Rankala tank and pools; rare.	A new record for India.
Mastogloia recta Hustedt	Rankala tank; occasional.	do.
M. — v. *pulchella* Voigt ..	Rankala tank; common. Also recorded from Ahmedabad.	do.
Melosira granulata (Ehr.) Ralfs ..	Marginal slime of tanks, pools, ponds, and filter-house drainage pools; very common.	5, 6, 17, 19, 22, 46.
M. — v. *angustissima* O. Müll. ..	Rankala and Kalamba tanks, filter-house drainage; rare.	42.
M. — v. *muzzanensis* Meister ..	Rankala and Kalamba tanks, filter-house drainage fairly common.	22
Navicula cryptocephala Kütz. ..	Widely distributed; common.	5, 12, 16, 24, 25, 47.
N. — v. *subsalina* Hust...	Rankala and Kalamba tanks and some pools; not common.	17.
N. — *cuspidata* Kütz. ..	Pools, ponds, and tanks; less common.	1, 5, 24, 46, 47.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
N. — f. *brevirostrata* f. nov. ..	Rankala tank; occasional. Also recorded from Lonavla.	A new record.
N. — v. *ambigua* (Ehr.) Cl.	Widely distributed; common.	16, 24, 46, 47.
N. — v. *conspicua* Venkat.	Tanks and ponds; not common.	17, 24, 42.
N. minuta (Cleve). A. Cl.	Rankala tank; rare.	A new record for India.
N. mutica Kütz. ..	Desiccated soils, marginal slime of tanks; common.	5, 18, 46, 47.
N. pupula Kütz. ..	Rankala and Kalamba tanks, and pools; common.	5, 19, 24, 46.
N. — v. *capitata* Hust. ..	Rankala and Kalamba tanks, and pools; fairly common.	16, 24, 43.
N. — v. *elliptica* Hust. ..	Rankala and Kalamba tanks, and pools; not common.	17.
N. pygmaea Kütz. ..	Rankala and Kalamba tanks; fairly common.	24, 42.
N. radiosa Kütz. ..	Pools and puddles, tanks; not common.	1, 5, 43.
Nitzchia amphibia Grun.	Widely distributed; common.	5, 6, 16, 17, 34, 42.
N. — v. *acutiuscula* Grun.	Small drying pools and ponds; less common.	17.
N. commutata Grun. v. *pamirensis* (Hust.) A. Cl.	Rankala and Kalamba tanks; not common.	A new record for India.
N. frustulum (Kütz.) Grun.	Wet soils, pond, pools, and puddles; fairly common.	16.
N. gandersheimiensis Krasske ..	Rankala and Kalamba tanks, and ponds; not common.	16.
N. obtusa W. Sm. v. *scalpelliformis* Grun. ..	Widely distributed; common.	16, 17, 34, 42.
N. palea (Kütz.) W. Sm. ..	Widely distributed, also in wet soils; very common.	1, 5, 17, 18, 34, 42.
N. thermalis Kütz. v. *minor* Hilse ..	Marginal slime of tanks, wet soils; fairly common.	18.
N. sublinearis Hust. ..	Pools and tanks; common.	16, 17.

List of Diatoms	Place of collection in Kolhapur	Previous place of collection in India and its author
N. tryblionella Hantz. v. *levidensis* (W. Sm.) Grun.	Pools and tanks; not quite common.	16, 42.
Pinnularia acrosphaeria Brèb. ..	Rankala, Kalamba, and other tanks; frequent.	5, 6, 19, 20, 21, 33, 42.
P. — v. *minor* Cleve ..	Widely distributed in ponds and tanks; never abundant.	17, 19, 20.
P. biceps Greg. v. *amphicephala* (May.) A. Cl. ..	Pools and tanks; not common.	A new record for India.
P. notata (Perag. & Hèr.) A. Cl. v. *rostrata* A. Cl.	Rankala tank; rare.	do.
P. kolhapurensis sp. nov. ..	Rankala tank; rare.	A new record.
Rhopalodia gibba (Ehr.) O. Müll. ..	Kalamba and Rankala tanks and some ponds; less common.	1, 4, 5, 17, 42.
R. gibba v. *ventricosa* (Ehr.) Grun. ..	Widely distributed; more frequent than the above type.	17, 42.
Stauroneis phoenicenteron Ehr. ..	Tanks, ponds, and puddles; fairly common.	5, 6, 21, 23, 27, 31, 34, 46, 47.
Surirella tenera Greg. ..	Kalamba tank; rare.	19, 42.
Synedra acus Kütz. ..	Pools and tanks; common.	5, 6, 17, 28, 47.
S. ulna (Nitz.) Ehr. ..	Widely distributed; very common.	1, 4, 5, 16, 19, 21, 22, 42.
S. — v. *amphirhynchus* (Ehr.) Grun. ..	Widely distributed; frequent.	1, 5, 16, 17, 19, 22, 47.
S. — v. *biceps* Kütz. ..	Rankala and Kalamba tanks; occasional.	19.
S. — v. *danica* (Kütz.) Grun. ..	Tanks, ponds, and pools; fairly common.	16, 19, 21, 22.
S. — v. *subaequalis* Grun.	Rankala and Kalamba tanks; not common.	22, 33, 46.

SUMMARY

For the first time the freshwater Diatomaceae of Kolhapur and its immediate environs are investigated. Of these an illustrated account is presented in these pages. In a separate table the distribution of forms is given indicating the places of collection in Kolhapur, previous places of collection in India and their authors, and new records for science as well as for India.

In all seventy-nine diatoms are recorded from the said area, of which thirteen are new records for India, and three species, two varieties, and one form considered to be new.

ACKNOWLEDGEMENT

The author wishes to express his grateful thanks to Rev. Fr. Francis Braganza, S. J., of St. Xavier's College, Ahmedabad, for correcting the Latin diagnoses ; and to Profs. J. B. Petersen, A°. Berg, Foged Niels, J. W. G. Lund, Dr. Hustedt, Mr. M. Voigt, and other friends for providing the literature.

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On the Occurrence of the Eel *Neenchelys buitendijki* Weber & de Beaufort in Indian Waters[1]

BY

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(*With one plate*)

While examining a collection of eels from Sassoon Dock—the principal fish landing place of Bombay City—a few specimens of *Neenchelys buitendijki* Weber & de Beaufort were obtained in April 1953. The species not having been recorded from India so far, regular searches were made in the subsequent fish catches for further material and relevant data regarding its occurrence. It was revealed that the species is not rare in this locality, and a large number of specimens was obtained. Since the original description of this eel (Weber & de Beaufort, 1916) was based on only two specimens it is thought desirable to describe the species in greater detail in the light of the present good series:

GENUS *Neenchelys* BAMBER

Gill openings separate, lateral. Distance from anus to gill opening much more than length of head. Body scaleless. Caudal confluent with anal and dorsal. Nostrils lateral. Pectorals present. Anus in anterior half of length. Tongue not free. Teeth acute, uniserial. Branchial openings in pharynx narrow slits. Intermaxillary plate pointed.

KEY TO THE SPECIES OF *Neenchelys* BAMBER

i. Origin of dorsal fin as far from gill opening as latter is from angle of mouth. Pectorals shorter than snout. ... *N. microtretus*

ii. Origin of dorsal fin not as far from gill opening as latter is from angle of mouth. Pectorals longer than snout. ... *N. buitendijki*

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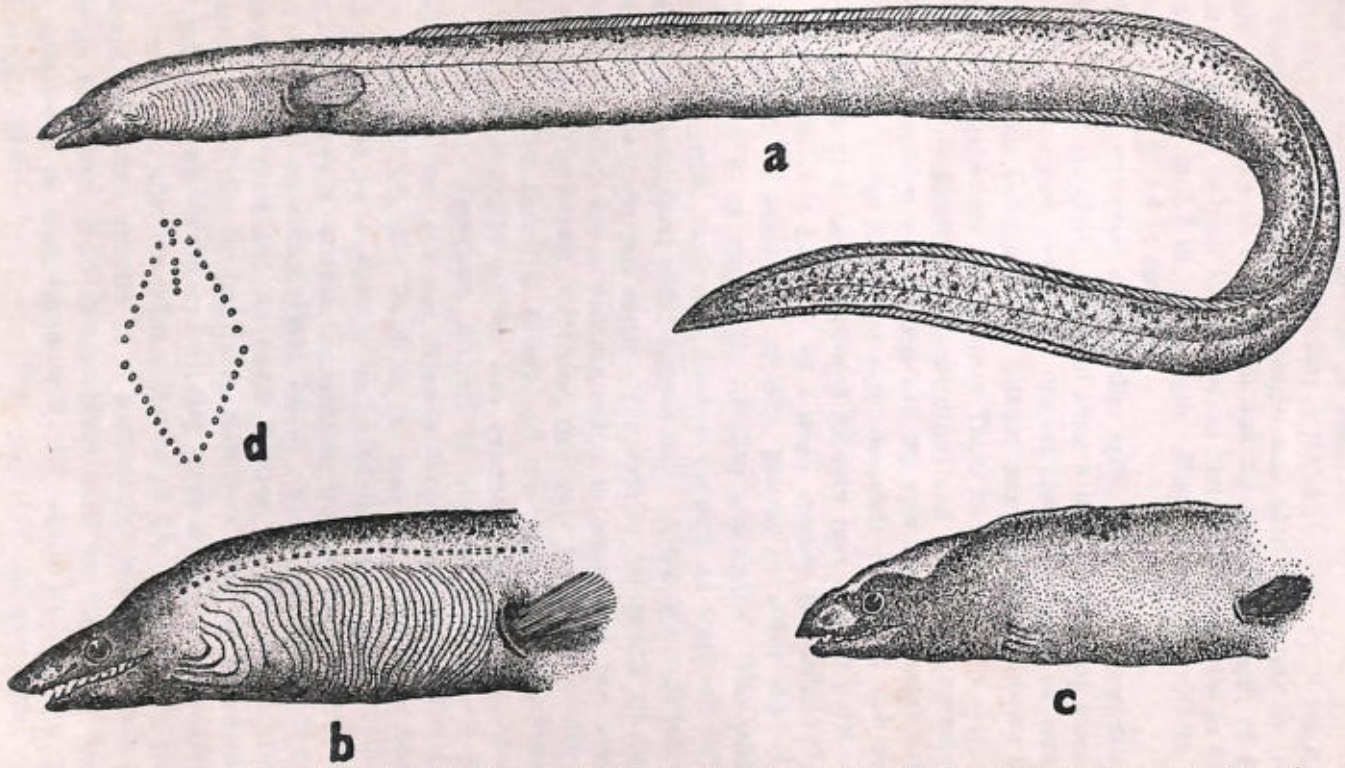

a. *Neenchelys buitendijki* Weber & de Beaufort x 1 ; b. Head of *N. buitendijki* x 2 ; c. Head of newly metamorphosed elver of *N. buitendijki* x 8 ; d. diagrammatic representation of the arrangement of teeth in *N. buitendijki*.

Neenchelys Buitendijki Weber & de Beaufort

Description: D. 335-346; A. 225-228; C. 9; P. 14-16; B. 31-36. Head 7.6 to 8.5 in total length and more than two in trunk. Height 19.8 to 24.6 in total length and 2.3 to 3.6 in length of head. Snout 6.5 to 7.3 in head length. Head and body 1.2 to 1.6 in length of tail and 2.3 to 2.7 in total length. Diameter of eye 19.3 to 25.5 in head and 3 to 3.4 in snout.

The body proportions generally agree with the description of Weber and de Beaufort (1916) but since a large number of specimens have been examined during the present study the range in variation has shown some increase. The detailed precision measurements made from fifteen specimens are given in Table I.

The body is scaleless, sub-cylindrical and posteriorly compressed. The head is conical and pointed and the eyes are very small without eyelids. The snout is conical and somewhat prominent due to the intermaxillary plate being produced forward into a sharp point. The anterior nostril is in the form of a small opening just behind the tip of the snout. A small flap of skin, present on either side of this opening, gives it an apparently tubulate appearance. The posterior nostril is a small, elongated, slit-like opening in front of the eye, more or less on a level with its lower half. A few mucilage pores are present on the nape and snout. The cleft of the mouth reaches far behind the orbit, for a distance equal to more than one diameter of the eye. The mouth is inferior, the lower jaw being smaller than the upper. The throat is silvery and the characteristic arrangement of the branchiostegals can be seen externally in the fresh condition (Plate, fig. *b*). Specimens stained in alizarin revealed 31 to 36 branchiostegals on each side, whereas Weber and de Beaufort (1916) have observed only 25. Teeth in the jaws are uniserial, acute, long and widely set in a slanting backward direction. The number of teeth in the jaws is variable, but generally number 8 on the maxillaries and 10 on the mandibles (Plate, fig. *d*). There are four teeth on the intermaxillary plate and an equal number on the vomer. On the anterior end of the intermaxillary plate two teeth are arranged side by side while all the others including those on the vomer are placed in a series one after the other. The tip of the intermaxillary plate is pointed and often appears as a horizontally directed median tooth. All the four teeth on the intermaxillary plate are depressible and can be considered as homologous with the mesial teeth of the genera *Muraena, Gymnothorax*, etc. The teeth on the front part of the

TABLE I

Precision measurements made on 15 specimens of *Neenchelys buitendijki* Weber & de Beaufort

(Recorded in thousandths of the total length)

Serial No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total length in mm.	58.5	66.0	79	92	115	117	122	128	149	155	158	161	179	222	273
Head	126	121	123	119	126	120	123	125	123	125	120	125	127	117	117
Height	32	31	42	41	41	43	43	45	42	46	51	48	50	47	46
Snout	17	18	18	8	17	17	18	18	17	15	18	18	19	18	15
Eye	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
Preanal distance	357	369	367	380	383	393	418	429	409	419	402	416	435	428	407
Predorsal distance	167	167	177	173	165	154	164	169	172	180	168	179	190	167	170
Tail	643	631	633	620	617	607	582	571	591	581	598	584	565	572	593

jaws are longer than those on the posterior part. Those on the vomer and the intermaxillary are large.

Lateral line commences from a little distance behind the eye, the distance being more or less equal to the length of snout. It continues in the form of a straight line in the dorso-lateral aspect of the body. This line generally appears to be a dotted line because of the presence of numerous ossified subcutaneous tubes wherein the sensory nerves end. These bony elements are seen to take stain very readily when specimens are treated with alizarin.

The vertical fins are low and are supported by unbranched rays. The pectoral fins are longer than the snout and they originate from close behind the gill openings. Branched fin-rays support these fins. The caudal is continuous with the dorsal and the anal fins. The origin of the dorsal fin is more than half as far from the gill opening as the latter is from the angle of the mouth. The anal fin originates from close behind the vent.

In the fresh condition, the fish is yellowish pink in colour. The portion of the body above the lateral line is pigmented with closely distributed, brown, branching chromatophores. In the tail region the pigmentation is more intense and uniform. The fins are generally whitish in colour and are unpigmented, but the posterior end of the dorsal and anal fins, as well as the whole of the caudal fin are black in colour due to intense pigmentation.

The size of the specimens in the collection varied from 58.5 mm. to 273 mm. in total length; the one which is 273 mm. is the largest known so far as the previous record was only 218 mm. (Weber and Beaufort). The number of vertebrae generally varies from 145 to 148 of which 53 are preanal.

Occurrence

N. buitendijki is found to occur in fair numbers among the shrimp catches landed at Sassoon Dock and Versova—the two fish landing places of Bombay City. They are generally caught in 'Dol' nets (bag nets used with the help of stakes or buoys) from depths varying from 8 to 10 fathoms. Although there are no data regarding its quantitative occurrence during any particular season, it appears more frequently in the catches from December to May, during which period the majority of the present collection was obtained.

Distribution

Bamber (1915) first created the family Neenchelidae to include a single specimen she had collected from the Sudanese Red Sea.

This specimen had been named by her as *Neenchelys microtretus*. There appears to be no further record of this species from anywhere. Weber and de Beaufort (1916) added another species (*N. buitendijki*) to this family based on only two specimens; one—the type 218 mm. long in Amsterdam Museum—probably from the Moluccas and the other, 129 mm., collected by Mr. Buitendijk from Java. Hardenberg (1931) noted this species as occurring 'very rarely' in the Rokan River mouth, off Sumatra, but added no further comment on the species. The present record extends the distribution of *N. buitendijki* to the west Coast of India (Bombay) where it is fairly common.

Biological Notes

The fact that the species was obtained from the 'Dol' net catches indicates that it is a bottom-living form. Specimens above 160 mm. were found to possess mature or maturing gonads. About 20 specimens were examined for stomach contents and it was found that the majority of the stomachs were gorged with polychaets while the others were empty.

The smaller specimens in the collection seem to be newly metamorphosed elvers of the species. In the smallest, which is 58.5 mm. long, the head is more conical and the upper profile less convex (fig. *c*). The olfactory pit still exists in the form of a depression and the contour of the brain is fairly evident. The full complement of the adult set of teeth is not seen at this stage, there being only 6 on the upper and 7 on the lower jaw. The tip of the intermaxillary plate projects out in the form of a large median tooth. In the throat region four branchiostegal rays are discernible. The pigmentation of the head is very feeble and consists of only one group of brown, branching chromatophores on the nape. In the body the most striking pigmentation is a few (generally 8-9) large pigment cells distributed at regular intervals along the lower portion of the lateral line. The brown pigment cells on the upper part of the body, which are so characteristic of the adults, have just begun to appear very faintly and the body is more or less transparent in the fresh condition. The position of the anus is slightly ahead of that of the adult (vide table I). It is seen from the measurements of the pre-anal distance and the tail that the position of the anus gradually shifts backwards as the fish increases in length. The diameter of the eye is greater in the smaller individuals.

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Identity of the plant *Piyaman* or *Madar-jamua*

BY

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AND

P. C. KANJILAL

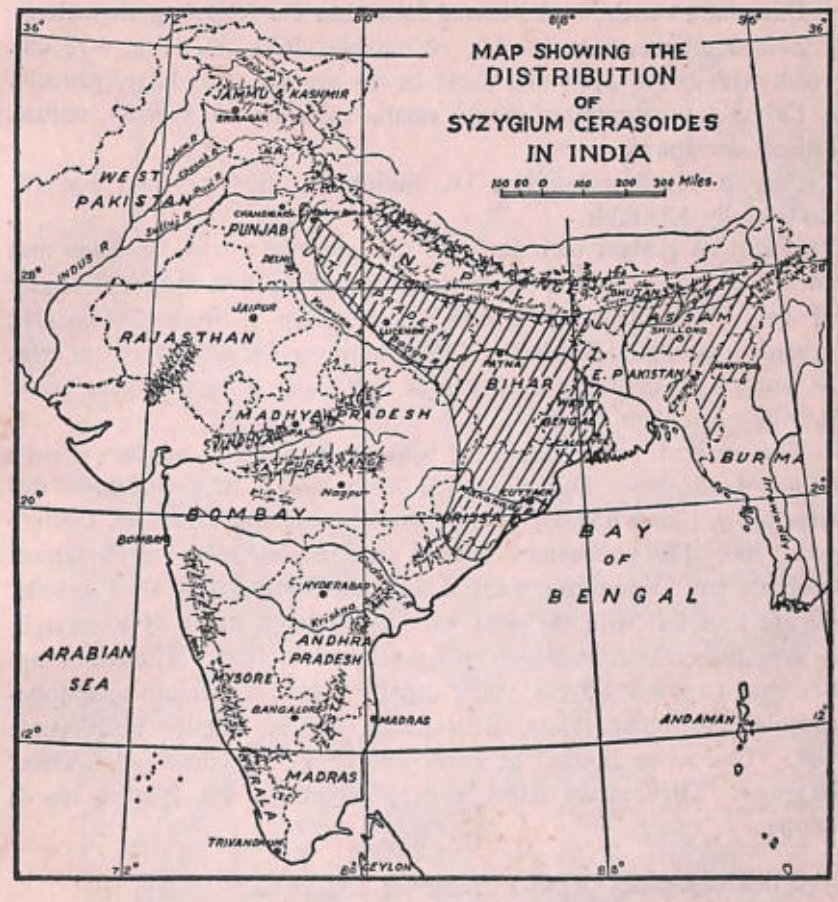
Lucknow

(*With one map and one plate*)

Forest officers and field botanists who are familiar with the *sal* forests of India have, no doubt, seen a tree commonly called *piyaman, madar-jamua, rai-jamua, boti-jamb,* and *dugdugiya.* The plant was hitherto commonly known as *Eugenia operculata* Roxb., and the species is frequently met with in grassland near such forests and grassy open spaces, where it occurs as a pioneer tree and a nurse to young *sal* plants. Its leaves usually turn bright red in winter before leaf-fall and, during the cold season, make a characteristic feature of the landscape. From the silvicultural point of view the species is therefore important as it serves as a nurse to *sal* (*Shorea robusta* Gaertn. f.) and helps its regeneration. Although the plant is known to forest officers and others, it was found that there is considerable confusion regarding its correct botanical identity. It is proposed here to clarify and establish the correct identity of the plant.

The species is distributed in the sub-Himalayan region from Uttar Pradesh to Assam, and is also found in Parasnath, Singbhum, Mayurbhanj, and Agartala. Outside India, it is found in upper and lower Burma and Chittagong (E. Pakistan). According to some authors the species has a wider distribution in south-east Asia including Borneo, the Philippines, and Australia. The accompanying map shows the distribution of this species in India.

Merrill and Perry (*J. Arn.* **18**: 322-343; 1934) in their series of papers on the revision of the genus *Eugenia* have preferred to isolate species with calyptrate calyx, which falls off with the petals, into the genus *Cleistocalyx.* In doing so, they accepted the earlier view of Blume who established the genus in his Mus. Bot. Lugd.-Bat. **1**: 84; 1840. Merrill and Perry transferred *Eugenia operculata* Roxb. to *Cleistocalyx operculata* (Roxb.) Merrill & Perry, but they unfortunately combined our broad-leaved plant with a narrow-leaved



calyptrate calyxed form. Their reasons for considering the large-leaved form under this species was that they could not find any constant characters in the apparently inadequate material which they examined. They have, however, stated: 'Of all the known species of the genus *Cleistocalyx*, this is the commonest, the most widely distributed, and perhaps the most misinterpreted.' This statement is significant, because one of the authors (P.C.K.), who examined a number of fresh flowers of the broad-leaved plant commonly known as *piyaman*, found to his surprise that it has larger flowers and *non-calyptrate* calyx and is therefore different from *Cleistocalyx* proper. This fact has led us to believe that *Eugenia operculata* as understood by Duthie and described in Hooker's FLORA OF BRITISH INDIA 2: 498 (1879) is a mixture of two or more species, of which at least one is *Cleistocalyx operculata* and the other is our broad-leaved non-calyptrate species.

Our plant, i.e. the broad-leaved form, has the following characters:

Leaves elliptic, suborbicular, or obovate, 9-21 cm. long, 6-13 cm. broad, with broad apex and short or no acumen, glandular, pellucid.

Calyx not calyptrate; sepals small, subacute to broadly obtuse, distinct, deciduous.

Corolla pseudo-calyptrate, i.e. falling off in one piece, but the petals easily separable.

It will be evident therefore that this plant is a true *Syzygium* and not a *Cleistocalyx*. It is therefore necessary to find a suitable name for this plant under *Syzygium* and separate it from *Cleistocalyx operculata* proper. Henderson (1949) however does not agree to treat the latter species under *Cleistocalyx* and calls it by its older name *Eugenia operculata* Roxb.

The earliest name for our broad-leaved form appears to be *Syzygium nervosum* DC. (Prod. 3: 260; 1828). Unfortunately, this name being a later homonym of *Syzygium nervosum* Lour. (Fl. Cochinchin. 308; 1790) becomes invalid under the rules of botanical nomenclature. Loureiro's plant is different from that of De Candolle. We are thus left with the next validly published name of Roxburgh, i.e. *Eugenia cerasoides*, which was described in 1832. The leaves are 9-21 cm. long and 4-8 cm. wide, usually oblong-lanceolate or elliptic-lanceolate to oblanceolate, with acuminate or bluntly short acute apex. This name is used as basonym for a new combination under *Syzygium*. The correct name and synonyms of the species are as follows:

Syzygium cerasoides (Roxb.) Chatterjee et Kanjilal f. *comb. nov.*

Eugenia cerasoides Roxb. Fl. Ind. 2: 488; 1832; Miq. Fl. Ind. Bat. 1: 443; 1855.

Syzygium nervosum DC. Prod. 3: 260; 1828 (*non* Lour.); Wall. in Wall. Cat. no. 3551 and 3551 B.

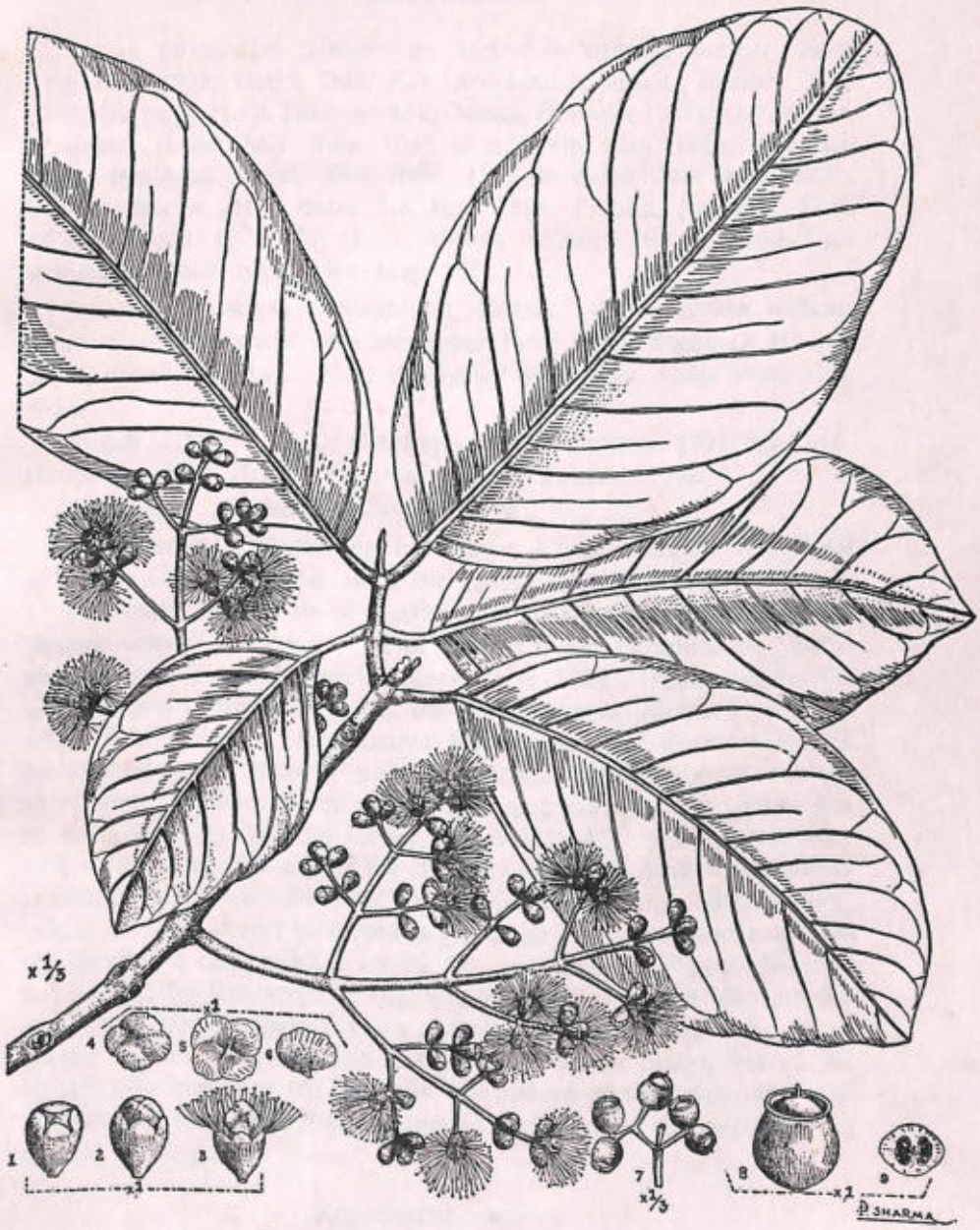
Eugenia operculata var. *obovata* Kurz, For. Fl. 1: 482; 1877.

Eugenia operculata Roxb. Duthie in Hooker's Fl. Br. Ind. 2: 498; 1879.

Eugenia operculata Roxb. var. *genuina* Koorders and Valeton, Bijdr. 6: 151; 1900.

Syzygium operculatum Neidnz. in Engl. and Prantl, Pflanzenfam. 3 (7): 85; 1898.

Note: We are not very sure what specimens Niedenzu had when he made the combination. It is perhaps probable that he had the broad-leaved form before him.



Syzygium cerasoides Chatterjee & Kanjilal

1. Flower bud; 2. Flower before anthesis; 3. Flower at anthesis, showing separation of the 'pseudo-calyptrate corolla'; 4. Corolla viewed from above; 5. Corolla seen on inner side; 6. Separated petal; 7. Fruits; 8. Fruit; 9. Cross section of ovary.

DISTRIBUTION

UTTAR PRADESH: Saharanpur, *McGallan* without number, dated 11th June 1903; Dehra Dun, *P.W. Mackinnon* without number, May 1898; Gurhwal, Herb. *Falconer* 484; Gonda, *Harsukh* 21678; Gorakhpur, Madholia range, *Shri Ram* 1043 dated 14th May 1916; Bahraich Dist., Bhachkai forest, *Shri Ram* 2561 B dated 29th May 1920; Pilibhit, *Inayat* 21675 dated 5th June 1898; Pilibhit, *Nawadia, G.R.* 1038 b dated 19th May 1914; Gonda, Bhamar range, *Tara Dutt* without number dated 23rd May 1922.

BIHAR AND ORISSA: Singbhum, Haines 148; Parasnath without name of collector dated 14th November 1858; Mayurbhanj, *D. Hooper* 38816 dated 29th June 1912; Cultivated Hort. Bot. Calc. Wall. Cat. 3551.

ASSAM: Singra, *A. C. Chatterjee* without number, 1902; Shakhati, Dhubdhara Hill, *A. C. Chatterjee* without number, 1902.

TIPPERAH: *Debbarman* 766 and 1228.

E. PAKISTAN: Chittagong hill tracts, *Kings collector* 372. (All specimens cited above are from the Calcutta Herbarium.)

The major collection of Roxburgh's specimens is lodged at the Botanic Garden at Brussels. This collection was examined by Merrill and a list of available species prepared in 1952. Unfortunately, the name *Eugenia cerasoides* Roxb. does not occur in this list (a copy of which is available at the Calcutta Herbarium), and therefore it may be concluded that there is no type specimen of this species existing at present. In the absence of any authentic material this species has to be typified by Wight's Icones tab. 615 (1843), which agrees very well with our species except for the drawing of the fruit which shows persistent sepals—a character not recorded by any other author. Wight has also correctly recorded the nature of petals and said that the species 'is distinguished by its free expanding petals—a character not noticed by Roxburgh'. This would indicate that he also noticed the petals which separate from each other before they fall. As a matter of fact the petals are imbricate. Miquel's description of the species also mentions the basically free nature of the calyx segments. Shri Ram's sheet no. 1043 mentioned above may be considered as a good lectotype.

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Remarks on Indian Cyprinid Fishes described by Jerdon (1849) under *Gonorhynchus* McClelland

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(*With a plate*)

INTRODUCTION

The fish survey of the Cauvery River and its tributary streams undertaken by me during March-April 1951, May 1953, and October 1954 has facilitated the clarification of the nomenclatorial status of many of the species described by Jerdon in his treatise on the 'Freshwater Fishes of Southern India', published in 1849. The bulk of his material came from the Cauvery watershed and he described a number of new species, the status or systematic position of many of which has hitherto remained uncertain. In the following pages, I have attempted to codify the nomenclature of three species described by Jerdon under the name *Gonorhynchus* McClelland (*nec* Gronow 1763 and Scopoli 1777). The species referred to are :

1. *Gonorhynchus gotyla* Gray
2. *Gonorhynchus McLellandi* Jerdon (New species)
3. *Gonorhynchus stenorhynchus* Jerdon (New species)

The three species are at present referable to the genus *Garra* Hamilton, of which it may be noted that the most up-to-date revision is that carried out by Hora (1921). Among the ichthyologists who have commented on Jerdon's species, mention must be made of Günther (1868), Day (1867, 1877), Annandale (1919), and Rao (1920). There has been no uniformity in the treatment accorded to Jerdon's above-mentioned species in earlier works, for some have considered all three as nominal species, while others have recognised one (*G. stenorhynchus*) as valid. This confusion seems to have been due to the few specimens that were available to them for study. My own collections and the examination of previous collections of *Garra* from the Cauvery system clearly show that three distinct species-groups can be recognised from this watershed, each exhibiting minor variations in the different tributary streams, a close study of which it is possible will eventually help in differentiating the different stream populations even into subspecies.

However, such detailed scrutiny does not come within the scope of the present paper.

Systematic Position of *Gonorhynchus Gotyla* Jerdon (nec Gray) (Plate, fig. C)

The description of *Gonorhynchus gotyla* given by Jerdon is brief; but comparison of the typical specimens of *Garra gotyla* Gray in the fish collection of the Zoological Survey of India (from north-eastern India) with the specimens from the river Cauvery, at present referable to Jerdon's description of *Gon. gotyla*, shows marked differences in the shape of the snout, the disposition of the tubercles on the snout, and certain body proportions, on which grounds it is better to consider the two as distinct, a course which was rightly adopted by Hora and others.

Günther (1868) placed *Gonorhynchus gotyla* Jerdon (*nec* Gray) in the synonymy of the composite species *Discognathus lamta* (Hamilton). Day (1877) included it in the synonymy of both *Discognathus lamta* and *D. jerdonia* (Day), with no comments. Annandale (1919), who was the next to remark on the species, placed it in the synonymy of *D. jerdonia* (Day) of which species he observed that it is 'common in the Bhavani river near the base of the Nilgiris both before and after the stream leaves its gorge . . . . Jerdon found it in the Manantoddy as well as the Bhavani and Day records it from the Wynaad.' Rao (1920) made no mention of *Gonorhynchus gotyla* Jerdon (*nec* Gray), but described *Garra lamta* and a variety of *Garra jerdonia* Day, viz. var. *brevimentalis* Rao, from the headwaters of the river Cauvery in Mysore. Of these, I consider his *G. lamta* (in part) and the variety *brevimentalis* as representing *Gonorhynchus gotyla* of Jerdon. Hora (1921) placed *Gonorhynchus gotyla* Jerdon in the synonymy of *Garra stenorhynchus* (Jerdon).

In my opinion, the species of *Garra* commonest throughout the river Cauvery is the one which agrees in most of the characters with the description of *Gonorhynchus gotyla* Jerdon. In this form the lateral-line scales are almost always 34 or less than that (32 to 34 and exceptionally 35). In the scalation, fin ray counts, and body proportions it closely resembles *Chondrostoma mullya* Sykes from the Krishna watershed further north, which in turn seems to be closely related to the genotype *Garra lamta* Hamilton. Until more detailed comparisons are carried out these may be considered conspecific. Adult specimens of the typical *G. lamta* that I have examined (from Chota Nagpur, Gangetic watershed) are of a maximum size of 75 mm. in standard length, while the Cauvery specimens appear to be much larger attaining a maximum standard length of about 130 mm. or more and possessing a broader adhesive disc with a narrower velum. Thus we find that the *G. lamta* species-group has a more or less continuous distribution from north-eastern India through

peninsular India to even Ceylon, where it is represented by another closely allied form *G. ceylonensis* Bleeker. The Cauvery specimens that I have compared with the specimens of *G. mullya* in my collection from the Poona area (type locality of *G. mullya*) do not show any noteworthy difference except that in the former the snout is more profusely covered with open mucous pores and horny tubercles. Until its consistency and significance are studied from considerably larger samples (for both males and females have pores and tubercles on the snout as in *G. stenorhynchus*, *G. gotyla*, *G. mcclellandi*, etc.), it will be possible to assign *Gonorhynchus gotyla* Jerdon (*nec* Gray) only to the synonymy of *Garra lamta* Hamilton. If the differences in the above-noted character or other meristic details prove significant enough for the recognition of distinct species or subspecies in the two watersheds, the availability of an already proposed name, *brevimentalis*, is indicated here to denote the specimens from the river Cauvery. No doubt, *G. lamta* in the Cauvery itself exhibits a certain diversity of characters, especially in the nature of the snout and the arrangement of the pores and tubercles, often showing intergradation with allied species and thus leading one to suspect interspecific hybridization in nature between the species of *Garra* occurring there. During field collections I have obtained *G. lamta* along with either or both the species *G. stenorhynchus* and *G. mcclellandi*, and the specimens of the three species collected from the Cauvery River in April-June and October-November showed that the mature females were mostly gravid, which suggests that their breeding seasons probably coincide. This, in addition to the similar habits of life exhibited by these species makes possible the more common occurrence of interspecific hybrids between these species. It will be interesting if more detailed studies are made in the light of these observations.

A brief re-description of *G. lamta* from the Cauvery River is given here based on specimens collected from the Manantoddy River (Wynaad), the Cauvery River (Mysore), and the Bhavani and the Moyar Rivers (Nilgiris), all tributaries of the main Cauvery River :

D. ii-iii, 8 ; P. i, 12-13; V. i, 8 ; A. ii, 5 ; C. i, 17, i ; L- l. 32-35 ; L. tr. 4-4½/1/2½-3 predorsal scales 10-11; circumpeduncular scales 16; scales between vent and anal origin 4-5 (The frequency distribution of the fin rays and scale counts are given on p. 530) ; anal fin when addressed reaching base of caudal fin ; snout without a proboscis ; mucous pores and horny tubercles present or absent on snout; tubercles when present arranged in more or less bilaterally symmetrical patches as follows: (1) antero-rostral patch at the tip of snout often in a continuous band, separated from the rest of the snout by a narrow deep furrow, (ii) postero-rostral patches, being two small laterally arranged patches in the middle of the snout behind the antero-rostral patch; (iii) antero-lateral

patches, being lateral to the postero-rostral patches; (iv) inter-nasal patches, being two patches of tubercles situated behind the postero-rostral patches between the anterior nostrils; and (v) inter-naso-orbital patch, being situated between the posterior margin of the posterior nasal opening and the anterior margin of the orbit on either side. All or a few of these patches may be present. Colour : a distinct black shoulder spot behind upper angle of gill-opening; a mid-lateral dark band commencing from behind opercle, often very faint and diffuse and ending in a precaudal spot; latter generally indistinct in larger examples ; two or three dark longitudinal incomplete narrow bands above and below dark mid-lateral band separated by lighter interspaces, all being well-defined on the sides of the caudal peduncle ; abdomen and ventral side of body yellowish white; fins hyaline, the pectoral and lower caudal finrays being generally darker.

Garra malabarica Day (1865) and *Garra alta* Day (1867) from the Cauvery River are synonyms of *Garra lamta* as designated here.

Systematic Position of *Gonorhynchus McLellandi* Jerdon
(Plate, fig. D)

The second species, namely *Gonorhynchus McLellandi* Jerdon, has for long been considered a nominal species and some ichthyologists have completely ignored it. Jerdon's description of it is cited in full below :

> 'Snout covered with numerous pores ; profile rising to the dorsal, slightly concave from that to the tail—head is to the whole body as 1 to $4\frac{1}{2}$, height is $3\frac{2}{3}$ in its total length ; two longish cirri, head depressed in front, dorsal fin rather high. D. 10. A. 7, &c.—Colour dusky green above, golden on sides and greenish white beneath ; caudal fin green in centre, reddish above and below; other fins yellow, edged with red ; cheeks golden, 36 scales along the body in 9 rows. Length 10 inches.' (Jerdon, 1849, p. 310.)

The species was noted as occurring in the 'Bowany River' at the foot of the Neilgherries and also in the 'Manantoddy River', both tributaries of the river Cauvery. I have collected the typical form of *Gonorhynchus mcclellandi*[1] from the Manantoddy River at Manantoddy (Wynaad) and find that Jerdon was wrong in characterising his species as having only two 'longish cirri', for my specimens show two pairs of barbels—the long rostral pair which Jerdon seems to have noted and a very short and rudimentary pair of maxillary barbels which are situated in the labial groove at the place where the rostral fold joins the 'adhesive disc' and is generally overlapped by the velum of the disc, thereby hiding it from view. *G. mcclellandi* is distinct from the

[1] The name *McLellandi* is correctly spelt here as *mcclellandi*.

remaining species of *Garra* occurring in the Cauvery River in a combination of characters, the most important being the comparatively more elongate and flattened body form, the distinctly conical or pointed snout, the characteristic number of about 36 lateral line scales (general range 35 to 37), and the position of the vent which is greatly removed from the origin of the anal fin. The frequency distribution of the fin rays and scale counts are given in the tables on p. 530. Mucous pores on the snout are present even in young specimens measuring about 2 inches, but one noteworthy feature is the almost complete absence of the large horny tubercles which are so characteristic of *G. stenorhynchus* and even *G. lamta* (from Cauvery River). My collections show that the combination of the specific characters given above is true of specimens of *G. mcclellandi* found throughout the Cauvery River. The only noteworthy difference in specimens from the different localities is the greater or lesser number of mucous pores present on the snout, but as this may be attributable to age and sex its taxonomic utility in this particular instance seems to be dubious. As for the colour of the species, the shoulder spot is present behind the upper angle of the gill-opening as in *G. lamta* and the dark mid-lateral band is well-defined in smaller specimens, while in larger examples it merges with the dark greyish colour of the upper half of the body. Incomplete dark narrow lateral bands above and below the mid-lateral band in the posterior half of the body (characteristic of *G. lamta* and *G. stenorhynchus*) are conspicuous by their absence. Almost the entire ventral half of the body is yellowish white (Plate, fig. D).

Thus with the re-discovery of *G. mcclellandi*, the following species described from the Cauvery River in Madras (*Garra platycephala* Rao) and those from the Bhavani River (*Garra jerdonia* Day and *Discognathus elegans* Annandale) do not seem tenable. None of these are specifically distinct, although Rao (op. cit.) gave the lateral line scale count in *G. platycephala* as 37 to 39, which seems to be an exceptionally high count. I have not come across such high counts in specimens from Mysore. Hora (1921) was right in considering *G. jerdoni* Day and *D. elegans* Annandale as conspecific, and both are considered here synonyms of *G. mcclellandi*. Thus, the following, it is felt, is the correct rendering of the synonymy *Garra mclellandi* (Jerdon):

Garra mcclellandi (Jerdon)

Gonorhynchus McLellandi Jerdon, *Madras J. Lit. and Sci.* **15**, p. 310 (1849). Type locality : Manantoddy River and the Bowany River, both tributaries of the Cauvery River.

Discognathus lamta Günther, (in part), Cat. Fish. Brit. Mus. **7**, p. 69 (1868).

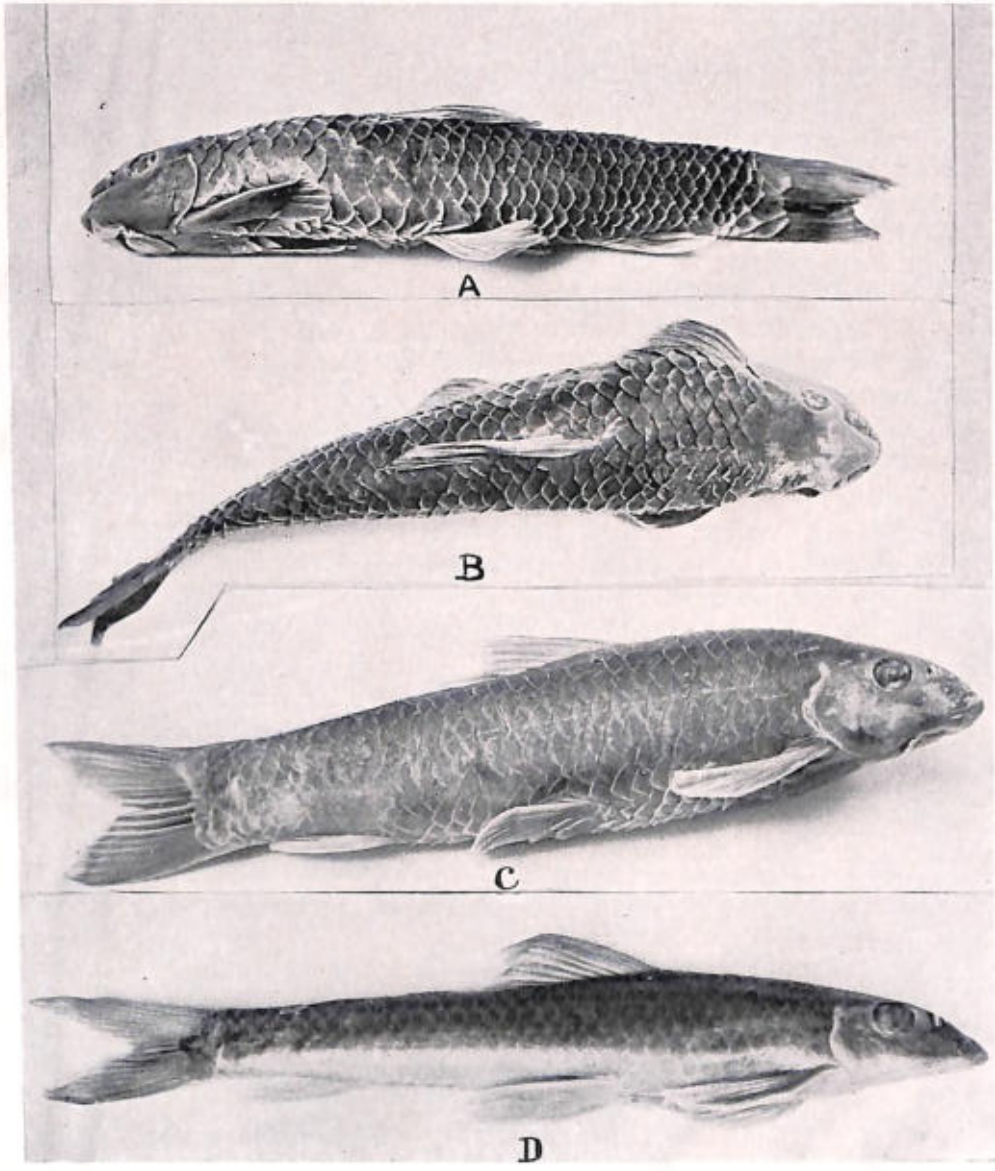
Garra jerdonia Day, *Proc. Zool. Soc. London*, p. 288 (1867). Type locality : Bhavani River at foot of Neilgherries and also Wynaad.

Discognathus jerdonia Day, (in part), Fish. India **2**, p. 528, pl. cxxii, fig. 6 (1877).
Discognathus jerdonia Day, (in part), Fauna Brit. India. Fish **1**, p. 247 (1889).
Discognathus lamta Jenkins, (in part), *Rec. Ind. Mus.* **3**, pp. 291-293 (1909).
Discognathus jerdoni Annandale, (in part), *Rec. Ind. Mus.* **18**, p. 73 (1919). [Pl. ix, fig. 2 ; pl. xi, fig. 3 and not pl. ix. fig. 1, which probably represents a specimen of *Garra lamta* subsp. *mullya* (Sykes,)]
Discognathus elegans Annandale, *Rec. Ind. Mus.* **18**, p. 76, pl. ix, fig. 4 ; pl. xi, fig. 5 (1919). Type locality : Bhavani River at base of Neilgherries.
Garra jerdonia Rao, *Ann. Mag. Nat. Hist.* (9), 4, p. 53 (1920).
Garra platycephala Rao, *Ann. Mag. Nat. Hist.* (9), 4, p. 56, pl. i, figs. 2, 2*a*, 2*b*, (1920). Type locality : Cauvery River at Seringapatam, Mysore.
Garra stenorhynchus Hora, (in part), *Rec. Ind. Mus.* **22**, p. 653 (1921).
Garra jerdoni Hora, *Rec. Ind. Mus.* **22**, p. 657 (1921).
Garra lamta Rao and Seshachar, (in part), *Half-yearly J. Mysore Univ.* **1**, (2), p. 126 (1927).

Pillay (1929), Hora and Law (1941), and Silas (1951) have recorded *G. jerdoni* as occurring in the rivers draining the Travancore hills. The single specimen that I collected from the Peermed Hills (Periyar watershed) is different from the typical *G. mcclellandi* in many details. In view of its uncertain position, references to *G. jerdoni* fom Travancore are not included in the above list of synonyms. *Garra mcclellandi* appears to be restricted to the Cauvery watershed.

Systematic Position of *Gonorhynchus stenorhynchus* Jerdon
(Plate, figs. A, B.)

Of the three species of *Gonorhynchus* described by Jerdon, this is the only species that has been recognised as valid by most of the earlier ichthyologists, although Günther (1868) placed it as a doubtful species under the genus *Discognathus* Heckel, and Day (1877) relegated it to the synonymy of the composite species *Discognathus lamta* (Hamilton). The single well-defined median proboscis of the snout is a sufficiently distinct character to separate *G. stenorhynchus* from other species of *Garra* occurring in peninsular India. Besides this, the following characters are equally important, and by them it can be distinguished from *Garra gotyla* Gray of northern India, which species is also characterised by the presence of a median proboscis on the snout. The characters referred to are (i) the more anterior position of the ' shoulder spot ' which does not extend behind the upper angle of the gill-opening. Annandale (1919) has correctly depicted its position in the drawing of *G. stenorhynchus* (Pl. ix, fig. 3), although its significance has never been commented upon. I consider this as an additional character of specific importance ; and (ii) the presence of a row of well-defined dark spots at the base of the branched dorsal fin rays, more clear from the third to the last branched rays. Many species of *Garra* lack this character, although it also occurs in species widely separated ; for instance in *Platycara notata* Blyth



Species of *Garra* Hamilton of the Cauvery Watershed

G. stenorhynchus (Jerdon): (A) Lateral, (B) Dorsal views of a specimen, 112 mm.; (C) *G. lamta* Hamilton, 106 mm.; (D) *G. mcclellandi* (Jerdon), 87 mm. (The measurements in millimeters denote the standard lengths.)

Photos: E. G. Silas

(= *Garra notata*) of Burma, *G. tibanica* Trewavas and *G. brittoni* Trewavas from south-west Arabia, etc.

The frequency distribution of the fin rays and scale counts are given in the tables on p. 530.

The striking resemblance of *G. stenorhynchus* to *G. arabica* Hora from Arabia is noteworthy and, as Trewavas (1941) has suggested, further collections of *G. arabica* from the Wadi Tiban basin will help to confirm the locality of the latter and also redefine the species. As it stands at present, but for the disjunct distribution I do not find any difference between *G. stenorhynchus* and *G. arabica* to consider them as specifically distinct. Even the shoulder spot in *G. arabica* seems to occupy a position identical with that seen in *stenorhynchus*, for Hora (1921, p. 679) notes the presence of 'an indistinct black dot on the operculum near its angle', which is unlike that seen in *G. lamta*, where the shoulder spot is behind the upper angle of the gill-opening, often entirely covering the first perforated scale of the line. Therefore, until fresh material of *arabica* is worked upon, it will be better to consider it as a geographical race of the earlier proposed species, *G. stenorhynchus*. Hora (1951) has given a complete list of synonyms of *Garra stenorhynchus* (Jerdon), which is to be accepted with one other minor change. *Gonorhynchus gotyla* Jerdon (*nec* Gray) does not belong to the synonymy of *G. stenorhynchus* but as pointed out earlier (p. 524.) is considered a synonymy of *Garra lamta* Hamilton.

Conclusion

The three species of *Gonorhynchus* described by Jerdon (1849) from the Cauvery River are re-designated here as follows :

1. *Gonorhynchus gotyla* Jerdon (*nec* Gray) = *Garra lamta* Hamilton.
2. *Gonorhynchus McLellandi* Jerdon = *Garra mcclellandi* (Jerdon).
3. *Gonorhynchus stenorhynchus* Jerdon = *Garra stenorhynchus* (Jerdon).

The study of the species of *Garra* from the Cauvery drainage once again emphasises the view expressed earlier (Silas, 1954) that the 'maze of species that are known at present to constitute the genus *Garra* seems definitely separable into different species-groups including polytypic species with infra-specific levels of differentiation ....'. The *G. lamta*-group has a range covering a greater extent of the distribution of the genus and is represented in the different drainages of the different geographical areas by species and subspecies. *G. mcclellandi*, with a higher scale count, more anteriorly situated vent, etc., seems to fall under a separate species-group which has representatives in north-eastern India and probably also as far east as Yunnan, south China, and Indo-China. The third species, *G. stenorhynchus*, belongs to the *Garra gotyla*-group

which probably also extends westward as far as Arabia. It is hoped that, when the genus is fully worked upon, the points raised here and the questions left unanswered will be clarified.

Summary

The nomenclature of three species of Indian cyprinid fishes described by Jerdon in 1849 under the genus *Gonorhynchus* McClelland have been clarified and the species redefined as *Garra lamta* Hamilton, *Garra mcclellandi* (Jerdon), and *Garra stenorhynchus* (Jerdon). Attention is drawn to the variations in certain features, especially the horny tubercles on the snout, scalation, etc. The studies also point to the possibility of inter-specific hybrids of species of *Garra* occurring in the Cauvery watershed. The above three species of *Garra* appear to belong to three distinct species groups.

TABLES SHOWING THE FREQUENCY DISTRIBUTION OF THE FIN RAY AND SCALE COUNTS IN SPECIES OF *Garra* FROM THE CAUVERY WATERSHED

Species	No. of lateral line scales						No. of predorsal scales			
	32	33	34	35	36	37	9	10	11	12
Garra lamta Hamilton ..	2	2	3	2	—	—	—	5	4	—
Garra stenorhynchus (Jerdon) ..	6	27	26	—	—	—	—	38	18	—
Garra mcclellandi (Jerdon) ..	—	—	—	14	15	1	—	26	2	—

Species	Scales around caudal peduncle				Scales between vent and origin of anal fin					
	14	15	16	17	4	5	6	6½	7	8
1. *Garra lamta* Hamilton ..	—	—	9	—	4	5	—	—	—	—
2. *Garra stenorhynchus* Jerdon ..	—	—	59	—	22	36	—	—	—	—
3. *Garra mcclellandi* (Jerdon) ..	—	2	28	—	—	—	—	1	20	9

Species	Scales between lateral line and origin of dorsal fin					Scales between lateral line and origin of pelvic fin				
	3	3½	4	4½	5	2	2½	3	3½	4
1. *Garra lamta* Hamilton ..	—	—	6	2	—	—	1	7	—	—
2. *Garra stenorhynchus* (Jerdon)..	—	1	50	6	—	—	1	53	3	—
3. *Garra mcclellandi* (Jerdon) ..	—	—	4	26	—	—	1	22	7	—

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Some Useful Weeds of Baroda, its Neighbourhood, and Pavagadh

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INTRODUCTION

Weeds grow everywhere and can tolerate almost any set of climatic conditions; they usually spring up with the first showers of the monsoon and continue as long as there is enough moisture in the ground.

We have been deeply interested in the study of the weeds occurring in the city of Baroda and its neighbourhood, particularly on Pavagadh Hill, 29 miles NE. of the city; we have made ample collections and recorded plenty of data, some of which we wish to present in the present paper. In our first paper we dealt with the weeds of the University Campus (1957); we paid attention to the various uses made of these weeds from the medicinal point of view; such information was obtained in the first instance from local Ayurvedic practitioners, and in this respect our data were of interest as being first-hand and authoritative.

In successive years we have extended the field of our activities to include the whole city of Baroda and the slopes of Pavagadh Hill. In the present paper we list only such plants as we have found to be used medicinally in the district under study. We give our plants following the order of Cooke's FLORA OF THE PRESIDENCY OF BOMBAY. The names enclosed within brackets after the scientific ones are names used locally for the plants.

LIST OF USEFUL WEEDS

PAPAVERACEAE

1. **Argemone mexicana** Linn. (Darudi)

A prickly herb, in flower most of the year. The oil from the seeds is used in skin diseases and ulcers. The roots are purgative.

CAPPARIDACEAE

2. **Cleome viscosa** Linn. (Kanfuti)

An erect, gladular herb; flowering in July to September. The juice of the leaves is used for headache and poured into ears for ear-ache. The seeds are carminative and are used to kill intestinal worms.

3. **Gynandropsis gynandra** Briq. (Tanmani; Adhiyakaran; Aadiyakarson)

An erect herb, flowering in July to November. A decoction of the root is given in fever. The juice of the plant is useful for scorpion-sting and fever. It stops pains of the body and ear trouble. The oil is used for skin diseases.

CARYOPHYLLACEAE

4. **Polycarpaea corymbosa** Lamk. (Jinapan Okhrad)

A herb, flowering in September to October. The application of the vegetative parts cures poisonous bites.

PORTULACACEAE

5. **Portulaca oleracea** Linn. (Moti Luni)

A succulent prostrate herb, flowering in March to December (almost throughout the year). As a pot herb it cures the diseases of the blood and stops urinary troubles.

ELATINACEAE

6. **Bergia odorata** Edgew. (Lavariyu; Runvad)

A decumbent herb, flowering in March to November. A paste prepared from the plant is used on scorpion-sting.

MALVACEAE

7. **Sida veronicaefolia** Lamk. (Bhonyabala)

A prostrate spreading herb, flowering in September to January. The leaves are applied on cuts and bruises.

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[1] [Mhaskar. K. S., and Caius, J. F., in 'Indian Plant Remedies used in Snake bite' (*Ind. Med. Res. Memoirs*, No. 19, Jan. 1931) write : " We have every reason to believe that our work is exhaustive, and we may safely *conclude that none of the Indian plants recommended for the treatment of snake-bite has any preventive, antidotal, or therapeutic effect*." The same authors after an exhaustive study of plants or plant combinations used in the treatment of scorpion sting, write : " None of the Indian Plant Remedies popularly used in the treatment of scorpion sting has been found to have any preventive, antidotal, or therapeutic effect."—EDS.]

8. **Sida spinosa** Linn. (Kantalobal; Gangeti)

An erect herb, flowering in October to April. The plant cures wounds, ulcers, and disorders of the bile. The root is a tonic, good for heart disease and asthma.

9. **Sida acuta** Burm. (Bala)

An undershrub, flowering in September to December. The root is utilised in nervous and urinary diseases.

10. **Sida cordifolia** Linn. (Mahabala; Khapat)

A velvety herb, flowering in September to December. The juice of the roots, leaves, and bark heals ulcers and wounds. Plant is used for urinary diseases, disorders of blood, and scurvy. The roots are applied on scorpion-sting.

11. **Abutilon indicum** Sweet (Kansaki)

A tall herb, flowering in May to November (almost throughout the year). The roots are used for fevers, cough and leprosy. The roots and leaves are taken internally for snake bite and urinary troubles.

TILIACEAE

12. **Triumfetta bartramia** Linn. (Jipati)

An undershrub, flowering in August to September. The plant increases the secretion of milk in females. It reduces swellings. The seeds are given in cases of dog-bite. The leaves are used in dysentery.

13. **Triumfetta rotundifolia** Lamk. (Jipato)

A herb or an undershrub, flowering in August to October. Used as a demulcent.

14. **Corchorus aestuans** Linn. (Jiteli)

An erect or prostrate herb, flowering in August to October. The seeds are used in pneumonia and the roots for cough.

ZYGOPHYLLACEAE

15. **Tribulus terrestris** Linn. (Gokharu)

A spreading herb, flowering in August to October. The entire plant with its fruits is useful in kidney diseases and for ulcers.

OXALIDACEAE

16. **Oxalis corniculata** Linn. (Aamalati; Khati Luni)

A tiny creeping herb, flowering in July to October. The plant is a remedy for scurvy and is given to relieve the effects of opium. Good for head-ache.

PAPILIONACEAE

17. **Tephrosia purpurea** Pers. (Sarapankho)

An undershrub, flowering in June to November. The plant is a tonic and has the property of purifying the blood. A decoction of the root is used for urinary troubles and its smoke stops cough. Oil from the seeds is best for eczema.

CAESALPINIACEAE

18. **Cassia occidentalis** Linn. (Kasundaro)

An undershrub, flowering in August to December. Externally, the seeds and leaves are applied on skin diseases, and for swellings. The roots are used in snake bite. Leaves are good for asthma, cough, and indigestion. The fruits are also used for cough.

19. **Cassia tora** Linn. (Kunvadiyo)

An erect herb or an undershrub, flowering in July to October. Used as a pot-herb, only after the first showers of rain, and has the property of curing cough, asthma, leprosy, and gastric troubles. It kills intestinal worms. Good for headache and promotes urinary discharges. The roots and seeds are applied on swollen parts and skin diseases. The roots purify the blood. An infusion of the plant is given to the animals infested with worms.

CUCURBITACEAE

20. **Coccinia indica** Wt. et Arn. (Tindora; Gholi; Gilodi)

A climber, flowering in July to September. The juice of the leaves and roots has a cooling effect and is used in diabetes. The flowers are used in disorders of the bile and jaundice. The fruits are applied on swollen parts and are used for disorders of the blood. As a pot herb it cures anaemia.

MOLLUGINACEAE

1. **Trianthema monogyna** Linn. (Vasu)

A prostrate succulent herb, flowering in April to November. The juice of the plant is a tonic for old age. A decoction of the roots is used for fevers, swellings and scorpion-sting.

RUBIACEAE

22. **Oldenlandia corymbosa** Linn. (Pitpapdo)
A small, delicate herb; flowering in July to October. The juice of the plant has a cooling effect. Used in jaundice. It is a blood purifier.

23. **Borreria hispida** Schum. (Madhuri Jadi)
A small herb, procumbent as well as decumbent; flowering in July to October. The plant is used in toothache.

COMPOSITAE

24. **Vernonia cinerea** Less. (Shahadevi)
A herb, flowering in July to September. The plant juice cures piles. The root is useful for dropsy. The juice of the roots is used in fever.

25. **Ageratum conyzoides** Linn. (Makadmari ; Ajgandha)
An erect herb, flowering in August to February. The plant is used for leprosy and diseases of the skin. The leaves heal cuts.

26. **Grangea maderaspatana** Poir. (Mundi)
A prostrate spreading herb, flowering in April to July. The juice of the plant is useful for irregular menses and pains of the ear.

27. **Sphaeranthus indicus** Linn. (Bodiyo Kalhar; Kalar; Gorakh Mundi)
A herb, flowering in December to January. The plant is a tonic used for ulcers, cough, anaemia, and asthma. The juice of the plant cures jaundice, leprosy, gastric troubles, wounds, and disorders of the bile. The fruits are applied for rheumatism.

28. **Xanthium strumarium** Linn. (Gadariun)
A herb, flowering in September to April. It is useful in malaria and improves appetite.

29. **Eclipta prostrata** Linn. (Bhangro)
An erect or prostrate herb, flowering in July to December. The root is useful for skin diseases. The plant has a cooling effect for the eyes, and keeps hair black if mixed with the oil. Used for cough, asthma, leprosy, and anaemia. It checks sexual appetite.

30. **Tricholepis glaberrima** DC. (Utkatari; Utkanti)
An erect, spinous herb; flowering in January to April. The plant is a tonic. The roots and seeds are useful. The root bark is used in urinary troubles. The roots are applied on snakebites and scorpion-stings. The roots if taken internally cure cough.

31. **Launaea nudicaulis** Hook. f. (Bhonypatri)

A prostrate spreading herb, decumbent; flowering in June to March. It checks fever.

ASCLEPIADACEAE

32. **Calotropis gigantea** R. Br. (Aakado)

A milky shrub, flowering throughout the year. The plant is a superlative remedy for leprosy, piles, intestinal worms, cough, dropsy, and skin diseases. It is good for digestion. Application of the milky juice relieves ordinary pains of the body. It is purgative. The roots are used for jaundice and its bark enhances perspiration. Oil boiled with the leaves is applied in paralysis. The leaves are used for headache and serpent bite. The flowers cure fevers and cough.

33. **Calotropis procera** R. Br. (Dholo Aakado)

A small shrub, flowering throughout the year. Its uses are the same as those of *C. gigantea* R. Br.

34. **Leptadenia reticulata** Wt. et Arn. (Nani Dodi)

A twiner, flowering in May to October. The plant is a tonic and a substitute for vegetables.

GENTIANACEAE

35. **Enicostemma verticillatum** (Linn.) Engler. (Kadavi Nai)

An erect herb, flowering in June to September. The plant purifies the blood. It is also used for hernia.

BORAGINACEAE

36. **Coldenia procumbens** Linn. (Okhrad)

A procumbent herb, flowering in August to October. The leaves are used for boils and rheumatism.

37. **Heliotropium marifolium** Retz. (Hathi Shundhan)

A decumbent herb, flowering in June to September. Tender shoots of the plant cure ulcers. The leaves are applied on scorpion-sting.

CONVOLVULACEAE

38. **Evolvulus alsinoides** Linn. (Jini Fudardi)

A prostrate herb, flowering in June to December. The plant is used in dysentery and is a good tonic for asthma.

39. **Convolvulus microphyllus** Sieb. ex Spr. (Shankhavali)

A prostrate herb, flowering in June to January. The juice of the plant with honey stops nausea, and is a tonic for delirious persons.

40. **Merremia emarginata** Hall. f. (Under Kani)

A small creeping herb, flowering in July to October. The juice of the plant is used in cases of rat-bite.

SOLANACEAE

41. **Solanum nigrum** Linn. (Piludi)

An erect herb, flowering in June to January. The juice of the plant is useful for piles and stops blood-vomits. The fruits are used in fever. An infusion of the leaves is used to remove the effects of opium. The plant is used as a pot herb for disorders of the bile.

42. **Solanum xanthocarpum** Schr. et Wendl. (Bhony Ringani)

A prostrate, spreading, spiny herb; flowering in January to May. The plant is used in asthma and relieves pains of the body. A decoction of the roots is good for cough and fevers. The fruits are smoked to relieve pain caused by decayed teeth. The application of the juice of the plant with honey is highly praised as a remedy for baldness.

43. **Physalis minima** Linn. (Popti)

A herb, somewhat procumbent; flowering in August to September. The plant is a tonic. It increases secretion of milk.

44. **Withania somnifera** Dunal. (Ghoda Aasun)

A small hairy undershrub, flowering in September to March. The plant cures weakness and is good for fever.

45. **Datura metel** Linn. non auct. plur. (Dhanturo)

A small, succulent shrub; flowering in September to March (almost throughout the year). The fruit boiled in sweet oil is a superlative remedy for skin diseases. All parts of the plant are smoked in to cure cough. The juice of the plant is used for mumps and guinea-worm. The leaves and roots are applied on scorpion-sting and swollen parts.

SCROPHULARIACEAE

46. **Bacopa monnieri** Pennell. (Jalnevari ; Bam)

A prostrate, spreading, succulent herb; flowering in August. Useful as a tonic in nerve weakness, asthma, and rheumatism.

47. **Striga euphrasioides** Benth. (Dholo Aagiyo)
An erect herb. Root parasite on grasses. Flowering in July to October. The plant improves appetite.

48. **Lindenbergia indica** O. Kuntze (Bhint Chatti)
A small, glandular herb. Lithophyte. Flowering in August to November. The juice of the plant is used in chronic bronchitis.

OROBANCHACEAE

49. **Orobanche nicotianae** Wight (Vakunbo)
A herb. Root parasite on tobacco plants. Flowering in December to February. A fodder for cattle.

ACANTHACEAE

50. **Peristrophe bicalyculata** Nees. (Kali Anghedi)
A herb, flowering in August to January. Used in snake bite.

51. **Rungia parviflora** Nees. (Khadsheliyo)
A decumbent herb, flowering in August to October. Used in fever and cough.

VERBENACEAE

52. **Phyla nodiflora** Greene (Ratveliyo)
A prostrate, creeping herb; flowering in June to October. An infusion of the leaves is given to children suffering from indigestion.

LABIATAE

53. **Ocimum gratissimum** Linn. (Aavachi-Bavachi)
A herb, flowering in July to October. The seeds are used for headache and dysentery. The juice of the plant stops nausea.

54. **Anisomeles indica** O. Kuntze (Chodharo)
An erect herb, flowering in June to October. The plant is used as a tonic in uterine affections and fevers.

55. **Leucas aspera** Spreng. (Kubo)
An erect herb, flowering in August to November. The juice of the leaves is used for scabies, jaundice, fevers, and swellings.

NYCTAGINACEAE

56. **Boerhavia diffusa** Linn. (Punnarnava ; Satodo)
A decumbent herb, flowering in March to November (almost throughout the year). The plant is applied on swollen parts and

cures ulcers of animals. The plant is highly praised for its property of curing dropsy. It promotes urinary discharges. The roots are used in opthalmic troubles, jaundice, and asthma. It stops disorders of the brain and fever.

AMARANTACEAE

57. **Digera muricata** Mart. (Kanajero)

A small herb, flowering in July to September. The plant is used as a vegetable and has a laxative effect.

58. **Amarantus spinosus** Linn. (Kantalo Dabho)

An erect, spinous herb; flowering in August to September. The root is used in eczema. The leaves are sometimes used as a vegetable and have a cooling effect.

59. **Amarantus gracilis** Desf. (Dhimado)

An erect herb, flowering in August to September. Young shoots are eaten.

60. **Amarantus polygamus** Linn. (Tandalajo)

A herb, flowering in August to September. Used as a vegetable and cures bowel trouble. The leaves have a cooling effect. It stops cough and purifies blood. Used on scorpion-sting. A good tonic for dropsy.

61. **Aerva lanata** Juss. (Kapuri Madhuri)

A herb, in flower most of the year. The root is useful for headache.

62. **Achyranthes aspera** Linn. (Anghedo)

A herb, flowering in September to February. The entire plant and the seeds are useful. It is highly praised for stopping nausea. It cures fever, cough, indigestion, toothache, dropsy, swellings, and skin diseases. Its stem is very good for cleaning the teeth. The bark or the roots are applied on scorpion-sting. The leaves cure piles. An infusion of the young shoots or the seeds with honey is used for rat-bite.

63. **Alternanthera sessilis** R. Br. (Jal Jambvo ; Panini Bhaji)

A prostrate, spreading herb; flowering in July to September. The plant is a good tonic and is used for dropsy.

CHENOPODIACEAE

64. **Chenopodium album** Linn. (Chilni Bhaji)

A herb, flowering in January to April. Used chiefly as a vegetable. It is laxative and purifies the urine. The juice of the plant is applied on burns.

ARISTOLOCHIACEAE

65. **Aristolochia bracteata** Retz. (Kidamari)
A prostrate herb, flowering in June to September. The plant juice is applied for ulcers in animals. Cures fevers and intestinal worms. Applied on swollen parts.

EUPHORBIACEAE

66. **Euphorbia hirta** Linn. (Nagala Dudheli)
An erect herb, flowering in June to November (almost throughout the year). The plant is used in bowel troubles.

67. **Phyllanthus niruri** Linn. (Bhonya Amli)
A small, erect herb; flowering in June to September. The entire plant is used in fever. It cures disorders of the blood and bile. The leaves are used for jaundice, anaemia, and cough.

68. **Chrozophora prostrata** Dalz. (Betho Okhrad)
A prostrate herb, flowering in May to June. It is used for cold and cough. The seeds are purgative.

69. **Acalypha indica** Linn. (Dadaro ; Vinchhi Kanto)
An erect herb, flowering in July to November. The plant is useful in bronchitis and pneumonia.

COMMELINACEAE

70. **Commelina nudiflora** Linn. (Aakhalo-Bokhalo)
An erect herb, flowering in July to October. Its application is good for burns.

CYPERACEAE

71. **Cyperus rotundus** Linn. (Moth)
An erect, glabrous herb; flowering in July to October. The tubers are used for disorders of the stomach.

GRAMINEAE

72. **Eragrostis** sp. (Dabha ; Darbha)
A slender, glabrous grass; flowering in July. Very good fodder grass. The roots are used in fevers and cough, and promote urinary discharges.

73. **Cynodon dactylon** Pers. (Daro)
A perennial grass, flowering in July to October. It is used in Hindu pujas for Lord Shri Ganesh. It is best for lawns. A good

fodder grass. An infusion of the plant stops bleeding from piles. Used in haemorrhage, eczema, and brain troubles. Stops nausea and fevers. It is a very good remedy for irregular menses. It is said, and believed by the public, that the roots tied with cotton thread to the hand stop fevers.

Summary

The present paper puts on record the useful weeds occurring in the city of Baroda and on the Pavagadh Hill mentioning their medicinal properties. Such information was obtained in the first instance from local Ayurvedic practitioners. This paper is based on the collections made during the years 1954 to 1957. The names used locally for all the weeds occurring in these areas are also given.

Acknowledgements

Our sincere thanks are due to Rev. Father H. Santapau, S.J., St. Xavier's College, Bombay, for going through this paper and for taking keen interest in this work, and for his very valuable suggestions given during the preparation of this paper. Thanks are also due to Shri Maganlal Mangalram Vaidya of Baroda and Shri A. P. Kothari of the Department of Botany, M.S. University of Baroda for corroborating the medicinal properties of the plants.

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Reviews

1. SOONDAR MOONI. By E. O. Shebbeare. Pp. 224 (21.5× 13.5 cm.). Line drawings and maps by the author. London, 1958. Victor Gollancz Ltd. Price 18*s*.

Mr. Shebbeare is well known in India as having acquired an almost unrivalled knowledge of forests, elephants, and other wild life of north and north-east India prior to World War II when he became Game Warden of Malaya. He had a distinguished career, having been on two Everest Expeditions and having finished up as Head of the Forest Department of Bengal. A very keen observer of natural history, particularly of wild (and tame) elephants, it is fitting that he should now have produced what must be one of the best books yet written on the Indian (or Asiatic) elephant.

Many writers on elephants tend to invest this creature with great intelligence and a certain amount of glamour in order to give their subject popular appeal. Some prefer to attempt to debunk the elephant legends. Mr. Shebbeare does neither of these, but in an enchanting story of an individual elephant in north-east India he depicts the life-history of one of these animals, elephant herd life in the wild, how these animals react to various natural and man-caused incidents, how they submit to capture, training and working for man, and thus lays on record a vast amount of first hand and authentic information on the subject. Though the story is mostly told through the eyes and mind of an elephant, there is a minimum of anthropomorphistic approach on the part of the author to his subject. Many years of close observation appear to have given the author an almost uncanny gift of being able to gauge the probable thoughts of elephants when confronted with various situations, both in their wild state and after capture and training.

There are numerous interesting references to other wild creatures in the book, to gaur, buffalo, tiger, leopard, bear, deer, and so on. The human inhabitants, moreover, of the locality are not excluded, and we are treated to realistic but very delightful descriptions of an elephant auction, of the great *melas* in Bihar, of tiger shoots and a host of other episodes. The author's line drawings are good enough to make us wish that there were more of them.

The main value of the book is that the author has given us a vast amount of valuable information on the Indian elephant. There are very few details on which anyone with experience of wild and tame elephants in this part of India could disagree. However, here are a few very minor criticisms. The drawing on the cover of Soondar

Mooni's mother is, judging from its hollowed head, of an older elephant than intended, and the baby is too large for a newly born one. The delightfully and amusingly expressed thoughts (on page 12) of a young elephant, so human and yet probably so typically elephantine also, could have been more appropriately attributed to a four or five year old calf than to a fourteen month one which would still be in the suckling, calf-at-heel stage. On page 19 the author states 'Although instances of a sort of David and Jonathan partnership between two young tuskers are not unheard of, bulls normally give one another a wide berth . . .' The reviewer has himself twice seen two wild *makhnas*, one fully grown and the other three-quarter grown, roaming together in the forest in close friendship; while he is informed by an Assamese friend, noted for his experience of elephant catching, that instances are common of wild bulls, two, three, or four (but not more) in number, forming a friendship, and that this is known as *maljuria* or 'wrestler-friends'.

The two year old Soondar Mooni, when captured with her mother, is described (page 80) as following the *koonkies* loose after leaving the stockade, and later (page 84) as returning to suckle her tied-up mother in the training camp. The reviewer has often seen calves of this age taken out of the stockade, and they have always been roped to a koonkie and have never suckled their mothers again. In fact the elephant catchers say that the captured mother will not and can not suckle her calf after the shock of capture. On page 102 the author says that Soondar Mooni's mother held up training 'by trying to stand on her head'. Possibly he must be speaking figuratively, as the reviewer has never seen an adult newly captured elephant trying to do this when struggling, though of course young baby elephants often do this.

Most of the facts of the author's distinguished career are given on the dust cover, with further information amusingly detailed in the Introduction by the Australian Minister for External Affairs, who was Governor of Bengal at the time of Mr. Shebbeare's return to India after the war when a tiger shoot was organized in his honour. What is not recorded is the fact that the author was one of the last of a dying race of forest officers in India who knew and loved their forests and the wild life therein more than the office chair, who (as 'the forester') 'slipped away to bed, where he put an alarm clock set for five under his pillow', and who would march on foot or on elephant-back through the forests until he came out the other side—no mean feat in north-east India.

This book is confidently to be recommended to all, both for its unique and authentic information about the forests, savannahs,

elephants and other wild animals of north-east India, as well as for its delightful style which sustains the reader's interest from beginning to end.

E.P.G.

2. THE FLORA OF PURANDHAR. AN ENUMERATION OF ALL THE PHANEROGAMIC PLANTS DISCOVERED IN PURANDHAR DURING THE YEARS 1944-1956. By H. Santapau. Pp. 1-158. Oxford Book and Stationery Co. New Delhi and Calcutta. (Date of publication and price not given.)

In this book is given a list of the flowering plants collected by the author during his visits to Purandhar during the years 1944-56. The arrangement followed is that of Cooke in his FLORA OF THE PRESIDENCY OF BOMBAY, which is the same as that followed in Hooker's FLORA OF BRITISH INDIA. The author has, however, made some modifications in the delimitation of the families, as he has split the Leguminosae, the Geraniaceae, the Boraginaceae, the Urticaceae, the Amaryllidaceae, the Scitamineae, etc. He has, however, curiously kept the Coniferae between the Monochlamydeae and the Monocotyledons. The author has modernised the nomenclature of the species in accordance with the International Rules of Botanical Nomenclature. The total number of plants described is 680, belonging to 101 Families and 399 Genera. Such local lists of plants are very useful to the plant geographer in tracing the origin of the component elements of the regional flora. It would, therefore, have been useful if the author had also given the regional distribution of the species enumerated.

In the Introduction, the author has drawn attention to the large number of 'rare and very rare plants' that have been preserved on the spot. It is these which give clue to the origin and past history of the flora of the higher regions of the Western Ghats. The reviewer wishes to draw attention to two such plants *Delphinium dasycaulon* and *Geranium ocellatum* var. *himalaicum*. Both these are of west Himalayan origin and migrated to Western Ghats on the one hand and to Ethiopia on the other producing specialised varieties in each case.

The author has done a distinct service to students of the Bombay Flora by the publication of this enumeration, and deserves congratulations for it. The size of the book is rather odd. It would have been more useful if the volume had been printed in a size suitable for carrying in the field.

S.P.A.

3. THE A TO Z of DOGS. By Barbara Woodhouse. Pp. 122 (16.5×11 cm.). Max Parrish, London, 1958. Price 7*s.* 6*d.*

Those who like their information in packet form will welcome this little addition to the legions of books on dogs. The author, who has lots of practical and useful advice to give her readers, does so in the shape of answers to the sort of questions that we find in the doggy columns of the newspapers; but the answers are given at greater length and with more detail than is possible there. The range covered is wide and the average dog owner will find guidance in the book for most of the things he can tackle without expert help. With reference to the training of dogs she is of the opinion that there are two sides to the question, and she has established a residential boarding school where owners and pets can be taken in hand together. Not a few of us will agree with her, with an uncomfortable consciousness that in this respect we too are sinners.

D.E.R.

4. PALAEMON. By S. S. Patwardhan, D.Sc. [Editor: Professor R. V. Seshaiya]. Pp. xx+102 (24.5×16 cm.) 65 text-figures. Calcutta: Zoological Society of India, 1958. Price Rs. 5.00.

The present monograph is largely a reprint of the first edition which was published in 1937 as memoir No. 6 in *The Indian Zoological Memoirs on Indian Animal Types* series under the editorship of the late Professor K. N. Bahl. It was out of print for several years and the issue of this edition meets a long-felt and pressing need of students and teachers of zoology in the Indian Universities.

The main body of the text and number of figures remain practically unaltered except for slight changes in the text at certain places clarifying some points which were left unexplained in the first edition. In addition there are introductory notes by the President and Editor of the Zoological Society of India, and the Convener of the Indian Zoological Memoirs Committee of the Society at the beginning, and a brief note about the Zoological Society of India at the end.

It is gratifying to note that the Zoological Society of India has now undertaken to edit and publish the *Indian Zoological Memoirs on Indian Animal Types* initiated by the late Professor K. N. Bahl. The present monograph is the first to be brought out under the auspices of the Society. It is neatly printed on semi-art paper. The illustrations are clear and well reproduced, and the attractive and strong rexine binding renders it suitable even for rough use on

laboratory tables. In spite of rising costs of printing the issue is reasonably priced. Along with others in the series, this monograph will continue to enjoy the popularity that it has achieved, among students and teachers of zoology in the Universities. The Zoological Society of India, the Convener and members of the Indian Zoological Memoirs Committee deserve to be congratulated for the production of this excellent memoir, and we hope that new additions to the series will follow soon in quick succession to make the study of zoology in Indian Universities self-sufficient.

K.K.T.

5. A ZOOLOGICAL GUIDE TO THE ZOOLOGICAL GARDENS OF CEYLON. By Major Aubrey N. Weinman. Pp. ix+167 (18.5 cm.×12.5 cm.), 3 coloured, 1 black-and-white, 89 illustrations, and 1 pictorial map. Ceylon, 1957. Printed at the Government Press. Price ?.

This booklet pertains to the Dehiwala Zoo in Colombo, and is written by its Director who states that the main purpose of it is to sustain the interest aroused by a visit.

The bulk of the text is a general account of mammals, birds, reptiles, etc. arranged in systematic order. A number of species not exhibited in the Zoo are also mentioned. The short notes on the prominent characteristics of many animals, together with the large number of photographs (including three in colour) should certainly help to foster and sustain the interest.

An Appendix gives a list of plants, divided into flowering trees, shrubs, creepers, orchids, etc., and another the Sinhalese, Tamil, and scientific names of the different species exhibited.

In the Foreword, the Minister of Home Affairs to the Government of Ceylon states that, though he has travelled extensively and visited many zoos in different parts of the world, the beauty of the site of the Gardens is unrivalled by any other.

In Delhi a large and very picturesque area has been set apart for the building up of a zoological park, and it is hoped that this will soon be opened to the public. In other parts of India, however, many of the excellent zoos privately maintained by the rulers of the erstwhile States are now sadly deteriorating.

The Bombay Zoo administered by the Municipality is also in sorry circumstances and it is possible that the appointment of an Advisory Committee and allocation of adequate funds would assist in the removal of some of the existing drawbacks. Such a committee is attached to the Zoological Gardens of Ceylon and includes members of

the Fauna Protection Society, the Department of Wild Life, and other individuals interested in the subject.

The Ceylon zoo authorities are certainly to be congratulated on the production of this excellent booklet, which is to be followed by Sinhalese and Tamil editions.

H.A.

6. THE DARWIN READER. Edited by Marston Bates and P. S. Humphrey. Pp. ix+481 (22.5 cm.×15.5 cm.). With one plate and several illustrations. London, 1957. Macmillan & Co. Ltd. Price 30*s*.

The name of Charles Darwin, the proponent of the theory of Organic Evolution through Natural Selection or the Survival of the Fittest needs no special introduction to our readers. The year 1959 has a special significance to all biologists as it marks the one hundredth anniversary of the publication of Darwin's epoch-making treatise THE ORIGIN OF SPECIES—a classic containing deductions based on years of painstaking research and field observations. Although highly controversial and inviting unprecedented criticism from all quarters, including some of his eminent fellow biologists, by publishing this book Darwin gave a new outlook to the science of biology and his thoughts and ideas embodied therein profoundly influenced the thinking world. Centennial celebrations are being held in various parts of the world to mark this milestone of progress in human endeavour to understand the laws of nature, and it is only fitting that a book containing extracts from Darwin's various writings in the form of an easily readable account should be published about this time.

Darwin was a prolific writer and to read and digest the mass of material that he wrote would be a task to any biologist, leave alone the layman naturalist! Mr. Bates and Mr. Humphrey, the editors of THE DARWIN READER, have in this book attempted to collate in a concise readable form extracts from Darwin's most important books, THE VOYAGE OF THE BEAGLE, THE ORIGIN OF SPECIES, THE DESCENT OF MAN, THE EXPRESSION OF EMOTIONS, THE AUTOBIOGRAPHY, and his published researches on plants and worms. Their choice of extracts from the THE AUTOBIOGRAPHY for the opening chapters of the book seems most appropriate as they are in Darwin's own words and are the best introduction to his work. The remaining five parts of the book contain extracts from the aforesaid works of Darwin, but it is regrettable that selections from the most voluminous book THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION should not

find a place in this compendium. However, reference is made in the brief editorial introduction to the interesting but now obsolete theory of 'Pangenesis' which Darwin developed. A bibliography of Darwin's writings and important books dealing with Darwin's biography, Darwinian influence, and contemporary evolutionary theory are given in a useful Appendix, and a thirteen page index concludes the book. The editorial notes and comments are kept to the barest minimum designed to aid in continuity of reading.

In the selection of extracts the editors have striven to bring together those embodying the most important ideas of Darwin and as far as possible the most readable prose, thus making it a highly interesting account of the life and work of a genius. For a fuller appreciation of the importance of field observations in the natural sciences nothing would be better than a perusal of the works of this greatest of all naturalists. To those wishing to delve more into the subject, recourse to Darwin's books in complete form, which are now available in reprint editions, will be necessary. THE DARWIN READER, easy to read and understand, should appeal to all those interested in the various disciplines of natural science and the phenomenon of evolution. This book is strongly recommended to all our readers and will form a valuable addition to any library.

E.G.S.

Miscellaneous Notes

1. TIGERS AND PORCUPINES

I used to wonder in my young days why a tiger, being such an intelligent and cautious animal, should kill a porcupine when other natural food was available. After many occasions for observation in the jungles by following tigers with a pair of binoculars from a safe distance, I am inclined to believe that the porcupine attracts the attention of the tiger due to the tastiness of its meat. For the tiger the porcupine is a toothsome morsel, and in spite of the protection afforded it by the pointed spines and quills the tiger does not hesitate to face the dangers involved. I have myself seen the peculiar way in which the tiger goes about to kill a porcupine. After his victim has been approached to a convenient distance, the tiger with a powerful stroke tosses the porcupine in the air and may give another blow if necessary. The porcupine usually hits a stone or some other hard object becoming unconscious and exposing its vital parts.

In the process of attacking its prey in this manner accidents are likely to happen. For example, small quills may get lodged in the tiger's pads while striking the animal which may be very difficult to extract by means of his teeth. Subsequently these may penetrate deeper into the festering wound and disable him in time.

Another likely place for wounds from a porcupine's quills is the mouth, or even the intestine. On many occasions I have found small quills in a tiger's droppings which had passed through the alimentary canal. All the same, there is a danger of some pieces of quills sticking in the intestines and causing ulcers. In fact, one such tiger was found dead on the banks of Shikarghar Tank, near Banbihar Sanctuary in 1943, in a skin and bone condition. The intestine of this animal had several ulcers in a festering state inside which pieces of porcupine quills were found. Another example of disability due to porcupine spines was that of a tigress destroyed by us in Dholpur on 5th May, 1945. For some days complaints were being received from an adjoining village about a tigress killing cattle at the rate of four or five animals a day. The peculiarity of these kills was that only the soft parts such as udder, testes, etc. were eaten and the rest of the carcass left untouched. Things came to a head when the tigress attacked a 10 year old boy from a field hutment of Maharajpura village, adjoining the Ramsagar Sanctuary. A hunt was organised and the tigress eventually traced and destroyed. Examination showed

that the mouth of the animal was in a diseased condition with large ulcers forming on the lower jaw. On cleaning and removing the flesh from the affected part I found a growth of deformity of the bone around the molars on the right hand part of the jaw with a piece of porcupine quill stuck inside. In this diseased condition the tigress was unable to hunt her natural prey and had no other recourse but to seek easier prey in cattle and men. This is a good example proving that porcupine quills may be responsible for turning a tiger into a man-eater.

Porcupines, it seems to me, are a potential source of danger to tigers and possibly also to other carnivorous animals in wild life sanctuaries. They are harmful likewise to the vegetation and trees, the roots of which are a part of their regular diet. There is definitely a case for the collection of more data regarding the ecology of porcupines with a view to determining whether, and to what extent, their elimination from wild life sanctuaries is desirable.

SANDS FORT,
DHOLPUR (C. RLY.), SARDAR BHUPENDRA KUMAR
RAJASTHAN,
July 16, 1958.

[The specimen was sent to the Bombay Veterinary College and we have received a note from the Principal which reads:

'The specimen sent by you consists of the lower jaw-bone (mandible) of a tiger. In the region of the molars on the right side, an irregularly spherical swelling has formed on the bone. It has a rough porous surface and a cavity on the inside. The cavitation has extended to the last molar posteriorly involving half of its root, and the first molar anteriorly involving the posterior half of its root. The second molar is absent in the specimen and must have dropped out owing to the destruction of the bone which held it in place.

'The nature of the lesion indicates that it was produced by suppurative osteitis caused by a wound and its subsequent infection. The wound might have been caused by any pointed object such as a porcupine quill as suggested.

'In suppurative osteitis there is a destruction of the bony tissue in the infection, resulting in its rarefaction. New bone may form under the periosteum which is not involved in the inflammatory process. Due to the rarefaction of the bone in the region, the

second molar must have dropped out. The complete destruction of the alveolus of the second molar suggests that the wound must have been caused in the region of the second molar and not at the third molar as is suggested by the present position of the quill, since, the inflammatory process spreads centrifugally from the focus of infection.

'Suppurative osteitis is an extremely painful condition. The bone becomes weak and may fracture even by slight force. This explains the peculiar food habit of the tiger of devouring the soft parts alone of its prey.'—EDS.]

2. A MUSK SHREW ATTACKING A SNAKE

The common musk shrew, *Suncus murinus*, is responsible for destroying a great many creatures that are harmful to mankind like cockroaches and other insect pests. It is known to feed upon a scorpion and even to attack a large frog (Blanford, W. T., 1888, THE FAUNA OF BRITISH INDIA MAMMALIA: 236-237). The author has not come across any record of the shrew attacking a snake.

In the last part of June 1957, one evening, a musk shrew was discovered by me dragging a keelback (*Natrix stollata*) into my house. The snake was a little under 1½ feet long; its head was badly damaged and the snake appeared to have been freshly killed. Apparently the shrew had killed it.

DEPARTMENT OF ZOOLOGY,
RAVENSHAW COLLEGE,
CUTTACK,
July 22, 1957.

B. K. BEHURA

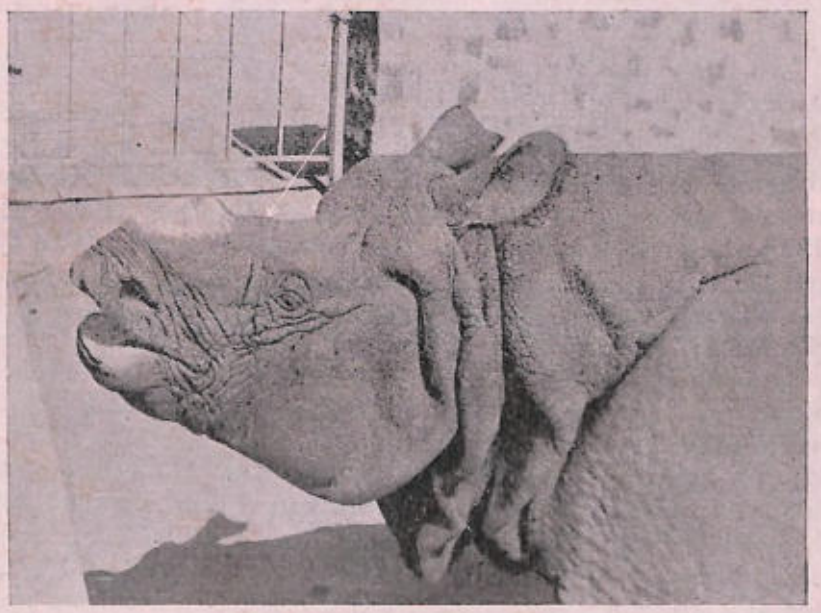
[The normal food of the musk shrew consists of cockroaches and other insects, but it is known to kill and eat bull-frogs [Wasey, G. K., *JBNHS* **10** (2): 330-331], toads [Prall, S.E., ibid. **13** (4): 669-700], guinea pig sucklings [Bannerman, W.B., ibid. **16** (4): 751-752]. It also eats vegetable matter such as roots (bulbs) of the 'bimli' grass and coconut pulp [Millard, W. S., ibid. **27** (1): 164]. Sterndale (MAMMALIA OF INDIA: 84) mentions bread and even scorpions as forming part of its diet. It is said to eat rice and grain too, but opinion seems to differ on this point.

Although in this case the evidence of killing the snake is merely presumptive, it is an interesting record. We can trace no previous mention of a snake in the varied dietary of the musk shrew.—EDS.]

3. ABNORMAL SITE OF HORN-GROWTH IN *RHINOCEROS UNICORNIS* LINN.

(*With a photo*)

In June of this year I received from the Honorary Secretary (Mr. Humayun Abdulali) two samples of material removed from the head of a captive Indian Onehorned Rhinoceros (*R. unicornis*) living in the Bombay Zoo. One sample comprised a clipping from the normal anterior horn which, as is commonly the case in captive specimens, had been rubbed down by the animal almost to the general level of the muzzle. The second sample was taken from an irregular horny growth which had arisen between the base of the normal horn and the forehead—approximately midway.



Sections from the material from the abnormal site examined microscopically prove to be identical in structure with normal horn-laminated strands of keratin.

The question naturally arises as to whether this secondary growth is compensatory for the loss of the normal horn from the excessive degree of friction to which it is subjected in captive animals. But whether the answer to this be affirmative or negative, it is of interest to note that it is at this site that a second horn normally grows in the two African Rhinoceroses (*Diceros bicornis* and *Ceratotherium*

simum) as well as in one smaller Asiatic species, the rare *Dicerorhinus sumatrensis*.

In connection with the rubbing down of the anterior horn Grzimek (1956)[1] remarks that captive rhinoceroses shed their horns about once every ten years and it takes approximately a year to become renewed.

THE ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK,
LONDON, N.W. 1,
July 17, 1958.

W. C. OSMAN HILL

4. RE-DISCOVERY OF THE SMALLER ASIATIC ONEHORNED RHINOCEROS (*RHINOCEROS SONDAICUS* DESMAREST) IN MALAYA

(*With a plate*)

Thanks to the helpful co-operation of Mr. Loke Wan-Tho of Singapore we reproduce two unique photographs of this 'extinct' rhinoceros obtained in Malaya under the most extraordinary circumstances. According to *The Straits Times* of Singapore (March 22, 1957) where the photographs were first published, they were taken by one Mr. P. G. Bazin of the Lima Blas Oil Palm Estate at Slim River in southern Perak. Ironically enough, the photographer had no idea of what he had in front of his camera! The young animal in the picture was identified by Mr. H. J. Kitchener, the Chief Game Warden of Malaya. In the account given by Mr. Bazin to *The Straits Times* it seems that the animal was first seen by the estate labourers, wallowing in a swamp by a field. It did not appear to be frightened but just got up from the wallow and slowly walked away regardless of the barking of dogs and chivvying by Mr. Bazin's Alsatian. The animal is said to have been followed for two hours along a forest road in a jeep at a distance of 10 yards behind, before it turned off into the jungle and disappeared.

The Smaller Onehorned, or Javan, Rhinoceros (*R. sondaicus*) was found in India within recent times but now appears to be extinct. In the last century it was recorded from the Rajmahal Hills (?), Sikkim Terai, Sunderbans and 'in the forest along the Mahanaddy River'. It was reported as frequenting swampy ground in the Sunderbans as well as dense hill forest up to altitudes of 4000 ft.

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[1] Grzimek, B. (1956): NO ROOM FOR WILD ANIMALS, Thames & Hudson, London. (translated from Kein Platz für Wilde Tiere).

The young "*Rhinoceros sondaicus*" (?) photographed in Perak, Malaya

(By courtesy *Straits Times, Singapore*)

At the present time it apparently occurs in Burma in small and diminishing numbers, Thailand, Java, Borneo, and Sumatra.

It differs from the Great Indian Onehorned Rhino (*R. unicornis*) in being somewhat smaller; height at the shoulder *c.* 5 ft. 8 in. against up to 6 ft. Skin not tuberculated but with a mosaic-like pattern as on the flanks of a crocodile; throat folds less heavy; shoulder folds joining above neck to form an anterior saddle-like nape fold. Horn in females small or absent.

No reports of the existence of *R. sondaicus* in Malaya were available during the last 20 years, and the animal was believed to have become extinct. It may be recalled that Mr. R. C. Morris who led an expedition to Malaya on behalf of Mr. A. S. Vernay to procure a specimen of this rhinoceros for the American Museum of Natural History in 1935—curiously enough in the very area where these photos were taken—returned empty-handed without even seeing any foot-prints except those of the Twohorned, *R. sumatrensis*, or obtaining any other clues. Mr. Morris appeared to be of the view (*JBNHS* **38**: 446) that *sondaicus* no longer existed in Malaya and specimens would have to be procured from Sumatra where it is still found. It is believed that commercial poaching of the animal was largely responsible for its disappearance.

Theodore Hubback, during his term as Chief Game Warden, after prolonged search in Malaya found a single living example which he was so convinced was the last of its species (and mateless) that he permitted it to be shot for some American Museum 'in the interest of science'. How dangerous it is to feel so convinced in such matters is shown by the re-emergence of the present animal which, being only half grown, could conceivably have a mother and father still living. Mr. E. O. Shebbeare who followed Hubback as Game Warden in Malaya for several years before the War did not even see the tracks of this rhinoceros—all of which makes the present discovery still more astonishing.

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET,
FORT, BOMBAY,
January 15, 1958.

EDITORS

[As the above note was about to go to press doubts arose in regard to whether the animal in the photos was really *R. sondaicus*. The chief reason for this doubt was the fact that one of the important keys to the identification of *R. sondaicus*, namely the prominent anterior nape fold formed by the joining of the shoulder folds on the neck [clearly shown in the excellent illustrations in the *Proc. Zool. Soc.*

London, 1874, Plate 28, and *J. Malayan Br. Roy. Asiat. Soc.*, 1937, **15** (2), Plates 3 and 4] is not visible in the picture. Mr. E. O. Shebbeare to whom the matter was referred, while still supporting Mr. Kitchener's identification of the animal as *sondaicus*, ended his letter by saying '. . . meanwhile I, for one, would be sorry to plump for either species as the original of the Lim Blas pictures'.

The matter must rest at this for the present, and we must await further conclusive evidence to dispel the doubts.—EDS.]

5. THE SHOU OR 'SIKKIM STAG'

AN APPEAL FOR INFORMATION ON ITS PRESENT STATUS

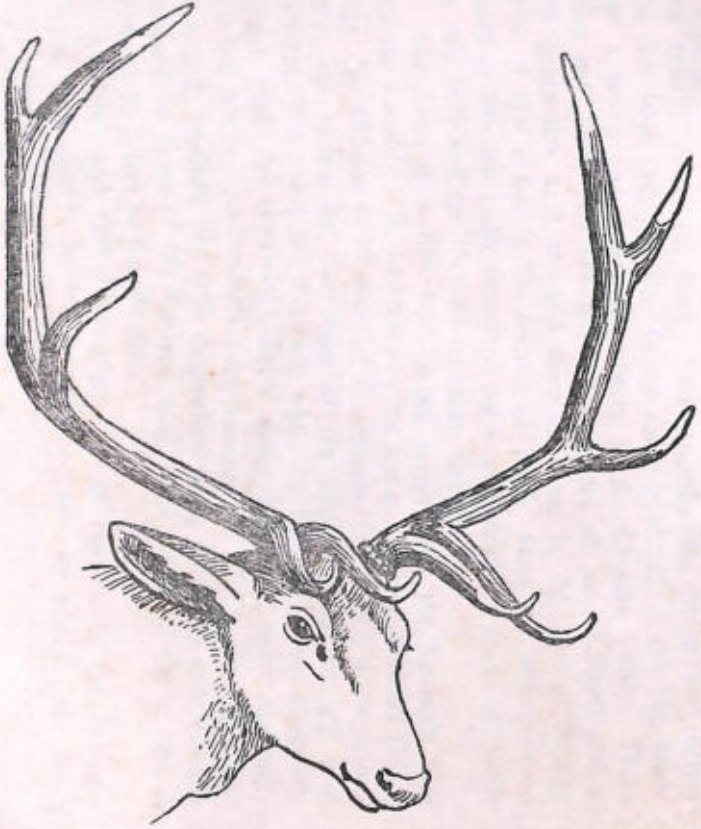
(With one plate)

A species of the Red Deer group known as the Shou (*Cervus affinis* Hodgson)[1] is probably nearing extinction, and any news of it would be most welcome. Unfortunately it is not found in India, not even in Sikkim although it is often referred to as the 'Sikkim Stag'. It is not found in Nepal. It is, or used to be, found in the Chumbi Valley of Tibet and sometimes in the adjacent valleys of north Bhutan, and then again in Tibet in the valley of the Tsangpo to the east of Lhasa.

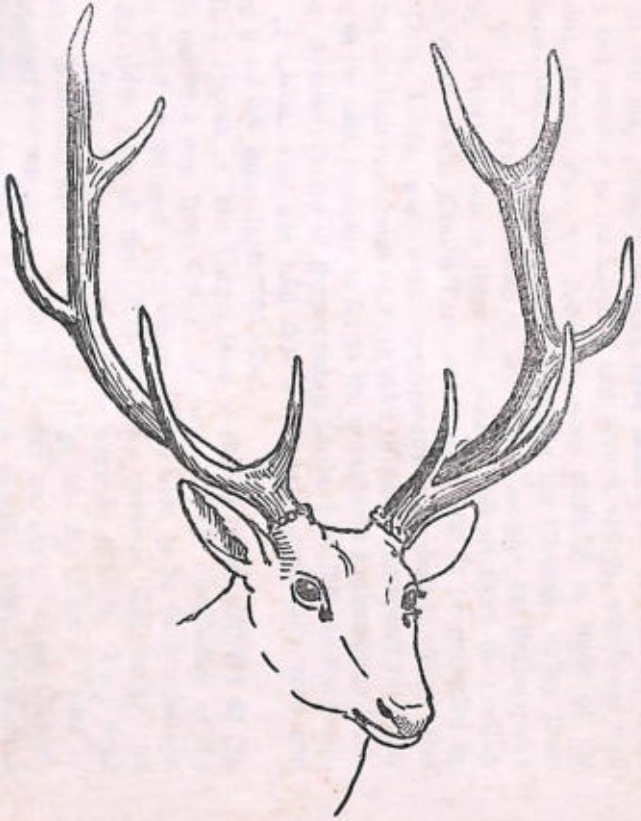
R. Lydekker in his GAME ANIMALS OF INDIA (1924) states that the Shou was at one time reported to be plentiful in western Tibet, near the source of the Brahmaputra, and that a young stag was also caught in 1912 in the upper reaches of the Tsangpo Valley near the Manasarowar Lake; but in Rowland Ward's RECORDS OF BIG GAME (1928) is the statement: 'The Shou is not found within 200 miles of the Manasarowar Lake. The authority on which this incorrect statement was originally made was solely based on the fact that a single antler was found in a temple near the Manasarowar Lake (Major G. Burrard).'

R. Lydekker confirms that the Shou is not found in Nepal and Sikkim, and that its main habitat is the Chumbi Valley and that its range extends into Bhutan. He quotes from a letter to the *Field* of October 27, 1906, written by Lt.-Col. H. A. Iggulden as follows: 'My own observations and enquiries on this matter may be of interest to naturalists, for whilst in Tibet with the military expedition of 1903-1904 I made enquires regarding this stag, and saw a considerable number of skulls and horns at various places between our boundary on the Talep Pass (Jalep ?) and Lhasa. I came to the conclusion that these deer are not found to the west of a line drawn north and south between Shigatse and the northern point of Sikkim. They are

[1] = *Cervus elaphus wallichi* Cuvier.—EDS.



THE SHOU or SIKKIM STAG



THE HANGUL or KASHMIR STAG

never found in Sikkim itself, as the climate there is too damp, though one or two may possibly at times have crossed the boundary. There are a fair number in the Chumbi and branch valleys, which are well wooded, though they are probably more plentiful in some of the northern Bhutanese valleys. After leaving the Chumbi Valley these deer are not again encountered until the Tsangpo or Brahmaputra Valley is reached, where there are some herds of them in a valley to the north of the Kamba Pass, which were said to be protected by the Dalai Lama, and were consequently unmolested. They also inhabit the high mountains on both sides of the Brahmaputra for many miles to the east, probably as far as the unexplored Brahmaputra Falls. I next definitely heard of them existing in the bare hills to the north-east of Lhasa, and was told that they were occasionally seen and killed some few miles from that city.'

R. I. Pocock in 'The Larger Deer of British India' (*JBNHS* **43** (3), 1942) quotes a note from Col. F. M. Bailey on the distribution of the Shou based on his own experience: 'Shous used to be fairly common on the ridge east of the Chumbi Valley between that valley and Bhutan. East of this there used to be some in Bhutan. They lived I think, in Bhutan but came over the ridge into the Chumbi Valley in the summer and autumn. About November and December the Chumbi Valley people cut fuel for their winter supply. Deep snow does not usually come till later. This disturbs the forest and drives the deer back into Bhutan. In the summer of 1921 I saw two hinds and a young one above Lingmotang in the Chumbi Valley. There must have been very few left and I believe all were exterminated a few years ago, as I am told there are none in this part of Bhutan now. I saw a few in the district of Tsari. Here the Shou will be more or less artificially preserved for a long time I hope, as the place is very holy and no life may be taken there.'

The Shou is a fine deer, much larger than the Kashmir stag (*Cervus hanglu*)[1]. R. Lydekker in his ROYAL NATURAL HISTORY (1894) says: 'In addition to its superior dimensions, this deer is distinguished from the hangul by the beam of the antlers being strongly bent forwards just above the trez-tine; while the bez-tine is less constantly longer than the brow-tine. Each antler seems to have constantly but five points. Antlers have been measured of 54, 55, and 55¾ inches in length; anything like such dimensions being only very exceptionally attained by those of the Kashmir stag. The height of the animal is from 4½ to 5 feet at the shoulder'.

As Tibet and even Bhutan are 'out of bounds' to the ordinary person, this note is written in the hope that its appeal may reach

[1] = *Cervus elaphus hanglu* Wagner.

those Indian Government officials whose work takes them near or into those parts, as well as the authorities of Tibet and Bhutan. If this fine deer is still in existence it is to be hoped that the authorities of the country and district concerned will take steps to safeguard it by legislation and by the creation of effectively controlled sanctuaries.

There is no reason why the Shou should not do well in captivity, provided that it is kept off soft grassy ground and enclosed in suitable sloping, stony and rocky ground. The high altitude zoos or deer parks newly created in Darjeeling and Gangtok should suit admirably for the preservation and breeding of this species.

The writer of this note cannot do better than end this appeal with an extract from THE YEARS OF TRANSITION (1949) by the twelfth Duke of Bedford, who was one of the world's authorities on deer. He wrote: 'I understand that many, or most, of the fine deer of wapiti type inhabiting Central and Northern Asia are threatened with early extinction in districts where game laws are very unlikely to be applied or enforced. If therefore the world should ever return to that degree of comparative sanity at which large sections of the human race no longer desire to murder each other, it is most desirable that collecting expeditions should be organized to obtain breeding stocks of the big deer of Asia for preservation in captivity. Government Departments should assist this venture instead of hindering it by needlessly severe import restrictions'.

Any information received from any source about the Shou will be most gladly welcomed by the undersigned, who will compile it and forward to the appropriate interests.

OATING P.O.,
ASSAM,
October 10, 1958.

E. P. GEE

6. A MYNA'S REMARKABLE ESCAPE FROM ELECTROCUTION

Hearing the excited chatter of Jungle Babblers, Common Mynas, and Redvented Bulbuls at 5.45 a.m. on 1st August, I went to see what the cause of the excitement was. I was at the scene in about 5 minutes and I found a Common Myna hanging limp from a live wire of the power line, its thighs touching a neutral wire below. Both its legs were gripping the live wire. Another myna was hanging with one leg on the live wire and the other leg on the neutral wire. Other mynas in a state of great excitement were flying around and alighting on the wires, sometimes dangerously close to the two

unfortunate birds. The second myna struggled (convulsed ?) three or four times and about two minutes later got released from the wires and flew away followed by most of the mynas. A few mynas, babblers, and bulbuls lingered for a while near the dead bird before they too went away. The body of the dead bird remained hanging on the wire all day, but was not there the next morning.

42 TREVOR ROAD,
NEW FOREST,
DEHRA DUN, U.P.,
August 11, 1958.

JOSEPH GEORGE

[The remarkable thing about the above incident is that the second bird was not instantly killed by the initial shock, but in spite of remaining stuck to the live wire for a couple of minutes it managed to struggle and release itself and actually to fly away! Mr. George informs us that the power line carried a voltage of 230 A.C.—EDS.]

7. THE BLACKBACKED WOODPECKER, *CHRYSOCOLAPTES FESTIVUS* (BODDAERT), IN CHITTUR KERALA

Sálim Ali says (The Ornithology of Travancore and Cochin, *JBNHS* **38**: 784) that he saw the Blackbacked Woodpecker only once in the course of his survey. In Chittur (part of the old Cochin State), altitude approx. 400 ft., and miles away from any kind of forest, I saw this bird on May 16, 1958. It was the call note that attracted my attention. It was a rapidly uttered, thoroughly unmetallic *kwirri-rr-rr-rr-rr* repeated 6 or 7 times running every few minutes. On the 16th I was able to watch the birds, a pair, from a distance of 45-50 feet. The triangular white patch on the back, set off by the surrounding black, makes the appearance of the bird distinctive. There is no danger of any/one familiar with the commoner woodpeckers mistaking the call note of this bird for that of the Goldenbacked (*Brachypternus benghalensis*) which is the common woodpecker of the area. The pair seen on 16-5-58 spent a few hours in a mango tope and visited a number of coconut and palmyra palms also. The bird was again noted on 23-5-58 and 5-6-58. On the last date I saw only one bird. But it uttered its notes regularly. At dusk it was going up a palmyra tree standing in the midst of fields.

GOVERNMENT COLLEGE,
CHITTUR, COCHIN,
KERALA STATE,
June 5, 1958.

K. K. NEELAKANTAN

8. THE VOICE OF THE KORA, *GALLICREX CINEREA* (GMELIN)

Very little seems to be on record about the voice of the Kora. The best account I have come across is in THE BIRDS OF BURMA, Smythies (1953), where he writes: 'The call or challenge of the male is a deep boom — *ogh-ogh-ogh* — uttered rapidly. When calling the neck is puffed out and the bill pointed vertically down; at intervals it is lowered out of sight and the note changes, sounding exactly as if the bird were blowing into the water (whether it actually does so has not been observed). Another common call, made by bending the neck forward, opening the bill, and working the throat, resembled the popping of corks. . .'

I should like to supplement the above with an account based on half an hour's observation under ideal conditions.

I have seen the Kora in Palghat only on two occasions. On 24 June 1957, at 9.30 a.m., I saw a male walking sedately along a field bund. It was dull blackish brown all over with long, brownish streaks on the wings. It had a fully developed comb. The tip of the comb and the part over the bill were red, the rest of the appendage being yellowish.

On 19 August 1957, at about 5.45 p.m., I was crossing the same stretch of paddy fields when I heard loud clucking calls. It was a male Kora, all black, with the comb and wattle red all over. The bird was on a low bund some 20 to 30 feet away from another bund which is regularly used as a foot-path. Though the bird was surrounded by full-grown paddy, from one point on the foot-path it could be seen very clearly. I stood there for a quarter of an hour fully exposed to the bird's view, but it either failed to notice me or ignored my presence. It seemed intent only on producing the loud call-notes which had first drawn my attention to it.

The notes uttered were chiefly of 3 sorts which had all a remote suggestion of 'booming'. They were produced almost incessantly and there was a definite rhythm about them. The posture of the bird and the nature of the sounds produced had an obvious relationship.

After finishing a series of call-notes, the Kora remained silent for a few seconds. At that time it invariably had its head raised. Keeping the head up, it uttered a series of 10 or 12 *kok-kok-kok-kok* calls, somewhat like the booming notes of the Chestnut Bittern; then, suddenly, it lowered its head with a steep bow and produced a number of deeper, hollower and metallic notes: '*utumb-utumb-utumb*' (*u* as in put). These notes were uttered with greater rapidity than the *kok-kok-kok* calls. The *utumb* sound was very like that

produced when a stone, the size of a lemon, is dropped into a deep well. If this is the sound referred to by Smythies, my opinion is that the bird does not lower its bill into water. On the day I saw it calling, the bird was on a field-bund, and could not have dipped its bill into the water.

After 10 to 12 '*utumb*'s, the Kora lifted up its head and resumed the *kok-kok-kok* calls. In between, as the head came up, a series of *kluck-kluck-kluck*'s was produced. I think their number was only 5 or 6 at the most.

As the bird had begun calling in this manner some time before I reached the spot, and continued to do so for another 15 minutes or more, I think it must have called without pause for half an hour at least.

No other Kora was seen or heard at that time anywhere in the area, nor did the behaviour of this bird suggest that he was expecting a rival to show up. At night on the 19th, whenever I listened, I could hear its notes. (My house was 300 to 400 yards away from the spot where the bird was seen.) It was heard at night regularly for a few days thereafter, but was not heard at all during or after the first week of September. By the middle of September most of the fields near my house had been reaped and the Kora could have found little shelter anywhere in the area.

GOVERNMENT COLLEGE,
CHITTUR, COCHIN,
KERALA STATE, K. K. NEELAKANTAN
June 5, 1958.

[H. G. Deignan in 'Birds of Northern Thailand' (*Bull. Smithsonian Inst.* No. 186 p. 108—1945) says: 'The bird with swollen neck and bill pointed at the ground uttered a series of short notes *owgh-owgh-owgh*, then dipping the head continued with a hollow-sounding *gook-gook-gook-gook*, the tones exactly like that of *Botaurus*. At times the two kinds of calls were interspersed, and without exception the head was lowered to produce the second sound'.—EDS.]

9. PHOTOGRAPHING THE LESSER FLORICAN, *SYPHEOTIDES INDICA* (MILLER), AT NEST

(*With three plates*)

The Lesser Florican is a monsoon breeding visitor to Kathiawar and arrives with the first rains. As soon as I got news of a florican's nest in a grass *veedi* some miles away, I went there with my hide. The nest was in the middle of the thick growth of grass which

covered the *veedi*. I put up the hide about 12 feet from the nest and bent down the grass in front so as to enable photographs to be taken. As the road was very bad I did not wish to come here again, and decided to take the risk of attempting to photograph immediately.

The female florican arrived a short while after my helper had left me in the hide and returned to the car. On seeing the lens she at once adopted an aggressive pose and advanced close up; in fact she was not more than a foot from the hide and I was unable to take photographs with my tele lens. After this display she went back to the nest and started pushing the eggs, one by one, back into the thick cover. When all the eggs were removed she started incubating them.

As I wished to take photographs of the bird incubating, I signalled to my helper to come over, and asked him to place the eggs in their former position in the open. Immediately he left the bird returned and again removed them into the grass. By this time it was getting late, so I signalled to my helper a second time to come over and move the eggs into the open. The bird did not remove them again but settled down and started incubating, and I did get the pictures I wanted.

I have noticed this habit of rolling the eggs into the cover also with other floricans that I have photographed.

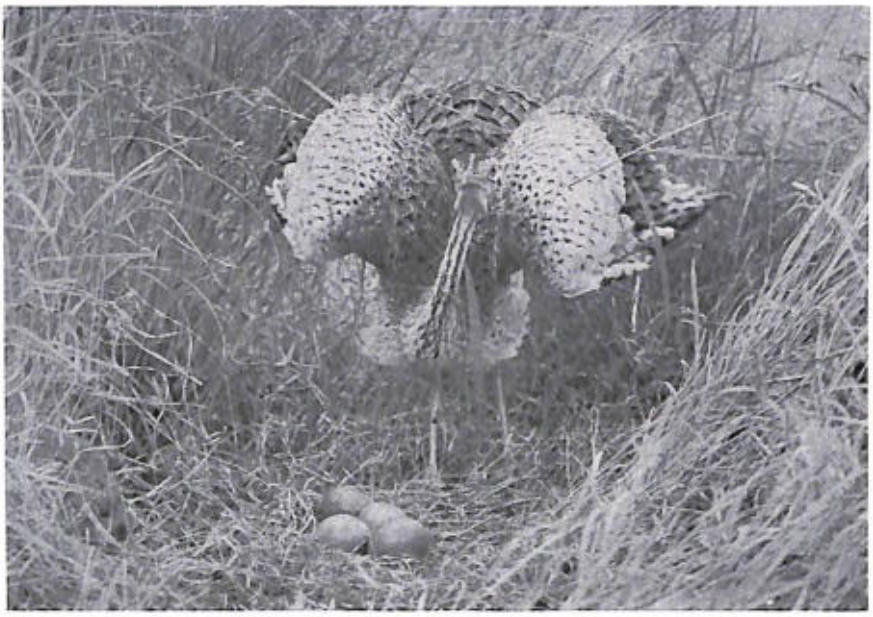
JASDAN, M. K. SHIVRAJKUMAR
July 9, 1958.

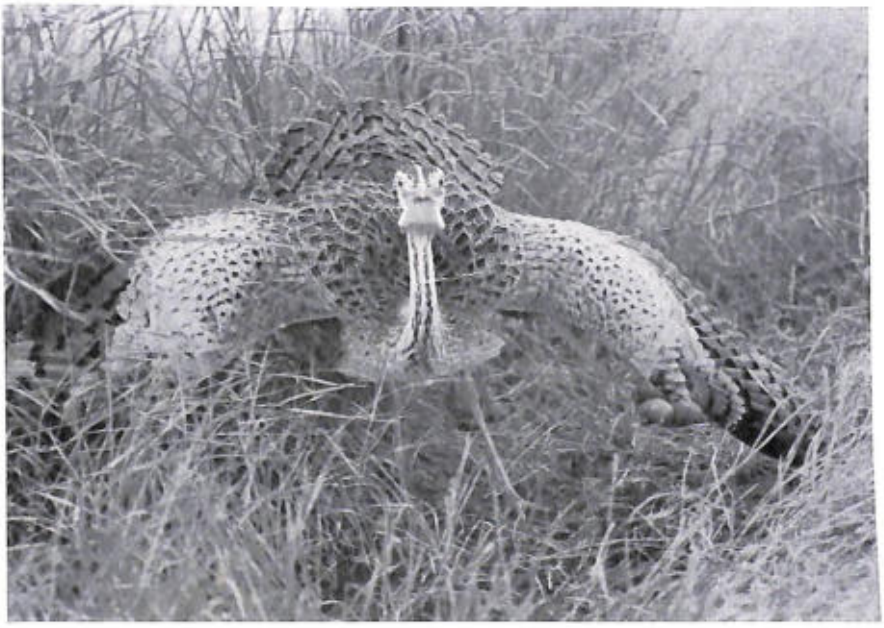
10. WILSON'S STORM PETREL, *OCEANITES OCEANICUS* (KUHL), AT COLOMBO

Since the compilation of scattered records of observations of Wilson's Storm Petrel in seas to the north of its breeding grounds by Roberts (1940), Gibson-Hill (1948), Serventy (1952), and others, a fairly complete picture has been obtained of the seasonal movements of this bird. From observations in the Indian Ocean and Arabian Sea, it appears, as Gibson-Hill (1948) has stated, that 'Wilson's Petrel is plentiful in the area comprising the western portion of the Arabian Sea, the Gulf of Aden and the southern half of the Red Sea, from June to September, and apparently absent from the southern half of the Indian Ocean'.

These areas, particularly the Gulf of Aden, are becoming increasingly well documented by reports from various voyagers, but

LESSER FLORICAN (FEMALE)





"On seeing the lens she at once adopted an aggressive pose and advanced close up...."

Photos : M. K. Shivrajkumar

LESSER FLORICAN (FEMALE)

"After this display she went back to the nest and started pushing the eggs, one by one, back into the thick cover."

Photos : M. K. Shivrajkumar

LESSER FLORICAN (FEMALE)

"When all the eggs were removed she started incubating them."

Photo : M. K. Shivrajkumar

there is still a paucity of records from the coasts of Ceylon. This region is of interest since Gibson-Hill (1948: 445) has been led to the conclusion that 'probably the main mass of birds reaches the neighbourhood of Socotra and the Arabian coast in May and June, and moves south by way of the waters off Ceylon in September and November'.

Gibson-Hill (1953: 89) was able to give only three 'formal records' of Wilson's Petrel in waters close to Colombo, these being for November 1908, July 1909, and October 1930. Other records, mentioned earlier by him (1948: 444), were of one bird seen near the entrance to Colombo harbour on 14 October 1946 by E. H. Bromley, and of birds 'probably of this species' seen by Legge in August 1874. More recently, Phillips (1955: 132) has reported the observations made by Mr. G. N. Grisenthwaite from the trawler 'Braconglen' in waters between Colombo and Cape Comorin, across the Gulf of Mannar, from November 1953 to November 1954. From these observations it seems that 'Wilson's Petrels . . . arrive in Indo-Ceylon waters during the last week in May . . . and . . . remain . . . chiefly in the shallower coastal areas . . . for approximately six months . . . and fly southwards . . . leaving Indo-Ceylon waters generally during the first or second week of November.' (Phillips, 1955: 133).

The purpose of the present note is to place on record that on 27 August 1955, while the S.S. 'Otranto' in which I was travelling was off the entrance to Colombo Harbour, I saw very large flocks of Wilson's Petrel close to the ship and extending westward for a considerable distance. I am unable to give any numerical estimate of these birds, but I would suggest that the flocks included several thousand birds. At the time I did not realise that this region was not so well documented as that near Aden, but my impression of these petrels was almost identical with that of Mr. Grisenthwaite in 1954: 'I was immediately impressed by the large numbers of Wilson's Petrel present; just clear of the harbour they were like flies.' (Phillips, 1955: 132). From Colombo, which we left on 28th August, to Aden very few birds of any kind were seen although, with the conditions of the sea and the general visibility, Wilson's Petrel would probably not easily have been overlooked. The noon sea temperatures and wind conditions during these days were as follows: 28 August 84°, SW. 3-4, moderate sea; 29 August 84°, SW. 3-4, moderate; 30 August 81°, WSW. 5-6, rough; 31 August 76°, WSW. 5-6, rough; 1 September 87°, W. 3, moderate; 2 September arrived at Aden.

Sewell (1955: 190) has summarised the meteorological conditions prevailing in the northern part of the Indian Ocean throughout the

year: December to February is characterised by winds blowing 'almost continuously from the north-east . . . constituting the North-east Monsoon; in March to May the winds are variable; from June to August the wind blows with considerable force from the south-west, constituting the South-west Monsoon; and in September to November conditions are again variable.' From Phillips's (1955) account, it appears, then, that Wilson's Petrel arrives in Indo-Ceylon waters during the period of variable winds at the close of the North-east Monsoon, and leaves again in a period of variable winds towards the beginning of the South-west Monsoon.

Murphy (1936), followed by others such as Gordon (1955), has shown clearly that a quantitative correlation may be made between meteorological and oceanographic conditions and the distribution of pelagic birds. Quite a lot is known about the spatial limits of the monsoons in the Indian Ocean and the oceanography has been well summarised in Schott's account (1935) where charts of the wind and water movements from February to March (Pl. XXIX, and see Sewell, fig. 1) and from August to September (Pl. XXX, and Sewell, fig. 2) are presented.

Further observation on Wilson's Petrel, particularly from waters east of Ceylon towards the coast of Sumatra are needed, and, when this region becomes as well known ornithologically as the Arabian Sea, some interesting correlations with the oceanographic conditions may doubtless be expected. Voyagers between Indo-Ceylon waters and the Malay Peninsula are in a favourable position to make worthwhile contributions to fill this gap, and such information will be welcome to all those concerned both with oceanography and with sea birds. Gibson-Hill's paper of 1948 may be referred to as an aid to the identification of small petrels likely to be seen in these waters.

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NEW ZEALAND,
May 1, 1958.

E. W. DAWSON

[Attention may be drawn to the note by Mr. Humayun Abdulali (1948, *JBNHS* **47**: 550) on this petrel outside Bombay Harbour in the third week of October, and to some previously published records of its occurrence in the eastern Arabian Sea, in the editorial comment thereto.—EDS.]

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11. PHOTOGRAPHING A COLONY OF EGRETS (*BUBULCUS IBIS* AND *EGRETTA GARZETTA*) IN ASSAM

(*With a plate*)

The ubiquitous egret must often be viewed by many people as a mere 'accessory' to grazing cattle or to the country's limitless paddy fields. Few of us can have had the opportunity (? or, the inclination) of observing these birds at close quarters. In fact, I myself would have missed such an opportunity had not a sizeable colony of both species of egret, decided to breed this year within half a mile of my bungalow. I felt 'duty bound' both to the Society, and my camera, to attempt to photograph what I was later to discover, were beautiful and fascinating subjects.

In his breeding plumage the Cattle Egret, when seen close to, is transformed into a bird of real beauty—the black legs, the pure white of the wings, the magnificent russet-brown of the neck and breast, and the yellow beak and eye yield a study that is really worthy of colour film. However, in these days of curtailed imports one has little choice with photographic material but this does have the salutary effect (or should have!) of stopping the 'one for luck' attitude of which so many photographers appear to be guilty—the writer included.

The accompanying illustrations were taken with a Leica camera, fitted with a 200 mm. telephoto lens, using Kodak Tri-X film exposed at 1/500th sec. at an apperture of f5.6 to f8. The camera was steadied by one of the supports of the machan, as the use of a tripod was prohibited by the great number of nests, at all angles, which surrounded the hide at ranges from ten feet upwards.

Although one tends to associate the egret with open country the nesting site for this particular colony was immediately adjacent to the local cinema—a more inappropriate and unsalubrious place for the rearing of young would be difficult to find even within a radius of twenty miles. I was unable to establish whether the birds have regularly used this site (as I believe both species tend to do), but this habit would seem to offer the only logical explanation for their strange choice.

The nests themselves were situated in clumps of bamboo which extended over an area of some one and a half acres. The population must have been about five hundred pairs with the Cattle Egret representing at least eighty per cent. Perhaps, conscious of their superior grace and elegance, the Little Egrets kept aloof from their counterparts, but they did not form a separate colony. Their nests, however, were identical as was the incubation period—some fifteen to twenty days with the eggs laid, in this instance, at the beginning of June. The incubating appeared to be the prerogative of the female in both cases[1] although the male of the Little Egret assisted in the building of the nest. Unfortunately, I was unable to observe whether both partners shared in feeding the young.

The Little Egret may lack a diversity of colour in its breeding plumage but exquisite 'aigrettes' render it a singularly worthwhile subject although difficult, as the plumes are shown to their best advantage only when the bird is alighting or in the act of flying. That the export of the 'aigrette' feathers is now banned is, to my mind, a sensible step in the right direction; for not only do these birds considerably assist the farmer, but also they adorn the paddy fields (which often require a relief from monotony) to an infinitely greater degree than their feathers do a woman's hat—which they usually don't!

It is so easy to take nature for granted that it isn't until one has a chance for a closer look that the beauty, variety, and charm of the commonplace are revealed. After photographing these egrets I have derived considerable enjoyment from observing other 'common' birds which, hitherto, I had considered to be merely a part of the countryside and, therefore, hardly worthy of a second glance. I hope, sincerely, that some readers may have a similar opportunity.

SYCOTTA T.E.,
KHARIKATIA P.O.,
ASSAM,
September 9, 1958.

J. H. BURNETT

[1] Actually, both sexes take part in incubation and feeding the young.—EDS.

A pair of Cattle Egrets in breeding plumage, Sibsagar Dist., Assam

A Little Egret about to leave its nest, Sibsagar Dist., Assam

Photos : J. H. Burnett

12. NOTES ON THE NESTING OF THE BLACKNAPED TERN, *STERNA SUMATRANA MATHEWSI* STRESEMANN, IN THE MALDIVE ISLANDS

Although I had met with the Blacknaped Tern in North Malé Atoll (*JBNHS* **55** (2): 211) where it is the most plentiful of the nine species of terns that are known to occur, I had not had the opportunity of studying the breeding of the species until I discovered several small nesting colonies in Addu Atoll, the most southernly atoll of the Maldivian Archipelago, during the month of June 1958.

On 2 June 1958 while passing a channel-marking pillar off the inner reef of Hittadu Island in Addu Atoll, I observed a pair of these terns mating on the top of the pillar. Enquiries showed that they were believed to lay their eggs, during May and June, on an uninhabited islet on the outer reef some 5 miles to the north. So I arranged to visit the place the next day.

Starting early in the afternoon, with very little wind, we rowed and sailed over to Bushy Island or Kanda Hera, an islet on the outer reef some 5 miles north-west of Gan Island, where we were living at the time. As we approached close to the islet which was scarcely more than a large coral bank clothed with scrub, dense in places but cleared and planted with a few coco-nut palms in the centre, the terns began to rise from the beaches and fly out to meet us. Circling the boat with continuous cries, in the manner usual to nesting terns when demonstrating their annoyance and concern at intrusion, they kept up a constant babel although their cries were less harsh and raucous than those of other species of colonial nesting terns that I had studied.

The colony was not a large one; I would estimate it at not more than 30 to 40 pairs. The eggs were not easy to find; they were scattered over the raised beaches, some 4 or 5 feet above the high water mark and 5 to 15 feet from the tide line, but they were not all laid close together or in one or two adjacent areas. On the contrary, one gained the impression that each pair had endeavoured to keep as far away as possible from other nesting pairs.

There were no nests. The eggs were laid either on the bare coral shingle, between small lumps of broken coral, or in shallow scrapes which appeared to have been formed by the birds setting down to brood the eggs, rather than intentionally. The eggs blended extremely well with their background of weathered grey coral shingle and sand, and were difficult to distinguish. 14 clutches were counted: 7 contained single eggs and 7 were of c/2 each. Possibly some of the single eggs represented half clutches, but two that were broken

by boatmen's feet were both incubated. Fourteen eggs were measured: they averaged 39.4 mm.×27.44 mm. (38 to 44 mm.×26 to 29 mm.).

In all eggs, except one, the ground colour was a light stone-grey, matching well the grey of the weathered coral on which they were laid. In the single exception, the ground colour had a distinct brown tinge. All eggs were typical 'terns' eggs', the markings consisting of spots, speckles, and blotches of sepia to light brown, overlaying smudges and faint blotches of purplish grey or lavender. Some eggs were considerably more heavily marked than others and some were more distinctly spotted than others. In several, the spotting and speckling was well distributed over the whole surface, with one or two hair-lines at the larger end; in others there was a well-defined zone of sepia blotches either midway round the egg or towards the larger end, while in three eggs there were large, dark brown blotches measuring up to 21×17 mm. and others of pale bluish grey. Apparently, blotches, when present, may be anywhere on the surface of the egg but usually they are towards the larger end.

An abnormally shaped egg, measuring 44×26 mm., was more or less unmarked at the smaller end but had a well-defined zone, round the larger, of underlying purplish grey with large and small spots of dark brown and purplish brown superimposed; elsewhere there were a few spots and faint smudges of sepia.

Leaving Bushy Island, we visited two other tiny coral islets on the outer reef—mere outcrops or flat biscuits, only a few feet above high water, with much broken coral-shingle thrown up on them by storms. Although over the first a few Blacknaped Terns were flying and demonstrated their annoyance at our intrusion, no eggs could be discovered; but on the second, which was rather the smaller, six pairs of c/2 were found after considerable searching. Again they were not all close together in one sector of the islet but were spread apart, with several yards between clutches.

Except that all eggs were in clutches of two, no differences were noted between this and the Bushy Island colony, distant about half a mile to the north. It was estimated that this colony numbered not more than 20 pairs.

A third nesting-colony was discovered on 13th June on a tiny storm-piled bank of broken cora shingle thrown up on the main outer reef on the south-western side of Gan Island (Addu Atoll). A few terns were visible, with the aid of field glasses, circling the islet from time to time so I waded out to investigate. As usual, as I approached, a number of Blacknaped Terns flew out to meet me and register their protests at my coming. At first, I could find nothing to

justify their concern but after a more intensive search and the watching of some of them as they alighted, I was eventually able to find three clutches c/2, c/1, and 4/1. It was evident that the members of this colony were only just commencing to lay and some of them were still engaged in choosing egg-sites.

Again there were no attempts at nests, the eggs in every case being laid on the bare coral sand, in very slight scrapes or, more truly, in smoothed circles of 1½ to 2 inches in diameter. The eggs themselves were very similar to those of the other two colonies.

The general breeding behaviour of the Blacknaped Tern, when nesting, appears to conform very closely to the normal behaviour pattern of the Sternidae; numbers fly out to meet the intruder on his approach to the breeding territory, circle screaming overhead throughout his stay, and quickly resettle themselves on their eggs or alight on coral knobs on his withdrawal. The voice of this tern is, however, less loud and harsh than in the majority of the family.

c/o R.A.F. GAN,
c/o AIR MOVEMENTS, W. W. A. PHILLIPS
KATUNAYAKE,
CEYLON,
August 8, 1958.

[The overall breeding range of the species *Sterna sumatrana* Raffles is islands in the Indian Ocean and western Pacific, north to the China Sea, south to New Caledonia. Within Indian limits the typical race (Burma, Malaysia) breeds in the Andaman and Nicobar Islands. The range of the race *mathewsi* (described from the Aldabra Islands north of Madagascar) is given as islands of the western Indian Ocean from the Seychelles, Amirante and Aldabra Islands, east to the Chagos Islands. The race occurring in the Maldives had remained undetermined until specimens were collected recently by Major Phillips (*JBNHS* **55**: 211).—EDS.]

13. THE PRESENT STATUS OF THE WHITEWINGED WOOD DUCK, *CAIRINA SCUTULATA* (S. MÜLLER)

(*With a plate*)

At its inaugural session at Mysore in 1952, the Indian Board for Wild Life placed two ducks of north-east India on the special Protected List. These two were the Pinkheaded Duck (*Rhodonessa caryophyllacea*) and the Whitewinged Wood Duck (*Cairina scutulata*).

Even at that time it was feared that the Pinkheaded Duck, of which there has been no really authentic report for a number of years, had become extinct.

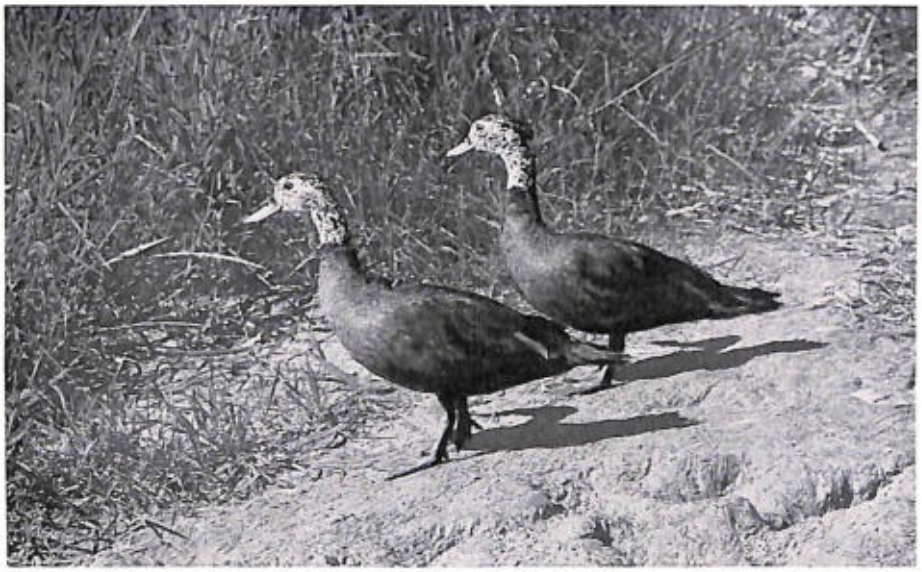
What of the status of the Whitewinged Wood Duck? I have been trying to collect information on this interesting bird which appears to be found only in Assam (as far as India is concerned), Burma, Malaya, and Indonesia. In Assam it is rarer in the districts of Goalpara, Kamrup, and Darrang; less rare in parts of Nowgong and Sibsagar; and more frequently found in Lakhimpur and Luhit Frontier Division (Sadiya), and possibly Cachar. For field identification it is a black and dark brown duck of large size, with spotted black and white neck, and with conspicuous white patches on the wings. It is not to be confused with the Nukta or Comb Duck (*Sarkidiornis melanotos*) of which the body is white below and of which the drake has a conspicuous knob or comb at the base of its bill.

A resident and non-migratory species, the Whitewinged Wood Duck frequents patches of water and long still pools of rivers in thick forests away from human habitation, especially near the foothills. Sometimes they are found in small parties of about six or less, but usually they go about singly or in pairs. During the heat of the day they generally remain in the shade of a tree, either on the water or on a branch. Therefore early morning and evening are the times when they are to be seen.

They nest in trees, either in holes of trees, or in large nests of sticks and rubbish in a fork of a tree or in a mass of branches. May to August is believed to be the time that breeding takes place. Some people say that these birds make a nest of grass etc. in scrub-jungle near water.

In 1913 J. C. Higgins mentioned this duck as being common in Upper Chindwin District of Burma, and comparatively so in Upper Assam. He saw three of them in Manipur on one occasion only. In 1915 H. Stevens met this duck near the Dibru River in Lakhimpur District, and near the Dejoo River in North Lakhimpur, and reported its call as being an unmistakable long drawn 'honk'.

Stuart Baker recorded in 1921 that he had found a great many of these ducks in Sadiya, and reported their presence in fair numbers in parts of Lakhimpur District, and refers to a few which had been seen or shot in other parts of Assam. In 1947 Sálim Ali and Dillon Ripley wrote: 'A pair were seen at Tezu and near Brahmakund in January. They haunt the jungle-grown streams and do not usually come out on to the broad gravel banks of the Lohit'.



Whitewinged Wood Ducks in captivity, about four months old

Adult bird in Alipore Zoological Garden, Calcutta

Photos : E. P. Gee

Early in 1956 I drew up and sent out a questionnaire (given at the end of this note) on the Whitewinged Wood Duck to a number of Forest Officers and tea planter sportsmen in order to find out the present status of this rare and interesting bird. I am grateful to the following persons who responded to this questionnaire and supplied me with interesting information: Frank Nicholls, H. K. Dodwell, J. R. Clayton, C. G. Allen, E. D. Hooper, C. D. Hopper, and the Director of Forests, N.E.F.A.

A pair or two of these ducks are reported to be now resident in the Behali Reserved Forest in the north of Darrang District. In the *bheels* and other pieces of water of the Ranga Reserved Forest, west of North Lakhimpur town, there are a few pairs. A fair number exist in the Phillobari area east of Doom Dooma town. They are to be found in all the streams running through the Dibru Reserved Forest. Occasionally a single bird or a pair is found in the forest near Digboi. I myself recently saw a pair on a long still pool of the Kaliani River in the Mikir Hills.

Though no news is at present available from many parts of north-east Assam and Cachar and though the little information available is sketchy, what has been found out so far is not altogether discouraging. Much more information is required from many more people, after which it will be possible to draw a more complete picture of the situation. The consensus of opinion of my informants so far is that this duck has become much rarer than it was fifteen to twenty years ago, chiefly due to its habitat gradually becoming opened up by deforestation and cultivation.

The Whitewinged Wood Duck appears generally to roost during the heat of the day on shady branches of trees low down near the water, coming out to feed in the evening and feeding all night. It is seen sometimes in the early morning before it retires. When encountered on the water, it is not particularly wary. In fact some correspondents consider it 'foolishly unwary'. It advertises its approach when flying and its presence when feeding by its loudly repeated call.

As to their enemies, apart from man with his deforestation and extending cultivation, Frank Nicholls reports that he has personally twice seen these ducks attacked by hawks while flying. One, he says, was actually struck down into the reeds, but later managed to fly away. This correspondent has also seen a large water monitor (*Varanus salvator*) swimming about in a *bheel* frequented by Whitewinged Wood Duck, and actually saw this lizard take a moorhen and even attack a cormorant.

I find that many people, even sportsmen who shoot regularly, are not aware of the identity of this duck. Although it is clearly

stated in gun licences in Assam that the Pinkheaded Duck and the Whitewinged Wood Duck are closed to shooting for the whole year and although it is not good eating, people shoot it or at it without knowing that it is a fully protected bird. This proves the need for wide publicity about this rare and vanishing species, so that everyone including the villagers in the forests will be able to assist in protecting it.

In my paper 'The Function of Zoological Gardens in the Preservation of Wild Life' [*JBNHS* **53** (1): 84] I wrote: 'The Whitewinged Wood Duck of north-east India, recently placed by the Indian Board for Wild Life on the list of birds proposed to be totally protected, is known to thrive in captivity: here is another opportunity of saving from extermination a species before it goes the way of the Pinkheaded Duck'. I am convinced that an effort should be made to keep and breed this duck in captivity in India.

I note that Stuart Baker in his INDIAN DUCKS AND THEIR ALLIES states: 'They are charming birds in captivity, and are tamed without the slightest difficulty. When the breeding season approaches, they, if not confined or pinioned, fly away; but throughout the cold weather months they may be allowed to wander about at their own discretion, and will always keep near home if regularly fed. When thus domesticated it is a curious fact that they never seem to use their wings as a means of locomotion, but will walk very long distances to and from water. A duck belonging to a planter whose house was nearly half a mile from water invariably *walked* there and back every evening, returning to the house for the hot hours of the day and for the night. This particular duck was the object of a wild infatuation on the part of a small domestic drake, who followed her about wherever she went, and as the Wood Duck could walk at, at least, thrice the rate the drake could, he eventually succumbed to sheer exhaustion and want of time to feed in. She, however, totally ignored all his advances, and in April flew away to find a wild mate.

'They are very impatient of heat, and the birds in my aviary always retired indoors as soon as the sun was up, and even in the cold weather they always kept under cover from 10 a.m. to 2 p.m. Those I sent down to the Calcutta Zoo died very quickly, except one fine drake, who lived about eighteen months before dying of the same disease which carried off the rest—an affection of the stomach.

'My birds were practically omnivorous, but would touch no dead animal food. Every other day a pail-full of small fishes was emptied into their tank, and by nightfall these were generally all accounted for; but any that died during this period were never eaten. In the

same way, worms that ceased to struggle were discarded, and grasshoppers, frogs and snails would only be taken if alive.

'They ate paddy and husked rice freely, and I have kept birds for some weeks on this alone, and they kept fat and well upon it, but, at the same time, when they were offered animal food they preferred it to the grain. Green food of all sorts they refused unless very hungry, and I could never induce them to eat any sort of water weed, though one would expect them to eat such in a wild state.

'They were extremely expert in catching fish; as a rule, they skimmed along the top of the water with the head and neck immersed, but when necessary would dive and chase the fish under water. Of course, their speed when doing so was not comparable to that of cormorants, or the diving ducks under the same circumstances, but it was sufficient to ensure the capture of almost any fish. They are very mild, well-behaved birds, and not, as a class, at all quarrelsome. Some tiny whistling teal shared their captivity, and were always treated with consideration and allowed their share of food, etc. As already said, they very soon become tame, and within a few weeks they were all tame enough to accept food from the hands of those they knew well; but generally when strangers appeared they retired to their inner room. When not feeding, they almost invariably sat on the perches and not on the ground, and they showed considerable activity in turning about on them; at the same time they kept their position almost entirely by balance and not grasp, as anything touching them at once upset them.'

Peter Scott, Honorary Director of the Severn Wildfowl Trust in Britain, wrote to me in September 1956 of the Whitewinged Wood Duck: 'We already have seven and they seem quite hardy. One lived out in England all through the war. They have not bred in England but a pair bred successfully in Holland in 1938; we are, therefore confidently expecting to breed them. We have only three females.'

Several persons in Assam have succeeded in rearing and keeping these ducks in captivity. From Towkok Mrs. Whyte wrote to me in 1955: 'These birds nest on our golf course every year. We hear their weird call long before we see them flying over the fairway in the late afternoon towards their nest. My husband picked this one up wounded and looked after it until it recovered. By that time it had grown quite tame so he kept it in a *pucca* pool in the compound. For company he put in a Muscovy Duck with it. The pair got on very well together apparently. However, one morning when he looked at them they were perfectly all right, two hours later he found the Wood Duck dead. We both think that the Muscovy was responsible.'

Mrs. Barron informed me in 1955 that at Phillobari some years previously: 'A pair of birds were brought to me from the interior jungle by an Assamese, who told me they were only to be found in the densest jungle beside water. They build their nests off the ground about three to five feet up in tree stumps as far as I could make out. I had box nests made for them about four feet off the ground of their chicken house, in which they seemed very happy. They did not breed. They were very handsome birds and allowed me to stroke and pick them up, and used to swim daily in a little cement pond in the garden'.

In 1956 I myself received a bird from a friend in the Doom Dooma District, and later two more from another friend near Tinsukia. These three did very well in a small *pukri* at the back of my bungalow. Although their wings were clipped they made repeated efforts to fly—not in order to escape (for they had become very tame) but because of their active habits. Once or twice when they did manage to leave the *pukri* and bungalow compound and wander some distance into the tea garden, they came back of their own accord. One of the three was eventually taken by a jackal, and for the safety of the remaining two I presented them to the Alipore Zoological Garden, Calcutta. One has since died, but the other is doing well. If only more birds could be obtained, an effort could be made to breed them.

Here is an excellent opportunity for the newly started State Zoo at Gauhati to construct a suitable pond with plenty of grass cover and thick tree shade all round it, to provide a home and breeding place for this rare and interesting duck of Assam.

The writer is keenly interested in receiving every available piece of information from every source about the Whitewinged Wood Duck. Should any readers of this, or their friends, obtain any information and forward it preferably in the form of answers to the questionnaire, they will be making a valued contribution towards the preservation of India's wild life.

Information wanted on the Whitewinged Wood Duck

1. In what localities are they found, and in what numbers?
2. Are they strictly resident in one place all the year round, or are they locally migratory?
3. Are they in the habit of feeding by day, or by night?
4. Where do they breed, and what sort of nest do they make?
5. When is the breeding season? Are there two broods?
6. Are there any cases of their eggs being taken and put under a domestic bird for hatching, with success?

7. Are there any cases of baby chicks being taken and reared?
8. Are there any cases of adult birds being caught and tamed?
9. Are any of these ducks alive in captivity now?
10. Are there any cases of these ducks breeding in captivity?
11. Are they wary birds, or foolishly unwary?
12. What are the factors working against their survival?
13. Are they becoming rarer year by year?
14. Have you any suggestions for their successful preservation?
15. Have you any other information about these ducks?

N.B. The above information is urgently needed, so that the Whitewinged Wood Duck may be properly protected and not become extinct. If you know of anyone else likely to be able to supply information, could you please pass this questionnaire on to him. All information may please be sent to me for compilation for forwarding to the appropriate authority.

DOYANG T.E.,
OATING P.O.
ASSAM,

E. P. GEE
Honorary Regional Secretary,
Eastern Region, Indian Board for Wild Life.

September 29, 1958.

14. MORE BIRD NOTES FROM KUTCH

Since K. S. Lavkumar kindly asked for and sent in some of my notes on bird occurrences in Kutch which appeared in Vol. **54**, No. 1 of this journal, I have been able to record one or two new birds for this area and also to substantiate two of my previous sight records for Kutch. I give these below along with notes, including some already mentioned by K. S. Lavkumar.

Culicicapa ceylonensis (Swainson) : Greyheaded Flycatcher

This bird was first noticed by me at Vijaya Vilas (Mandvi) in January 1948, but at that time I could only catch a fleeting glimpse of the bird. However, on 24th December 1956 I observed at least 3 or 4 birds in the same locality, and I saw them regularly during my stay at Mandvi for about a fortnight. I eventually secured a specimen to be sent to the Bombay Natural History Society. This is the first record of the bird in Kutch.

Chibia hottentotta (Linn.) : Haircrested Drongo

A most unusual occurrence for this part of India. I first came across this bird in January 1948, and I saw it again on 29th December

1956 in the same place, Vijaya Vilas, and I shot the specimen which was later on sent to Mr. Sálim Ali who confirmed my identification. Besides the bird shot by me I saw a second one on the same day which, even after one month when I visited Mandvi again, was still there.

Dicrurus longicaudatus Jerdon: Grey Drongo

R. S. Dharmakumarsinhji was the first to spot this bird at Mandvi in January 1955 in the Vijaya Vilas Palace grounds and one bird was collected by M. K. S. Fatehsinhji which was sent to the B.N.H.S. In subsequent years I have found this bird to be quite a common, and at times numerous, cold weather visitor to places in Kutch where there are shady groves such as are to be found at Sarad Bagh in Bhuj, Vijaya Vilas Palace grounds in Mandvi, etc. I have also come across this species elsewhere in Kutch, but only as stray birds.

Dicrurus caerulescens (Linn.): Whitebellied Drongo.

One bird was seen by me in my own compound in Bhuj near the Jubilee Ground on 1st November 1956. Later on I observed two birds which remained here till 15th March 1957. As far as I know this bird also has not been recorded by anyone in Kutch.

Ciconia ciconia (Linn.): White Stork

I first came across this stork in the Banni during December 1954 when I saw one bird on a shallow lagoon. On 29th January 1955 while out for a houbara shoot I saw one bird on the Rávalpír tank near Mandvi. This bird of course has been recorded by Lester in August 1895, but the Sálim Ali survey failed to come across it in Kutch.

Lobipes lobatus (Linn.): Rednecked Phalarope

Also a first record for Kutch. I observed this bird in May 1948, and then again on 15th May 1949 on Devisar tank which is situated about 10 miles from Bhuj. This may not be a particularly uncommon visitor, since it can be easily overlooked by the uncritical observer.

JUBILEE GROUND,
BHUJ, KUTCH,
April 15, 1958.

M. K. HIMMATSINHJI

15. TRINKET SNAKE (*ELAPHE HELENA*) WITH ABNORMALITIES IN VENTRAL SCALATION

(*With a photo*)

The serpent in question was forwarded to me by the Honorary Secretary, Mr. Humayun Abdulali, for my opinion on the abnormalities noted in the scalation over a length of 40 mm. on the anterior part of the animal.

The following extract from Mr. Abdulali's first letter dated 1st June 1957 explains the circumstances:

'A few days ago a friend brought in a trinket snake (*Elaphe helena*) which he had obtained from a madari or snake-charmer. A few inches behind the head it bore marks of an injury, in the healing of which the ventrals over a distance of about 40 mm. had been completely lost and replaced by small transverse scales!'

The above letter was accompanied by a photograph showing the

post-cranial region in a spirally twisted condition, and on the strength of this and assuming that the abnormality was, as suspected, traumatic in origin, I expressed the opinion that repair of a fairly large wound had been effected by contraction of scar tissue which had resulted in dragging down part of the lateral and dorsal scaly skin to close the gap. I did not consider that there had been any new scale-formation. My opinion was shared by my friend, Dr. Angus Bellairs, to whom I submitted the photograph.

Some time afterwards the preserved specimen was sent to me, and on examination I found that the affected area of skin had been partly dissected off. In spreading this out and studying the scalation more critically, I am now of opinion that the abnormality is probably congenital and not due to injury.

We have no positive evidence of the snake being injured. The area affected is such that the injury, if it ever occurred, must have

been an extensive one—involving removal of a relatively large slice of skin by the bite of some predator. Such an injury would almost certainly prove fatal as serpents do not recover readily on account of the slow rate of tissue growth, which leaves ample time for attack by parasites, e.g. maggots, or by ants.

Assuming, therefore, that injury had not occurred, we must fall back on the hypothesis of congenital abnormality. This is supported by the scale arrangement. At both extremities of the elliptical abnormal area are transversely disposed ventral scales of transitional size and shape. These are succeeded by small scales arranged in rather irregular transverse rows linking up on each side with normal dorsal type scales. About 19-20 ventrals are replaced by scales of abnormal size and shape. Anteriorly, the transition is less abrupt, especially on the right where five large oblong scales occur in succession, their fellows being represented by small quadrate scales, or, more posteriorly, by oval scales showing tendency to unibrication. In the caudal half of the abnormal area, small oval or quadrate scales replace the ventrals on both sides.

I therefore now consider that the error is due to abnormal development in the embryo, due to some inhibiting factor or local change of the environment of development at the time when the ventrals are being laid down.

THE ZOOLOGICAL SOCIETY OF LONDON,
REGENT'S PARK,
LONDON, N.W. 1,
July 17, 1958.

W. C. OSMAN HILL

16. CAN SNAKES PRODUCE VOCAL SOUNDS?

Some time back the Society received the following letter from Dr. B. K. Behura, Department of Zoology, Ravenshaw College, Cuttack:

'A python (*Python molurus*) measuring about nine feet two and a half inches was kept under captivity by me at the Department of Zoology since May 1954 until its death in September 1957. On 12 April 1957 finding the water-can inside the cage of the reptile empty, I poured a glass of water into the can from above the cage, and to my surprise I heard a distinct 'Umh' resembling the sound of a man in agony. Shri U. C. Panda, a Lecturer of the Department who was standing near the cage also heard the same and we had no doubt that the sound had come from the python in the cage.

'It would be interesting to know whether other snakes also produce sound and the circumstances under which they do so.'

Not far from Bombay on 9 January 1955 I saw a large Dhaman (*Ptyas mucosus*) which, when chased, went into a hole. We caught hold of its tail and after considerable effort, which included some rough handling, pulled it out and carried it to camp where Messrs Sálim Ali and B. Biswas of the Zoological Survey of India were also present. While being carried and for some considerable time afterwards, it uttered several kinds of noises which included a low whine and variations thereon.

Upon receipt of Dr. Behura's letter I wrote to Dr. W. C. Osman Hill, Prosector, Zoological Society of London, whose reply reads in part:

'Our experience here is that no snake produces any sound other than hissing, but the quality and tone of the hiss may be altered by the presence of pathological secretions within the respiratory passages. I think this may be the case with the Python mentioned, which agrees with a record we have for a Boa. But the case of the Dhaman appears unique as this was presumably a healthy animal.

'I am told that in some travel books cases have been cited of Anacondas snoring, but this has never been confirmed by scientists.'

BOMBAY NATURAL HISTORY SOCIETY,
91 WALKESHWAR ROAD, BOMBAY 6, HUMAYUN ABDULALI
September 11, 1958.

17. LARVAL WATER-MITES (HYDRACARINA) PARASITIC ON INSECTS, WITH NOTES ON THE DISPERSAL OF SMALL FRESHWATER INVERTEBRATES

This paper summarises the previous literature on larval water-mites parasitic on insects and gives records of my observations on this subject with a discussion of the life-history and the direct and indirect effects of the parasite on host insects. The general problem of the dispersal of small freshwater invertebrates by flying animals is reviewed.

There are many recorded instances of larval water-mites parasitising aquatic insects. The adult mites are free-living and carnivorous. They lay eggs on water plants and the six-legged larva which hatches out attaches itself to a variety of aquatic animals. Both vertebrates and invertebrates are hosts to these parasites. They have been reported on the Corixidae (water boatmen) by Soar (1901), Hungerford (1919), Pearse and Walton (1939), Griffith (1945), Lansbury (1955), and Leston (1955). I found them on the corixid species *Sigara lateralis* Leach,

S. dorsalis Leach, *S. distincta* (Fieb.), *S. fossarum* Leach, *S. nigro-lineata* Fieb., and *Hesperocorixa linnei* (Fieb.) [Fernando (1956), unpublished]. They have also been reported from the Notonectidae (backswimmers) by Soar (1901), from the Dytiscidae (diving beetles) by Soar and Williamson (1925), and from the hydrophilid beetle *Helophorus brevipalpis* Bedel by me [Fernando (1956) unpublished]. Carpenter (1928), Ward and Whipple (1945), and Mellanby (1953) refer in general to larval water-mites parasitic on insects.

In Ceylon I have found larval water-mites parasitising aquatic insects on a few occasions. They were found on the water scorpion *Ranatra elongata* Dohrn, taken from a drying up pond in Habarana. Five specimens of this water scorpion were captured and all of them were heavily infested, the mites being attached to the thorax, abdomen, and legs, very often on the soft parts between the chitinous plates of the body. The largest number of mites on a single individual was 16. The slowness of movement of these insects and the fact that the pond was drying up and crowded with insects accounts for the large number of mites. A single larval mite was found on the lower surface of the abdomen of the water strider *Hydrometra vittata* Stal, captured at Nugegoda. In the dytiscid beetle *Eretes sticticus* L., also taken at Habarana with the water scorpions, 5 specimens of a total catch of 16 were infested. Two or three mites were found on a single insect and they were attached to the dorsal surface of the elytra and the underside of the thorax and abdomen.

Larval water-mites are sometimes found on terrestrial insects with aquatic larva. Ward and Whipple refer to this phenomenon in general. Weerekoon (1956) found four larval mites attached to the abdomen of the chironomid fly *Chironomus* (*Chironomous*) *supplicans* (Meigen) taken in an emergence trap. I found a single larval water-mite on the underside of the thorax of the dragonfly *Diplocodes trivialis* Rambur, captured at Nugegoda. Weerekoon (personal communication) suggested that the larval mites probably attached themselves anew after the final moult of the insect larva. It seems more likely however that the shedding of the larval or pupal skin does not remove the larval mite.

The dispersal of freshwater invertebrates by larger animals is a very important phenomenon and results in the spread of the species into isolated bodies of water. I have found water-mites in isolated bodies of water. Boycott (1936) found small bivalves in isolated ponds and considers birds to be the chief agency in their dispersal. He suggested that aquatic insects may be effective over short distances. Charles Darwin in his famous book THE ORIGIN OF SPECIES was the

first to focus attention on the importance of larger animals in the dispersal of smaller forms. He believed this phenomenon to be widespread, and recorded two instances one of the freshwater mollusc *Ancylus* carried on the water beetle *Colymbetes*, and the other of a duck carrying freshwater shells on its feet. Kew (1895) published a book on the subject of the dispersal of shells in which he recorded instances of bivalves attached to aquatic insects. Carpenter (1928) discusses the role of insects in the dispersal of Mollusca and Arachnida and suggests that they play an important part in extending the range of species found in ponds and streams. Fernando (1954) recorded bivalves on Corixidae and has summarised the earlier literature on the subject of dispersal of Mollusca by aquatic insects. Weerekoon (1956) suggests that water-mites are dispersed from one body of freshwater to another by insects. Since water-mites are found commonly on aquatic insects which are known to fly from one body of freshwater to another [Fernando (1956) unpublished] these are an effective means of dispersal of the mites.

Leston (1955) records earlier deaths among mite-infested, overwintering Corixidae in spring. It is likely, however, that the weaker and therefore slower moving of insects are more easily infested in the first instance. The same author mentions that the formation of the dorsal air film in Corixidae is interfered with by the presence of the mites.

Further observation is likely to show that larval water-mites infesting insects is a widespread phenomenon. The larval mite obtains its nourishment from the insect and must therefore cause some harm to it. The extent of this harm is not known. There is no definite evidence that mite infestation increases the mortality of the insects directly. However, indirect effects by hindering the insect in its movement and generally weakening it are likely to result in increased mortality as a result of predation, as has been shown in the case of parasitised fish by Van Dobben (1952). An interesting feature in the life history of these mites is that moulting of the insect larva does not remove the larval mites. Insects play an important part in the dispersal of the mites from one body of freshwater to another as in the case of some other invertebrates.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CEYLON,
COLOMBO,
February 17, 1958.

C. H. FERNANDO

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18. ADDITIONS TO THE CRAB FAUNA OF BOMBAY STATE

(With two plates)

An account of the Brachyuran fauna of the Bombay coast was given in the previous issues of this journal (Chhapgar, 1957, *JBNHS* **54**: 399-439; 503-549). Collections of the crabs made subsequent to the publication of this report on 'The Marine Crabs (Decapoda: Brachyura) of Bombay State' revealed the occurrence of three new distributional records. A systematic description of these three forms is given below.

Tribe BRACHYGNATHA

Subtribe OXYRHYNCHA

Family *HYMENOSOMIDAE*

Genus **Elamena** Milne-Edwards

Elamena sindensis Alcock

Elamena sindensis, Alcock, *Journ. As. Soc. Bengal* **69**, p. 386 (1900).
Kemp, *Rec. Ind. Mus.* **13**, p. 274 (1917).
Tesch, *Siboga Exped. Rep.* **39** c, p. 24 (1918).
Chopra and Das, *Rec. Ind. Mus.* **32**, pp. 424, 425 (1930).

Four females from Okha are in the present collection. The largest measures:

length of carapace	..	5.00 mm.
breadth of carapace	..	4.75 mm.

This species can be distinguished by the pyriform carapace with upturned edges, and the triangular front. The tips of the dactyli of the walking legs are triunguiculate.

This species has been previously recorded from Karachi and the Persian Gulf. This is the first record from Bombay State.

Family *MAIIDAE*

Subfamily INACHINAE

Genus **Achaeus** Leach

Achaeus lacertosus Stimpson

(Plate I)

Achaeus lacertosus, Haswell, *Catalogue Austr. Crust.*, p. 3 (1882).
Henderson, *Trans. Linn. Soc. London* (Zool.), p. 341 (1893)
Alcock, *Journ. As. Soc. Bengal* **69**, p. 172 (1895).
Barnard, *Ann. S. Afr. Mus.* **38**, p. 19 (1950).
Pillai, *Bull. Central Inst. Travancore* **2**, (1951).

Two female specimens were collected at Bombay, clinging to colonies of *Gorgonium*. The larger one measures:

length of carapace	..	7.25 mm.
breadth of carapace	..	6.25 mm.
length of rostrum	..	0.60 mm.
length of first walking leg	..	21.80 mm.

This species is distinguished by the smooth, triangular carapace with inflated branchial regions. The rostrum is short and bifid. The eyestalks are straight, and have no tubercle on their front margin. The walking legs are very long and slender, the first pair being more than three times the length of the carapace. The dactyli of the last two pairs are very strongly falcate (semicircular), and their inner margins bear recurved spines.

The specimens were heavily encrusted with algae and hydroid colonies, which necessitated cleaning in dilute sodium hypochlorite before the structure of the carapace and legs could be made out.

This species has been previously recorded from the Andamans, Palk Straits, Orissa, and Travancore, also from Australia, Persian Gulf, and South Africa. This is its first record from the Bombay coast.

Family *OCYPODIDAE*

Subfamily OCYPODINAE

Genus **Gelasimus** Latreille

Gelasimus inversus sindensis Alcock

(Plate II)

Gelasimus inversus sindensis, Alcock, *Journ. As. Soc. Bengal* **69**. p. 356 (1900).
Gelasimus inversus, Barnard, *Ann. S. Afr. Mus.* **38**, pp. 94, 95 (1950).

Numerous specimens, of both sexes, were collected at Umarsadi. The measurements of an average sized male are:—

length of carapace	..	10 mm.
breadth of carapace	..	16 mm.
breadth of front	..	3 mm.
length of larger hand	..	23 mm.

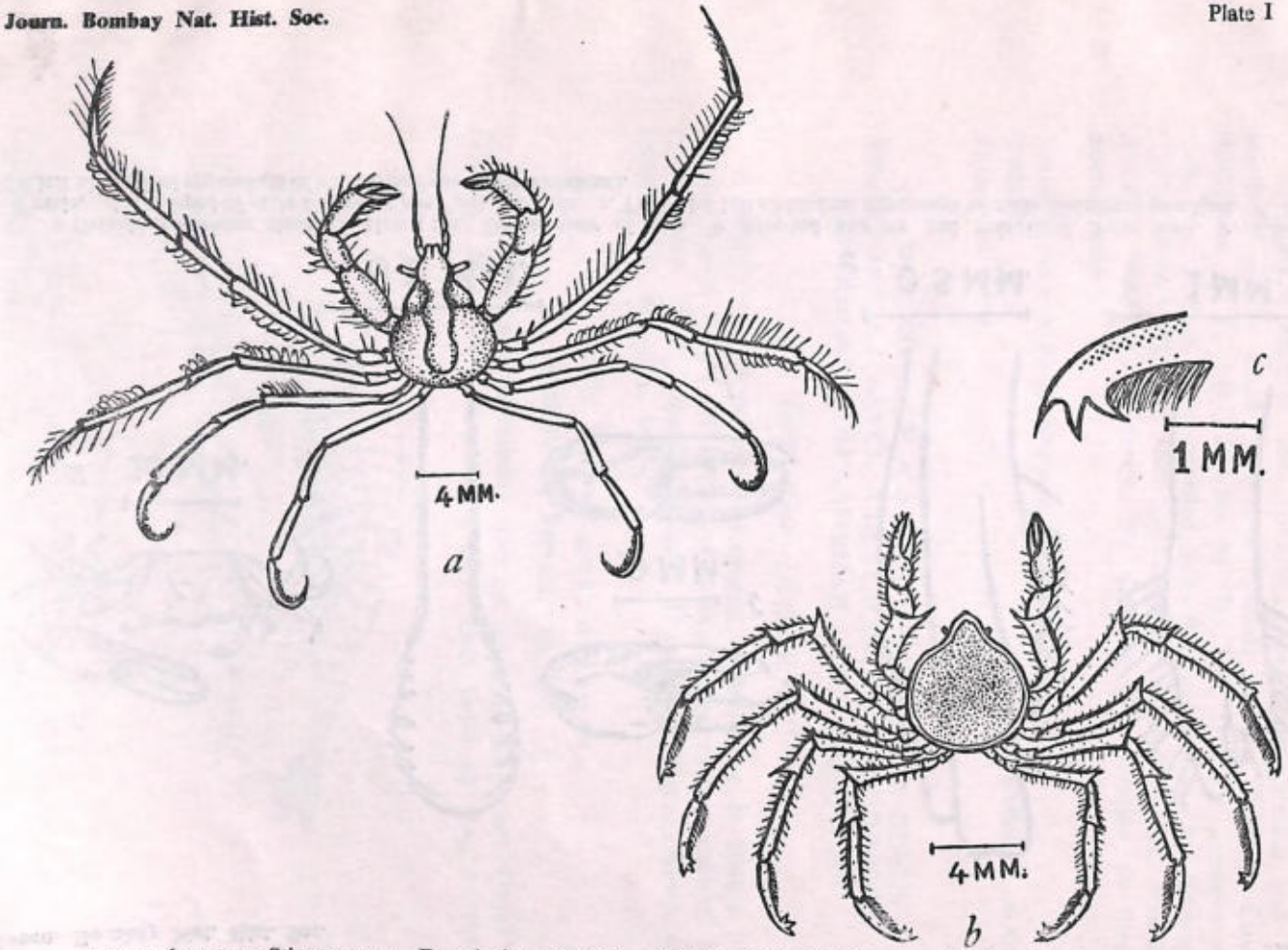
This subspecies closely resembles *Gelasimus annulipes* Latreille, but can be distinguished from the latter by the nature of the larger male cheliped. The arm of the chelipeds in *G. inversus sindensis* is trigonal with sharp edges, the upper edge rising into a distinct lobe or crest, and the distal end of the inner edge also forming a crest or blunt tooth. The upper border of the palm bears several longitudinal rows of granules. There is only one oblique granular ridge on the inner surface of the palm, running along the dentary edge of the thumb. The crest continuous with the lower border of the thumb present in *G. annulipes* is absent. The thumb is straight and has a simple tip.

Colour is similar to that of *Gelasimus annulipes*. The middle of the outer surface of the palm of the larger cheliped in the male has, however, a rosy tinge.

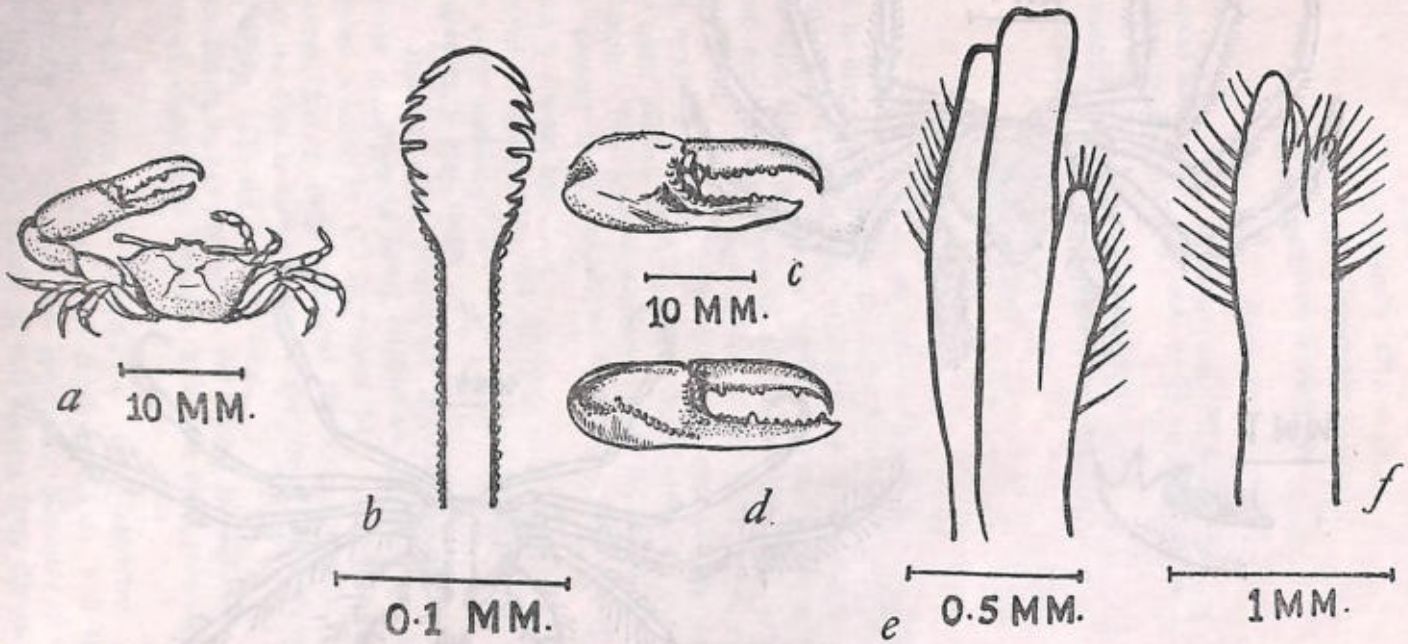
The anterior male abdominal appendages resemble those of *Gelasimus annulipes* in being bilobed at the tip. The larger of the two lobes which, in *G. annulipes* has a truncate-tipped bilobed appearance, has a single rounded tip with a groove. The smaller lobe on the side is situated nearer the tip of the appendage than in *G. annulipes*. The tip is more hairy.

Spooned hairs are present on the second maxillipeds. The 'spoon' consists of about eight rounded lobes on each side, continuing into hairs.

Barnard gives the distribution of *Gelasimus inversus* as Madagascar, South Africa, east coast of Africa, and the Red Sea, and Alcock has recorded the subspecies *sindensis* from Karachi. Hence this is the first record of this species from the Bombay Coast.



Achaeus lacertosus Stimpson : *a*. Dorsal view of crab. *Elamena sindensis* Alcock : *b*. Dorsal view of crab. *c*. Tip of walking leg, enlarged.



Gelasimus inversus sindensis Alcock : *a*. Dorsal view of crab. *b*. Spooned hair on 2nd maxilliped, front view. *c*. Cheliped of male. *d*. Cheliped of male *Gelasimus annulipes* Latreille. *e*. Tip of 1st left abdominal appendage of male *Gelasimus annulipes*. *f*. Tip of 1st left abdominal appendage of male *Gelasimus inversus sindensis*.

CORRECTION

My earlier remarks that *Gelasimus annulipes* Latreille and *G. marionis nitidus* Dana were new records for the Bombay Coast [Chhapgar, B. F., 1957, *JBNHS* **54** (3): 509; 510] are incorrect as these have already been recorded from Bandra, Bombay by Altevogt [1955, *JBNHS* **52** (4): 702-716]. I am thankful to Dr. Rudolf Altevogt, Münster University, for drawing my attention to these discrepancies.

TARAPOREVALA MARINE BIOLOGICAL STATION,
BOMBAY, B. F. CHHAPGAR, M.SC.
August 16, 1958.

19. DIAGNOSIS OF A NEW SPECIES OF THE GENUS *BRANCHINELLA* SAYCE (CRUSTACEA : BRANCHIOPODA : ANOSTRACA) FROM SAMBHAR LAKE, RAJASTHAN*

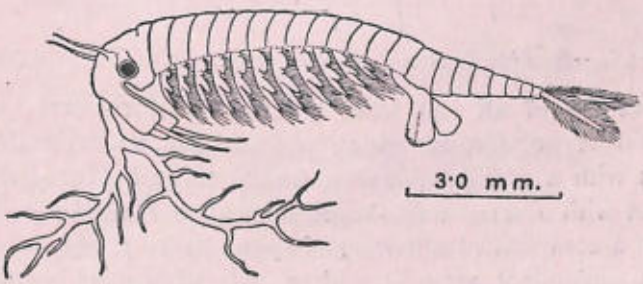
(*With three text-figures*)

A collection of branchiopod crustacea, made by Dr. B. Biswas of the Zoological Survey of India during November 1956, contained a new species of the anostracan genus *Branchinella* Sayce, which is being briefly described below.

Family THAMNOCEPHALIDAE

Branchinella biswasi,[1] sp. nov.

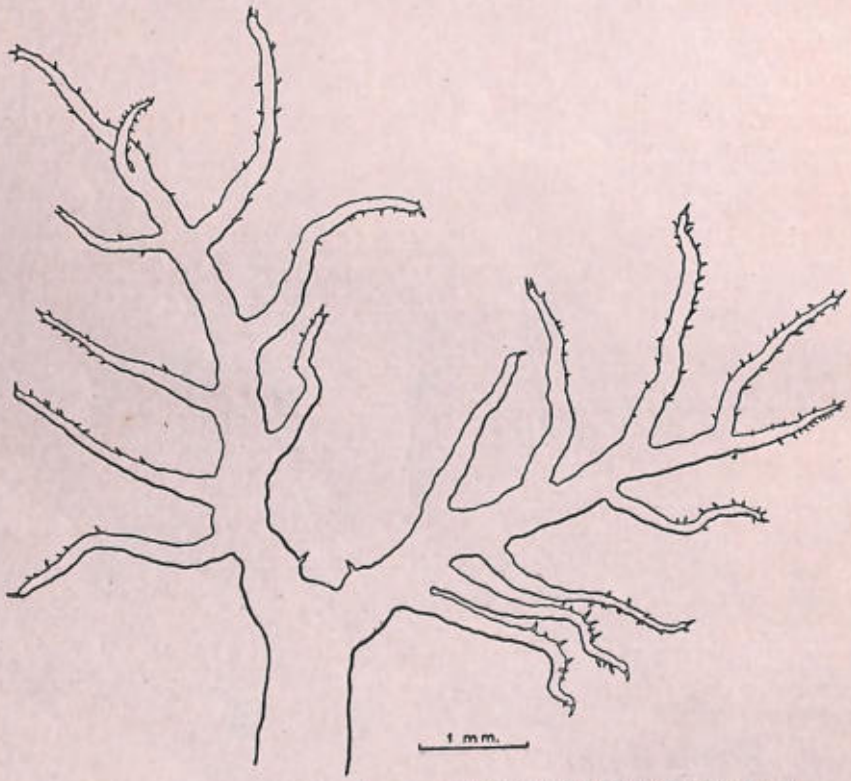
Male.—Generally resembling that of *Branchinella ornata* Daday[2] (Text-fig. 1). Frontal appendage more than twice as long as the



Text-fig. 1.—*Branchinella biswasi* sp. nov. ♂

* Published with the permission of the Director, Zoological Survey of India.
[1] Named after Dr. B. Biswas who collected the specimens.
[2] Daday de Dees, E., (1910) : *Ann. Sci. Nat.* (9) **11** : 91-489.

second antenna, extending as far as the end of trunk when stretched back. Basal part, about a fifth as long as the entire appendage, thick and flabby; distal four-fifths bifurcated, each bifurcation with 4-6 secondary branches, irregularly arranged on each side; each secondary branch with scattered spinules more profuse towards the apex; apex tipped with 1, 2, or 3 spinules (Text-fig. 2).



Text-fig. 2.—*Branchinella biswasi*, sp. nov. Distal part of frontal appendage.

Endites 3-5 of all legs with 2, 2, 1, anterior setae respectively, praeepidodites non-serrate, entire, without any notch in the middle.

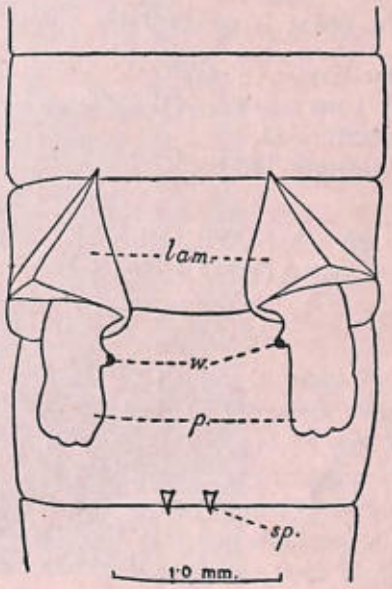
Penes with a triangular lamina frontal to each (Text-fig. 3, *lam.*); basal part with a small wart-shaped appendage (Text-fig. 3, *w.*), distal part with a complicated armature of spines as in *B. ornata.*

Third abdominal segment with a pair of median ventral spines on its posterior margin (Text-fig. 3, *sp.*).

All other characters as in *B. ornata.*

Female.—Resembling male. Second antenna with a rounded apex without an acute point. Ovisacs large extending back up to the middle

or end of the sixth abdominal segment. No median ventral spines on the posterior margin of the third abdominal segment.



Text-fig. 3.—Ventral view of abdomen of male of *B. biswasi: lam.* triangular lamina frontal to penes ; *p.* Penes (Not fully everted, so the distal part with armature of spines not visible.) ; *sp.* Ventro-median spines on the third abdominal segment ; *w.* Wart-shaped appendage on the basal part of the penis.

Size.—Males 6.5 to 18.7 mm. in length. Females measuring 8.0 mm. to 25.5 mm.

Types—Holotype: ♂ (12.0 mm.), Regd. No. C3652/1, Zoological Survey of India.

Paratypes: 30 ♂♂ (6.5 to 18.7 mm.), 34 ♀♀ (8.0 mm.-25.5 mm.) Regd. No. C3653/1, Zoological Survey of India.

Type-locality.—Sambhar Lake at Nawa, Nagaur Distr., Rajasthan. Coll. Dr. B. Biswas, 16 Nov. 1957.

Remarks.—B. biswasi closely resembles *B. ornata* Daday recorded by Daday[2] (p. 269) from Kalahari in Bechuanaland and by Barnard[3] (p. 201) from Potchefstroom in Transvaal, both from south Africa. The important differences are presence in *B. biswasi* of a wart-shaped appendage on the basal part of penes, a pair of median-ventral spines on the posterior edge of the third abdominal segment, and the absence of a notch on the praeepipodites of legs.

---

[3] Barnard, K. H. (1929) : *Ann, S. Afr. Mus.* **29** : 181-272.

This is the second species of *Branchinella* from India, the other being *B. kugenumaensis* Ishikawa recorded by Linder[4] from Madras and *B. kugenumaensis* var. *madurae* Sanjeeva Raj[5] from Madura. The genus is now for the first time recorded from north India.

ZOOLOGICAL SURVEY OF INDIA,
34, CHITTARANJAN AVENUE, K. K. TIWARI
CALCUTTA-12,
September 18, 1958.

20. A NOTE ON VERY HEAVY FOULING OF COPPER SHEATHED HULLS OF NAVAL CRAFT AT BOMBAY

(*With a plate*)

Copper sheathing of ships' hulls has been considered to be the most successful method for prevention of marine fouling and attack of marine borers (1). The use of such protective sheathings has lost its popularity only with the development of suitable anti-fouling paints. However, even now copper sheet coverings are used to protect wooden hulls and also for other special reasons. Some of the Indian Naval craft with wooden hulls have their underwater portions covered with copper sheets and during dry-docking of such vessels at Bombay, it has been observed that generally the plates remain unfouled or lightly fouled with the worms (*Hydroides norvegica* Gunnerus). However, during the first quarter of 1958 a few of the craft, when dry-docked, were found to have been very heavily fouled. This was an unusual observation and the present account is based on data collected from three such vessels.

OBSERVATIONS

The fouling observed on the copper-sheathed hulls was found to be uniformly heavy at all regions of the hull and also at all depths, beginning from the portion just below the boot-top area. A significant feature was that the fouling was mostly due to different species of Bryozoans. A porton of the hull above the bilge-keel of one of the boats is shown in Fig. 1, which gives a clear idea of the intensity of fouling observed. Representative collections of the fouling were made and the organisms present were identified as follows:

Crisia eburnea Linnaeus: Colonies of this erect polyzoan were found in large numbers and the bunches had grown to a maximum

[4] Linder, F. (1941): *Zool Bidrag Uppsala*, **20**: 101-202, pl. i.
[5] Sanjeeva Raj, P. J. (1951): *Curr. Sci.* **20**: 334.

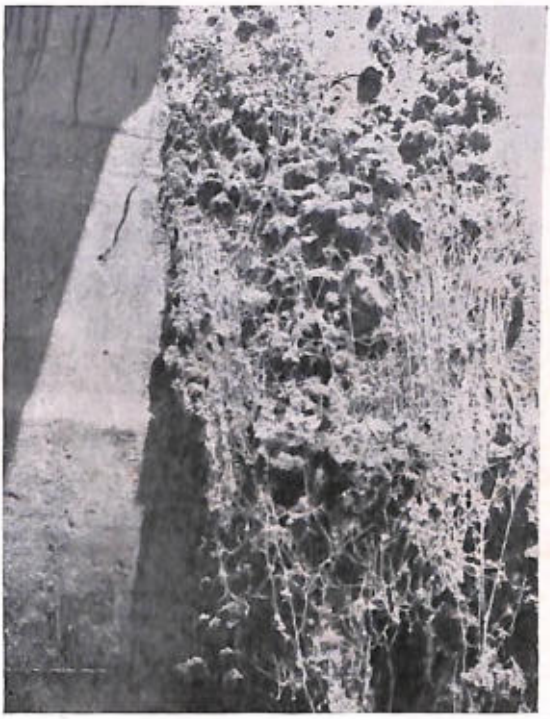


Fig. 1. Fouling of copper sheathing above the bilge-keel. (Portion on the left has been scraped, exposing copper plates.)

Fig. 2. Barnacle fouling on copper sheathing.

height of about 4 cm. These organisms were responsible for about 60% of the fouling settlement.

Zoobotryon sp.: These polyzoan colonies also were present in large numbers and comprised about 20% of the total fouling. The 'ropes' of the organisms are easily distinguishable in the photograph (Fig. 1).

Membranipora tenuis Desor.: This encrusting polyzoan was responsible for about 10% of the fouling. The colonies had grown to a maximum diameter of 3 cm.

The rest of the fouling present on the hulls was mostly due to tube worms of the species *Hydroides norvegica* and also a few barnacles of the species *Balanus amphitrite*. Free living animals like amphipods, small gastropods, etc. found among the polyzoan colonies have not been taken into consideration for this account.

One of the craft examined had a moderate settlement of barnacles (*Balanus amphitrite variegatus* Darwin and *Balanus amphitrite communis* Darwin) just below the boot-top area on one particular region (Fig. 2). This was the only occasion when barnacles have been found in significant numbers on the copper plates. No special reasons could be deduced for this occurrence.

The copper sheets had been fixed to the wooden hulls with copper nails and no contact with iron or zinc structures were noticed. Such contacts with other metals have at certain times been found responsible for fouling of copper (1). The heavy fouling observed in the present instance was not at all localised, but was, on the other hand, uniformly heavy throughout the under-water portions of the hulls. From the growth of the organisms concerned, it could be ascertained that the settlement had occurred within a period of three to four months. This particular season was a period of very heavy polyzoan fouling in Bombay waters, unlike previous years (2), as could be noticed from an analysis of data obtained from the examination of other ships and non-toxic panels exposed from a floating raft. It will also be of interest to mention that among the polyzoans thus collected during the period the most prevalent were colonies of *Crisia eburnea*.

Remarks

From the observations described above, it appears that the extraordinary abundance of polyzoans in the Bombay waters during the period November-February 1957-58, was responsible for the heavy fouling of the copper sheathing which apparently had remained un-

fouled till that time. Fouling depends on the toxicity of the surface, sensitivity of the organisms concerned to the poison, and the seasonal abundance of the settling stages (1, 3). The polyzoan fouling described above could not be attributed to any decrease in the toxicity of the copper plates, or to any galvanic action. Further, these polyzoans had never been observed to settle on copper sheathing during previous seasons. The accumulation of corrosion products on copper has been quite usual and such plates, during earlier observations, had remained either unfouled or lightly fouled with tube worms only, after varying periods of service. Since the polyzoan fouling described above had occurred within a period of three to four months, and the sheathing had remained unfouled till that time, it is probable that biological factors like prolificity, gregariousness, etc., must have been the cause for the unusual phenomenon. It may be mentioned here that little only is known regarding the fundamental aspects of the action of copper on living organisms (4), and hence further investigations in this direction will be of value. The observations recorded above are of importance in the testing of antifouling surfaces also, because it is evident that during trials proper attention has always to be given to the biological peculiarities of the period. In order to collect further data regarding fouling of copper in tropical waters, the Laboratory has started a series of experiments with panels exposed on the floating raft.

Our thanks are due to Shri P. I. Thampy for his kind help in the identification of polyzoans.

NAVAL CHEMICAL & METALLURGICAL LABORATORY, NAVAL DOCKYARD, BOMBAY,
July 17, 1958.

V. GOPALAKRISHNAN
V. V. KELKAR

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1. Marine Fouling and its Prevention. United States Naval Institute, 1952.
2. Ranga Iyengar, S., Gopalakrishnan V. and Kelkar, V. V. (1957) : Studies on Marine Fouling Organisms in Bombay Harbour. *Defence Science Journal*, **7**, (4).
3. Pyefinch, K. A. (1948) : Biological Aspects of the Fouling Problem. *Journal of the Oil and Colour Chemists' Association* **31**, No. 341.
4. — — — (1950) : Studies on Marine Fouling Organisms. *Journal of Iron and Steel Institute.*

21. A NOTE ON A SPECIES OF *CISSUS*

(With five figures)

While investigating the origin and development of the tendril in *Cissus* I came across in Gujarat a species of *Cissus* resembling *C. quadrangularis*, but the specimen could not be compared with the reported species in Cooke's FLORA OF BOMBAY PRESIDENCY. It was identified as *C. quadrangularis* Linn. by Kew and *C. quadrangularis* (L.) Willd. by Indian Botanic Garden, Calcutta. Rev. Father H. Santapau informed me (11th Feb. 1956) that the specimen 'is near *C. quadrangularis* but it is not this species'. Recently I came across the same species growing in south India and the typical *C. quadrangularis* with its quadrangular stem was also found. When the specimens were again referred to Kew, the Director kindly informed me that Dalzell in 1857 pointed out that the plant called *C. quadrangularis* by Roxburgh, Wight, and Arnott appeared to be different from a similar plant found throughout Gujarat. The Gujarat plant has unwinged stems, ovoid fruits, trilobed or unlobed leaves, and tuberous roots, whereas the plant described by Roxburgh and others from Madras has winged stems, smaller globose fruits, unlobed leaves, and fibrous roots. I have observed both the types of plants in Gujarat and south India. I have also noted some anatomical differences between the two specimens. On the basis of my few observations Rev. Father H. Santapau recently (Nov. 18th, 1957) confirmed that 'it is clear that there are two species of *Cissus*':

1. *Cissus quadrangularis* Linn., identified by Dalzell as the plant of Gujarat, with rounded stem, etc.
2. *Cissus edulis* Dalz. the plant of south India, with square stems; the plant of Gujarat with square stems is the same as that of south India.

But I agree with Father H. Santapau that there is still need of more observations. I shall be grateful if the readers of this journal will kindly send me flowering and fruiting material of both the species.

I am grateful to Rev. Father Santapau, for kindly going through this note and helping me in identification. My thanks are due to the Director, Kew Gardens for help, Professor T. C. N. Singh, Professor and Head of the Department of Botany, for his interest and facilities, and to my students Shri T. Govindrajulu and S. Krishnan for the diagrams.

DEPT. OF BOTANY,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR (S. INDIA),
July 9, 1958.

J. J. SHAH

22. SOME NOTES ON THE GENUS *MUSSAENDA* LINN.

Species of the genus *Mussaenda* are a common and conspicuous feature of the flora of the Western Ghats from near sea-level to over 6000 ft. Gamble, in the FLORA OF THE MADRAS PRESIDENCY, distinguishes four species characterised by the enlarged white or cream calyx lobe—*M. glabrata* Hutch., *M. laxa* Hutch., *M. frondosa* Linn., and *M. hirsutissima* Hutch. In the FLORA OF BRITISH INDIA, however, these are all included as varieties of *M. frondosa* Linn.

An opportunity to examine specimens from varying elevations readily presents itself on the western outlet from Munnar to Alwaye in the northern part of the Kottayam District of Kerala. This road drops from about 5000 ft. at Munnar to some 300 ft. at Neriyamangalam on the Periyar River in a distance of 35 miles. The country traversed by the road was formerly covered with dense forest but has been extensively cleared in the past twenty years and there are now only small relics of the original cover. Munnar itself lies in a dissected plateau almost completely surrounded by hills rising to 6000 to 8000 ft. Within this plateau *Mussaenda* is very common up to about 6000 ft. and all the numerous specimens examined fall into *M. hirsutissima* Hutch. On the other hand specimens examined at the foot of the ghat road all agree with *M. glabrata* Hutch. At intermediate elevations, specimens agreeing with *M. laxa* Hutch. have been collected at the lower levels and with *M. frondosa* Linn. at higher ones.

These four 'species' from a series characterised by increasing hairiness, increasing density of the inflorescence, and decreasing leaf size with increasing elevation. They could be suitably considered as members of an 'ecocline' rather than as distinct species but there is obviously room for closer investigation of this interesting and well marked group.

MUNNAR P. O.,
HIGH RANGE,
KERALA STATE,
SOUTH INDIA,
July 16, 1958.

W. WILSON MAYNE, B.SC., M.I. BIOL.

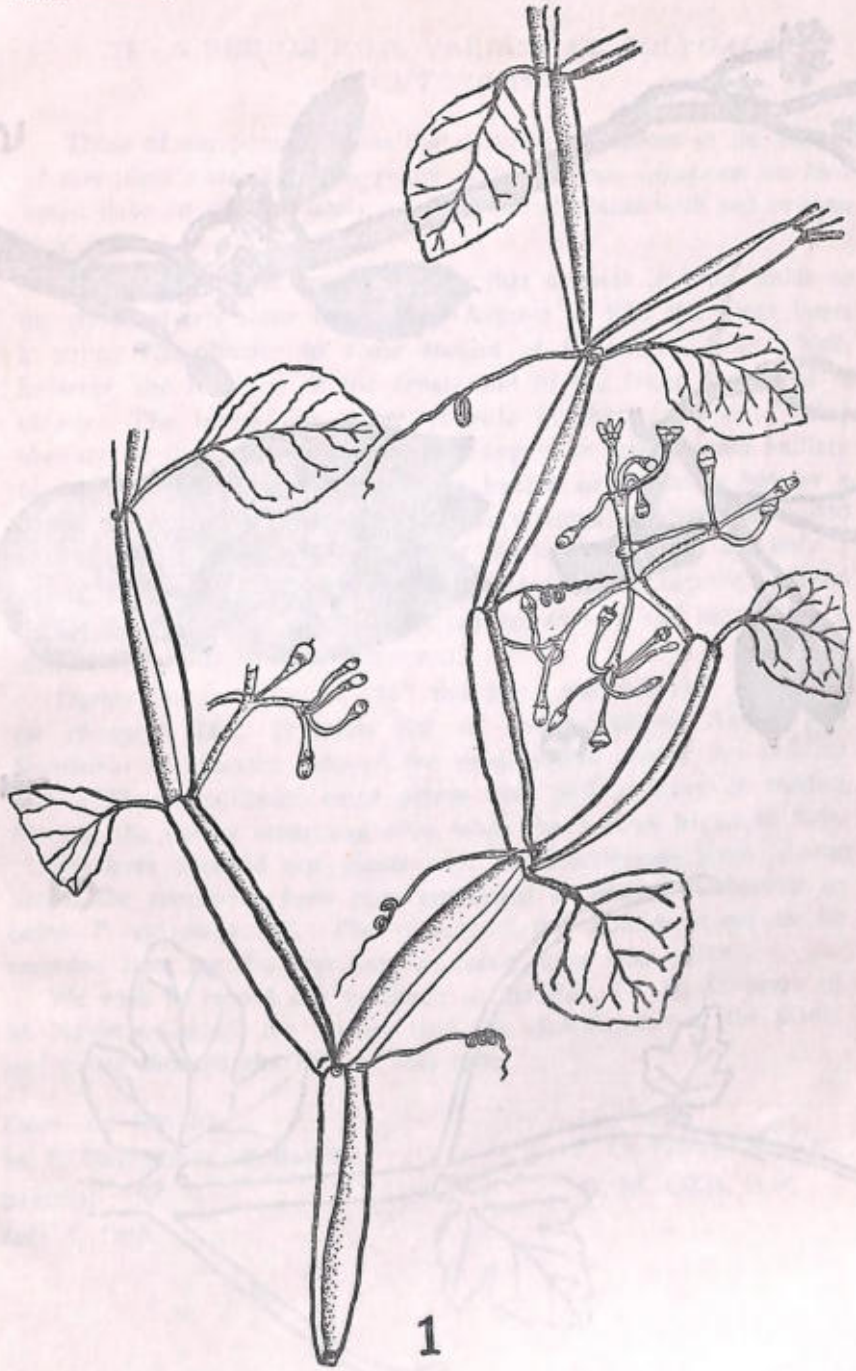


Fig. 1. *Cissus quadrangularis* from South Arcot District, Madras. Note the typical quadrangular and winged stem.

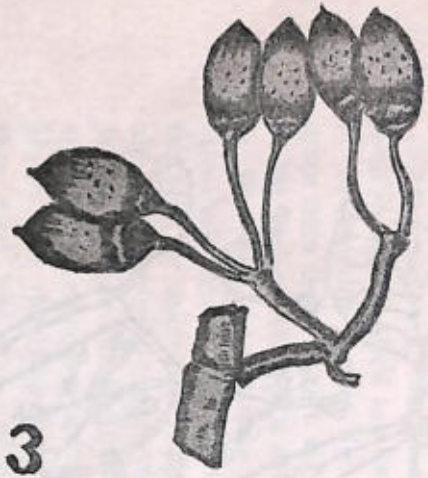


Fig. 2. *Cissus* species from Gujarat. Note the cylindrical stem. Fig. 3. Fruits of *Cissus* species from South Arcot District.
Fig. 4. L. S. flower of *Cissus* species. Fig. 5. Flowering material of *Cissus* species from South Arcot District.

23. A RED OR ROSE VARIANT OF *POLYGALA ERIOPTERA* DC.

Those of our popular floras that mention the colour of the flowers of this plant state that it is yellow; on numerous occasions we have noted it to be so; but lately we have found plants with red or rosy pink flowers.

This is an annual monsoon plant that appears in grass fields or on grassy slopes some time about August; at first the plant bears a strong resemblance to some species of *Crotalaria*, from which, however, the structure of the sepals and of the fruits distinguish it clearly. The leaves are rather variable in shape and size, being obovate, or linear, or elliptic; flowers appear in few-flowered axillary racemes. Sepals 5, of which two are hyaline or colourless but for a strong green midrib. The petals are very irregular, somewhat united at the base, forming a sheath round the stamens; there are only 3 petals. Stamens 8. The fruit is a 2-seeded pubescent capsule enclosed within the two larger sepals; the seeds are smooth and hairy, with a distinct strophiole at the anterior end.

During the monsoon of 1957 this plant was collected repeatedly on Pavagadh Hill, 29 miles NE. of Baroda; during August and September the flowers were of the usual yellow colour; on October 2nd, 1957, we collected some plants with pink or rosy or reddish flowers, the colour remaining even when the flowers began to fade.

We have checked our plants with the descriptions given in our floras; the specimens have been confirmed in Blatter Herbarium as being *P. erioptera* DC. The colour of this species seems to be recorded here for the first time as being other than yellow.

We wish to record our gratitude to the Rev. Fr. H. Santapau of St. Xavier's College for helping with the identification of the plants and going through the MS. of this note.

DEPT. OF BOTANY,
M. S. UNIVERSITY OF BARODA,
BARODA,
July 5, 1958.

V. G. PHATAK, D.SC.
G. M. OZA, M.SC.

24. *CRYPTOSTEGIA MADAGASCARIENSIS* BOJ.— A NEW RECORD FOR BOMBAY

(*With one plate*)

In our intensive field studies on the family Asclepiadaceae we have often come across a plant that for a time troubled us; it seemed to agree to some extent with the common *Cryptostegia grandiflora* R. Br., but there seemed to be too many differences that called for an explanation. We have finally identified our problem plant as *Cryptostegia madagascariensis* Boj., which has turned out to be a new record for Bombay or even possibly for India; we do not find any description of the plant in our common floras.

The two plants can be distinguished by the following key:

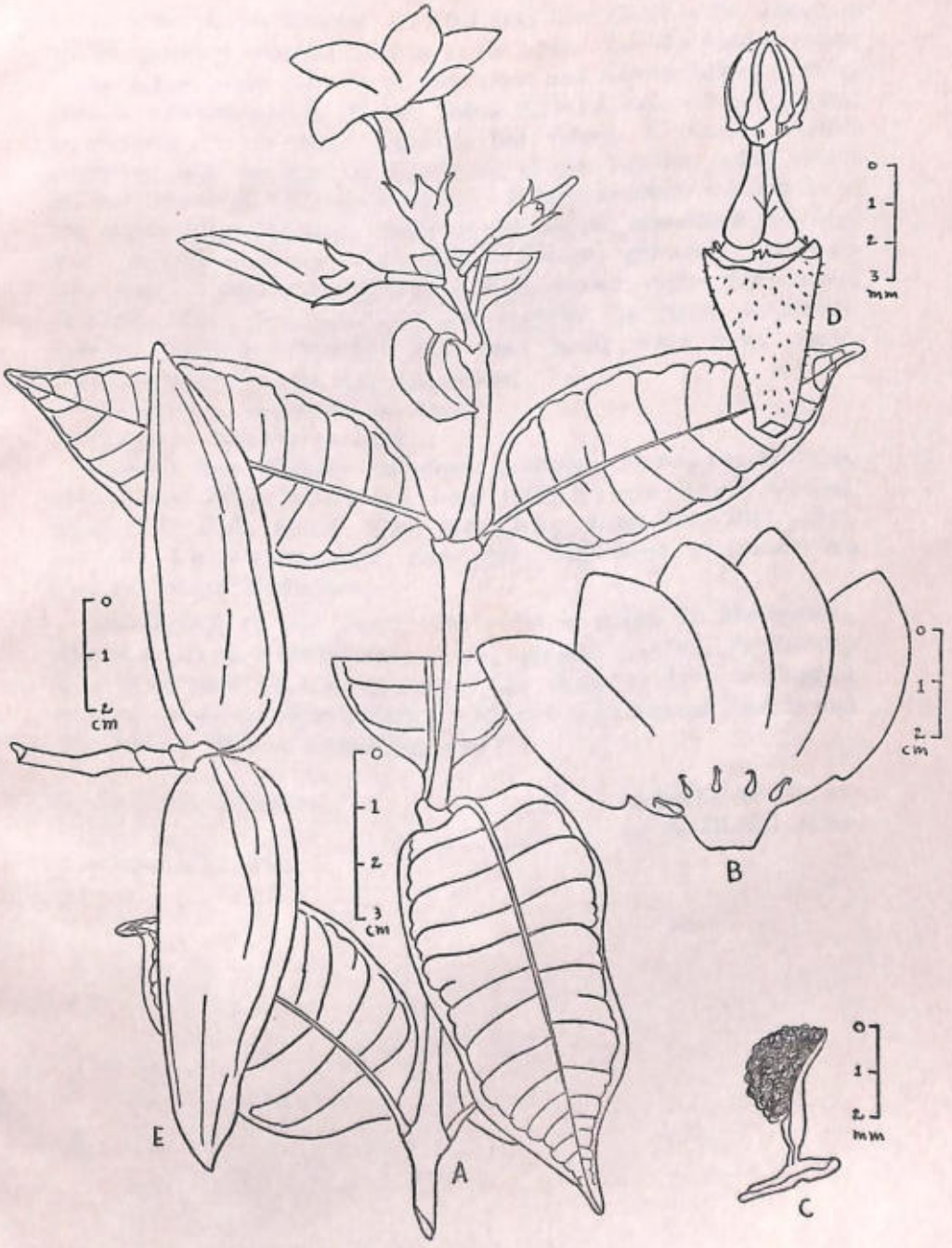
Corona lobes cleft into two long, filiform segments; each follicle up to 12 cm. long	... *C. grandiflora*
Corona lobes entire, subulate with incurved tips, each follicle up to 7 cm. long	... *C. madagascariensis*

In passing it may be remarked that *Cryptostegia*, *Hemidesmus*, and *Periploca* have hitherto been placed in the family Asclepiadaceae; Schumann, in Engler and Prantl's *Die Natürl. Pflanzenfam.* 1895, placed these genera under the subfamily Periplocoideae; A. Bullock, in *Kew Bull.* 1956, erected the family Periplocaceae for the group. In our opinion there is ample justification for this separation into a family.

We give herewith a description and some notes on our new record:

Cryptostegia madagascariensis Boj. Hort. Maurit. 212, 1837; Decne. in DC. Prodr. 8 : 492, 1844 ; Bot. Mag. t. 7984, 1904.

An erect, suberect, or climbing *shrub*, 1.5-2 m. high. Branches terete, swollen at the nodes, lenticelled and warted. *Leaves* opposite, decussate, exstipulate, petiolate, coriaceous, 3-4×1.5-2 cm., ovate or elliptic-oblong, shortly acuminate at the apex, subacute or rounded at the base, glabrous on both sides, dark green and glaucous above, paler beneath; lateral nerves 9-12 pairs, coming out at nearly right angles to the midnerve, and uniting into a clear intramarginal nerve; petioles 5-8 mm. long, compressed, glabrous, glandular in the axils. *Flowers* showy, white tinged with rose or purple, in few-flowered, terminal dichotomous cymes; peduncles 1.8-2 cm. long, compressed, glabrous, lenticelled; bracts 6×2 mm., caducous, linear, acute, puberulous; pedicels 1 cm. long, stout, terete, glabrous or nearly so.



Cryptostegia madagascariensis Boj.

A. Flowering branch; B. Dissected corolla showing corona; C. Pollen mass; D. Pistil; E. Fruit.

Calyx lobes deeply divided, 1.2×0.4 cm., lanceolate, acute, glandular within, glabrous outside, ciliolate at the apex. *Corolla* funnel-shaped, 6 cm. across when fully open; tube short and narrow below, opening into a subcampanulate throat; lobes 3.2×1.8 cm., oblong, acute, overlapping to the right, glabrous but velvety to touch. *Corona* corolline, near the base of the throat, of five subulate lobes, which are 6-7 mm. long, with incurved tips. *Filaments* short, subconnate at the base; anthers sagittate, adnate to the stigma; connective produced into apiculate-deflexed tips; pollen masses granular; translator lanceolate. *Ovaries* two, glabrous, many-ovuled; style short, stout, glabrous; style apex dome-shaped. *Follicles* in pairs, divaricate, woody, 3-angled, glabrous, 7×2 cm. Seeds 6×2 mm., ovate, glabrous; come 2.5 cm. long silky white.

Flowering: September to April.

Fruiting: January to April.

Records from Bombay examined: KONKAN: Bassein, *Santapau* 21204; *Irani* 2187; Andheri, *Irani* 1662; Santa Cruz, *Dhruna*, Sept. 1950; *Bole*, March 1950; Bombay, *Irani* 731, 1418, 1745. DECCAN: Shivajinagar, *Irani* 181. All these specimens are kept in Blatter Herbarium.

Distribution of this plant: The plant is native in Madagascar, whence it has been cultivated in tropical gardens generally; in Bombay it is often seen as a hedge plant, and seems to have established itself as an escape from gardens in Bombay and Salsette Islands and near Poona. It is a good hedge plant.

ST. XAVIER'S COLLEGE,
BOMBAY 1,
September 20, 1958.

H. SANTAPAU, S.J.
N. A. IRANI, M.SC.

Gleanings

Nature's anti-sepsis

The maggots of the bluebottle and some other flies are like the spider in that they can eat no solids. They too emit a fluid, which dissolves the meat and turns it into a putrefying liquid as they go along. In a recent book, I mentioned this fact and, impressed by the quick-acting potency of this fluid, idly suggested that, some time perhaps, a use might be found for it. This brought me a letter from a surgeon, part of which I will quote:

'. . . you refer to bluebottle grubs exuding a liquid which you think might have some use. You may like to hear of one use which I believe is now recognised.

'During the first World War I was surgical specialist at a Casualty Clearing Station which was posted first behind the salient and for the rest of the war on the Somme. We were usually five to ten miles back from the line and it often happened that we did not get the casualties for two or more days and the numbers were so great that some did not get attended for another day. The soil of the salient, and the Somme, was teeming with tetanus and gas gangrene organisms, and if wounds could not be excised and cleaned up soon after infliction the chances were that they rapidly developed gas gangrene, often with fatal results. Perhaps you have come across such conditions, but if not I may tell you that a gangrenous wound is most unpleasant both to nose and eye.

'We found that many wounds on arrival at the C.C.S. were swarming with maggots and we soon noticed that when the maggots were cleared away a red, healthy, granulating surface appeared where they had been and that the men were not so ill as one would have expected. We therefore took to exposing some of the wounds to the flies and got them fly-blown and the results were often good, but the question always arose as to whether one was justified in holding up operation while the flies did their job. The operation consisted of very complete excision of the wound and all infected tissues. Anyway there is no doubt that the maggots did a very good job and I believe the pathologists did some research into the subject later on, but I did not hear much more about it.'

Extract from John Crompton's LIFE OF THE SPIDER.

Rena fishing in the South Sea island of Raroia

Bengt Danielsson, a member of the famous Kon-Tiki expedition, who afterwards returned to the island of Raroia, gives an interesting account of *rena* fishing on the island in his book THE HAPPY ISLAND:

'We hurried down to the shore . . . Fifty yards from the land a white cloud of shrieking gulls hung over a big black patch in the water. It was clearly a gigantic shoal of fish. Despite the savage attacks of the birds the black patch gradually increased in size; in half an hour's time it was as large as a market-place. The time seemed to have come to start fishing, and Teka gave orders for preparations to be made. To our great astonishment the whole crowd dashed off at once, and in a little while we were alone with Teka. . . . We did not need to wait long before the first to go came back with large bunches of palm leaves under their arms. By degrees the rest of the villagers returned, and each of them carried at least five large palm leaves.

'Now you'll see how we make a *rena*,' said Teka, and slit a palm leaf in two along the central nerve. 'A *rena* is much better than a net for catching *komene*.'

'Then he laid one half on top of the other and took a new leaf. All round us all the Raroians were slitting palms leaves in two in the same way. In a little while the whole beach was covered with neat little piles, each of five half-leaves. The next stage of the work followed immediately. Our friends collected in small groups and began to fasten the bundles together with fibres and palm leaves. Then they joined the bundles lengthwise. As soon as a length reached about thirty feet a man caught hold of each end of it and began to wring it much as one wrings water out of a sheet. The natural consequence was that the lobes of the leaves pointed in all directions so that the length looked more like a garland, or a tinsel band on a Christmas tree, than anything else. When all the different groups had done this they began to splice the lengths together to make a single garland, which when completed was some 500 yards long. At last the fishing could begin!

'Two of the strongest men took hold of one end of the palm garland, and the rest of the Raroians placed themselves along it at equal intervals. We hastened to follow their example. We waded slowly and cautiously out into the shallow water and approached the shoal of fish. The garland of leaves closed slowly about its prey like a gigantic green snake. We had soon encircled the leaping mass of herring-like fish. The air was still full of shrieking, fluttering gulls, which followed us closely as we began to wade back to the beach. When we had got into water about four inches deep and had drawn the circle of leaves together to half its original size they reluctantly disappeared.

'A few yards from the beach we stopped. The fish were now packed so tightly that they could no longer move, and clearly nothing

remained to be done but to scoop them up. To make this work easier the women picked up palm leaves which had been left over and in a twinkling plaited together handly baskets, while many of the men took off their hats and used them as scoops. Half an hour later a long row of shining silver fish lay on the beach, and the distribution could begin . . . When they had at last finished we were able to take no fewer than twenty-one fish each!

'I need hardly add that all our friends ate up every single fish the same afternoon and next day were looking out hungrily for fresh shoals of *komene*. They did not need to look in vain, for there were plenty of them that day and the days that followed. My notes show that for over two months we made at least three *rena* expeditions a week, and each time the catch was between 1,000 and 3,000 *komene*.'
—Bengt Danielsson in THE HAPPY ISLAND—KON-TIKI ISLE.

Report on the Birth of a Wild Elephant

I was at the Kudasilawal lagoon about 8 a.m. one morning when nine elephants came out of the jungle into the open space around the lagoon. I climbed one of the rocks there and waited. One of the elephants, the cow which afterwards gave birth, went down on its knees and gently lay down on its side with its legs outstretched, remaining in that position for several minutes. The other eight elephants stood around her, caressing her all over her body with their trunks. The cow then rose to her feet, walked away a few paces, and lay down again as before. The other elephants, save one, went into the surrounding jungle; this one remained standing by the cow. More minutes passed and the cow then rose again, walked a few paces away and again lay down, and this time turned over to the opposite side, pivotting on her spine. It remained like this for about ten minutes and then rose once again, went a few paces and again lay down. This time it got up almost immediately after it lay down. As it rose, I noticed a pale, pink coloured bag about two feet in diameter, protruding out of its genitals. With the protruding bag in this position, the cow paced to and fro, apparently quite normally, for about ten minutes, and then the bag burst open and a watery fluid poured forth from it. Just at this time, the other elephant, which had remained with the cow throughout, strolled away and joined the rest of the herd which was all the time in the jungle close by. Several minutes after the water-bag burst open, the cow again lay down. It was now about 9 a.m. The cow lay still in her prone position, only moving and tossing her trunk around, but uttering no sound, not even a groan, for about half an hour. Her abdomen was rising and falling at

regular intervals and she appeared to be heaving. Two elephants from the herd in the jungle walked slowly up to the prostrate cow, felt her with their trunks in the region of the genitals, and then returned to the jungle.

Shortly afterwards, the cow stretched out her hind legs wide apart and without any noticeable signs of strain, the head and forelegs of the calf appeared. Immediately after, the cow rose to its feet and then again, in a few seconds, went down on its knees and lay down. Almost at once the calf was dropped and the cow immediately rose up and walked away for about ten paces. At this time the cow bled profusely from the genitals. Having gone this distance, the cow again lay down on its side and kept tossing and turning over from side to side. The calf lay on the ground where it was dropped and was wriggling about. It was covered all over with what appeared to be a slimy liquid. About fifteen minutes later, one of the elephants with the herd came up to the calf, raised it with its trunk about four feet clear off the ground, and then gently placed it back on the ground. This elephant then made a loud, rumbling noise, and all the other elephants in the herd came out of the jungle, trumpetting and making various noises, and approached the new born calf. Each one of them in turn moved the calf about with its trunk and feet and threw sand on the calf. This went on for about half an hour at the end of which the calf stood up, quite dry and steady on all fours. The calf, after rising, tried to suck milk from other elephants. Its mother, which continued to remain lying down and tossing about for several minutes longer, then dropped the afterbirth while lying on the ground. She rose immediately afterwards, picked up the afterbirth and ate a portion of it. She tore a part of it to pieces and flung it away and also trod on portions of it. The afterbirth appeared like a large sack in a portion of it, with elongations similar in appearance to the tentacles of an octopus. Some portions of the afterbirth were fleshy, while others were like lumps of 'nerves'. The whole was coloured purple in some parts, in others pinkish or reddish. The baby elephant did not appear to have a umbilical cord. It was about 2½ feet high and its little trunk was about twelve inches long. About 15 minutes after the cow dropped the afterbirth and did away with most of it, she walked up to the calf which was now in the midst of the herd. The cow, on reaching her calf, trumpetted, lifted the calf with her trunk and took it away from the other elephants. She then placed the calf on the ground. The calf was now trying to suck milk from its mother. The cow went down on her knees and rested her head on the ground. The calf then reached for the breasts and sucked off both breasts for a

considerable time. The cow then rose, picked up the calf in her trunk, poised it high up to her chin, and walked away in the centre of the accompanying herd into the jungle. I then came down from the top of the rock.

I found the ground where the cow was lying smeared with blood and a slimy fluid. I cut a piece from what was left of the crushed afterbirth. The portion I cut contained blood and appeared to consist of tubes, each about two inches in diameter and two feet long.

Game Guard W. L. A. Andris of Yala Range, Ceylon, in Administration Report of the Department for Wild Life, 1953.

[Three other eye-witness accounts of the birth of an elephant calf are published in previous volumes of the *Journal* (Tutein-Nolthenius, 1935, **38**:183; Morris, 1936, **38**:613; Vincent, 1946, **46**: 183) to which reference is invited.—EDS.]

CORRIGENDA

Vol. 54, No. 3, August 1957

p. 733, line 7 : For ' intermaxillary teeth ' please read ' intermaxillary plate '

line 9 : For ' intermaxillary place ' please read ' intermaxillary plate '

p. 735, line 7 : For ' Hegord ' please read ' Hefford '

lines 10 to 13 : For ' In addition .... *M. talabonoides*.' please substitute ' Pillay (1948) observed the species in commercial quantities in Kathiawar coast. Observations made on the numerous hauls taken by the trawlers along the Kathiawar coast showed occasional occurrence of this species, although the major portion of the eel catch comprised of *M. talabonoides*.'

p. 739, line 11 : For ' long line catches ' please read ' bag-net catches '

' References ', 1st line : For ' The Studies on the .... ' please read ' Studies on the .... '

Vol. 54, No. 4, December 1957

p. 971, lines 7 to 9 from bottom please read as : ' ranges from 6.5 to 8.5 showing that the soils are mostly alkaline in nature.'

p. 972 : In the table of ' Analysis of Soil Samples ' please read the last two columns as under :

pH	Remarks
7.5	Alkaline
7.0	Neutral
8.5	Alkaline
7.0	Neutral
7.0	,,
7.5	Alkaline
6.5	Acidic
7.5	Alkaline
7.0	Neutral
8.5	Alkaline
8.5	,,
8.0	,,

Vol. 55, No. 1, April 1958

p. 64, line 15 : For '*Chela* (*Allochella*) *fasciatus*' please read, '*Chela* (*Allochela*) *fasciata*'.

Vol. 55, No. 2, August 1958

p. 357, line 24 : For 'A FIELD GUIDE TO BIRDS OF BRITISH ISLES AND EUROPE by Guy-Mountfort and Roger Peterson', please read 'A FIELD GUIDE TO THE BIRDS OF BRITAIN AND EUROPE by R. Peterson, G. Mountfort, and P.A.D. Hollom'.

p. 373, line 6 : For the word 'atokous' please read 'epitokous'

p. 374, lines 7 and 8 : For '*Armandia Leptocirris*' please read '*Armandia leptocirris*'

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