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FIRST ANNUAL REPORT

ON THE

ZOOLOGICAL SURVEY OF INDIA

FOR THE YEAR

1916-1917.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1917

This Report may be bound as an Appendix to Vol. XIII of the "Records of the Indian Museum."

Report on the Zoological Survey of India for the year 1916-17.

INTRODUCTION.

THE Zoological Survey of India was inaugurated on July 1st, 1916. Its formal constitution and the immediate reasons for its recognition as an Imperial department are set forth in the Government resolution reprinted as Appendix A to this report. It is, however, in all essential features, a product of evolution and there are two facts that it would be unjust to forget :—

(1) That the Trustees of the Indian Museum put forward their proposals for its recognition in ignorance that Government had already under consideration the formation of a zoological department, and

(2) that the development which placed the Zoological Section of the Indian Museum in a position to claim recognition was due to the scientific work of a succession of naturalists, who had laboured in official obscurity for nearly a hundred years.

There is no duty more difficult to perform, and more seldom performed, by a public body than the graceful abdication of powers it cannot exercise. This the Trustees have done. There is no stronger evidence of the growth of scientific appreciation in India than the generous self-negation they have maintained in their recent attitude towards zoology.

The inauguration of the new department must, therefore, be regarded on the one hand as an official recognition of the practical value of pure zoology—a recognition all the more marked in that it was granted in war time—and on the other as an opportunity for the due development of the work set on foot by the Curators of the Asiatic Society of Bengal and the Superintendents of the Indian Museum. *Their* work—that of McClelland, Blyth, Anderson, Wood-Mason and Alcock—is briefly described in "The Indian Museum : 1814—1914." I propose here to give a still briefer account of my own stewardship as their successor.

Zoological Work in the Indian Museum : 1906—1916.

In the decade previous to the recognition of the Zoological Survey the most noteworthy advances in the zoological work of the

Indian Museum have been those connected with publications and with field-work.

At a much earlier date occasional monographs on sections of the Indian fauna were written by members of the staff and others and published by the Trustees, but these memoirs, though they maintained a high standard of excellence, failed, mainly owing to their sporadic appearance, to be accepted by the scientific world at large as the results of genuine Indian research. In the *Records* and the *Memoirs of the Indian Museum*, the issue of both of which began in 1907, we have now an organ universally recognized as emanating from India. Apart from all Imperial or departmental feeling, I do not think that any unprejudiced person acquainted with the state of scientific research in this country would deny that these journals have had a stimulating effect on Indian zoology. Their issue has not only resulted in the publication of Indian work in India, but has induced zoological research by proving that it could be done in the country, in spite of lack of scientific atmosphere and other chimæras formerly supposed to stand in its way. The research has been carried out not only in Calcutta, but in Lahore and Madras, in Bangalore, Agra and Allahabad. Twelve volumes of the *Records* and six of the *Memoirs* have now been published; they have contained 241 papers written in India, and 24 written by Indians.

No small share in the success of these publications is due to the artists now attached to the Zoological Survey, Babu S. C. Mondul, Babu A. C. Chowdhary and Babu D. N. Bagchi. Their work is in a sense well known to all students of the Oriental fauna, but of its very nature is apt to escape notice and to be credited rather to the authors of the papers than to its executants.

When I became Superintendent of the Indian Museum in 1906, touring, owing to the accumulation of work at headquarters and the numerical insufficiency of the staff, had become an obsolete practice. My first attempts to revive it were met by the question, Do officers of the British Museum go on tour? But, though I was the only permanent gazetted officer at the time, I was allowed to tour, at first almost surreptitiously and then openly. A notice of the inauguration of the Zoological Survey in "Nature" has, in my opinion justly, laid stress on its importance in relation to faunistic exploration. What we are now doing in this direction will be indicated in my account of the year's progress.

Minor lines in which progress has been made are the systematic exchange of specimens with museums throughout the world; the extension of the informal system by means of which we were able to obtain the assistance of specialists in different countries; the growth of the library; the fitting up of new laboratories, and the organization of popular lectures. Last but perhaps not least important of the ways in which we have advanced is the realization, forced upon us by the present war, of our own strength in zoological research and of the fact that we are able to go forward, slowly but none the less surely, with little assistance from abroad, Perhaps we have expended too much energy in the last few years in distributing collections abroad, greatly indebted as we have been to those who have assisted us by examining them. Our primary work must be done in India.

Other points might also be noticed in dealing with the progress of the department, especially the re-organization and increase of the staff, but this is rather the root of the tree of progress than its fruit. All that need be said is, that on the inauguration of the Survey, the staff, small as it was, was more than double what it had been ten years before. Without the whole-hearted assistance of its members gazetted and non-gazetted, no progress could have been made, for in a scientific department the director can only direct, not create.

Future Work of the Department.

The new department commenced its official career with a staff of four scientific officers. To any school-boy it must be clear that four men cannot conduct a real survey of the Indian Empire. In theory we should visit every district in India and Burma, investigate, and collect specimens of, its complete fauna, study the relationships of the different species and finally work out the collections at headquarters. In practice all we can do is to visit a few selected localities of limited area and there investigate the animal communities of some particular environment, or make collections of the species belonging to some particular group or groups. At headquarters we can only work out a very small proportion of the specimens we collect or obtain from other sources. The department had to be called a Survey because analogous departments in botany, geology, etc., are called Surveys. The term is appropriate in so far as it expresses the nature, but not the extent, of our work.

The lines of progress most likely to be profitable in the Zoological Survey can be laid down with greater precision than is usually the case in a new department, because it existed and developed as it were in embryo for many long years before it was officially brought to birth. Our primary function can hardly be to conduct either morphological or economic research. These are subjects rather for the colleges of India on the one hand and for the technical departments on the other. Our investigations must be those of pioneers preparing the road along which morphologists, biologists, economic entomologists, students of fisheries and others may travel in the future. We are far from contemning morphological or economic research, but we do not think that the time is ripe for us to devote our time to morphology; we realize the temptations that beset the man bound to provide practical results; we pray to be delivered from these temptations, and we are convinced that it is impossible to build a solid structure of practical results except on a sound basis of pure science.

For the present we propose to work mainly in two directions, firstly, in the revision of the Oriental species of certain groups of animals (such as Decapod Crustacea, Fish and Sponges) on which one or other of us can claim the knowledge of a specialist, and secondly, in the faunistic and biological study of fresh and brackish water in India and other Asiatic countries, more particularly in lakes and deltaic creeks. For the investigation of such creeks the estuarine tracts of India provide unique opportunities; so far as lakes are concerned, their very paucity renders them a fit object of investigation on the part of a staff so small.

In the resolution constituting the Zoological Survey the Director is formally appointed Zoological Adviser to the Government of India. It is, therefore, his duty to bring to the notice of Government any zoological problem that calls for investigation in this country. Perhaps, however (as experience has, indeed, already shown), his advisory functions can in most cases be exercised most efficaciously by direct and informal correspondence with officers engaged in research. Even when the questions submitted to him are outside the knowledge of the members of the Survey, as must be the case in the majority of instances, it is usually possible to obtain some light upon them from the correspondents of the department.

PROGRESS IN 1916-1917.

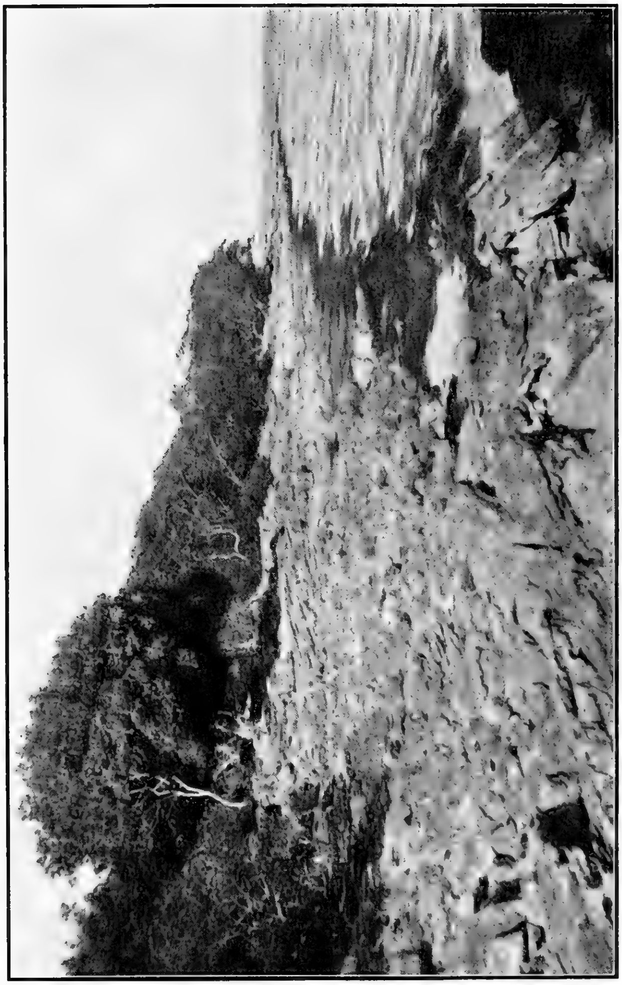
In dealing with the work of the first year, or rather the first eight months, of the Survey's official existence I propose to deal more particularly with the field-work carried out by officers of the department, the research conducted in its laboratories and the improvements in progress in the Museum galleries.

Touring and Field-work.

The following statement shows the tours undertaken:—

To Barkuda, Chilka Lake, from 14th to 23rd July, 1916 .	10 days.
To Portuguese India and N. Canara from 24th August to 19th October, 1916	57 ,,
To Bangalore and Madras from 1st to 12th October, 1916 .	12 ,,
To Allahabad, Agra, Delhi and Lahore from 17th to 30th November, 1916	14 ,,
To the Mutlah River from 6th to 17th December, 1916 .	12 ,,
To Mysore from 7th to 20th January, 1917	14 ,,
To Southern Shan States (Burma) from 8th February to 13th March, 1917	34 ,,
	153 ,,

The first of these tours, to the Chilka Lake, was undertaken with the object of studying the fauna of a small island (Plate A) lying about a mile off the mainland and surrounded by brackish



SHORE OF BARKUDA ISLAND, CHILKA LAKE.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

water. The stony soil of the island and a rainfall probably smaller than that of the neighbouring mainland and certainly never excessive do not encourage either a luxuriant growth of vegetation or the existence of a rich fauna, but the greater part of the island is covered with fairly dense jungle in which bushes and even large trees flourish in abundance. All these trees and shrubs have tough glossy leaves and a rather sombre foliage. The largest are figs of two species, the Banyan (*Ficus bengalensis*) and *Ficus rumphii;* the most abundant shrub is *Glycosmis pentaphila*, a common form in waste lands in many parts of India. True xerophytic plants also occur, for example Cacti (*Cereus* and *Opuntia*), which have probably been introduced accidently, and an indigenous tree-euphorbia (*Euphorbia nivula*).

An island in the Chilka Lake.

The fauna of the island is even less rich than that of the plains of India generally and many species that are abundant on the adjacent mainland are here very scarce or altogether absent. The only terrestrial mammals are the Chital, of which a small herd has been introduced by the owner of the island for sporting purposes, a large reddish mungoose, a form of the common black rat, which is fairly abundant round the bungalow, a mouse and a small shrew. There are no small birds in the woods and most of the larger species that occur are forms of very wide distribution. Among the land birds perhaps the commonest are the Indian house-crow and the jungle-crow. Both of these fly over from the mainland in large numbers every evening to roost on the island, and a few individuals of both also spend the day there when the fruit of the Banyan, to which they are very partial, is ripe. The common green pigeon is also abundant, and flocks of the grey hornbill are often to be seen or heard. Five species of lizards and four of snakes were found on the island. The most interesting specimen obtained was an unique example of a limbless snake-like lizard to which I have given the name *Barkudia insularis*. It was found burrowing in dry earth between the buttresses of a Banyan tree. Two of the snakes are small burrowing forms and only one, the common krait, which is very scarce, is poisonous. Only three species of land snails were seen. They form the subject of a paper by Lieutenant-Colonel H. H. Godwin Austen, F.R.S., shortly to be published in the *Records of the Indian Museum*. The most noteworthy features among the Arthropoda are the small number of species represented, the absence of large or conspicuous forms (except among the butterflies and dragonflies) and the large proportion of predaceous species.

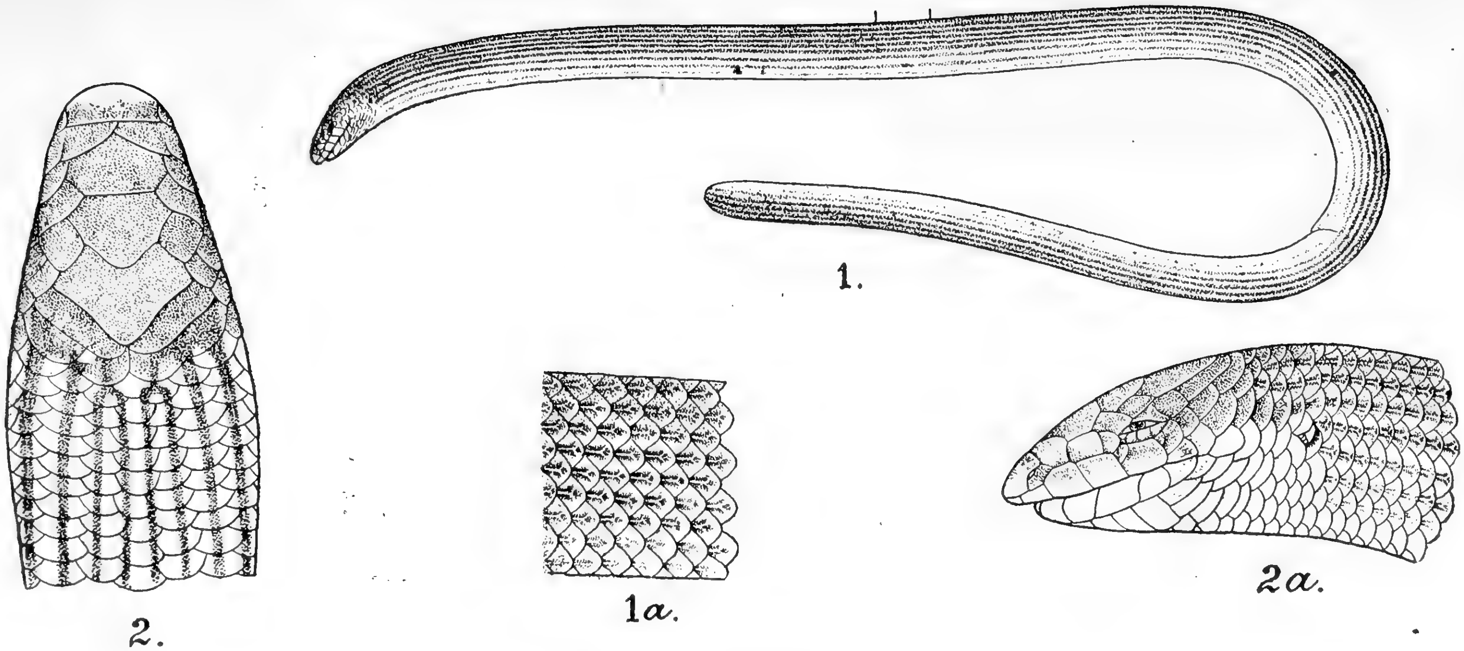
Perhaps the most interesting element in the fauna is that associated with the fig-trees and in particular with the Banyan. Apart from the species that feed on its fruit and leaves (which do not seem to be numerous), this element lives mostly either in dead wood or in the earth. The great horizontal branches of the tree are supported on vertical trunks that originate from them in the form of aerial roots, so reach the soil and then grow stout and trunk-like. These supports frequently rot away and then the branches fall in ruins on the ground. The fauna of their dead wood is comparatively poor, entirely lacking the Lamellicorn beetles found in dead wood in damper districts, but includes interesting beetles of the family Tenebrionidæ, and species of the orders Thysanura and Collembola, as well as a considerable number of wood-lice. The main trunks of the Banyan and also those of Rumphius' fig are strengthened at their base by stout buttresses that project in such a way as to form pockets or recesses filled with loose soil. In these pockets flourishes a fauna rich in burrowing forms, many of which are predaceous. It includes a number of trap-door spiders (Mygalomorphæ), several Myriapoda and the only terrestrial earthworm yet found on the island. It also includes the peculiar lizard referred to above and two (*Typhlops acutus* and *T. diardi*) of the four snakes found upon the islands.

Tour in Portuguese India and North Canara.

Of Mr. Kemp's tour in Portuguese India and North Canara it is difficult to give a brief summary, because large areas were covered and very rich and diverse faunas studied. Its main objects were two—to study the estuarine fauna of Goa, and to collect specimens of the animals of the dense evergreen jungles that lie inland, in British territory, in the same part of India. The Portuguese authorities treated Mr. Kemp with great courtesy and gave him much assistance in his work. In saying this I refer particularly to Captain Froilano de Melo, Director of the Bacteriological Laboratory, Instituto de Analises e Vacina, Nova Goa, and Captain F. de Vasconcellos, Port Officer at Mormagao. I also wish to express the thanks of the department to Mrs. Kemp for the great help she has given on this and many other occasions in the arranging and labelling of the collections obtained on tour. The main results of a zoological expedition that extends over more than a very limited area cannot be appreciated immediately. Its importance must depend rather on the material it provides for future study than on any immediate result of a precise nature. Generally speaking, Mr. Kemp's tour was of importance for two reasons:—(*a*) It provided material for the study of the brackish water fauna of Western India and for the comparison of this fauna with that of the deltaic tracts that abut on the Bay of Bengal, and (*b*) it supplied us with collections from the tropical jungles of a part of the country in the fauna of which the Indian Museum was poor. The collection of Decapod Crustacea was extremely rich, more particularly in crabs, while several new or interesting species are represented among the lizards and frogs; at least two snakes new to the collection of the Survey were also obtained.

Tours of inspection.

My own tour to Bangalore and Madras, which was undertaken during the Durga puja holidays, had as its main object the inspection of the Indian Institute of Science, to the Board of Visitors of which I was elected some years ago. It was also useful to me, so soon after the foundation of the new department, to be able to discuss matters with Sir



Barkudia insularis, gen. et sp. nov.

Fig. 1. —Lateral view of the type specimen (x 15).
,, 1*a*.—Lateral scales from near middle of body, further enlarged. The position of these scales is indicated in fig. 1 by two short vertical lines.
,, 2. —Head from above x 5.
,, 2*a*.—The same from right side.

Alfred Bourne, the Director of the Institute and probably the senior biologist now in the country. I took the opportunity to discuss Survey business with several other zoologists at Madras and Bangalore, and to collect certain common South Indian freshwater molluscs, crustacea and dragonflies of which fresh specimens were wanted in connection with work in progress either in the Survey's laboratories or at the hands of our correspondents abroad.

My tour to Allahabad, Agra, Delhi and Lahore was also mainly a tour of inspection. Its ultimate goal was the meeting of the Board of Scientific Advice at Delhi, but I was anxious to see the laboratories and libraries of the chief colleges of Northern India and to gain precise information as to the extent to which help might be expected in the work of the Survey. In every case offers of assistance were freely made.

The Mutlah River.

Our investigations in the Mutlah River, undertaken mainly by Mr. Kemp, had greater general interest. They were carried out in close co-operation with the Deputy Director of Fisheries, Bengal, whose department placed its fine steam launch, the 'Kitty,' at the disposal of the Zoological Survey. Mr. T. Southwell, the Deputy Director (now Director), also accompanied Mr. Kemp for several days.

The Mutlah River is one of the largest of the numerous waterways that traverse the Gangetic delta and is navigable for ships of large tonnage as far as Port Canning. It varies greatly in depth, but in the main channel there is nowhere less than 4½ fathoms at low spring tides; over considerable areas the water is 8 fathoms deep. The level of the water varies greatly according to tide; there is as a general rule a difference of about 10 feet between high and low tide. The water is nearly always laden with silt and doubtless shows great seasonal variation in salinity. It is never very salt.

The fauna of the river-bed appears to be very limited; but, though poor in species, it is abundant in individuals. The chief interest of this fauna is the extraordinary resemblance that the species bear to those inhabiting great depths in the sea. If any one with experience of both deep-sea and shallow-water faunas were to have made a casual inspection of the contents of the nets we hauled in the Mutlah River, he would probably have expressed the opinion that the catch came from deep water not less than 400 fathoms in depth. The similarity exists chiefly in three characters, in colouration, in the peculiar translucent and gelatinous appearance of certain fish and prawns, and in the production of long feeler-like processes or appendages; it is in most cases quite superficial. The reason for it will be discussed by Mr. Kemp in a paper that will shortly be published in the *Records of the Indian Museum*.

In addition to discovering this interesting phenomenon Mr. Kemp obtained a very valuable collection of Decapod Crustacea and other estuarine forms, some of which appear to be new to science while others are extremely scarce in collections.

Floating Island, Inlé Lake, S. Shan States.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

Dr. Chaudhuri visited Mysore primarily in order to attend the fourth meeting of the Indian Science Congress at Bangalore as representative of the Zoological Survey, but he also examined, so far as an outbreak of plague permitted him, the fish of certain large tanks in the neighbourhood of Seringapatam. A century ago the distinguished ichthyologist Buchanan-Hamilton obtained in these tanks several fish that had not been rediscovered. Dr. Chaudhuri made an interesting collection, which stress of other work has rendered it impossible for him to work out as yet. It contains several of the lost fish and also in all probability species new to science.

Visit to Mysore.

The last tour undertaken by the department in the financial year 1916-17, by Dr. F. H. Gravely and myself, went further afield than any other. Its object was to investigate the fauna of a lake on the Shan Plateau, the fauna of which is a remarkably isolated one. With the assistance of Mr. G. C. B. Stirling, C.I.E., Superintendent of the Southern Shan States, and Mr. C. E. Browne, I.S.O., Political Adviser in Yawnghwe, the Inlé Lake in that State was selected as being readily accessible and at the same time practically unknown from a zoological point of view; the only animals previously reported from it being a series of fish collected by the late Mr. E. W. Oates and described by Dr. G. A. Boulenger of the British Museum.

Inle Lake, Southern Shan States.

The lake is of great interest from a purely limnological point of view and seems to be the last survivor of a network of water-basins and small streams that occupied, at a period geologically by no means remote, a very considerable area on the Shan Plateau. It belongs to the type of lake that has been called "solution lakes," that is to say, its basin has been dissolved out of limestone by the action of water. Like most shallow lakes it seems to be gradually filling up. This is due both to the deposition of the silt brought down from surrounding hills by streams, and to the growth and decay of aquatic and marginal vegetation. Curious floating islands (Plate B) comparable on a small scale to the *sudd* of the Nile are constantly being formed round the edge by the latter agency. The lake is now about 14 miles long and nowhere more than 12 feet deep. Its soft muddy bottom bears a luxuriant growth of water-weeds and its water, which is strongly charged with lime, is remarkable for its glassy clearness.

The fauna has little relationship with any other yet known, but probably will be found to be similar in some respects to that of the upper Salween. Fortunately for the investigator who has limited time at his disposal, it is, like that of the Mutlah, rich in individuals, but poor in species. So far, only a preliminary examination has been possible, but this has already shown that the fish include representatives of a considerable number of new species and of three new genera. One of these is a minute eel, so different from any form hitherto described that it must be regarded as the type of a new family. It is distinguished from all other living eels at present known to science in the strong development of the bone and fin of the tail. This is one of several very curious little fish of extremely small size that have hitherto escaped the attention of ichthyologists. Most of them are remarkable not only in structure, but also for their brilliant colouration. Bright colouration, indeed, is characteristic of the fish-fauna of the lake as a whole and is probably correlated with the transparency of the water.

The molluscs of the Inlé Lake are hardly less remarkable than the fish. For some reason they have as a rule many of the characters of deep-water forms. A group of pond-snails is further interesting not only on account of the bizarre shape and bright colour of their shells, but also because of the fact that an almost complete series of transitional forms between them and almost normal forms was found in different parts of the lake, in smaller bodies of water and fossil in the surrounding country. When fully illustrated, this series should take its place among the most remarkable instances yet discovered of variation correlated with environment.

Ethnographical work in the Southern Shan States.

Our tour to the Inlé Lake was the only one in which we attempted anything of the nature of ethnographical research. There I obtained two collections of considerable interest, one illustrating the apparatus used in fishing—fish-spears, nets and traps; the other that employed in weighing agricultural produce and dried fish in the local markets. The fishing apparatus, though it includes some interesting types, is not very remarkable. So far as possible I collected a duplicate set of specimens for the new Imperial Museum which is to be built in Delhi some day, as well as a first set for the Indian Museum.

The weighing-beams, scales and weights have a greater general interest on account of their strange diversity and primitive character. Most weighing apparatus depends on the principle of leverage, but three main types of construction may usually be recognized among the contrivances of primitive people. They are (i) the scales, in which the object to be weighed is suspended from one end of a rigid beam and balanced against "weights" from the other; (ii) the steelyard, in which the object to be weighed is suspended from one end of a beam but balance is attained by shifting a single weight along the latter; and (iii) the weightless beam or *bismer*, in which there are no moveable or detachable weights, balance being attained by shifting the position relative to the centre of the beam of the point of suspension. All these types are to be found in use in the Inlé bazars, and also a fourth type (Plates C, D) resembling the *bismer* but with a moveable scale-pan instead of a moveable point of suspension. The *bismers* differ from those used in many parts of India (and also in the Scandinavian countries of Europe) in that they possess a series of fixed suspending strings instead of a loop that can be moved along a scale on the beam. This form is perhaps peculiar to those parts of Eastern Asia in which Tai (Shan or Siamese) influence exists; I have seen it myself among the Siamese

WEIGHING-BEAM WITH MOVEABLE SCALE-PAN. FORT STEDMAN.
S. SHAN STATES.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

WEIGHING-BEAM (PLATE C) IN USE IN FORT STEDMAN BAZAAR.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

of the north-eastern states of the Malay Peninsula. An account of the weighing apparatus will be published by the Asiatic Society of Bengal.

The value of the collection of fishing and weighing apparatus is greatly increased by the excellent photographs of it in use taken by Dr. Gravely in the course of our tour. He also secured other photographs of ethnographical interest, including a series illustrating the funeral cars of the daughter of a Shan chief, one of the operation of tatooing a boy's legs in an Intha monastery, and several illustrating the peculiar method of rowing adopted by the fishermen of the lake, who use their legs as well as their arms in the process.

At the personal request of Sir Harcourt Butler, Lieutenant-Governor of Burma, I submitted to him a note on the fisheries of the Inlé Lake, written of course mainly from a biological point of view but also discussing the dangers to which an under-staffed local fishery department is liable in India, with historical instances. This note has since been published by the Government of Burma.

In order that the interesting flora of the lake and its floating islands might be studied, Dr. H. G. Carter, Officiating Director of the Botanical Survey of India, was kind enough to arrange that a collector from his department should accompany us. The specimens he obtained are not only of botanical interest but greatly facilitate the study of the general biology of the lake. I am a believer in the co-operation in field-work of different biological departments, but the financial sections of the Civil Service Regulations throw great difficulty in the way of any such co-operation, in so far as they insist upon a rigid separation between the finances of the different Imperial Surveys. In the present instance difficulties of the kind were overcome by a special grant.

Field-work near Calcutta.

Our tours have not blinded us to the fact that much faunistic work still remains to be done in the immediate neighbourhood of Calcutta. We have probably not yet by any means exhausted the fauna of the Museum compound, but I will refer here only to two week-ends spent by Mr. Kemp and myself at the Royal Botanic Gardens at Sibpore. In a worm-eaten post on the shore of the River Hughli we found the first specimens of a new and interesting genus of crabs; we obtained other new and interesting crustacea from the river itself; and, perhaps strangest of all, we found on bricks at the edge specimens of a fresh-water polyzoon that one of us had just described from an out-of-the-way part of the Siamese Malay States. Considering the fact that the Hughli has been explored by naturalists for the last fifty years and that my two immediate predecessors made a special study of its crustacea, nothing could better illustrate our present ignorance of even the better-studied elements in the fauna of even well-explored parts of India.

Research.

(*a*) *Zoology.*

Taxonomic research.

Zoological research undertaken in the laboratories of the Indian Museum is mainly of two sorts—taxonomic and faunistic. In both branches the work is also geographical, and indeed it is impossible to draw a definite dividing line. The taxonomic side of our investigations consists chiefly in the classification of certain parts of the vast collections that have accumulated, and are now accumulating much more rapidly than heretofore, in the store-rooms of the Museum. So far as possible, all collections are sorted out on their receipt into the main groups represented. There are definite places for unnamed specimens of each of the principal orders of the animal kingdom. Each officer has always some particular order or family in hand. As soon as the accumulated material permits, he sets to work to revise the Indian (or in some cases the Oriental) species of the group at which he is working, and finally produces either a short paper or a more lengthy monograph as the result of his research. In this way, in the first year of the Survey's official existence, Dr. Gravely has been working at the beetles of the family Passalidæ, Mr. Kemp at certain families and genera of the Indo-Pacific Decapod Crustacea, Dr. Chaudhuri at the freshwater fish of various parts of Asia and I myself at the Indian tortoises. Mr. E. Brunetti, though not a member of the staff, has also worked at the Oriental Diptera, while Mr. C. A. Paiva, Special Entomological Assistant, has begun to study the water-bugs. In the work of the scientific officers it is a recognized principle that the study of the geographical distribution of species cannot be divorced from that of their taxonomic position. It is only when this principle is recognized that taxonomy can be legitimately regarded as survey work. So far as may be, also, we feel bound, with the special opportunities for investigation we enjoy in a tropical country, to consider the biology of animals in reference to their systematic position. The great drawback to all purely systematic work undertaken by zoologists who are not acquainted with the living fauna is that they are almost bound to ignore the question of adaptation to environment.

Faunistic research.

Our faunistic differs in degree rather than in kind from our taxonomic work. It exists at present mainly in the study of the fauna of certain lakes and estuaries in relation to geography and biology and in particular to the correlation between environment, general physiology and form. In the year 1914 Mr. Kemp and I, occasionally with the assistance of Dr. Chaudhuri and Dr. Gravely, made very large collections and extensive observations on the fauna of the Chilka Lake in Orissa and the Ganjam District of Madras. Previously, in 1912, I had studied while on leave the fauna of the Lake of Tiberias in Palestine, while more recently, in 1915 and 1916, I investigated that of three large lakes in different parts of Eastern Asia, namely, Lake Biwa in Japan, the Tai-Hu in the Kiangsu Province of China and the Talé Sap in the peninsular part of Siam. The material from all these three expeditions, as well as that from the Inlé Lake and from other localities visited on tour by members of the Survey, is now being studied in Calcutta, more particularly by Mr. Kemp and myself, with a view to the possible discovery of general principles underlying the faunistic peculiarities of the different types of lakes. So far as we have gone at present we have been struck rather by the extreme diversity of the animal communities of different Eastern lakes than by any common phenomena. Certain characters seem to be characteristic of deep-water forms, but one finds forms with precisely the same characters occurring from time to time in very shallow water, and it is clear that the number of factors to be taken into consideration in estimating the faunistic peculiarities of any one lake is not only very large, but depends almost as much on the way in which the different factors are combined as on the factors themselves.

(*b*) *Anthropology.*

Somatological research.

The Anthropological Section of the Indian Museum has been left in the hands of the Zoological Survey and the Director remains in charge of the ethnological gallery. Physical anthropology certainly finds a more appropriate place in the Zoological Survey than in any other research department at present constituted in India. For some years past I have been attempting to develop this branch of investigation in our laboratories, in which a fairly complete set of anthropometrical instruments has been installed. Most anthropologists would, I think, admit that the accepted system of anthropometry, though it has received the *imprimatur* of several international congresses, is by no means successful in elucidating the differences and relationships between allied races of the human species. No zoologist would attempt to base a description of an animal solely on data such as it provides; if he did so in the first instance he would be careful to indicate precisely the points in which it differed from allied forms. In human beings a practised eye can always recognize differences that it is beyond the power of anthropometry to express. The object of my investigations has been, therefore, not so much to discover the measurable differences between different races and individuals as to enquire what the visible differences mean and how they can be best expressed. With this object in view I have taken a large series of full-figure photographs of representatives of the different races that constitute the extremely mixed population of Calcutta. These photographs have all been taken to scale and so far as possible under the same conditions. Measurements have also been obtained of a large proportion of the persons photographed. It has naturally been very difficult to obtain subjects for these experiments and every effort has been made to avoid offending racial or other susceptibilities, but I believe that the series will prove valuable in the study of somatology.

Musical instruments.

Shortly before the end of the financial year in March, 1917, we were so fortunate as to obtain the assistance of Dr. G. H. Meerwarth, Assistant Curator of the Ethnographical Museum of the Russian Academy of Sciences, in the scientific arrangement of the musical instruments displayed in the Museum gallery. A little guide-book to the collection he is preparing, though naturally to a large extent compiled, will, I believe, be a real contribution to ethnography. I will refer to Dr. Meerwarth's work again in describing the progress made in the Museum galleries.

PUBLICATIONS.

Official publications.

The serial publications of the Zoological Survey are two, the *Records of the Indian Museum* and the *Memoirs of the Indian Museum.* In the negociations for the recognition of the new department it was accepted as a principle that as little change as possible should be made in its organization. In reference to the publications in particular we decided to avoid the grave bibliographical inconvenience that would have been involved in a change of title. The "Records" and the "Memoirs" will therefore continue to be issued in their old form and with as little interruption as may be possible in war time. A list of the papers issued in them since the beginning of the financial year 1916-17 is given in appendix H.

The special volume of the "Memoirs" on the faunistic survey of the Chilka Lake is still in the course of publication; we hope in the present year to be able to write '*finis*' to the volume of the "Records" devoted to the Abor Expedition of 1911-12.

Non-official publications.

As the experience of the Survey extends we find ourselves in a position to undertake a certain amount of work (in some cases based on our own collections and in others on those submitted for identification by institutions abroad) on the fauna of countries beyond the limits of the Indian Empire. Thus, as a direct result of my Far Eastern tour in 1915-16, I was able, in collaboration with Dr. T. Kawamura of the Otsu Laboratory, to make a special study of the sponges of Lake Biwa in Japan, in Shanghai I prepared short preliminary descriptions of those collected in the Tai-Hu Lake, while in the Raffles Museum at Singapore I selected examples of the deep-sea barnacles obtained from telegraph cables in the Malay Archipelago. In each instance the results were contributed to a local scientific journal;—the account of the sponges from Japan to the *Journal of the College of Sciences, Imperial University, Tokyo;* that of the Chinese sponges to the *Journal of the North China Branch of the Royal Asiatic Society;* that of the Malayan barnacles to the *Journal of the Straits Branch* of the same Society. In special work of the kind I think that this is the correct course to follow. If we in India claim the right to advance Indian zoology by publishing our results in India we are morally bound to assist the scientific men of other countries situated less advantageously than ourselves, to do the same.

For the more comprehensive results of my tour the Council of the Asiatic Society of Bengal have generously undertaken to publish a special volume of the *Memoirs* of the Society, entitled "Zoological Results of a Tour in the Far East" and edited by myself. One part had already appeared before the end of the financial year 1916-17. I have also communicated a short preliminary paper on the fauna of the Talé Sap to the *Journal of the Siam Natural History Society.*

Dr. B. L. Chaudhuri has published in Bengali a popular lecture on the freshwater fish of Bengal that he delivered in the Museum; he has also published a short synopsis in English.

Library.

As it has been asserted recently at a meeting of the Indian Science Congress that no adequate zoological library exists in India, I will say a few words of general information about our library. I came out to India myself from the University of Edinburgh in 1904 and had then made use of the University libraries at Oxford, Cambridge, Liverpool and St. Andrews: since, I have used those of Tokyo and Kyoto and have visited most of the scientific libraries in India. I do not hesitate to state, with this experience and with the knowledge to be gained from the literature of the subject, that the library of the Zoological Survey is not only by far the most important zoological library in Asia but also perfectly adequate, in conjunction with those of the Asiatic Society of Bengal and the Geological Survey of India and in so far as all branches of pure zoology are concerned, for research in this country, provided that opportunities can be given to honest investigators to visit Calcutta occasionally. Very few great national libraries lend out books. So long as the library of the Zoological Survey was under the direct control of the Trustees it was necessary to have an unalterable rule that no book should leave the Museum premises. Since I have become personally responsible I have in a few instances relaxed this rule. The number of books, mainly zoological but including a few anthropological and general publications, is approximately 12,000. The number of serials received annually before the war about 220; 152 of these were received in exchange. The number actually being received now is only 183, owing to the fact that we are not obtaining any German or Austrian periodicals. The annual grant is Rs. 4,000.

I would like here to pay a tribute to Mr. C. O. Bateman, Librarian, to whose diligence and intelligent interest for some 19 years the good order of the library is due.

The additions of 1916-17, which are specified in detail in appendix I, number 1,143. Two hundred and eighty-five books and periodicals were purchased, 645 received in exchange and the remainder presented. The additions show a fair increase—about 130 books—over the number added last year. Among noteworthy additions the following may be mentioned :—

1. A set of the first twelve volumes of the Connecticut Academy of Sciences for the years 1866—1907.
2. Reports X—XXIII (1899—1915) of the Danish Biological Station at Copenhagen.
3. A complete set of the Annals of the Genoa Museum, with the exception of the first volume, which is out of print.
4. Ten volumes of the journal of Economic Biology for the years 1905—1915, all that were published. This work is being continued as the "Journal of Zoological Research."

Museum Galleries.

We are often asked why we do not put up vernacular labels in the Museum galleries. But in which vernacular? Over twenty languages are spoken by the visitors to the Museum. And what is the use of a label in any vernacular to a man totally illiterate in all, as over 90 per cent. of our visitors are believed to be? Nevertheless, the question, though put without thought, suggests a much more searching one. Why do we not arrange the galleries of the Indian Museum in a manner suitable for India? Because neither staff nor money is available. Personally, after ten years' practical study of the problems involved, I should like to see both the Zoological and the Ethnological galleries entirely cleaned out, refitted in a much more simple and more dignified style; to make them above all things an example of order and cleanliness, reduce the number of exhibits and instead of labelling specimens with labels which few of the visitors can read and fewer still understand, provide a number of neat and intelligent persons, who were interested themselves, to explain the exhibits in the different vernaculars. I hesitate to suggest what this would cost, for in India the price of chaste simplicity is above that of rubies. The number of educated people—I do not include students [1] learning labels by rote for examination purposes—who visit the Museum is almost infinitesimal, and unless Calcutta experiences an intellectual revival of which no signs are apparent, must always remain extremely small, as compared with that of ignorant and illiterate persons to whom its educational message must be entirely subconcious if not delivered verbally. We have been striving for years to bring the galleries of the Indian Museum up to the level of those of a municipal museum in one of the larger English provincial towns.

[1] There is less necessity for medical students to make use of the Museum now that teaching conections are available elsewhere in Calcutta.

This under present conditions we must continue to do. In addition to funds we need the whole time of an exhibition officer of deep scientific knowledge, of wide sympathies, of artistic taste, with a talent for languages, and above all with the teaching instinct. He would have to have a staff of trained guides and preparators. What we have is the odd moments of four scientific men engaged in other work and on tour for a large part of the year.

In these circumstances all we can do, unless we are to stagnate, is to add patches of new cloth to the old garment, with results that are often, at any rate until the whole is replaced, incongruous. A plan was prepared by Mr. S. W. Kemp some years ago for a complete re-organization of the large invertebrate gallery. He contemplated a sweeping away of all the old cases, all the old labels and most of the old specimens. His scheme was, therefore, a drastic one, more particularly as it was to be applied to a gallery in which extraordinary pains had been taken, with great success in some directions, in the labelling and display of the collections. As the Trustees, however, were able and willing at the time to spend a considerable amount of money I agreed to carry it out in part and new cases sufficient to contain the molluscs and one or two other groups, as well as several faunistic exhibits, were ordered from a Chinese carpenter. Before many of them had been constructed war broke out and the price of glass went up. We were unable to go on with the scheme, except very slowly. Sufficient of the cases for the re-arrangement of the molluscs are now, however, finished. Dr. Gravely has undertaken the exhibition of this interesting group of animals and will shortly go on tour to the sea-coast to obtain additional specimens for dissection and the like. The rest of the gallery, remaining for the time being in its old state, will be very much less satisfactory than it was before; but we hope to change the whole of the exhibits gradually as funds permit. In the present financial crisis we can hardly ask for special grants.

Proposed re-arrangement of the Molluscs.

The fact that Dr. Meerwarth of the Ethnographical Museum of the Russian Academy of Sciences happened to be staying in Calcutta made it possible for him, in return for duplicate specimens to be given to the Petrograd Museum, to re-arrange a part of the ethnographical exhibits. We chose the musical instruments as being perhaps the most representative Indian collection in the gallery and agreed that they should be arranged in such a way as to illustrate the evolution of the different types. Dr. Meerwarth has given me the following note :—

Re-arrangement of the musical instruments.

" In March and April 1917 I undertook to arrange the very rich and valuable collection of musical instruments which forms a part of the Ethnological Section. I also compiled a catalogue in which I tried to show the development of the complicated types from the most primitive instruments of savages. I have divided the material according to the way the sounds are produced into (1) string instruments, (2) wind instruments, (3) instruments of percussion. This classification, though not entirely scientific, is convenient and easily understood by a wider public. Among the string instruments it is especially instructive to trace their origin back to the hunting bow, the prototype of the harp. In the one-stringed beggar instruments, used to this day all over India, I believe to have found a type, which in the countries round the Mediterranean led to the lyre. Of special interest are the typically Indian string instruments of the "Kinnar" and northern Vina type in their interesting use of the gourd as sound-board.

Among the instruments of percussion I should like to mention the unique collection of wooden instruments—sound-boards, bells, etc. The collection of drums is probably unparalleled in its wealth of varieties.

The collection suffered from one disease, which—I am compelled to say—has spread all over the Section ; I mean an abnormal congestion. The only way out of the difficulty is to divide the collections into (1) show collections, representing the main types, (2) collections for special study. The collections under No. 1 should be exhibited in the gallery with a suitable catalogue ; not too many in each case otherwise the receptive power of the visitor will soon get tired. The collections for study should be carefully stored in a place where they are accessible for specialists. This division can naturally only be undertaken by an expert."

Collections.

Additions to the Zoological collections.

The most important additions to the zoological collection made during the year are those obtained by officers of the department while on tour. Their nature has already been indicated and I need refer here only to those that we have obtained through the generosity of private donors, our system of exchange being very largely in abeyance for the present.

The departure from India of His Excellency Lord Carmichael of Skirling, late Governor of Bengal, has deprived the Survey of a constant and most generous donor of Indian zoological material. The specimens obtained by his collectors in the Darjiling district and elsewhere have been of very great value. We have to thank the following collectors, most of whom have also contributed in former years, for a large number of interesting specimens :—

Major F. P. Connor, I.M.S., for a miscellaneous collection from Mesopotamia.

Mr. C. H. Dracott for a collection of butterflies and other insects from the E. Himalayas.

Mrs. A. Drake for spiders from Serampore, Bengal.

Captain R. B. Dent, I.A., for a collection of insects, fish and reptiles from the North-West Frontier Province.

Mr. F. Hannyngton, I.C.S., for a collection of insects from Coorg.

Dr. W. C. Hossack for a collection of insects, fish and crustacea from Java.

Babu A. K. Maiti for an exceptionally large crocodile skull from the Contai district, Bengal.

Mr. L. W. Middleton for tortoises from Assam.

Colonel H. T. Pease, I.C.V.D., for insects from the Jhelum Valley.

Mr. C. G. Rogers, I.F.S., for a miscellaneous collection from Upper Burma.

Mr. H. C. Robinson for a collection of reptiles and batrachia from Java.

Dr. Malcolm Smith for reptiles and frogs from Siam.

Lieutenant-Colonel J. Manners-Smith, V.C., for a collection of leeches, frogs, etc., from Nepal.

Captain R. B. Seymour Sewell, I.M.S., for miscellaneous collections from the Gulf of Suez, Aden, etc.

Mr. T. Southwell for a miscellaneous collection from Northern and Eastern Bengal.

Mr. C. L. Steele for a miscellaneous collection from the North Canara District, Bombay.

Lieutenant-Colonel C. R. Stevens, I.M.S., for a collection of marine fish and crustacea from Karachi.

Major F. H. Stewart, I.M.S., for a small miscellaneous collection from Hong Kong.

The Rev. W. S. Sutherland, D.D., for a collection of spiders from Kalimpong.

Mr. W. L. Travers for a valuable collection of tortoises from the Jalpaiguri district of Bengal.

Dr. N. W. F. Woodlands for a collection of specially preserved Hexactinelid sponges from Japan.

A noteworthy feature of these donations is the large area whence they come—from Egypt to Japan and from Siam to Arabia. To some extent, but not entirely, this is owing to the war. The remarkably fine marine collection from the Gulf of Suez and that of reptiles from Aden presented by Captain Sewell were obtained while he was on active service. This is also the case with the specimens from Mesopotamia presented by Major Connor.

Our anthropological collection, to use the term in its wide sense, has been enriched not only by the two series of photographs to which allusion has already been made and by the weighing and fishing apparatus from the Southern Shan States, but also by fishing apparatus and other specimens from Mysore and Orissa presented by Dr. B. L. Chaudhuri, by a series of Javanese shadow-play figures purchased in Calcutta (of special interest as illustrating the Javanese concept of Indian heroes), a fine Tibetan saddle presented by the executors of the late Surgeon-Major J. O'Leary, and by several other ethnographical specimens of less importance. Mr. J. H. Hutton, I.C.S., Sub-Divisional Officer, Mokokchung, Naga Hills, helped us greatly by pointing out certain discrepancies in the clothing of the Naga figures in the gallery and by presenting photographs and cane belts by means of which the mistakes might be corrected. The additions to the anthropological collection have thus been considerably larger and more important than has been the case for many years past.

Additions to the Anthropological collections.

Preservation and arrangement of the collections.

The zoological collections have remained in good condition and advances have been made in the re-arrangement of the representatives of several groups of animals, notably in the collection of Asiatic squirrels, most of which have been recently returned from the Kuala Lumpur Museum, where the skins have been carefully repaired under the superintendence of Mr. H. C. Robinson, Director of Museums, Federated Malay States; in that of the Decapod Crustacea; in that of the freshwater Gastropod shells, and in the entomological collection generally. Perhaps the most notable advance, however, in this direction has been the entire re-arrangement of the mammal skeletons, which have been stored in new boxes on iron racks in a room cleared for the purpose. A plan of the room prepared by Mr. Kemp makes it possible for the first time to gain ready access to the skeletons of any particular family or genus. As large numbers of dead mammals are constantly being received from the Calcutta Zoological Gardens and many of these are skeletonized, the collection is now becoming a valuable one. We trust that when normal conditions are reassumed, its arrangement will be of use not only to our own department but also to the palæontologists of the Geological Survey.

Progress in naming of the Zoological collections.

Most of our correspondents in Europe have been obliged to diminish, if not to forego altogether, the assistance they gave us so generously in times of peace. A few, however, have been able to find spare moments in the stress of more pressing work. We are specially indebted to Lieutenant-Colonel H. H. Godwin-Austen for the work he has done on the land molluscs of the Abor country and Madras, to Mr. F. F. Laidlaw for the naming of dragonflies, to Mr. G. J. Arrow of the British Museum for work on the Lamellicorn beetles, to Mr. S. Maulik of the Imperial College of Science, London, for work on Chrysomelid beetles and to Dr. W. E. Collinge of St. Andrews for naming Isopod Crustacea.

Our helpers in Asia on the other hand have been able to give us even greater assistance than hithertofore. Foremost among them stand Lieutenant-Colonel J. Stephenson, I.M.S., of Lahore and Mr. E. Brunetti, who has worked so constantly in the Museum for many years past. Colonel Stephenson has not only named numerous land and freshwater Oligochæta but has published important papers in the *Records of the Indian Museum.* Mr. Brunetti's devotion to the study of the Diptera cannot be judged solely by the results as yet published, for he has been occupied very largely in preparing a new volume for the official *Fauna of British India.* Dr. R. H. Whitehouse, of the Agra College, has made considerable progress in naming the Survey's collection of land planarians, while Mr. J. Hornell, of the Madras Fishery Department, has revised all the Indian shells of the genus *Meretrix.*

Outside India we have received much help from Professor A. Oka of Tokyo, who has named and described the collection of Ascidians and also the leeches collected by myself in Eastern Asia; from Messrs. H. C. Robinson and C. Boden Kloss of the Federated Malay States Museum, who have named numerous birds and mammals; from Dr. P. van der Goot of Salatiga in Java, who has worked out the Aphidæ of the collection.

Re-organization of the Office.

When the Zoological and Anthropological Section of the Indian Museum underwent its metamorphosis into the Zoological Survey of India it was found that many of the rules applicable to an institution governed by a body of Trustees were not applicable to a Government department. For example, under the old system money in hand at the end of the financial year could not be returned to Government but was credited to the Trustees' banking account, whereas in all Government departments money unspent on the 1st of April ceases to exist so far as the department is concerned. No new clerical appointments of a permanent nature could be made at the time and it was desirable that the necessary re-organization should be carried out so far as possible with the permanent staff through which it would have to be administered in future. The Trustees of the Indian Museum generously agreed in these circumstances to pay the salary of an experienced clerk transferred temporarily from the office of the Comptroller, India Treasuries. Babu J. M. Mullick was deputed for this purpose for about six months. He gave very great assistance and was largely instrumental in carrying through the changes of procedure smoothly and with a minimum of trouble. The permanent staff, and in particular the Head Clerk, Babu J. N. Bagchi, and Mr. E. C. Dormieux, Chief Gallery Assistant, also worked with great diligence and intelligence in the matter.

N. ANNANDALE,
Director,
Zoological Survey of India.

APPENDIX A.

Extract from the Government of India, Department of Education, Resolution No. 19-Museum, dated Simla, the 20th June 1916.

The Government of India have had under their consideration for some time past a scheme for the constitution of a Zoological Survey of India on the basis of the Zoological and Anthropological Section of the Indian Museum, Calcutta. The scheme has recently been approved by the Secretary of State for India and His Excellency the Governor General in Council is pleased to publish the details for the information of local Governments and Administrations and the general public. The Survey will come into force on July 1st, 1916.

2. In March 1913 the Chairman of the Trustees of the Indian Museum forwarded a representation from the Superintendent of the Zoological and Anthropological Section of the Museum regarding the recognition of the Zoological Section as a Zoological Survey. The Government of India who had already under consideration the desirability of establishing on a sound basis a Zoological Survey of India informed the Trustess of the Museum that they would be prepared to consider a scheme for such a survey on lines somewhat similar to the existing Botanical Survey and asked to be furnished with the necessary details. The Trustees accordingly submitted their proposals at the end of September 1913. They represented that, though it had been definitely recognised in the past that field work and zoological research formed an important part of the official duties of the scientific officers of the Zoological and Anthropological Section of the Museum, both branches of work had been necessarily undertaken in a somewhat haphazard manner. Different officers had taken up the investigation of different groups of animals and had visited various parts of India and Burma in connection with their investigation without there being a definite programme drawn up each year or a comprehensive scheme of research instituted. In short, this part of the duties of the section had been in an experimental stage. They thought accordingly that the time had come to pass to further developments and suggested the establishment of a Zoological Survey. The detailed proposals of the Trustees were approved by the Board of Scientific Advice to whom they were submitted and the Government of India in recommending them to the Secretary of State in their Financial despatch No. 366, dated the 11th December 1915, urged the following additional considerations in support of the scheme:—"In the first place" they stated "since medicine, more specially tropical medicine, is intimately connected with certain branches of zoology, it is obvious that anything that furthers the interests of zoological research in this country will indirectly benefit medicine and sanitation materially. Secondly, outside interest in Indian zoology has increased in recent years and more attention is now devoted to it by individuals and societies in India. In the publication entitled—Records of the Indian Museum—35 original papers on zoology have been published since March 1914, of which 14 have been written in India. Ten contributors of notes or papers have been zoologists resident in this country who are not Members of the museum staff, while not less than five contributors have been Indians. Moreover, at the present time a survey of mammals is being carried on by the Bombay Natural History Society to which we have recently given a grant of Rs. 7,500."

3. The proposals as finally sanctioned by the Secretary of State are as follows:—

(*a*) The headquarters of the Survey will be the Indian Museum. The reports in recent years of the Zoological and Anthropological

Section of the Indian Museum show that a good deal of zoological research work is already being done by the staff of the Section. The Museum has an excellent library and new completely equipped laboratories. It also contains and preserves comprehensive zoological collections both from India and from other countries in Asia and issues two series of publications, *viz.*, "Records of the Indian Museum" and "Memoirs of the Indian Museum" in which is embodied the zoological work already accomplished. It also provides facilities for students of superior scientific status to work at advanced zoology.

(*b*) The scheme regarding the Zoological Survey entails the breaking up of the organisation now known as the Zoological and Anthropological Section of the Indian Museum into two parts, one of which will become a Government Department under the title of the Zoological Survey of India and will be primarily concerned with zoological investigation and exercise such advisory functions as may be assigned to it by Government, while the other part will remain as the office of the Trustees of the Indian Museum and will be organised for the present on the lines laid down in the existing bye-laws of the Museum. One effect of the proposals will be that the Zoological and Anthropological Section will be brought into line with the Geological, Archæological and Industrial Sections which are in the charge of the Director of the Geological Survey of India, the Director General of Archæology in India and the Director of the Botanical Survey of India respectively.

(*c*) The whole of the staff, office establishment and menials of the Zoological and Anthropological Section of the Museum with the exception of those employés of the Section who are engaged solely in connection with the maintenance of discipline, cleanliness, etc., in the Museum as a whole and the chaprasis employed by the Trustees, will be transferred to the Zoological Survey. The Superintendent of the present Zoological and Anthropological Section will become the Director of the Zoological Survey with his headquarters at the Indian Museum. He will, however, continue to be *ex-officio* Secretary to the Trustees but the Government of India do not consider it desirable to lay down the condition that this combination of posts shall continue indefinitely, provided that if a separate Secretary is at any time appointed no increased cost to Government is thereby involved. He will also continue for the present to perform the duties of Superintendent of the Indian Museum. The Director of the Zoological Survey will be regarded for the purposes of the Indian Museum Act as Superintendent of the Zoological and Anthropological Section of the Museum.

The superior staff of the Zoological Survey will be as follows:—

1 Director, Zoological Survey of India. The first Director will be Dr. Annandale, B.A., D.Sc., C.M.Z.S., F.L.S., F.A.S.B., the present Superintendent of the Zoological and Anthropological Section.

1 Superintendent, Zoological Survey of India.

2 Assistant Superintendents, Zoological Survey of India.

Besides the above, the Surgeon Naturalist to the Indian Marine Survey will be considered an officer of the Zoological Survey and be styled *ex-officio* Assistant Superintendent of the Survey. He will carry out his work in direct connection with the Zoological Survey, but he will be liable to military duty in case of emergency and will be subject to naval discipline while on board the "Investigator."

(*d*) The Zoological Survey will be a scientific department of the Government of India under the direct control of the Department of Education just as the Botanical Survey is under that of the Department of Revenue and Agriculture.

The relations between the new Survey and the Trustees will be regulated by clause 7 (*a*) of the Indian Museum Act (X of 1910) and will be identical with those that at present exist between the Archæological Survey and the Trustees except that the Director of the Zoological Survey, as stated in paragraph 3 (*c*) above, will be *ex-officio* Secretary to the Trust. The Trustees will lend to the Director of the Zoological Survey their zoological collections, retaining visiting powers in the Zoological Section as in the others in which a similar loan has been effected. They will, however, retain full control of their Secretary's office.

(*e*) It will be the duty of the Zoological Survey to act as guardians of the standard zoological collection of the Indian Empire and as such to give every assistance in their power both to officials and to others, in the identification of zoological specimens submitted to them, arranging, if requested to do so, to send collections to specialists abroad for identification in cases in which no specialist is available in India. The Survey will also obtain the fullest possible information about the systematic and geographical zoology of the Indian Empire and will place this information at the disposal of inquirers. It will not, however, interfere in any way with private enterprise in zoological matters or with the scientific work of other Imperial or Provincial Government departments.

The Forest and Agricultural Departments subordinate to the Government of India have agreed to collaborate in the Zoological Survey on the same condition of co-operation as exists between the Botanical Survey and other Government departments, *i.e.*, collaboration without subordination. Local Governments and Administrations will, it is hoped, similarly allow their officers to co-operate with the Zoological Survey without being in any way subordinate to its Director. Their co-operation will be most welcome and valuable.

(*f*) The Director of the Zoological Survey will act as Zoological Adviser to the Government of India in the same way as the Director of the Botanical Survey acts as Botanical and the Director General of Archæology as Archæological Adviser. He will be treated as a head of a department and will be empowered, subject to the usual conditions, to re-appropriate funds within his budget grants from one head to another and to create temporary appointments up to Rs. 50 a month.

Just as the Director General of Archæology is in charge of the archæological collection of the Indian Museum, so the Director of the Zoological Survey will be in charge of the zoological and anthropological collections.

(*g*) The zoological publications of the Indian Museum will be continued in their present form and under their present titles but will be edited by the Director of the Zoological Survey instead of by the Superintendent of the Indian Museum. The great bibliographical inconvenience involved in any change of name will thus be avoided and any break of continuity rendered unnecessary.

(*h*) The personal allowance of Rs. 200 a month at present given to the Senior Assistant Superintendent, who will be styled Superintendent, Zoological Survey of India, shall be made a regular part of the pay of his post. The effect of this change is as shown below :—

Present.	*Future.*
1 Superintendent, Zoological and Anthropological Section, Indian Museum, Rs. 1,000—80—1,400 with free quarters.	1 Director, Zoological Survey of India, Rs. 1,000—80—1,400 with free quarters.
1 Senior Assistant Superintendent, Rs. 500—40*—700 with free quarters. Personal allowance, Rs. 200.	1 Superintendent, Zoological Survey of India, Rs. 700—40*—900 with free quarters.
1 Assistant Superintendent,† Rs. 500—40*—700.	1 Assistant Superintendent,† Zoological Survey of India, Rs. 500—40*—700.
1 Assistant Superintendent,† Rs. 500—40*—700.	1 Assistant Superintendent,† Zoological Survey of India, Rs. 500—40*—700.
* (Biennially.)	* (Biennially.)

† Admitted to the benefits of the Calcutta house allowance scheme.

(*i*) The income of the Trustees of the Indian Museum from private sources, *viz.*, gate money (average Rs. 1,300) and sale of publications (average Rs. 800), which are of a fluctuating nature, shall be credited to Government and in their place an annual fixed grant of Rs. 10,708 shall be given to them to meet their charges.

4. The financial effect of the scheme is as shown below :—

The details of the income, which at present ordinarily suffices to meet the normal annual expenditure of the Zoological and Anthropological Section, were in 1913-14 as follows :—

	Rs.
(1) Grants from Government on account of (*a*) non-gazetted establishment including the special entomological assistant whose pay (Rs. 100—15—250) is met from the special educational grant, (*b*) maintenance, and (*c*) acquisition of specimens	61,970
(2) Receipts from gate money (average Rs. 1,300), sale of publications (average Rs. 800) and savings on non-gazetted establishment and on gazetted staff (average Rs. 1,200)	3,300
(3) Average cost of superior staff (*i.e.*, 1 Superintendent and 3 Assistant Superintendents) paid by Government	41,090
TOTAL .	1,06,360

The funds of the Section will be distributed as follows :—

Museum.

(1) Grant to the Trustees of the Museum for general museum work, *viz.* (1) Rs. 8,708 on account of establishment as now revised, and (2) Rs. 2,000 on account of petty expenditure . . .	10,708

Zoological Survey.

		Rs.
(1)	Gazetted staff	41,090
(2)	Non-gazetted establishment	22,132
(3)	Grant for contingencies and travelling allowances of gazetted and non-gazetted establishment .	34,000
(4)	Ethnological gallery	529
(5)	Special entomological assistant . . .	2,430
	TOTAL .	1,10,889
	Deduct Rs. 1,200 on account of probable savings on non-gazetted and gazetted establishment . .	1,200
		1,09,689

It will be observed that taking the expenditure as a whole the scheme involves at present an extra cost of about Rs. 3,300 a year. Financially the main effect of this scheme is that Government will in future make a grant of Rs. 10,708 only to the Museum instead of its present grants, but will accept responsibility for the whole of the expenditure of the Zoological Survey.

5. In conclusion, the Governor General in Council trusts that the coordination and systematisation of zoological work throughout India, which will be a necessary consequence of the establishment of a zoological survey in such a manner as will avoid overlapping and assist in the filling up of gaps will be of considerable value to this country.

Order.—Ordered that a copy of this resolution be forwarded to the Local Governments and Administrations noted on the margin * for information and necessary action.

* **Madras.**
Bombay.
Bengal.
Bihar and Orissa.
United Provinces.
Punjab.
Burma.
Central Provinces.
Assam.
North-West Frontier Province.
Coorg.
Delhi.

Ordered, also, that a copy be forwarded to the Department of Revenue and Agriculture, Army Department, Home Department, Finance Department, Foreign and Political Department for information, and to the Secretary to the Trustees of the Indian Museum and the Director, Zoological Survey of India, for information and guidance, and that the resolution be published in the Supplement to the *Gazette of India.*

E. D. MACLAGAN,
Secretary to the Government of India.

APPENDIX B.

Leave granted to non-gazetted officers during 1916-17.

Mr. C. A. Paiva, Special Entomological Assistant, privilege leave from 2nd January 1917 to 1st February 1917.

Mr. J. B. Richardson, Entomological Assistant, privilege leave from 1st April 1916 to 13th April 1916.

Mr. R. A. Hodgart, Zoological Collector, privilege leave from 15th May 1916 to 7th June 1916.

Mr. E. C. Dormieux, Gallery Assistant, combined leave for six months (*i.e.*, privilege leave for 13 days and the rest on medical certificate) from 12th September 1916 to 11th March 1917.

Babu J. N. Bagchi, Head Clerk and Accountant, privilege leave from 23rd October 1916 to 22nd December 1916.

Munshi Atiur Rahman, Registration Clerk, privilege leave from 22nd August 1916 to 29th September 1916.

Babu S. C. Mondul, Marine Artist, privilege leave from 12th October 1916 to 23rd December 1916.

Mr. A. Martin, Head Taxidermist and Store-keeper, privilege leave from 11th July 1916 to 11th August 1916.

Badal Ram, Apprentice Taxidermist, leave without allowance from 9th January 1917 to 31st March 1917.

Hari Har, Collection Tender, privilege leave from 12th May 1916 to 27th June 1916.

Sukhi Chand, Collection Tender, privilege leave from 12th October 1916 to 14th November 1916.

Gopi Ram, Collection Tender, privilege leave from 27th November 1916 to 11th December 1916.

Phagoni Ram, Collection Tender, privilege from 31st July 1916 to 30th August 1916 and leave without allowance from 31st August 1916 to 30th September 1916.

APPENDIX C.

Specimens sent to specialists for study or for identification during the year 1916-17.

Three valves of *Placuna* sp. from Siam to Dr. S. Fujita of Tokyo.

Four lots of land Isopods to Dr. W. E. Collinge of St. Andrews.

A lot of Mysidacea from the Talé Sap with two named Japanese species, the latter for verification of names, to Mr. W. M. Tattersall of Manchester.

The types of the following mammals:—*Mus bowersii*, Anderson, *Mus humei*, Thomas; *Mus berdmorei*, Blyth; and *Macacus leoninus* (Blyth) (all returned except the last two) and two lots of unnamed mammals to Mr. C. Boden Kloss of the Selangor Museum, F. M. S.

Two frogs for examination to Dr. van Kampen, Blœmendæl, Holland.

Two lots of mammals including the types of *Nesokia barclayana*, Anderson, and *Mus cinnamomeus*, Blyth (returned) to Mr. Oldfield Thomas, F.R.S., British Museum, London.

Two lots of land shells from the Malay Peninsula and Siam to Mr. F. F. Laidlaw of Uffculme, Devonshire, England.

Six lots of shells including the type of *Glessula blanfordiana*, Nevill (the latter returned) to Col. H. H. Godwin-Austen of Surrey, England.

A lot of Gordiid worms including Japanese and Chinese collections to Professor L. Camerano of Turin.

Specimens of mollusca (*Solenaia soleniformis*) to Dr. Ekendranath Ghosh of the Medical College, Calcutta.

Two lots of named lizards including the type of *Tachydromus houghtonianus*, Jerdon (returned) and several unnamed lizards to Dr. G. A. Boulenger, British Museum, London.

Several lots of named shells (returned) to Mr. E. Vredenburg of the Geological Survey of India.

A lot of Amphipods and Isopods including the Talé Sap collection to Dr. Chas. Chilton of Christchurch, N. Z.

Three lots of Oligochæta including Japanese and Chinese collections (the latter returned) to Lieutenant-Colonel J. Stephenson, I.M.S., of Lahore.

Four lots of named and unnamed mollusca (four returned) to Mr. J. Hornell of Tuticorin.

The type of *Mangelia fairbanki*, G. and H. Nevill (Mollusca) (returned) to Mr. Chas. Hedley of Sydney, Australia.

A specimen of *Vipera russellii* (Shaw) (returned) to Dr. Malcolm Smith of Bangkok, Siam.

Four lots of tadpoles (three returned) to Mr. C. R. Narayan Rao of Bangalore.

Three lots of Planarians, including the type of *Bipalium delicatum*, Whitehouse (the latter returned), to Professor R. H. Whitehouse of Agra.

A lot of named mollusca to Dr. H. A. Pilsbry of Philadelphia, United States of America.

A Siamese collection of mollusca to Mr. Tom Iredale of the British Museum, London.

One lot of cockroaches from the Malay Peninsula to Dr. R. Hanitsch, Singapore.

The collection of Scutigeridæ and one lot from the Malay Peninsula to Professor F. Silvestri of Portici, Italy.

One lot Attidæ (ant-mimicking spiders) from Siam to Professor K. Narayan, St. John's College, Agra.

Several lots Odonata (including specimens from Dr. E. H. Hankin) to Mr. F. F. Laidlaw of Uffculme, Devonshire.

One lot cockroaches, earwigs, and Stenopelmatids (including two named species) from caves in the Malay Peninsula to Professor L. Chopard of Paris.

One lot Cryptostomes (Chrysomelidæ) to Mr. S. Maulik of the Imperial College of Science, London.

One lot Aleurodidæ (named and unnamed), duplicate named Psyllidæ and one lot Aphidæ to Professor P. van der Goot of Salatiga, Java.

One lot Anoplura to Mr. B. F. Cummings, British Museum, London.

Cotypes of Melolonthidæ and one lot Dynastidæ, Rutelidæ, Cetoniidæ and Melolonthidæ to Mr. G. J. Arrow, British Museum.

Ants from Siam to Mr. W. M. Wheeler of Basto, United States of America.

One lot Malacoderm and Rhipicerid larvæ and adults to Mr. H. E. Andrews, London (lost by enemy action).

APPENDIX D.

Collections returned during 1916-17 that were sent out in previous years

(Owing to risk of loss the return of most of the specimens has been postponed till the conclusion of the war.)

By Mr. H. B. Preston . . .	Nine lots of shells.
,, Colonel Godwin-Austen . .	Two lots of shells.
,, Mr. H. C. Robinson . .	Mammals (Sciuridæ mostly returned).
,, Professor L. Chopard . .	One lot Cavernicolous Orthoptera.
,, Mr. G. A. K. Marshall . .	One lot named Curculionidæ.
,, Mr. G. J. Arrow . . .	One lot named Rutelidæ and Cetoniidæ.
,, Professor W. M. Wheeler .	The collection of named ants.

APPENDIX E.

Exchanges and presentations made during the year 1916-17.

(a) *Specimens received.*

From the British Museum (Natural History) . . .	1 species of Tadpole, 1 species of Spider.
,, the Selangor Museum, Kuala Lumpur . . .	17 species of Reptiles, 11 of Batrachia and 68 of Mammals.
,, the Otsu Laboratory, Otsu .	33 species of fish.
,, the Shanghai Museum, Shanghai . . .	8 species of Reptiles and 5 species of Batrachia.
,, Dr. Malcolm Smith . .	3 species of Reptiles and 10 species of Batrachia.
,, Mr. Jas. Hornell . .	64 shells (varieties of *Turbinella*) and a collection of *Ampullaria*, *Paludina*, *Planorbis*, and *Lamellidens*.
,, Mr. E. Brunetti . . .	1 species of Diptera.
,, Mr. C. F. Baker . . .	10 species of Coccidæ.
,, Mr. J. L. Mitter . . .	3 species of Stomoxyinæ.
,, Imperial Institute, Pusa .	5 species of Phalacridæ.
,, Professor H. Leefmans, Java	4 species of Capsidæ.

(b) *Specimens sent out.*

To the British Museum (Natural History)	10 species of Reptiles and 1 species of Cryptostome Beetles.
,, Mr. Boden Kloss, Kuala Lumpur	2 species of Chelonia and 2 species of Batrachia.
,, Dr. Van Kampen . . .	4 species of Tadpoles.
,, the State Museum, Pudukkottai	1 species of Bird.
,, Professor A. Oka, Tokyo, Japan	10 species of Polyzoa and 5 species of Leeches.
,, the Otsu Laboratory, Otsu, Japan	10 species of Polyzoa, 1 Leech, 3 species of Batrachia, 2 species of fish and 21 lantern slides.
,, Dr. J. H. Ashworth . .	1 species of Parasitic worms and shells.
,, Colonel H. H. Godwin-Austen .	3 species of shells.
,, Dr. J. R. Henderson . .	9 species of shells.
,, Dr. Malcolm Smith . .	6 species of Tadpoles and 2 species of Reptiles.
,, the Revd. A. Hosten . .	2 species of shells.
,, Mr. Baini Parshad . . .	12 species of Batrachia and 4 species of Syrphidæ.
,, the Colombo Museum . .	30 species of Crustacea.

To	Mr. Narayan Rao	9 species of Tadpoles.
,,	Dr. B. Parisi	19 species of Crustacea.
,,	Professor H. Leefmans	2 species of Capsidæ.
,,	Mr. G. C. Crompton	3 species of Mantidæ.
,,	Professor P. van der Goot	5 species of Aphidæ.
,,	Professor V. de Salvaza	5 species of Passalidæ.
,,	Mr. L. C. Harlten	27 species of Coleoptera and 12 species of Hemiptera.
,,	Mr. C. F. Baker	13 species of Parasitic Hymenoptera.
,,	Dr. E. Pawlousky	12 species of scorpions.
,,	Mr. M. C. Bonig, Andamans	2 species of spiders and 4 species of Coleoptera.

APPENDIX F.

Type specimens of new genera, species, subspecies, and varieties added to the collection during the year 1916-17.

Reptilia.

Barkudia insularis, Annandale (new genus) ; *Lachesis coorgensis,* Rao.

Batrachia.

Nyctixalus robinsoni, Annandale.

Fish.

Gobius ostreicola, Petroscirtes bhattacharyæ, Engraulis annandalei, E. kempi, E. rambhæ, Arius satparanus, Ophichthus chilkensis, Chaudhuri, *Panchax parvus,* Raj.

Mollusca.

Cryptaustenia bicolor, Austenia aborense, A. alba, A. siyomensis, Girasia maculosa, G. gladstonei, Dihangia koboensis (new genus), *Galongia kempi* (new genus), *Durgella aborense, Minyongia kempi* (new genus), Godwin-Austen ; *Cuthona henrici* and *Elysia chilkensis,* Eliot.

Crustacea.

Pontophilus pilosus, P. parvirsotris, Iphinoe sanguinea and *Paradiastylis culicoides,* Kemp.

Oligochæta.

Drawida jalpaigurensis, Perionyx pincerna, P. parvulus, P. pulvinatus, P. inornatus, P. fulvus, Stylaria kempi, Pheretima trivandrana, Ph. kuchingensis, Octochætus barkudensis, Megascolex trivandranus, M. pentagonalis, M. pumilio, Megascolides tenmalai var. *karakulamensis, M. oneilli* var. *monorchis, Lampito dubius, Notoscolex gravelyi, Eutyphœus annandalei* var. *fulgidus, Glyphidrilus tuberosus,* Stephenson.

Echinoderma.

Oligometra intermedia, Clark.

Polyzoa.

Chitaspis athleticus (new genus), *Hislopia malayensis, Paludicella pentagonalis,* Annandale.

APPENDIX G.

List of donors to the collections during the year 1916-17.

Andrews, H. L.
Annandale, Dr. N.
Austen, E.
Baker, C. F.
British Museum (Nat. Hist.), London.
Brown, J. Coggin.
Brunetti, E.
Burton, B. H.
Carmichael, H. E. Lord.
Carter, Dr. H. G.
Caunter, J.
Chaudhuri, Dr. B. L.
Chilton, Dr. Chas.
Clapton, T.
Connor, Major F. P., I.M.S.
Cragg, Major F. W., I.M.S.
D'Abreu, E. A.
de Melo, Capt. F.
Dent, Capt. R. B., I.A.
Dodds, W. K.
Dracott, C. H.
Dunn, W. N.
Ethridge, R.
Fletcher, T. B.
Flower, Captain S. S.
Fujita, Dr. S.
Godwin-Austen, Lt.-Col. H. H.
Gravely, Dr. F. H.
Harold, Lt.-Col. C. F.
Hartless, A. C.
Henderson, Dr. J. R.
Hirase Conchological Museun, Kyoto, Japan.
Hodgart, R. A.
Hornell, Jas.
Howell, G. C. S.
Hunt, Holman.
Ishibashi, Dr. E.
James, D. R.
Kemp, S. W.
Kira, S.
Lane, Major Clayton, I.M.S.
Lister, R. S.
Lloyd, Major R. E.
Lucknow Museum.
Mackwood, F. M.
Marine Survey of India.
Masson, J. N.
Maxwell, Mrs. E. S.
Milton, A.
Mitchell, F. J.
Mitter, J. L.
Molesworth, Miss.
Mondul, S. C.
Morgan, J. G.
Nakazawa, Dr. E.
Oka, Professor A.
Otsu Rinko Zikkensho.
Paiva, C. A.
Pease, Col. H. T.
Pedler, H.
Pershad, Baini.
Rogers, A.
Rogers, C. G., I.F.S.
Raj, B. Sundara.
Rao, C. R. Narayan.
Salvaza, V. de.
Sarawak Museum.
Selangor Museum.
Sewell, Captain R. B. S., I.M.S.
Smith, Col. J. Manners.
Smith, Dr. Malcolm.
Smith, Col. F.
Sobhan, A.
Southwell, T.
Stanley, Dr. A.
Stephenson, Lt.-Col. J., I.M.S.
Stevens, Lt.-Col. C. R.
Stewart, Captain F. H., I.M.S.
Sutherland, Rev. W. S.
Travers, W. L.
Trivandrum Museum.
Tytler, Col. H.
White, E. B. D.
Yoshida, S.
Zoological Gardens, Calcutta.

APPENDIX H.

PUBLICATIONS.

(a) *Official—Issued by the Survey.*

Name of Journal.	*List of Papers.*
Records of the Indian Museum, Vol. VIII, Pt. IX. (Zool. Results of the Abor Expedition, 1911-12).	44. Terrestrial Isopoda, II *W. E. Collinge.*
	45. Mullusca, VI. *H. H. Godwin-Austen.*
Records of the Indian Museum, Vol. XII, Pt. III.	9. A new *Chlamys* from Calcutta. *S. Maulik.*
	10. Description of two new fish from the Chilka Lake. *B. L. Chaudhuri.*
	11. Description de la larve de *Lasiodactylus chevrolati*, Reitt. (Coleoptera, Nitidulidæ). *P. de Peyerimhoff.*
	12. Contributions to a knowledge of the Terrestrial Isopoda of India, Pt. II. *W. E. Collinge.*
Records of the Indian Museum, Vol. XII, Pt. IV.	13. Notes on Indian Odonata. *F. F. Laidlaw.*
	14. Some Lignicolous beetle-larvæ from India and Borneo. *F. H. Gravely.*
Records of the Indian Museum, Vol. XII, Pt. V.	15. Notes on the Ciliate Protozoa of Lahore. *B. L. Bhatia.*
	16. The Cephalopoda of the Indian Museum. *Anne L. Massy.*
Records of the Indian Museum, Vol. XII, Pt. VI.	17. Notes on the freshwater fish of Madras. *B. Sundara Raj.*
	18. Studies in Indian Helminthology, No. III. *F. H. Stewart.*
Records of the Indian Museum, Vol. XII, Pt. VII.	19. On a collection of Oligochæta belonging to the Indian Museum. *J. Stephenson.*
Records of the Indian Museum, Vol. XII, Pt. VIII.	20. & 21. Notes on Crustacea Decapoda in the Indian Museum, VI, VII. *S. Kemp.*
Records of the Indian Museum, Vol. XIII, Pt. I.	1. Description of a new species of Isopod of the Genus *Synidotea*, Harger, from the Gulf of Mannar. *W. E. Collinge.*
	2. Notes on the type specimens of some Burmese and Himalayan Rats. *C. Boden Kloss.*
	3. Notes on *Lachesis anamallensis* and allied forms. *C. R. Narayan Rao.*
	4. A new genus of limbless skinks from an island in the Chilka Lake. *N. Annandale.*

Name of Journal.	*List of Papers.*
	5. A list of the dragonflies recorded from the Indian Empire. Pt. I. *F. F. Laidlaw.*
	6. On two new sub-species of squirrel from Southern India. *H. C. Robinson.*
Memoirs of the Indian Museum, Vol. V, No. 4 (*Fauna of the Chilka Lake*).	Mollusca Gastropoda and Lamellibranchiata, with an account of the anatomy of the common *Solen*. *N. Annandale, S. Kemp* and *E. Ghosh.*
	Mollusca Nudibranchiata. *Chas. Eliot.*
	Stages in the life-history of *Gobius*, *Petroscirtes* and *Hemirhamphus*. *D. R. Bhattacharya.*
	Cumacea. *S. Kemp.*
	Fish, Pt. I. *B. L. Chaudhuri.*
Memoirs of the Indian Museum, Vol. V, No. 5. (*Fauna of the Chilka Lake*).	Fish, Pt. II. *B. L. Chaudhuri.*
	Some Terrestrial Isopoda from the shore of the Lake. *Chas. Chilton.*
Memoirs of the Indian Museum, Vol. VI, No. 2.	The Indian varieties and races of the genus *Turbinella*. *J. Hornell.*
	A note on the Geological History of the genus *Turbinella*. *E. Vredenburg.*
Memoirs of the Indian Museum, Vol. VI, No. 3.	Three plates to illustrate the Scalpellidæ and Iblidæ of Indian Seas, with synonomy and notes. *N. Annandale.*

(b) *Unofficial—Published in India or abroad by officers of the department.*

Name of Journal.	*Title of Papers.*
Journ. North China Branch Roy. Asiat. Soc., Vol. XLVII, pp. 49-52 (1916).	Freshwater sponges from the Tai Hu (Great Lake) of the Kiangsu Province, China. *N. Annandale.*
Journ. Straits Branch Roy. Asiat. Soc., No. 74, pp. 281-302 (1916).	Barnacles from deep-sea Telegraph cables in the Malay Archipelago. *N. Annandale.*
Mem. Asiat. Soc. Bengal, Vol. VI, pp. 1-74. (*Zoological Results of a Tour in the Far East.*)	Introduction: Polyzoa; Entoprocta and Ctenostomata; the Mollusca of L. Biwa, Japan. *N. Annandale.*
Journ. Nat. Hist. Soc., Siam, Vol. II, pp. 90-102 (1916).	Preliminary report on the Fauna of the Talé Sap or Inland Sea of Singgora. *N. Annandale.*
Mem. Asiat. Soc., Bengal, Vol. VI, pp. 75-82. (*Zoological Results of a Tour in the Far East.*)	Aquatic Hemiptera from the Talé Sap in Peninsular Siam. *C. A. Paiva.*
"Vijnan" (Science), Vol. V, Pt. 9, pp. 409-417.	Bānglār mithā jalēr māch. *B. L. Chaudhuri.*

APPENDIX I.

Additions to the Library.

Books purchased.

1. Anderson, J., Herpetology of Arabia.
2. Bleeker, P., Reis door de Minahassa en den molukschen Archipel, Vols. I-II.
3. Cash, J., and Wailes, G. H., British Freshwater Rhizopoda and Heliozoa, Vol. III.
4. Dejean, Catalogue des Coléopteres de la collection de M. le Comte—. 3rd Edit.
5. Duckworth, W. L. H., Morphology and Anthropology, 2nd Edit., Vol. I.
6. Fantham, H. B., Stephens, J. W. W., and Theobald, F. V., The Animal Parasites of Man.
7. Forel, F. A., Le Léman. Monographie Limnologique, Vols. I-III.
8. Lotsy, J. P., Evolution by means of Hybridization.
9. Macleay, W. S., Essays on Annulose Animals, Vol. I, pt. 1.
10. Meek, A., The Migrations of Fish.
11. Michælsen, W., Land und Susswasserfauna Deutsch Sudwastafrikas, Hefts 2-3.
12. Michælsen, W., Meeresfauna Westafrikas, Hefts 2-3.
13. Needham, J. G., and Lloyd, J. T., The Life of Inland Waters.
14. Punnett, R. C., Mimicry in Butterflies.
15. Russell, E. S., Form and Function.
16. Schönherr, C. J., Synonymia Insectorum, Vol. I, pts. 1-3.
17. Siboga Expeditie, mon. xxviii *a*, xxxix *a* 1-2, *b* 1.
18. Wood Jones, F., Arboreal Man.
19. Worsdell, W. C., Principles of Plant Teratology, Vol. I.

Serials purchased.

1. *Allahabad.*—Indian Forester, Vol. XLII, Nos. 3-6 and 9-12; Vol. XLIII, Nos. 1-3.
2. *Baltimore.*—Journal of Experimental Zoology, Vols. XVIII-XXI; Vol. XXII, No. 1.
3. *Boston.*—American Naturalist, March to December 1916 and January 1917.
4. *Boston.*—Journal of Morphology, Vols. XXVI-XXVII; Vol. XXVIII, No. 1.
5. *Calcutta.*—Indian Medical Gazette, April to December 1916 and January to March 1917.
6. *Cambridge.*—Biometrika, Vol. XI, Nos. 1-3.
7. *Cambridge.*—Journal of Anatomy and Physiology, Vol. L, Nos. 3-4; Vol. LI, No. 1.
8. *Cambridge.*—Journal of Genetics, Vol. V, Nos. 3-4; Vol. VI, Nos. 1-2.

9. *Cambridge.*—Parasitology, Vol. V, No. 4; Vols. VII, VIII and IX, No. 1.

10. *Kyoto.*—The Entomological Magazine, Vol. II, Nos. 2-3.

11. *Leyden.*—Zoologisch Mededeelingen, Vols. I-II.

12. *London.*—Annals and Magazine of Natural History, March 1916 to February 1917.

13. *London.*—Entomologists Record, Vol. XXVIII, Nos. 3-12; Vol. XXIX, No. 1.

14. *London.*—Ibis, April 1916 to January 1917.

15. *London.*—Journal of Economic Biology, Vols. I-X.

16. *London.*—Journal of Zoological Research, Vol. I, Nos. 1-4.

17. *London.*—Museums Journal, Vol. XV, Nos. 9-12; Vol. XVI, Nos. 1-8.

18. *London.*—Man, March 1916 to February 1917.

19. *London.*—Nature, March 9th, 1916 to February 15th, 1917.

20. *London.*—Quarterly Journal of Microscopical Science, Vol. LXI, Nos. 3-4.

21. *London.*—Science Progress, Nos. 33-43.

22. *London.*—Transactions of the Entomological Society for 1915, Nos. 3-5 and 1916, Nos. 1-2.

23. *London.*—Zoological Record, Vol. LI, 1914.

24. *London.*—Zoologist, December 1915 and March to December 1916.

25. *Paris.*—Annales des Sciences Naturelles, Ser. 10, Vol. I, Nos. 1-6.

26. *Philadelphia.*—Entomological News, Vol. XXVII and XXVIII, No. 1.

27. *Philadelphia.*—Transactions of the American Entomological Society, Vol. XLII, Nos. 1-4.

Books and Serials received in exchange.

1. *Adelaide, Public Library, Museum and Art Gallery.*—Annual Report for 1915-16.

2. *Adelaide, Royal Society of South Australia.*—Transactions and Proceedings, Vol. XXXIX.

3. *Amsterdam, Koloniaal Institut.*—Vereeniging, 1915.

4. *Bangalore, Mysore Government Museum.*—Annual Report for 1915-16.

5. *Bangkok, Natural History Society of Siam.*—Journal, Vol. I, No. 5 and Vol. II, Nos. 1-2.

6. *Basel, Naturhistorisches Museum.*—Bericht 1916.

7. *Basel, Naturforschenden Gesellschaft.*—Verhandlungen, Vol. XXVII.

8. *Berkeley, California University.*—Publications in Zoology, Vol. XII, Nos. 13-17, Vol. XIII, Nos. 11-13, Vol. XV, Nos. 2-3 and Introduction, Vol. XVI, Nos. 10-17, Vol. XVII, Nos. 1-6.

9. *Bombay, Natural History Society.*—Journal, Vol. XXIV, Nos. 3-4.

10. *Brisbane, Queensland Museum.*—Memoirs, Vol. V.

11. *Brooklyn Museum.*—Science Bulletin, Vol. III, No. 1; Museum Quarterly, Vol. II, Nos. 2-4, Vol. III, Nos. 1-2; Annual Report for 1915.

11*a*. *Buitenzorg, Department Van Landbouw.*—Contributions a la Faune des Indes Neerlandaises, Vol. I, No. 3.

12. *Calcutta, Asiatic Society of Bengal.*—Journal, Vol. XI, Nos. 9-11, Vol. XII, Nos. 1-6; Memoirs, Vol. V, No. 4, Vol. VI, No. 1.

13. *Calcutta, Geological Survey of India.*—Records, Vol. XLIII, No. 2, Vol. XLV, No. 4, Vol. XLVII, Nos. 1-3; Memoirs, Index to Vols. XXI-XXXV; Palæontologia Indica, new series, Vol. V, No. 3.

14. *Cambridge, Philosophical Society.*—Proceedings, Vol. XVIII, Nos. 5-6, Vol. XIX, No. 1.

15. *Cambridge University Museum.*—Report of the Museum for 1915.

16. *Cape Town, South African Museum.*—Annals, Vol. XIV, No. 2, Vol. XV, No. 3; Annual Report for 1915.

17. *Chicago, Field Museum.*—Zoological Series, Vol. X, No. 14; Ornithological Series, Vol. I, No. 10.

18. *Christchurch, Canterbury Museum.*—Annual Report for 1915.

19. *Claremont, Pomona College.*—Journal of Zoology, Vol. VII, No. 4.

20. *Colombo Museum.*—Spolia Zeylanica, Pt. XXXVIII; Annual Report for 1915.

21. *Copenhagen, Danish Biological Station.*—Reports X-XXIII.

22. *Copenhagen Museum.*—Danmark Expeditionen til Gronlands, Vol. III, Nos. 16-19; Danish Ingolf Expedition, Vol. III, No. 5.

23. *Copenhagen, Danske Naturhistoriske Forening.*—Videnskabelige Meddelelser, Vol. LXVII.

24. *Dublin, Royal Irish Academy.*—Proceedings, Vol. XXXIII, B. 1-3 and C. 1-11.

25. *Durban Museum.*—Annals, Vol. I, No. 3; General Guide to the Museum; Annual Report for year ending July 1915.

26. *Edinburgh, Royal Society.*—Proceedings, Vol. XXXVI, Nos. 1-2; Transactions, Vol. L, Nos. 3-4.

27. *Florence, R. Stazione Entomologia Agaria.*—Redia, Vol. XI, Nos. 1-2.

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CALCUTTA
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I. DESCRIPTION OF A NEW SPECIES OF ISOPODA OF THE GENUS *SYNIDOTEA*, HARGER, FROM THE GULF OF MANNAR.

By WALTER E. COLLINGE, *D.Sc., F.L.S., etc., Research Fellow of the University of St. Andrews.*

(Plate I).

Dr. Annandale has kindly submitted to me for examination and report, a small collection of Isopoda belonging to the family Idoteidae, from the Indian Museum collection.

As yet very little is known of the members of this family from the Indian Ocean, and although the different genera and species find their greatest development in the colder seas, there is every reason to suppose that there are many genera and species awaiting discovery in the Indian Ocean.

The present collection contains a single new species referable to the genus *Synidotea*, Harger, from coral reefs at Kilakarai, Gulf of Mannar.

The genus *Synidotea* was constituted by Harger[1] in 1878 for a group of Isopoda characterized by the following features:—a multiarticulate flagellum of the antennae, a 3-jointed palp on the maxillipedes, the absence of coxal plates on the dorsal side of the mesosomatic segments, a single metasomatic segment, and uropoda with an endopodite only.

Miers[2] regarded the genus, as known to him, as synonymous with *Edotia*, Guérin-Mén., but although these two genera, at first sight, appear very similar, they are quite distinct from one another.

In all there are some sixteen or seventeen species belonging to this genus, but the detailed structure of very few of them has been described and figured. Miss Richardson[3] has given figures of the maxillipedes of some species, but unfortunately these are incorrect in many cases.

The species here described is the first, I believe, that has been collected in Indian waters, the remaining species being distributed as follows:—

1. *S. hirtipes* (Milne-Edw.). Cape of Good Hope, South Africa.
2. *S hirtipes* var. *laevidorsalis* (Miers). Jatiyama Bay, Japan.

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1 *Amer. Journ. Sci.*, (Ser. 3), vol. XV, p. 374 (1878).
2 *Journ. Linn. Soc. Lond.*, vol. XVI, p. 65 (1881).
3 *Bull. U.S. Nat. Mus.*, no. 54, pp. 376-393 (1905).

3. *S. pallida*, Benedict. Choukof Island, Alaska.
4. *S. erosa*, Benedict. Sannakh Island, Alaska.
5. *S. nebulosa*, Benedict. Bering Sea, Alaska, etc.
6. *S. angulata*, Benedict. Off Cape Johnson, Washington.
7. *S. bicuspida* (Owen). Alaska, Bering Sea and Kara Sea.
8. *S. marmorata* (Packard). Labrador.
9. *S. laticauda*, Benedict. San Francisco Bay.
10. *S. harfordi*, Benedict. California.
11. *S. nodulosa* (Kröyer). Arctic Seas and Pacific Coast as far as British Columbia.
12. *S. laevis*, Benedict. Alaska and Bering Sea.
13. *S. consolidata* (Stimpson). Pacific Grove, California.
14. *S. muricata* (Harford). Arctic Ocean.
15. *S. picta*, Benedict. Alaska and Bering Straits.
16. *S. ritteri*, Richardson. San Francisco, California.
17. *S. setifer*, Barnard. South Africa.

Synidotea variegata, n. sp.

(Pl. I, figs. 1-10).

Body oblong-ovate, female rather wider than the male, dorsal surface convex, almost smooth. Cephalon (fig. 1) wider than long, narrowing posteriorly, frontal margin straight, posteriorly there is a deep transverse furrow. Eyes large and oval, situated in the middle of the extreme lateral margins. Antennulae (fig. 2) with the first joint expanded, second and third short and wide, subequal; flagellum nearly two and a half times the length of the last peduncular joint, setae in bunches. Antennae (fig. 3) first and second joints subequal, together equal to the third, fourth rather longer and narrower, fifth half again as long as the fourth; flagellum composed of 21 joints and small apical style. First maxillae (fig. 4) with outer lobe terminating in 8 denticulate spines, inner lobe terminally has 2 long setose spines and a small setule. Maxillipedes (fig. 5) short and wide, palp 3-jointed, basal plate short but prolonged on the inner margin anteriorly, epipodite broad and excavate on the posterior margin, distal inner lobe rounded terminally. Segments of the mesosome (fig. 7) 2-4 subequal, 5-7 somewhat shorter, pleural plates of first segment with anterior and posterior angles rounded, in 2-4 anterior angle is produced forward a little and posterior angle rounded, 5-7 truncate, coxal plates not present on the dorsal side. In the middorsal line of segments 2-4 is an arcuate depression towards the anterior margin (fig. 6). Thoracic appendages 2-4 small and directed forwards, 5-8 larger and directed backwards. Metasome (fig. 9) composed of a single segment with narrow lateral sutures indicating a further coalesced segment, terminal segment with straight lateral margins gradually narrowing posteriorly, posterior margin bluntly rounded with small median notch, dorsal surface very faintly keeled. Uropoda (fig. 10) with lateral margins almost straight, excepting at the hinge, rounded anteriorly and setose on the inner margin, on the outer posterior margin is a small denticulate spine; endopodite with straight inner margin and cut away on the outer side.

Length 7·5 mm. Colour (in alcohol) varying from a slaty-grey to yellow with irregular sepia-coloured markings.

Habitat.—Kilakarai, Ramnad District. From coral reefs. 12-ii-1913. No. $\frac{9306-09}{10}$ (*S. W. Kemp*).

Type.—In the collection of the Indian Museum.

This species exhibits a slight relationship to *S. harfordi*, Benedict and *S. angulata*, Benedict, from both, however, it differs in a number of structural features. It agrees with the former species in the form of the cephalon and in having the small rounded median notch or indentation on the posterior margin of the metasome. In the form of the mesosomatic and metasomatic segments it is not unlike *S. angulata.*

The mouth parts are undescribed for most species of this genus. In *S. variegata* the outer lobe of the 1st maxilla terminates in eight denticulate spines. Harger[1] states that in *S. nodulosa* (Kröyer) the outer lobe is armed with stout, curved, denticulate spines, and shows nine of these in his figure.

Stebbing[2] in his description of *S. hirtipes* (Milne-Edw.), states that there are ten or eleven spines on the outer lobe in that species, some of which are denticulate, and that the inner lobe is narrow at both ends and has two, rather long, plumose setae.

The 2nd maxilla in *S. nodulosa,* as figured by Harger, is very distinct from anything I have seen in any other species of this genus.

The maxillipedes of *S. variegata* are short and wide, a character common to most members of the genus.

The 2nd, 3rd and 4th segments of the mesosome are subequal and longer than the remaining three. This feature is more apparent in the wider female than in the male. All the segments are convex and the pleural plates of 1-4 stand out slightly. There is no trace of the coxal plates on the dorsal side.

In *S. harfordi* the lateral margins of all of the pleural plates are straight and in *S. angulata* the margins of segments 1-4 are angulate, those of 5-7 only being straight. In *S. variegata* the condition of the lateral margins of segments 1-4 and 5-7 forms a link between the two above mentioned species. In the 1st segment the angles are rounded anteriorly and posteriorly and in 2, 3 and 4 the anterior angle is produced forward slightly and the posterior angle rounded; the remaining segments are truncate.

The metasome is rather wider than in *S. harfordi*, and more bluntly pointed than in *S. angulata.*

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[1] *Rept. U.S. Fish and F. Comms.*, 1878 (1880), p. 299, pl. vi, fig. 35c.
[2] *South African Crust.*, pt. II, p. 61 (1902).

EXPLANATION OF PLATE I.

Synidotea variegata, n. sp.

FIG. 1.—Dorsal view of the cephalon. × 14.

,, 2.—Dorsal view of the left antennule. × 35.

,, 3.—Dorsal view of the left antenna. × 21.

,, 4.—Ventral side of the terminal portions of the inner and outer lobes of the left 1st maxilla. × 110.

,, 5.—Ventral side of the right maxillipede. × 56.

,, 6.—Fourth segment of the mesosome showing the arcuate marking.

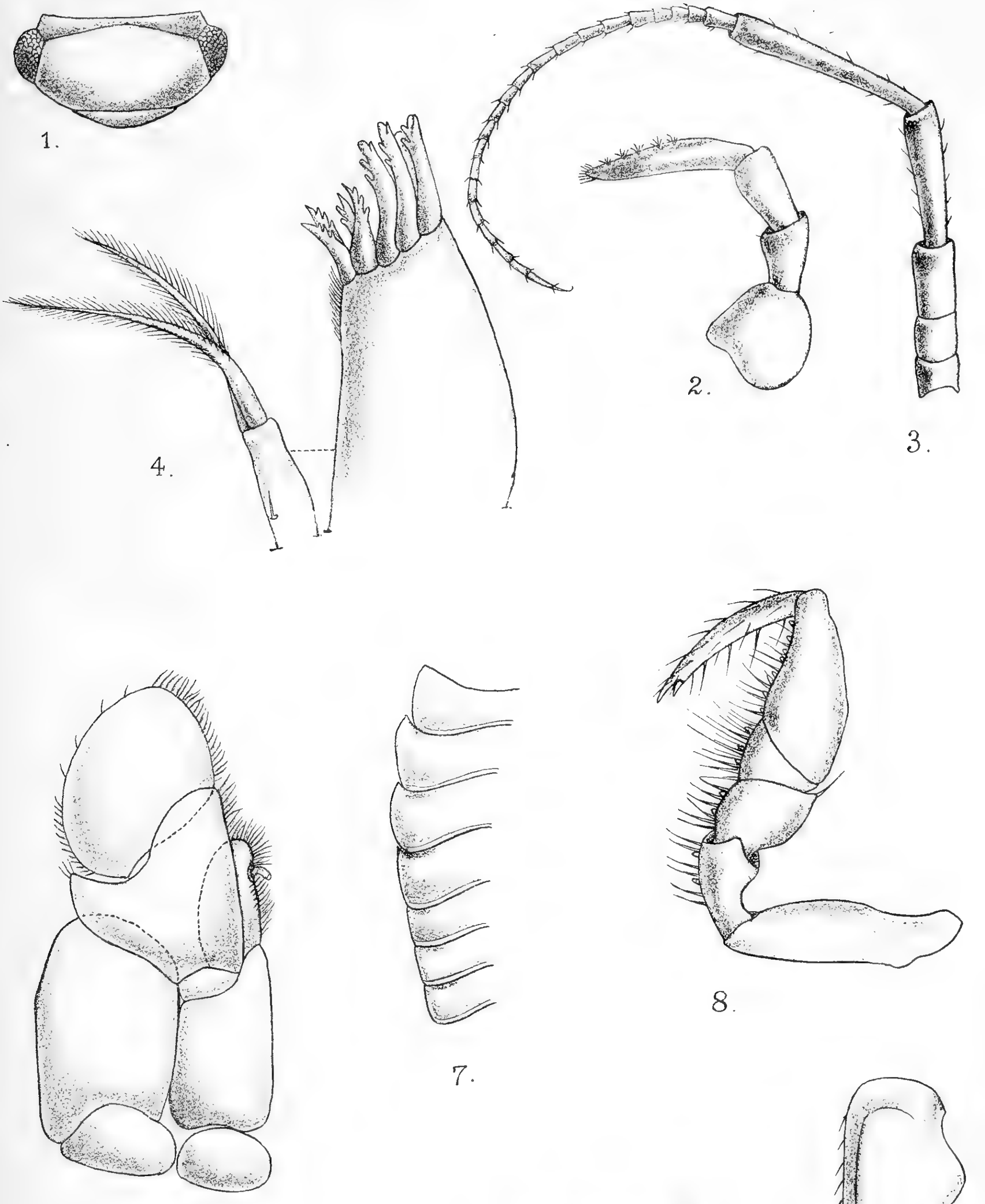
,, 7.—Dorsal view of the lateral portions of the mesosomatic segments. × 12·5.

,, 8.—Ventral view of the 2nd thoracic appendage. × 42.

,, 9.—Dorsal view of the metasome. × 15.

,, 10.—Right uropod. × 21.

I desire to express my thanks to the Executive Committee of the Carnegie Trust for a grant to defray the artist's charges for the above figures.



R.S.K, del.

A. Chowdhary, lith.

SYNIDOTEA VARIEGATA, n. sp.

II. NOTES ON THE TYPE SPECIMENS OF SOME BURMESE AND HIMALAYAN RATS.

By C. BODEN KLOSS, *F.Z.S.*

The authorities of the Indian Museum have recently lent me for examination the types of some long-described species in the collections at Calcutta, and these slight notes on some little-known animals and little-studied material may be of use to workers on Eastern mammals.

Rattus bowersi (Anderson).

Mus bowersi, Anderson, *Anat. and Zool. Res.*, p. 304, pl. xvii (1878); Thomas, *P.Z.S.*, 1886, p. 62; Sclater, *P.Z.S.*, 1890, p. 524, pl. xliv, fig. 2; *id.*, *Cat. Mamm. Ind. Mus.*, II, p. 62 (1891); Thomas (*partim*), *Ann. Mus. Civ. Gen.* (2*a*), X (XXX), p. 937 (1892).

Epimys bowersi, Thomas, *Journ. Bombay Nat. Hist. Soc.*, XXIV, p. 410 (1916).

The type is an adult female with slightly worn teeth collected by Anderson at Hotha, Kakhyen Hills, near Bhamo, Upper Burma. The body, which is preserved in alcohol, no longer serves to indicate the colour of the animal in life but shows that the pelage is of the same hispid type as in *R. berdmorei* (Blyth) and *R. ferreocanus* (Miller),[1] being composed of long, slender spines or bristles and a much softer under-fur.

The skull is in poor condition, as both the zygomata and the whole of the left side of the palate and tooth-row are broken, while the tips of all the incisors are much chipped The species, however, is now well-established and a good number of specimens are available for examination in the South Kensington and Genoa Museums.

Mr. Thomas (*Journ. Bombay Nat. Hist. Soc.* XXIV (1916), p. 409) has forestalled me in a comparison of this species with *R. ferreocanus* of the Malay Peninsula: while, however, he had at his disposal numerous specimens of *bowersi* but only one of *ferreocanus*, there are available to me, on the contrary, several examples of the latter in the collections of the Federated Malay States Museums, but only the type of *bowersi*.

Thomas states that *bowersi* is larger, having a greatest length of skull of 55—57 mm., while that of *ferreocanus* is about 53 mm. One of three adults skulls of the latter, however, measures 55·5, so it is not impossible that when a larger series is available we shall

[1] *Proc. Biol. Soc. Washington*, XIII, p. 140, pls. iii, iv, fig. 2 (1900); type from Trang, Peninsular Siam.

find that there is not the difference in size at present believed. The skulls of both are of the same elongate form, only slightly curved above from front to back,[1] but the bullae of *bowersi* are considerably larger and more dilated than those of *ferreocanus*: on the other hand the molars are smaller (both shorter and narrower), the alveolar lengths of the upper tooth-rows being respectively 8·7 and 9·4 in skulls of equal length. In the type of *bowersi* the incisors are light orange-yellow; in *ferreocanus* they are ivory with pure white tips. The latter, though a member of the *bowersi* group and representing it in the Malay Peninsula, appears to be a well-marked and distinct species.

Some measurements of the type skull of *bowersi* are:—greatest length, 54·0; condylo-basilar length, 47·8; basilar length, 44·7; palatilar length, 25·2; length of palatal foramina, 9·0; diastema, 17·0; upper tooth-row (alveolus), 8·7; nasals, 20·7×5·3; inter-orbital breadth, 8·0; greatest cranial breadth, 21·3.

2. **Rattus berdmorei** (Blyth).

Mus berdmorei, Blyth, *Journ. Asiat. Soc. Bengal*, XX, p. 173 (1851); *id.*, *op. cit.*, XXIII, p. 343 (1863); Sclater, *P.Z.S.*, 1890, p. 524; *id.*, *Cat. Mamm. Ind. Mus.*, II, p. 71 (1891).
Epimys berdmorei, Thomas, *Journ. Bombay Nat. Hist. Soc.*, XXIV, p. 413 (1916).

All that remains of the type of this species, which was obtained by Berdmore at Mergui, Tenasserim (and which is still unique), is a portion of the skull including the zygomata to their posterior roots and possessing above the greater part of the parietals, but lacking below the bullae and basioccipital, etc.

I am glad to find that Thomas (*l.c.s.*) shares my opinion that this species possesses the same large bullae as my *R. b. magnus* of South-Eastern Siam (*P.Z.S.*, 1916, pp. 57-61, text-figure 1, where details and measurements of the skull of *berdmorei* are also given). The mandible has disappeared but the upper incisors are of similar colour to those of *bowersi* and show the same lack of curvature.

3. **Rattus rattus robustulus** (Blyth).

Mus robustulus, Blyth, *Journ. Asiat. Soc. Bengal*, XXVIII, p. 294 (1859); *id.*, *op. cit.*, XXXII, p 343 (1863).
Mus rattus var. D. *rufescens*, Sclater, *Cat. Mamm. Ind. Mus.*, II, p. 66 (1891).

The type of this form, an adult male with slightly worn teeth obtained by Berdmore at Schwegyin, Tenasserim, is a spirit specimen with a practically perfect skull.

It shows the following external dimensions:—head and body, 163 (approx.); tail 153 (possibly slightly imperfect); hind-foot, 33·5; ear, 19·5.

[1] Sclater's figure is excellent; Miller's (*loc. cit.*, fig. 4) I regard as less satisfactory.

The colour of the pelage has been discharged and altered by spirit, but the fur of the undersurface was apparently white with a grey base and the hands and feet were white.

I am unable to say how the skull compares with other Indo-Chinese forms of *rattus*, but it is quite distinct from those of Central and South-east Siam or of the Malay Peninsula. The upper profile is less curved, the rostrum is lighter but longer and the bullae are much smaller and much less dilated, while the tooth-row, diastema and palate seem longer. As compared with two scarcely adult examples of "*rattus*" from Calcutta (the only Indian material to hand) the skull though of larger size with broader palatal foramina has again much smaller and more constricted bullae.

Measurements of skull: greatest length, 45·8; condylo-basilar length, 40·2; basilar length, 37·5; palatilar length, 21·8; palatal foramina, 8·9×3·3; diastema, 12·5; breadth of palate between anterior roots of m^3, 5·9; length of upper tooth-row (alveolar), 7·3; upper edge of ante-orbital foramen to tip of nasals, 15·9; nasals, 18×3·8; inter-orbital breadth, 6·5; zygomatic breadth, 21·0.

It is not easy to understand how Blyth subsequently (*J.A.S.B.*, XXXII, 1863, p. 342) considered this animal to be the same as his *Mus berdmorei*.

4. **Rattus concolor** (Blyth).

Mus concolor, Blyth, *Journ. Asiat. Soc. Bengal*, XXVIII, p. 295 (1859); *id. op. cit.*, XXXII, pp. 74, 344 (1863); Sclater, *P.Z.S.*, 1890, p. 526, pl. xliv, figs. 3, *a*, *b*, *c* (1890); *id.*, *Cat. Mamm. Ind. Mus.*, II. p. 68 (1891).

The types of this species, three specimens collected by Berdmore at Shwegyin, Tenasserim, and preserved in alcohol, are unsatisfactory. Specimen (*e*) of Sclater's catalogue is apparently adult though the teeth show no signs of wear, (*f*) is smaller than (*e*) and sub-adult with teeth quite unworn, while (*g*) is a juvenile. As the skull of (*e*) is unfortunately badly crushed I select the female specimen (*f*) as lectotype; for the skull figured by Sclater (*l.c.s.*) is evidently not one belonging to a member of the type series, but to some much larger individual. The skull (*f*) is complete and is in good condition except that the right parietal region is crushed inwards.

No colour details are available owing to long immersion in spirit.

Measurements of specimen (*f*):—head and body about 100 (108)[1]; tail, 112 (131); hind foot, 23·3 (25); ear, 13·6 (15).

Skull: greatest length, 29·0; condylo-basilar length, 25·0; basilar length, 23·0; palatilar length, 13·2; length of palatal foramina, 5·6; diastema, 7·5; length of upper tooth-row (alveolar), 4·9; length of nasals, 10·4; inter-orbital breadth, 4·5; zygomatic breadth, 14·2.

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[1] Measurements in parentheses are those of the male individual (*e*).

5. **Rattus blythi**, nom. nov.

Mus cinnamomeus, Blyth, *Journ. Asiat. Soc. Bengal*, XXVIII, p. 294 (1859); *id., op. cit.*, XXXII, p. 341 (1863).
Mus fulvescens, Thomas (*partim*), *P.Z.S.*, 1881, p. 537; Sclater, *P.Z.S.*, 1890, p. 524; *id., Cat. Mamm. Ind. Mus.*, II, p. 69 (1891).

Mus cinnamomeus, Blyth, was described from two individuals collected by Berdmore at Shwegyin, Tenasserim, one of which has been mounted while the other is a skin in alcohol: both are accompanied by somewhat damaged skulls.

I propose to regard specimen (*a*) of Sclater's catalogue as the type for Blyth's name; for the measurements given by him, in his first account, were obviously made on a skin, while it is highly improbable that the colours he gave were recorded from the spirit specimen when another was available.

The mounted individual is in poor condition, the ears are very imperfect and the entire tail is missing.

The absence of the latter is unfortunate; for apart from the greater size of the animal, the impression conveyed by its pelage is that it is a member of the *cremoriventer* group,[1] distinguished by the slightly pencillate, unicoloured tail (of which a large form, *E. tenaster*, has recently been described by Thomas from Mt. Muleyit, Tenasserim, 5000 ft.).[2] On the whole the spines of the dorsal pelage are much slenderer than those of *cremoriventer* but a few are present which approach them in breadth and stiffness.

The skull, with teeth only slightly worn, closely resembles those of aged examples of *cremoriventer* and appears to differ only in narrower, less spatulate nasals and broader ante-orbital plates: the bullae are quite of the "*jerdoni*" type—small, flattish and but little dilated.

The upper incisors are, however, much more curved backwards and both pairs are *ivory-white* with no tinge of orange on the exposed portion—a character quite unknown in any rats of this section. On account of these features I think we must regard this rat as an example of a distinct species, and since the name *cinnamomeus* is preoccupied (Pictet, *Not. Anim. Nouv. Mus. Gen.*, 1844, p. 64, pl. xix) I propose to call it *blythi* after its first describer.

The pelage was said to have originally the upper parts as bright, or scarcely less so, as the British dormouse; of a fine cinnamon colour with inconspicuous black tips, the under parts white abruptly divided from the cinnamon hue above. Length of head and body about 152; tail, 197; hindfoot, 32 mm.

The colour of the dorsal fur to-day is perhaps best described as somewhat between the "ochraceous-orange" and "ochraceous-tawny" of Ridgway[3] and grey at the base. The pure white

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[1] Miller, *Proc. Biol. Soc. Washington*, XIII, p. 144, pl. v, figs. 2, *a, b, c* (1900).
[2] Thomas, *Ann. Mag. Nat. Hist.*, (8) XVII, p. 425 (1916).
[3] *Colour Standards and Nomenclature*, 1912.

undersurface is sharply margined and extends down the inner and posterior sides of the fore-limbs on to the hands: the front and inner sides of the thighs are white also, but the white feet are isolated by a "cinnamon" band round the ankles, which colour also extends slightly down the median line of the metapodials.

Some measurements of the skull are:—greatest length about 38·0; palatilar length, 15·4; length of palatal foramen, 6·4; diastema, 9·4; upper tooth-row (alveolus), 6·0; nasals, 13·9×3·9; palatal breadth between last molars, 4·8.

6. **Rattus jerdoni** (Blyth).

Leggada jerdoni, Blyth, *Journ. Asiat. Soc. Bengal*, XXXII, p. 350 (1863).
Mus jerdoni, ? Thomas (*partim*), *P.Z.S.*, 1880, p. 537; Sclater (*partim*), *P.Z.S.*, 1890, p. 525; *id.*, (? *partim*), *Cat. Mamm. Ind. Mus.*, II, p. 69 (1891).
Epimys fulvescens, Wroughton, *Journ. Bombay Nat. Hist. Soc.*, XXIV, p. 427 (1916).

The type of Blyth's *Mus jerdoni* (specimen *m* of Sclater's catalogue) was collected at Darjeeling by Jerdon, and is in a very bad state of preservation. The skin has been mounted and is now much torn and discoloured with the tail broken. The skull, which appears to have been removed later, consists of little more than the anterior portion; one zygomatic arch is complete, though fractured, but the tips of the nasals are broken away. The mandible is in fair condition.

The skull is that of a very young animal as only the first two molars are in sight. The combined lengths of these two molars, upper and lower as far as they show, are 5·0 and 4·8 mm. respectively.

The colour was described by Blyth as being "bright dark ferruginous above, pure white below; some fine long black tips intermingled among the spines of the back; limbs marked with blackish externally; the feet white. Length about 102; tail, 76; hindfoot 22 mm."

It was originally therefore much darker in colour than *fulvescens*, "*cinnamomeus*," etc., but not greyish like *niveiventer*. The colour to-day is very near Ridgway's "cinnamon-brown" on the back, becoming "ochraceous-tawny" on the lower parts of the sides (the base of the fur, as usual, grey) and one does not receive the impression that the darkish tone is due to immaturity only. The distribution of white on the underparts is as I have noted in the case of Blyth's "*cinnamomeus*."

On the rump the darker-tipped, pale spines are slender and elastic but they are stiff and flattened on the sides and mid-body. *The outer sides of the ears are very thickly clad with comparatively long hair of the same colour as the head.* The tail appears to have been bicoloured as stated by authors subsequent to Blyth; it is clad with very fine short hairs.

Thomas in 1886 (and other writers have followed him) held that *jerdoni* could always be separated from *fulvescens* on account of its bicoloured tail, whereas in the latter the lower side was of the same tone as the upper: but quite recently Wroughton (*l.c.s.*) has come to the conclusion that *jerdoni* must be identical with *fulvescens* of which, therefore, it would be a synonym. I do not think, however, that we can yet take this as proved.

Associated with *jerdoni* by Sclater is a skull with much worn teeth from Darjeeling (specimen (*a*) of his catalogue). It most resembles the skulls of *cremoriventer* and of the type of "*cinnamomeus*" but is longer and relatively narrower with a rather long, pointed rostrum; the incisors are orange-coloured and are just a trifle more curved than those of the former. Available dimensions are:—greatest length, 40·0; condylo-basilar length, 32·8; basilar length, 30·3; palatilar length, 16·4; palatal foramina, 6·9×2·9; diastema, 10·0; upper tooth-row (alveolar), 6·3; palatal breadth between last molars, 4·3; posterior edge of ante-orbital foramen to tip of nasals, 13·2; nasals 15·3×4·5; inter-orbital breadth, 6·0; zygomatic breadth about 16·5; cranial breadth, 15·0.

III. NOTES ON *LACHESIS ANAMALLENSIS* AND ALLIED FORMS.

By C. R. Narayan Rao, *M.A., L.T., Mysore University, Bangalore.*

(Plate III).

I had an opportunity to examine recently a small collection of viperine snakes from Coorg and I noticed that the description of *Lachesis anamallensis* given by Boulenger in his volume on "Batrachia and Reptilia" (*Fauna of British India*, p. 430) really covers two distinct species. Obviously there is considerable divergence of opinion in regard to the specific characters of this viper. Major Wall gives sketches of it in his book on "*The Poisonous Snakes of India*", which do not quite fit in with Boulenger's description referred to above. For example, the figures indicate only one postocular and eight upper labials, while Boulenger makes out "two or three small postoculars and nine or ten upper labials." Moreover, Major Wall mentions (page 53) that small scales may or may not be intercalated between the nasal and the second labial, which fact is not noticed by any of the early writers.

Fayrer gives examples of specimens which differ from Günther's description of the scales on the head and on the body of *T. anamallensis* as being more or less distinctly keeled in twenty-one rows (*Thanatophidia*, p. 20). Jerdon regarded (*Journ. As. Soc. Bengal*, 1854, vol. XXII, p. 523) his *Trigonocephalus malabaricus* as very closely allied to *T. nigromarginatus*, forms which have since been considered identical respectively with *T. anamallensis* and *T. trigonophalus* (Boulenger, *Faun. Brit. Ind., Rept. and Bat.*, pp. 430-431). It is also noteworthy that Günther calls attention to Jerdon's reference to smooth scales in his description of *Trigonocephalus malabaricus* and he maintains that "they are keeled in our species as in all Trimeresuri." Further he proceeds to mention that "Mr. Elliot possesses a drawing of a young specimen, named *T. malabaricus* (Jerd.). It resembles our species in coloration, but has a white, black-edged temple-streak instead of a black one. Mr. Jerdon does not mention either a black or a white temple-streak" (*Rept. Brit. Ind.*, p. 387).

After examining the specimens in my collection I cannot resist the conclusion that these writers are really alluding to two distinct species which in certain respects possess common characters, and Boulenger's description accordingly requires, in my opinion, recasting; for his diagnosis of *T. anamallensis* is wide enough to receive several species of Trimeresuri. I make out that *Trigonocephalus malabaricus* is specifically distinct from *T. anamallensis*, and I give below separate diagnoses for them. I retain the specific name of the former species given by Jerdon.

Lachesis anamallensis [1] (Günther).

Trimeresurus anamallensis, Boulenger, *Faun. Brit. Ind., Rept.,* p. 430 (in part only); Günther, *Rept. Brit. Ind.,* p. 387.

Head considerably longer than broad, in the ratio of 5 to 3, and distinctly triangular. Snout far more acute than round, and the temporal swellings modest. Scales on the margin of snout in front more or less concave; they may form a distinct outer ridge in some cases. Scales on the head small, cycloid, slightly imbricate. Those on the snout and the scales adjacent to the supraoculars are slightly larger. Internasals separated by a big scale. Supraloreal descends to connect the nasal and the second upper labial which forms the anterior boundary of the facial pit. One or two intercalary scales between the nasal and the 2nd upper labial rarely absent. Rostral broader than deep. The upper margin of rostral visible from above. Supraocular faintly or distinctly divided into two. Seven to eleven scales between the supraoculars. Two or three postoculars and a single subocular. The second loreal slightly more than half the size of the first or the third. Nine or ten upper labials separated from the subocular by two rows of scales: the lower series consisting of bigger scales, the posterior ones keeled. Twelve to thirteen lower labials and seven sublinguals. In some specimens the fourth sublingual is quite as large as the first. Temporals fairly large and keeled.

Body. Neck very much narrower than the posterior region of body which is fairly rounded. Scales round the neck 23 to 26, in the middle of body and the preanal region 21 to 23. All the scales on the body keeled. Sometimes those on the posterior region smooth, hexagonal, non-imbricate. Scales on the thickest portion of the body large. Ventral shields: 147 (138 to 155, Boulenger).

Tail perfectly rounded, acutely pointed and strongly prehensile. In spirit specimens the tail may become twice coiled. Subcaudals, two rows 47 (44 to 58, Boulenger).

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[1] Major Wall adopts the nomenclature of Dr. Noguchi and perhaps the justification for such a procedure is that it is more convenient to have a common terminology. In such a case *Bothrops, Trigonocephalus, Trimeresurus* and *Lachesis* would be synonymous generic terms, but it is doubtful whether the generic identity of the Asiatic and the American species has been established. Dr. Noguchi agrees with Stejneger that the South American *Lachesis* is sufficiently characterized by the peculiar scutellation of the tail. Apart from this, the more or less prehensile nature and the shortness of the tail in the Asiatic forms and other general characteristics peculiar to this group are sufficient for Stejneger to employ the designation of *Trimeresurus* for these forms. But Noguchi considers that there is greater affinity between the Asiatic and New World pit-vipers than there are differences and accordingly uses the common generic name *Lachesis*. It has the merit of simplicity and in this paper his terminology is followed.

Colour. Green or sometimes yellowish, side of the belly with or without white spots: these are edged below by a black longitudinal band. The white spots when present become horseshoe-shaped markings in the preanal region. Dorsal surface with large oval or lozenge-shaped brown spots which run into a zigzag line posteriorly. Head mottled. Two roundish green or yellow spots on the front of the nape. Temporal streak present. A dark transverse line between supraoculars and another behind the internasals only in the green forms. Lips green, belly green, tail banded with brown or green stripes. Tail sometimes speckled. Young forms have a conspicuous black temporal streak. Body green. Tail banded by white bands which are incomplete. Tip of tail white (Total length $2\frac{1}{2}$ ft. Tail 4·5 inches, Boulenger).

Habitat. South India. This is a purely arboreal snake and its staple food consists of small birds, rodents and lizards. The colour of the body exactly harmonizes with its surroundings, variegated by light and shade, and the animal is thus able to attack victims without being noticed. The fangs are enormously big, a specimen 25 inches long may have fangs measuring nearly 12 mm. along the outer curve.

Lachesis malabaricus (Jerdon).

Trigonocephalus (Cophias) malabaricus, Jerdon, *Journ. As. Soc. Bengal,* XXII, p. 523 (1854).
Trimeresurus anamallensis, Boulenger, *Faun. Brit. Ind., Rept.,* p. 430 (in part).

Head. The interorbital space fairly deeply concave. Snout marked off from the head, with a conspicuous out-crop of large imbricate scales. Head (without the snout) squarish; temporal swellings conspicuous. Snout rounded. Rostral scale squarish. Internasal large, united or only separated anteriorly by a very minute white fleshy tubercle. The supraloreal forms the roof over a secondary pit formed by the nasal and the second labial, which are in contact. This secondary pit may or may not open into the loreal pit by a dorsal groove; the supraocular somewhat narrow, divided into three, clasped by two large scales; 6 to 8 scales between the supraoculars, faintly or obtusely keeled; 8 or 9 upper labials. The second praeocular always less than half the size of the first or the third which are nearly equal. Subocular large, single, and one large postocular or two small ones. Three small, very strongly keeled temporals, very often conical. Occasionally the first upper labial fused with the nasal. One large scale intercalated between the fourth and fifth upper labial and subocular. The series of scales between the subocular and the upper labials strongly keeled; ten lower labials and five sublinguals.

Body not fat. Neck about the size of the preanal portion; 21 rows of scales round the neck, round the thickest portion of the body and in front of the anal region; all strongly keeled. Ventral shields 150 to 160; anal entire, fairly large.

Tail perfectly triangular in cross section, not prehensile, subcaudals in two rows, 55 to 58.

Colour. Body rufous with broad brown bands; head also rufous. Spirit specimens show a broad temporal band with a few white dots in the centre, sometimes the whole surface of the body is brownish with deeper bands. Ventral surface steel bluish, a few white spots on the sides in the anterior third of the body. Tail dark with gray bands or dotted white. Ventral surface of the tip of the tail whitish with the extreme point black. Total length 19 inches, tail 3·5 inches.

Habitat. West coast of Peninsular India, including Coorg. This species is not arboreal like its congener *L. anamallensis*, but frequents low scrubby jungle full of dried twigs. The protective disguise is almost perfect and it is reported to be very fierce in its habits.

Lachesis coorgensis, sp. nov.

The collection of snakes received from Coorg, which forms the subject matter of this paper, included this species, a specimen of which I am sending to the Director of the Zoological Survey of India. I have named the snake after the place from where the specimens were obtained and it may be described as follows :—

Head perfectly oval, slightly broader than long, snout nearly squarish, passing insensibly into the head, temporal swellings large, scales of the head and snout moderate, smooth and imbricate. Internasals separated by a scale nearly as long, and the rostral broader than deep by at least 1 mm. A groove or a secondary pit formed by the supraloreal, nasal and the second upper labial may or may not be present. When present it opens behind into the loreal pit. The second loreal less than half the width of the first or the third, supraocular large, broken into three, sometimes into four divisions: one very large postocular, subocular sometimes divided, usually four small rounded smooth temporals. Nine upper labials, third and the succeeding ones separated from the suboculars by a row of three broad smooth scales. Sometimes an intercalary small scale between the third loreal and the supraocular, the same also separating the third labial and supraocular. Twelve lower labials and four sublinguals, the hinder scales of the temporal region very broad and keeled.

Neck and Body. Neck about the girth of preanal region or markedly narrower, scales round the neck 24, round the thickest portion of the body 21 to 23. In the preanal region 15 to 16. Ventral shields 152 to 153, the preanal incomplete and the penultimate shield notched in the middle, anal entire and broad.

Tail slightly prehensile, thick, truncated at the end; it is compressed and oval in cross section, with a small spine at the tip; subcaudals in two rows, 35.

Colour. Head brown, sometimes suffused with yellow, a very broad temporal band (conspicuous in spirit specimens) edged with white, rostrum and upper lip gray, lower lip either gray or brownish, body reddish-yellow with gray cross bands, ventrally grayish. Sometimes bluish with white spots all along the side, shaped, involving the lateral scale and half of the succeeding ventral shield. Colour markings on tail somewhat similar to those of *L. malabaricus*. Total length 23 inches, tail 2·5 inches.

Habitat. Coorg Town, alt. 3500-4000 ft. (South India). These specimens were found on an Acacia tree in a plantation and the protective colouration is most striking.

EXPLANATION OF PLATE III.

Lachesis anamallensis (Günther).

FIGS. 1-2.—Side and upper views of head after Major Wall.
,, 3-5.—Side, upper and lower views of head (type).

Lachesis malabaricus (Jerdon).

FIGS. 6-8.—Side, upper and lower views of head.

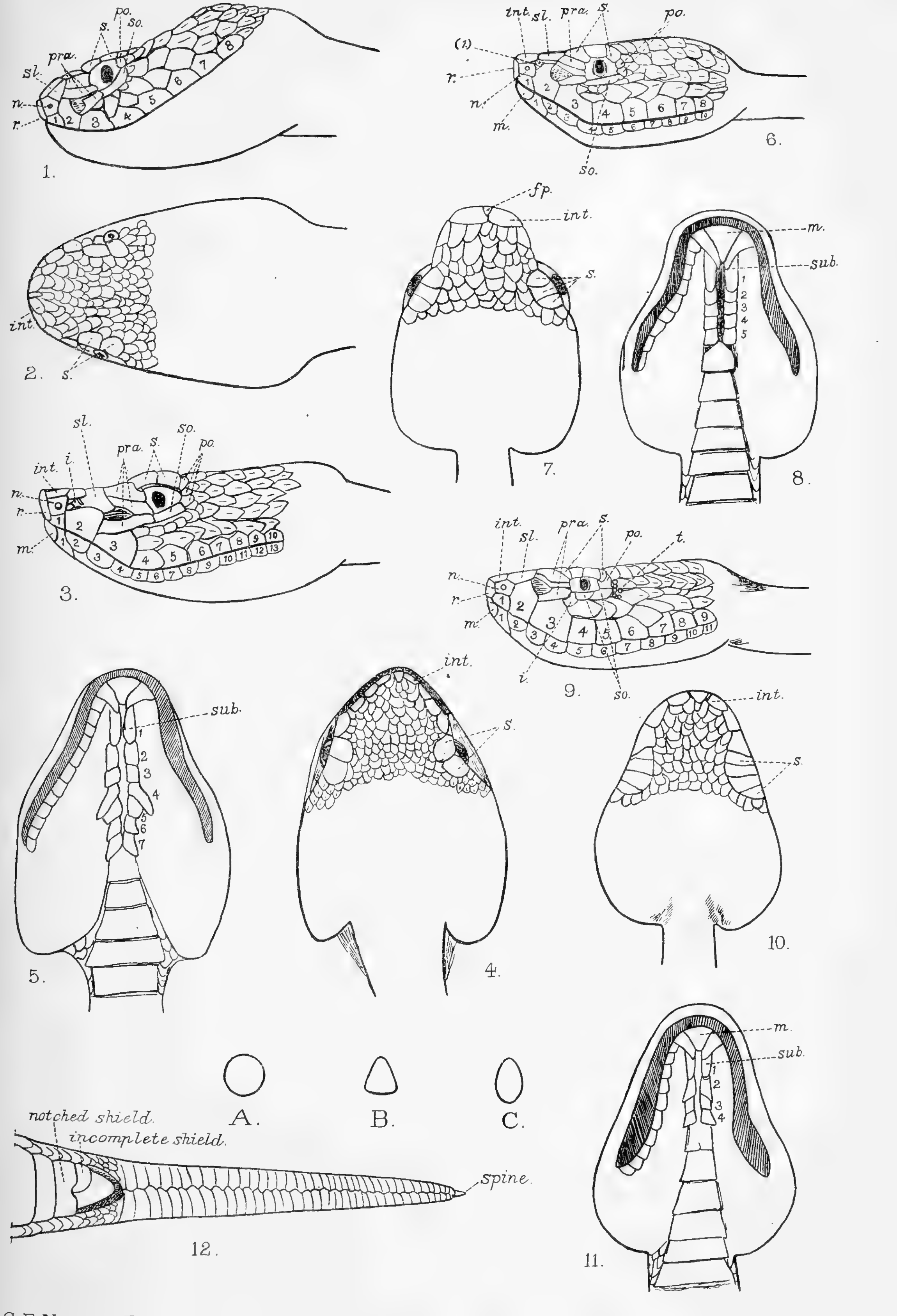
Lachesis coorgensis, sp. nov.

FIGS. 9-11.—Side, upper and lower views of head.
FIG. 12.—Under surface of tail.

LETTERING.

A. Section of tail in *L. anamallensis.*
B. ,, ,, *L. malabaricus.*
C. ,, ,, *L. coorgensis.*

(1.) = secondary pit: fp. = fleshy papillae: i. = intercalary scale: int. = internasal: n. = nasal: m. = mental: po. = postocular: pra. = praeocular: r. = rostral: s. = supraocular: sl. = supraloreal: so. = subocular: sub. = sublingual: t. = temporal.



C. R. Narayan Rao, del. A. Chowdhary, lith.

SOUTH INDIAN PIT-VIPERS.

IV. A NEW GENUS OF LIMBLESS SKINKS FROM AN ISLAND IN THE CHILKA LAKE.

By N. Annandale, *D.Sc., F.A.S.B., Zoological Survey of India.*

The island of Barkuda is situated in the extreme north-eastern corner of the Madras Presidency. It is about three quarters of a mile long by half a mile broad and lies in the Chilka Lake a mile off the mainland. The water[1] round it is always brackish but varies in salinity with the seasons.

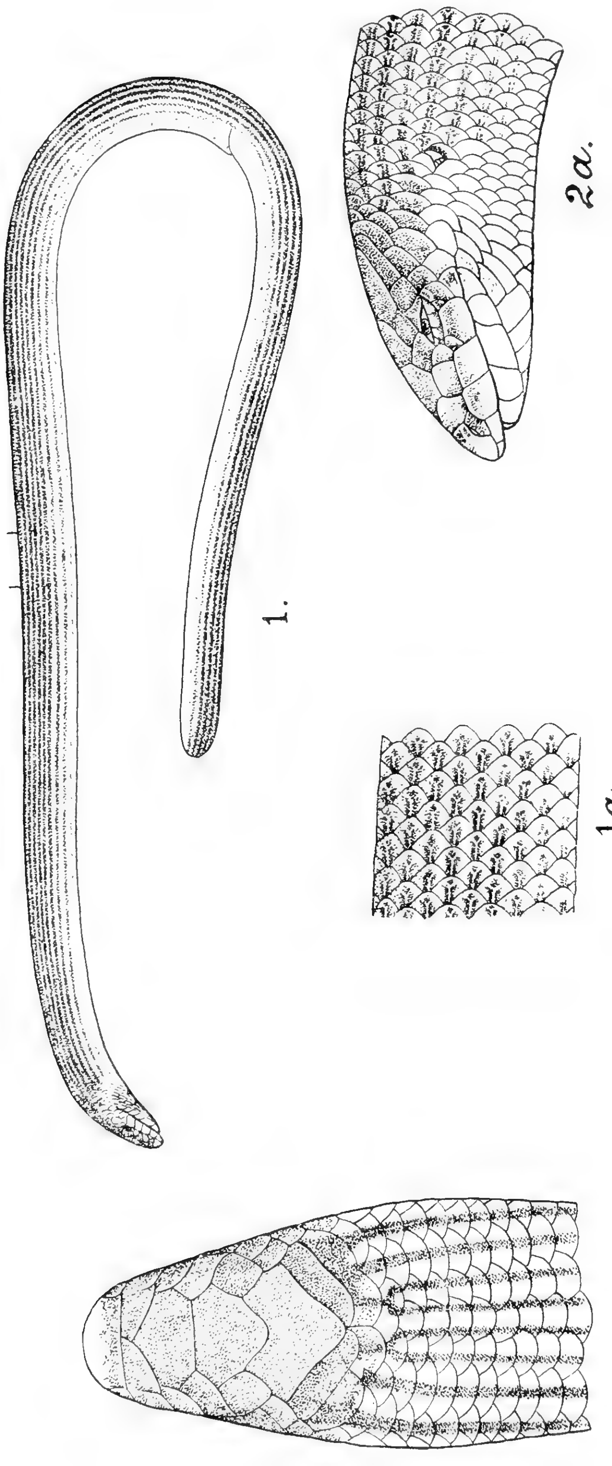
A stony laterite soil and a rainfall probably smaller than that of the neighbouring mainland and certainly never excessive do not encourage either a luxuriant growth of vegetation or the existence of a rich fauna, but the greater part of the island is covered with fairly dense jungle in which bushes and even large trees flourish in abundance. All these trees and shrubs have tough glossy leaves and a rather sombre foliage. The largest are figs of two species, the Banyan (*Ficus bengalensis*) and *Ficus rumphii*; the most abundant shrub is *Glycosmis pentaphila*, a common form in waste places in many parts of India. True xerophytic plants also occur, for example Cacti (*Cereus* and *Opuntia*), which have probably been introduced accidentally, and an indigenous tree-euphorbia (*Euphorbia nivula*). One of the few creepers, a vine with a curious segmented stem (*Vitis quadrangularis*), also belongs to this category.

There is no cultivation on the island, but paths have been cut, a considerable area cleared for the erection of a bungalow and wells and a small pond dug. The only permanent human inhabitant is the keeper of the bungalow.

The fauna of the island is even less rich than that of the plains of India generally and many species that are abundant on the adjacent mainland are here very scarce or altogether absent. The only terrestrial mammals are the Chital (*Cervus axis*), of which a small herd has been introduced by the owner of the island for sporting purposes, a large reddish mongoose (probably *Mungos smithii* or a local race thereof) and a form of the common Black Rat (*Rattus rattus*), which is fairly abundant round the bungalow.

There are no small Passerine birds in the woods. Most of the larger species that occur are forms of very wide distribution. Among the land-birds perhaps the commonest are the Indian

[1] See Annandale and Kemp, *Mem. Ind. Mus.*, V, p. 10 (1915).



Barkudia insularis, gen. et sp. nov.

FIG. 1.—Lateral view of the type specimen (× 1⅓).
,, 1*a*.—Lateral scales from near middle of body, further enlarged. The position of these scales is indicated in fig. 1 by two short vertical lines.
,, 2.—Head from above × 5.
,, 2*a*.—The same from the right side.

House-Crow (*Corvus splendens*) and the Jungle-Crow (*C. macrorhynchus*). Both of these fly over from the mainland in large numbers every evening to roost on the island, and a few individuals of both also spend the day there when the fruit of the Banyan, to which they are very partial, is ripe. The common Green Pigeon (*Crocopus chlorogaster*) is also common, and flocks of the Grey Hornbill (*Lophoceros griseus*) are often to be seen or heard.

The most noteworthy features among the Arthropoda are the small number of species represented, the absence of large or conspicuous forms (except among the Lepidoptera and Odonata) and the large proportion of predaceous species.

Perhaps the most interesting element in the fauna is that associated with the fig-trees and in particular with the Banyan. Apart from the species that feed on its fruit and leaves, which do not seem to be numerous, these animals live mostly either in dead wood or in the earth. The great horizontal branches of the Banyan are supported on vertical trunks that originate from them in the form of aërial roots, so reach the soil and then grow stout and trunk-like. These supports frequently rot away and then the branches fall in ruins on the ground. The fauna of their dead wood is comparatively poor, entirely lacking the Lamellicorn beetles found in dead wood in damper districts, but includes interesting beetles of the family Tenebrionidae, and species of the orders Thysanura and Collembola, as well as a considerable number of wood lice. The main trunks of the Banyan and also those of Rumphius's Fig are strengthened at their base by stout buttresses that project in such a way as to form pockets or recesses filled with loose soil. In these pockets flourishes a fauna rich in burrowing forms, many of which are predaceous. It includes a number of trap-door spiders (Mygalomorphae), several Myriapoda (among the most interesting of which is perhaps the curious little Scolopendrid centipede *Pseudocryptops agharkari*, Gravely[1]) and the only terrestrial earthworm[2] yet found on the island. It also includes the peculiar lizard which it is the main object of this paper to describe and two (*Typhlops acutus* and *T. diardi*) of the four snakes found upon the island.

Family SCINCIDAE

Genus **Barkudia**, nov.

The palatine bones do not meet in the median line of the palate, which is toothless. The teeth are conical. The eye is very small and surrounded by relatively large scales; the lower eye-lid is scaly, the upper eye-lid not developed. The ear-opening

[1] *Rec. Ind. Mus.*, VII, pp. 416-417 (1912). Dr. Gravely tells me that specimens from Barkuda represent the race (*singbhumensis*) he described from Chota Nagpur.

[2] Stephenson, *Rec. Ind. Mus.*, XII, pp. 340-341, pl. xxxiii, figs. 32, 33 (1916). Three aquatic species are found on the shore (see Stephenson, *Mem. Ind. Mus.*, V, pt. i, pp. 139-146, pl. x (1915), and V, pt. 6 (*ined.*).

is distinct but minute. The nostril is situated in a distinct nasal: it is remote from the first labial and separated from the rostral by a rounded tubercle. Three azygous shields exist on the top of the head; there are no praefrontals or frontoparietals. The body is elongate and snake-like, with no external trace of limbs.

Type-species.—Barkudia insularis, sp. nov.

The genus is closely allied to *Sepophis*, Beddome, which was described from almost the same part of India but from hilly country, and to *Chalcidoseps*, Boulenger, only known from Ceylon. It differs from both in the position and structure of the nostril.

Barkudia insularis, sp. nov.

The head is small, somewhat flattened above, triangular, but with the snout bluntly rounded in front; the snout projects far beyond the lower jaw. The rostral is large, the portion seen from above being considerably longer than the suture between the supranasals; the frontonasal is somewhat longer than the rostral, bluntly pointed in front, transverse, heptagonal; the frontal is broader than long and angularly emarginate laterally by the second supraocular; the interparietal is broader than long, emarginate anteriorly, hexagonal, larger than either the frontonasal or the frontal. The rostral extends beneath the nasal to the first labial; four upper labials are present, the second being the largest and the third entering the orbit; there are two scales between the orbit and the supranasals, both considerably larger than the nasal. There are three supraoculars but no true superciliaries: a single relatively large scale intervenes between the second and third supraoculars and the orbit. A small subocular is present near the anterior margin of the orbit, and a larger praeocular above it; there are two postoculars. The ear-opening is situated some distance behind the gape and is provided with minute lobules.

There are twenty scales round the body. There are two enlarged praeanals with a narrow scale external to each on either side of the vent.

The total length of the head and body is about 30 times the greatest breadth of the latter. The tail is stout, tapering very little and bluntly rounded at the tip.

The *colour* of the body is yellowish-white, with fourteen fine dotted longitudinal black lines on the back and sides; the head is blackish above, marbled with yellow, the tip of the snout yellow. The ventral surface is unspotted.

Measurements.

Total length	164 mm.
Head	9 ,,
Body	96 ,,
Tail	59 ,,
Greatest vertical diameter of body ..	5 ,,

Habitat.—Barkuda Island, Chilka Lake, Ganjam district, Madras Presidency.

Type.—No. 18075, *Rept.*, Zoological Survey of India (Indian Museum).

The only specimen of this species as yet known was dug from loose earth among the roots of a Banyan-tree (*Ficus bengalensis*) by Dr. F. H. Gravely in July, 1916. The earth was dry at the time.

The following is a list of the other terrestrial reptiles[1] known to me from Barkuda:—

Lizards.	Snakes.
Hemidactylus frenatus.	*Typhlops acutus.*
Hemidactylus brookii.	*Typhlops diardi.*
Calotes versicolor major.	*Dendrelaphis tristis.*
Varanus bengalensis.	*Bungarus caeruleus.*

The only frog is *Rana cyanophlyctis*, which is abundant in the small artificial pool in the middle of the island.

[1] For an account of the aquatic species see *Mem. Ind. Mus.*, V, pp. 167-174 (1915).

V. A LIST OF THE DRAGONFLIES RECORDED FROM THE INDIAN EMPIRE WITH SPECIAL REFERENCE TO THE COLLECTION OF THE INDIAN MUSEUM.

Part I. The Family Calopterygidae.

By F. F. Laidlaw, *M.A.*

(Plate II).

This is the first part of a series of papers in which I hope to give a full list of the dragonflies of the Indian Empire. The number of species occurring within the limits of the Empire is considerable, as one would expect from the size of the area under consideration, and from the great variety of physical conditions found in different parts of the country.

I hope that these papers will at least serve to show how little is known of this fascinating group of insects, and will stimulate those who are fortunate enough to have opportunities, to add to what is known of them, both of their life-history and of their distribution.

The material used in drawing up the list is as follows:—

Firstly, the large collection of the Indian Museum entrusted to me for revision by Dr. Annandale. The collection contains a very large number of specimens which have been named by the late Baron de Selys. These specimens although unfortunately often dilapidated have an historical value.

Secondly, an extensive collection of several hundreds of specimens sent to me by Mr. H. Stevens from Gopaldhara (Assam).

Thirdly, additions made to the Indian Museum collection in the last two years by members of the Museum staff.

Note on Classification adopted, and on nomenclature.

I follow here Needham in giving family rank to the first of the two great divisions of existing zygopterous dragonflies (Needham, *Proc. U.S. Nat. Mus.*, XXVI, p. 742; 1903).

This procedure is adopted by Ris in the paper quoted below, and in other recent papers; by Muttkowski and others.

Following the example set by Ris and Tillyard, two amongst the foremost entomologists of to-day, I retain for the family the name Calopterygidae, using the term as synonymous with Selys'

Calopteryginae, and equivalent to Kirby's Agrioninae. Further I propose in this series of notes to use the term Agrionidae as equivalent to Kirby's Coenagrioninae. I am aware that this is opposed to the views and practice of authorities on nomenclature. I comfort myself with the reflection that if I sin, it is in good company. Needham (*loc. cit.*) allows three subfamilies for existing Calopterygidae. One of these, Thorinae, is entirely (tropical) American. The second which he calls Vestalinae I prefer with Tillyard to label Calopteryginae; the third is his Epallaginae, less the genera *Rhinocypha*, *Micromerus*, *Libellago* (and *Rhinoneura*). I propose to erect a separate subfamily the Libellaginae to contain these. They form a compact natural group readily distinguished from the Epallaginae their nearest relatives. I admit that they are probably a specialized offset from the Epallagine series, but it is I believe convenient to contrast them with typical members of that series.

In the matter of quotations I give references as a rule only to papers published subsequently to Kirby's Catalogue of Odonata, and to that invaluable work of reference.

The following list of the Calopterygidae recorded from the Indian Empire includes 14 genera, or 66 per cent of the genera found in the Oriental Region, and no less than 35 per cent of all existing genera known ; allowing 40 genera for the whole world. And this wealth is the more striking in that Peninsular India and Ceylon are by no means rich in genera or species of the family.

The Indian genera fall into two main categories.

A.—Genera largely confined to the mountain-systems of the North-East, often extending east to China and even Japan.

CALOPTERYGINAE.	*EPALLAGINAE.*
Mnais.	*Bayadera.*
Matrona.	*Anisopleura.*
Caliphaea.	*Philoganga.*

B.—Genera with wide distribution in Indo-Malaya.

CALOPTERYGINAE.	*EPALLAGINAE.*	*LIBELLAGINAE.*
Neurobasis.	*Pseudophaea.*	*Rhinocypha.*
Vestalis.		*Micromerus.*

Lastly, *Echo* extending through Assam and Burma into China, reaches also down the Malay Peninsula into Sumatra.

Group (A) can be reinforced by sections of the genus *Rhinocypha*, viz. *unimaculata* and *trifasciata*.

Group (B) might reasonably include the section *fenestrata* of the same genus.

It will be noticed that Ceylon and Peninsular India have only representatives of group B.

Sub-family *CALOPTERYGINAE.*		Range. All tropical and temperate continental lands except Australia.
Genus	Species	
Echo		Assam, Burma, Malay Peninsula, S. China, Tonkin, Sumatra.
	margarita, Selys	Assam, Burma.
Mnais		Burma, Japan, China.
	andersoni, McLachlan	Burma, Yunnan.
	earnshawi, Williamson	Burma.
Matrona		Burma, Assam, West China, Japan, Tonkin.
	basilaris, Selys ? race *nigripectus*, Selys	Himalaya, Moupin, Indo-China, Burma, Assam.
	? sp.	Himalaya.
Neurobasis		Oriental Region to N. Guinea.
	chinensis (Linn.)	Oriental, with well-marked races in Celebes, Philippines and N. Guinea.
Vestalis		Indian Empire, Indo-China, Malay Peninsula and islands to Philippines.
	gracilis (Ramb.)	India, Ceylon, Burma, Assam, Tonkin.
	apicalis, Selys	Ceylon, S. India.
	smaragdina, Selys	Burma, S. China.
Caliphaea		Nepal, Assam, S. China.
	confusa, Selys	Nepal, Assam.

Sub-family *EPALLAGINAE.*		Tropical continental lands (except Africa and Madagascar), S. E. Europe, Asia Minor.
Genus	Species	
Bayadera		Himalaya, Indo-China, S. China.
	indica (Selys)	Darjiling, Assam.
	hyalina, Selys	Khasia Hills, Kurseong, Formosa.
Epallage		Greece, Asia Minor, Persia, Kashmir.
	fatima (Charp.)	As genus.
Anisopleura		Himalayas to Burma.
	comes, Hagen	Himalayas to Assam.
	lestoides, Selys	Himalaya, Tonkin.
	furcata, Selys	Burma.
Pseudophaea		Indian Empire, Indo-China, S. China, Malaya to Philippines.
	dispar (Ramb.)	Nilghiri Hills.
	ochracea (Selys)	Burma to Malay Peninsula, Indo-China (Borneo?).
	brunnea (Selys)	Burma to Indo-China.
	masoni (Selys)	Burma, Indo-China.
	splendens (Selys)	Ceylon.
	carissima, Kirby	Ceylon.
Philoganga		Himalaya, S. China.
	montana, Selys	Darjiling.

Sub-family *LIBELLAGINAE*		Old-world Tropics.
Genus	Species	
Rhinocypha		India (excl. Ceylon), Assam, Burma, Oriental Region to N. Australia and Solomon Is.
group *trifasciata*	*trifasciata*, Selys	Darjiling and westward.
	bifasciata, Selys	Assam.
	immaculata, Selys	Assam, Khasia Hills.

group *fenestrella*	*cuneata*, Selys	Darjiling to Assam.
	fenestrella spuria, Selys	Khasia Hills, Burma.
	,, *quadrimaculata*, Selys	Himalayas to Burma.
group *trimaculata*	*trimaculata*, Selys	Assam.
	unimaculata, Selys	Himalaya, Darjiling to Assam.
	ignipennis, Selys	Assam.
group *fenestrata*	*iridea*, Selys	Burma.
	bisignata, Selys	Deccan.
	perforata (Perch.)	Burma, Siam, Malay Pen., Hainan.
	biforata, Selys	Burma, Siam, Malay Peninsula.
	whiteheadi, Kirby	Assam, Tonkin, Hainan.
Micromerus		India, Ceylon, Indo-China, Malaya, Philippine Is., Celebes.
	lineatus (Burm.)	India, Ceylon, Assam, Burma, Malaya.
	finalis, Selys	Ceylon.
Libellago		Tropical Africa, Burma to Philippine Is.
	asiatica, Selys	Burma, Tonkin, Philippine Is.

The accompanying diagram will serve to show at a glance the distribution of Indian genera so far as it is known to me. Genera occurring in neighbouring subregions which do not extend into the limits of India are named in brackets. Dotted lines between districts are intended to show that the faunistic relations of such districts are very close. I should add that the diagram was suggested to me by those in Mr. Beddard's book on Zoogeography.

Genus **Echo**, Selys.

1. **Echo margarita**, Selys.

Echo margarita, Kirby, *Cat. Odonata*, p. 101 (1890).
,, ,, Laidlaw in *Fascic. Malayenses* (Zoology), pt. I, p. 192 (1903).

1 ♂. Cherrapunji, Assam. $(\frac{8201}{20})$, x-14 (*S. W. Kemp*).
Type locality of the species.

When I defined the genus *Climacobasis* for a male specimen of the species which I then called *C. lugens*, I had not seen a male example of this species, or indeed of any species of the genus *Echo*. The present example differs from the female in having an elongate pterostigma, exactly like that of my *Climacobasis*. The only character then separating *Climacobasis* from *Echo* falls to the ground and *Climacobasis* must be regarded as a synonym of *Echo*.

The following list of the species of the genus may be useful:—

Echo margarita, Selys.

Echo margarita, Kirby, *Cat. Odonata*, p. 101 (1890). Loc. Assam.
Race *tripartita*, Kirby, *Cat. Odonata*, p. 101 (1890). Khasia Hills.

Echo uniformis, Selys.

Echo? uniformis, Kirby, *Cat. Odonata*, p. 101 (1890). Sumatra.
Echo uniformis, Kruger, *Stettin Entomol. Zeit.*, 1898, p. 72.
Echo iricolor? Kruger, *loc. cit.*, p. 72.

Echo incarnata, Karsch. S. China.

Echo incarnata, Karsch, *Berlin. Ent. Zeitschr.*, XXXVI, p. 455 (1891).
,, ,, *id.*, *Entomol. Nachr.*, XX, p. 84.

PALAEARCTIC REGION.

KASHMIR

Epallage 1
(? *Calopteryx*)

HIMALAYA

**Rhinocypha* 2

Matrona 1 *Bayadera* 2
Neurobasis 1 *Anisopleura* 2
Caliphaea 1 *Philoganga* 1
**Rhinocypha* 3

ASSAM

Echo 1
Matrona 1
Neurobasis 1
Vestalis 1
Caliphaea 1

Bayadera 2
Anisopleura 2
**Rhinocypha* 4
Micromerus 1

INDO-CHINA

Psolodesmus
Calopteryx
Dysphaea
Tetraneura

IRANIA

CENTRAL INDIA

Neurobasis 1
Micromerus 1
Vestalis 1 ?

BURMA

Echo 1
Matrona 1
Mnais 2
Neurobasis 1
Vestalis 2

Bayadera 2
Anisopleura 2
Pseudophaea 6
**Rhinocypha* 4
Micromerus 2
Libellago 1

DECCAN

W.

Neurobasis 1 *Pseudophaea* 1
Vestalis 2 *Rhinocypha* 1
Micromerus 1

E.

Neurobasis 1
Vestalis 2 (?)
Rhinocypha 1 ?
Micromerus 1 ?

MALAYA

Dysphaea
Tetraneura

CEYLON

Neurobasis 1 *Pseudophaea* 2
Vestalis 2 *Micromerus* 2

* Numbers after *Rhinocypha* refer to groups not species.

Archineura basilactea, Kirby, *Ann. Mag. Nat. Hist.* (6) XIII, pp. 84-86, text figs. (1894).
,, ,, *id.*, *op. cit.*, pp. 455-456.
Archineura incarnata, M'Lachlan, *Ann. Mag. Nat. Hist.* (6) XVII, p. 370 (1896).

Echo modesta (Laidlaw). Malay Peninsula.

Echo modesta, Laidlaw, *Proc. Zool. Soc. London*, 1902 (1), p. 84, pl. vi fig. 6.
Echo (*Climacobasis*) *modesta*, Laidlaw in *Fascic. Malayenses* (Zoology), pt. I, p. 191 (1903).
Climacobasis modesta, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 186, fig. 17 (1904).
Climacobasis lugens, Laidlaw, *Proc. Zool. Soc. London*, 1902 (1), p. 85, pl. vi, fig. 5.

Echo maxmia, Martin. Tonkin.

Echo maxmia, Martin, *Mission Pavie*, Neuroptères (sep.), pp. 16-17.

The confusion which has arisen in the synonymy of this interesting genus appears to me to be due to the fact that de Selys founded the genus on a female specimen of *E. margarita* the wings of which he figured.

The females of all the species of the genus so far as is known have very small trapezoidal pterostigmata. When attempting to find a place for the male of *E. modesta* I was struck by the considerable length of the pterostigmata which contrast markedly with the small corresponding structure of the female (see Williamson's photographic figures, *loc. cit.*).

When Selys described the male *E. margarita* he did not call attention to this difference in the sexes, and I was not aware of its existence.

The male of *E. uniformis*, however, appears from Kruger's account to have a small pterostigma like the female.

The same peculiarity evidently largely induced Kirby to erect the genus *Archineura* for the large *E. incarnata*, but he had a further justification in the dense reticulation of the anal area in that species. I do not know the female of this species, nor have I seen an example of Martin's *E. maxmia*, but I am now of the opinion that all these species may properly be referred to the Selysian genus.

Genus **Matrona**, Selys.

2. **Matrona basilaris**, Selys.

Matrona basilaris, Kirby, *Cat. Odonata*, p. 100 (1890).
,, ,, McLachlan, *Ann. Mag. Nat. Hist.* (6) XVII, p. 370 (1896).
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15 (1904).
Matrona nigripectus, Kirby, *loc. cit.*, p. 100.
,, ,, Martin, *loc. cit.*, p. 15.
Matrona basilaris race *nigripectus*, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 52 (1891).
See also Foerster, *Ann. Soc. Ent. de Belgique*, XLI, p. 206 (1897).

I have before me eight examples of the genus representing probably two distinct races, and have examined the material in the

British Museum. The former include 1 ♀ "Upper Assam." Length of hind-wing 49 mm.; breadth of hind-wing 17 mm. Neuration especially at base of wings more complicated than in other specimens ($\frac{1623}{9}$).

2 ♂ ♂ 2 ♀ ♀ Cherrapunji, Assam, alt. 4,000 ft., taken by S. W. Kemp.

Length of hind-wing,	♂	.. ..	37·5 mm.
,, ,, ,,	♀	.. ..	37 ,,
Breadth ,, ,,	♂	.. .	12 ,,
,, ,, ,,	♀	.. ..	12 ,,

2 ♂ ♂ 1 ♀ Shillong, Khasia Hills ($\frac{6306\text{-}6307}{20}$).

Length of hind-wing,	♂	.. ..	41 mm.
,, ,, ,,	♀	.. .	44 ,,
Breadth ,, ,,	♂	.. ..	14 ,,
,, ,, ,,	♀	.. ..	14·5 ,,

The males agree in colouring with the race '*nigripectus*.' It is evident that more material is required here to estimate specific values.

Genus **Mnais**, Selys.

3. **Mnais andersoni**, McLachl.

Mnais andersoni, Kirby, *Cat. Odonata*, p. 101 (1890).
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 485 (1891) (*partim*).
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 185 (1904).

The Museum collection contains a single adult male of this species, in poor condition. It is from Leito in Burma, and bears a label written by de Selys. ($\frac{3920}{13}$).

4. **Mnais earnshawi**, Williamson.

Mnais earnshawi, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 185, fig. 16 (1904).
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 485 (1891) (*partim*).

Not in the Museum collection. I have not seen an example of this species.

Known only from Burma. Distinguished from *M. andersoni*, so far as the males are concerned, by the venation of the wings being yellowish red, in *andersoni* it is black.

Genus **Vestalis**, Selys.

5. **Vestalis smaragdina**, Selys.

Vestalis smaragdina, Kirby, *Cat. Odonata*, p. 103 (1890).
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 488 (1891).
,, ,, subsp. *velata*, Ris, *Supplementa Entomologica*, No. I, p. 56, t. iv, fig. 2 (1912).

2 ♀ ♀ 1 ♂ Cherrapunji, Assam, 4,400 ft., 2—8-x-14 (*S. W. Kemp*) ($\frac{8189}{20}$).

Recorded from Khasia Hills; Meteles (Burma) by de Selys; Moupin (*M'Lachlan*); Tsa-Yin-San (Kwang-Tung) by Ris as subspecies *velata*.

6. Vestalis gracilis (Ramb.).

Vestalis gracilis, Kirby, *Cat. Odonata*, p. 102.
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 55 (1891).
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 183, fig. 15 (1904).
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15.
,, ,, Laidlaw, *Rec. Ind. Mus.*, VIII, p. 340.

The limits of the range of this species are not sufficiently known. Williamson records it for Burma and Lower Siam. The Abor Expedition obtained examples in Assam, and I have specimens from Gopaldhara taken by Mr. Stevens. The Museum has specimens from Sibsagar ($\frac{6303}{20}$). Also the Museum collection includes spirit specimens from Cochin State, 5 ♂ 4 ♀, which are certainly *gracilis*. They differ from the Assam-Burmese specimens in one respect, the metallic colouring of the body is coppery in hue, that of the eastern and northern specimens is brilliant emerald green.

I have not seen specimens from the great river-valleys; nor yet from the hills west of Assam, but the collection contains a damaged female specimen from Cutch ($\frac{2923}{4}$).

7. Vestalis apicalis, Selys.

Vestalis apicalis, Kirby, *Cat. Odonata*, p. 102.
Neurobasis apicalis, *id.*, *Proc. Zool. Soc. London* 1891, p. 204, pl. xx, fig. 2.
Vestalis apicalis, *id.*, *Journ. Linn. Soc.* (*Zool.*) XXIV, pp. 558-559 (1893).

A characteristic species of Ceylon and apparently also of Southern India. I found one specimen a female in a tube with three examples of *V. gracilis*, taken apparently at the same time and in the same place with them in Cochin State ($\frac{8225}{20}$).

The collection includes also an imperfect male ($\frac{3915}{13}$) and an immature female ($\frac{3918}{13}$), both from Ceylon. I have also seen examples from Kadur district (Mysore) in the British Museum.

Genus Caliphaea, Selys.

8. Caliphaea confusa, Selys.

(Pl. II, fig. 1).

Caliphaea confusa, Kirby, *Cat. Odonata*, p. 108.
Notholestes elwesii, McLachlan, *Ent. Mon. Mag.*, XXIV, p. 31 (1887).
,, ,, Kirby, *Cat. Odonata*, p. 111.
See also McLachlan, *Ann. Mag. Nat. Hist.* (6) XVII, p. 371 (1896).

The position of the genus is obscure. Features of the neuration worthy of remark are: the petiolation of the wings, the position of the nodus at one-third of the wing length from the wing base, and the characters of the sectors of the quadrilateral. These points I think all suggest specialization. The metallic body-colour and the shape of the anal appendages of the male may indicate a relationship to the Calopteryginae, rather than to the Epallaginae. I am inclined to regard *Caliphaea* as an early off-shoot from the main Calopterygine stem which has undergone specialization along lines of its own. I am indebted to Mr. Stevens for specimens and to Messrs. H. and F. E. Campion for the photograph showing the wings of a male.

Genus **Anisopleura**, Selys.

9. **Anisopleura lestoides**, Selys.

Anisopleura lestoides, Kirby, *Cat. Odonata*, p. 108.
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 489.

I have examined specimens of this form from the neighbourhood of Darjiling, and from Mr. Stevens's collection from Gopaldhara, where the species appears to be abundant.

10. **Anisopleura comes**, Hagen.

Anisopleura comes, Kirby, *Cat. Odonata*, p. 108.
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 459.

This, the largest species of the genus, is common near Darjiling, and I have seen specimens from Kurseong (*N. Annandale*) as well as many from Gopaldhara in Assam (*H. Stevens*). The latter are distinctly smaller than those from further west. I have also seen specimens from the Forestry Research Museum taken near Bhowali, Kumaon.

11. **Anisopleura furcata**, Selys.

Anisopleura furcata, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 488 (1891).
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 181, fig. 13.

Recorded by Selys from Puepoli in Burma (*loc. cit.*), where it was collected by Fea.

Genus **Bayadera**, Selys.

12. **Bayadera indica** (Selys).

Bayadera indica, Kirby, *Cat. Odonata*, p. 108 (1890).
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15.
,, ,, Ris, *Supplementa Entomologica*, No. I, p. 49 (1912).

Specimens are in the Museum collection from Lord Carmichael's collection, taken in May in the Darjiling district at an altitude of from 1,000-3,000 ft. above the sea. (c.c. 1163, etc.).

13. **Bayadera hyalina**, Selys.

Bayadera hyalina, Kirby, *Cat. Odonata*, p. 108.
,, ,, Ris, *Supplementa Entomologica*, No. I, pp. 50-52, text-fig. 3, taf. iv, fig. 1 (1912).

Recorded from the Khasia Hills by Selys. A single damaged and very mature male collected by Mr. Stevens probably belongs to this species. It has the wings evenly tinged with yellow, so that at first sight it resembles somewhat *Euphaea ochracea*.

Genus **Pseudophaea**, Kirby.

14. **Pseudophaea dispar** (Ramb.).

Pseudophaea dispar, Kirby, *Cat. Odonata*, p. 109 (1890).

Not in the Museum collection. Known from Southern India only.

15. **Pseudophaea splendens** (Selys).

Pseudophaea splendens, Kirby, *Cat. Odonata*, p. 110 (1890).
,, ,, *id.*, *Jour. Linn. Soc. London (Zool.)* XXIV, p. 560 (1893).

2 ♂ ♂ Nalanda, Ceylon. ($\frac{3899}{13}$).

This fine species is I think a local development of the stock to which also *P. variegata* (Ramb.) belongs.

16. **Pseudophaea carissima**, Kirby.

Pseudophaea carissima, Kirby, *Journ. Linn. Soc. London (Zool.)*, XXIV, pp. 559-560 (1893).
,, ,, var. *viridissima*, *id.*, *loc. cit.*

Evidently closely allied to *P. splendens*.

Not in the Museum collection. I have examined the type and other specimens in the British Museum.

17. **Pseudophaea masoni** (Selys).

Pseudophaea masoni, Kirby, *Cat. Odonata*, p. 110.
,, ,, *id.*, *Ann. Mag. Nat. Hist.* (6) XIV, p. 113 (1894).
Euphaea masoni, Laidlaw, *Fascic. Malayenses* (Zool.), Pt. I, p. 194.
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15 (1904).
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 182 (1904).

Not in the Museum collection.

In addition Martin (*loc. cit.*) gives *Pseudophaea bocki*, McLachlan as a species from 'India.' This is a Sumatran species which he records also from Tonkin. As he does not give a more precise localization I only make note of it here and hope that I shall be able to get fuller information from Mr. Martin later.

18. **Pseudophaea ochracea** (Selys).

Pseudophaea ochracea, Kirby, *Cat. Odonata*, p. 109
Euphaea ochracea, Selys, *Ann. Mus. Civ. Genova*, (2) X, pp. 56-57 (1891).
,, ,, Laidlaw, *Proc. Zool. Soc. London* 1902 (i), p. 87.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 181, fig. 14 (1904).
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15 (1904).

The Museum collection contains only a single damaged male of this species. It is fairly common in the Malay Peninsula. The Museum specimen is from Puepoli, Burma.

19. **Pseudophaea brunnea** (Selys).

Pseudophaea brunnea, Kirby, *Cat. Odonata*, p. 109.
Euphaea brunnea, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 57.
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 15 (1904).

This is a large form closely allied to the smaller *P. ochracea*. A very similar large species or subspecies from Lombok has been named *Euphaea lava* by Foerster, but I am not able to find the reference.

P. brunnea is not in the Museum collection.

Genus **Philoganga**, Kirby.

= *Anisoneura*, Selys (nom. praeocc.).

20. **Philoganga montana** (Selys).

Philoganga montana, Kirby, *Cat. Odonata*, p. 111.
See also Ris, *Supplementa Entomologica*, 1912, No. 1, pp. 44-48, fig. 1.

The position of this remarkable genus in the subfamily Epallaginae is doubtful. Other genera included by Selys in the legion *Amphipteryx*, which do not concern us here, though not necessarily allied to *Amphipteryx* will also probably require to be removed from the subfamily.

Genus **Rhinocypha**, Ramb.

This is the most characteristic genus of dragonflies of tropical Asia, striking both in respect of the great beauty and brilliance of its members and of the abundance of species. In the whole Oriental Region the island of Ceylon and the great valleys of N. India alone are lacking in representatives.

The arrangement I have adopted in the following list differs a little from that hitherto used, especially in the grouping together of *R. unimaculata* and *R. trimaculata*. I believe these species to form a natural group within the genus. I hope that students who have the good fortune to be able to study these fascinating and exquisite insects in the field will soon furnish us with information as to their life-history and habits.

Mesothoracic triangle reaching the antealar sinus.
Triangle very large, rather rounded at apex ... Group *trifasciata*.
Wings of male opalescent, hind-wings with opaque bands ... ... spp. *trifasciata, bifasciata*.
Wings colourless in both sexes... ... sp. *immaculata*.
Triangle large, pointed at apex; in the female in some cases not reaching the antealar sinus. Wings of males broad, with brilliant amethyst irridescence and rich purple opacities ... Group *fenestrella*.
Mesothoracic triangle not extending one-half the length of the mid-dorsal carina. Wings of males

narrow, with amethyst irridescence and purple opacities ... ... Group *fenestrata*.
No mesothoracic triangle; wings of males with rich coppery irridescence. Tibias and femurs of females with light marks on anterior surfaces ... Group *unimaculata*.

The males of the groups *immaculata*, *fenestrella* and *fenestrata* all have the anterior surfaces of the hinder pairs of tibias of a beautiful chalky white colour, which, as Annandale has remarked, are shown conspicuously by them when mating. Of the group *unimaculata*, the species *unimaculata* has this surface of the tibias of a yellowish colour, *trimaculata* is said by Selys to have them "probably whitish" (Selys, *Monograph. Calopt.*, p. 212); *ignipennis* seems to be without this character. In passing it may be remarked that the males of the Bornean species *R. cucullata*, Selys, have the anterior surface of the two hinder pairs of tibias not white but of a vivid chalky blue.

Group IMMACULATA.

21. **Rhinocypha trifasciata,** Selys.

(Pl. II, fig. 2).

R. trifasciata, Kirby, *Cat. Odonata*, p. 113 (1890).

5 ♂ ♂. Kailana, N.-W. Provinces (*J. C. Moulton*).

It seems likely that this form has a westernly distribution, whilst the next, *viz. R. bifasciata*, Selys, is its representative in Burma and Assam.

22. **Rhinocypha bifasciata,** Selys.

R. bifasciata, Kirby, *Cat. Odonata*, p. 113.

3 ♂ ♂. Gopaldhara (*H. Stevens*).

This form is so closely allied to the preceding that it may be treated as a local race; or, by reason of its differences from *R. trifasciata* being constant, as a distinct species according to the views held by the list maker. I prefer to treat it as distinct as a matter of convenience.

1 ♀ (?). Gopaldhara, 4-x-14 (*H. Stevens*).

The mesothoracic triangle is continued up to the antealar sinus, the outer two-thirds of the pterostigma is of a bright-yellow colour. The mesothoracic triangle is not by any means as broad as in the female of *R. immaculata*, where it equals in size that of the male. Antero-lateral bands and postero-lateral spots are present on segments 2, 3, 4 of the abdomen. The specimen is fully adult.

23. **Rhinocypha immaculata,** Selys.

R. unimaculata, Kirby, *Cat. Odonata*, p. 113 (misprint).
R. immaculata, *id.*, *ibid.*, p. 186.

2 ♂ ♂ 3 ♀ ♀ ($\frac{8203}{20}$), Cherrapunji, Assam, 4,400 ft., 2—8-x-14 (*S. W. Kemp*).

The female differs from the male in colour, mainly in that the markings on the head and dorsum of the thorax are of a yellowish green colour instead of being bright blue. The large mesothoracic triangle, so conspicuous in the male, is outlined in colour but its central part is black. The abdomen has an antero-lateral stripe on segments 2, 3, as well as a postero-lateral spot of yellow colour on the same segments. The latter mark only is present in the male, at least when adult. The rest of the abdomen in both sexes is black.

The anterior surface of the two posterior pairs of tibias of the male is white and the curious exudation, referred to by de Selys (*loc. cit.*), is well seen in the spirit specimens.

Group UNIMACULATA.

24. **Rhinocypha unimaculata**, Selys.

(Pl. II, fig. 3).

R. unimaculata, Kirby, *Cat. Odonata*, p. 113 (1890).

This is the largest of all Indian species of the genus. It is abundant from Darjiling to Assam, but the limits of its range are not known.

The dimensions of a male specimen are:—

Length of hind-wing	..	31 mm.
,, ,, abdomen	..	24 ,,

25. **Rhinocypha trimaculata**, Selys.

R. trimaculata, Kirby, *Cat. Odonata*, p. 113.

The locality 'Thibet' given for this species by Selys should almost certainly be rather Assam. I have not seen an example of this, one of the smallest and probably one of the rarest of the *Rhinocyphas*; it is closely allied to *R. ignipennis*.

26. **Rhinocypha ignipennis**, Selys.

R. ignipennis, Kirby, *Cat. Odonata*, p. 113.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, pp. 179-181.

2 ♂ ♂ ($\frac{8202}{20}$), Cherrapunji, Assam. 1 ♂, 1 ♀ ($\frac{8283}{20}$), Shillong, Assam, 4,900 ft.

The female specimen has the anterior surface of the femurs marked with white.

Group FENESTRELLA.

This group is restricted entirely to the mainland of Asia ranging from the Himalayas to the extremity of the Malay Peninsula. The species or races present marked individual variation, and in view of this I think it well to treat some of the species as local races, a course already suggested by de Selys in his paper on the Dragonflies of Burma (*Ann. Mus. Civ. Genova*, (2) X (XXX), p. 491, 1890) for *spuria* and *quadrimaculata*. I have not seen an example of Foerster's *R. adamantina*, but I think it will be found to be a race of *cuneata*.

The members of this group are I think the most brilliantly coloured and beautiful of all the genus.

A. Apical spot on hind-wing always approaching to within two cell-rows of anterior wing margin (post-nodal costal and post-nodal radial rows).
Large species (hind-wing 26 mm. long or more).
Range: Himalaya, Darjiling eastwards ... *R. cuneata*, Selys.

B. Apical spot on hind-wing never less than 4 cell-rows from anterior wing margin ... *R. fenestrella*, Ramb.
a. Large form, hind-wings 25 mm. or more in length.
Range: Khasia Hills ... ... race *spuria*, Selys.
b. Smaller form (hind-wings 23 mm. or less in length).
Northern race.
Range: Himalaya (Darjiling) to Burma race *quadrimaculata*, Selys.
Southern race
Range: Burma; Siam to Singapore ... race *fenestrella*, Ramb.

27. **Rhinocypha cuneata**, Selys.

(Pl. II, fig. 4).

R. cuneata, Kirby, *Cat. Odonata*, p. 113.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 173.

Specimens examined from Darjiling District and Gopaldhara, 16 ♂♂, 2 ♀♀.

Scarcely two of the males are alike in detail, though the general resemblance is close. Variation consists chiefly in differences in size of the apical hyaline spot of the hinder wing, and in the extent of subdivision of the median series of spots; in the example figured (from Gopaldhara) this series is broken into three areas, more usually it consists of two only; one specimen shows three on one side and two on the other. The average length of the hind-wing of the male is about 27·5 mm., extreme measurements are 26·5 mm. and 28 mm.

28. **Rhinocypha fenestrella quadrimaculata**, Selys.

R. quadrimaculata, Kirby, *Cat. Odonata*, p. 112.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 176, fig. 8.
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 17.

Specimens examined from Darjiling District, Sikkim, Gopaldhara, Narbong Valley, Tenasserim.

Average length of hind-wing (22 specimens) 22·5 mm., extremes 21·5—23 mm.

Williamson (*loc. cit.*) has pointed out that *quadrimaculata* may be distinguished from *fenestrella* by having the anterior of the median row of spots decidedly nearer the nodus, and the middle spot of the row about half the length of the anterior and posterior spots; in *fenestrella* the three are more often sub-equal (see his figures 8-11, *loc. cit.*). Specimens of *quadrimaculata* from Darjiling have occasionally all the spots of the median row quite small though there is marked individual variation both in these and in the size of the apical spot.

On the whole, however, it is correct to say that the specimen figured by Williamson, which is from Burma, is less easy to distinguish from *fenestrella* than the average specimen from Darjiling so far as my experience goes.

29. **Rhinocypha fenestrella spuria**, Selys.

R. spuria, Kirby, *Cat. Odonata*, p. 113.
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 59.

2 ♂♂, Khasia Hills, old Museum collection.

Labelled by de Selys *R. quadrimaculata*.

Length of hind-wing 28 mm.

These specimens from their size and their locality are evidently examples of the race described as *R. spuria* by de Selys. Except on account of their large size I believe they cannot be distinguished from typical *quadrimaculata*.

De Selys gives the length of the hind-wing of his examples as 26-27 mm.

There are two males in the British Museum collection which I believe belong to this race. They are labelled from the Chin Hills, Burma.

30. **Rhinocypha iridea**, Selys.

(Pl. II, fig. 5).

R. iridea, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), pp. 492-494 (1891).

This beautiful species is not represented in the Museum collection. There are several examples in the British Museum.

It occupies a position somewhat isolated in the group to which it belongs. Its wings are distinctly wider than in other species of the *fenestrata* series, and the colour pattern is to some extent, I think, intermediate between the typical *fenestrata* forms and the *quadrimaculata* group. I am inclined to regard it as an annectant species between the two groups. In its own group its nearest ally would appear to be *R. fenestrata* (Ramb.) of Java. The present species is probably confined to Burma.

31. **Rhinocypha biforata**, Selys.

R. biforata, Kirby, *Cat. Odonata*, p. 114.
,, ,, Laidlaw, *Proc. Zool. Soc. London*, 1902 (i), p. 88.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 179, fig. 12 (1904).

Ranges from the Malay Peninsula to Burma. Not in the Museum collection.

32. Rhinocypha bisignata, Selys.

(Pl. II, fig. 6).

R. bisignata, Kirby, *Cat. Odonata*, p. 114.

3 ♂♂, Parambikulam, Cochin State, 1700—3200 ft. ($\frac{8263}{20}$).

Resembles *R. biforata* in general in the colour pattern of the wings, and is probably closely allied to that species, "representing" it in S. India. It differs from other species of the section to which it belongs in the body-colours, the markings being of an orange red here whilst other species have them lilac or blue.

So far as is known this is the only representative of the genus found in Peninsular India, and it does not reach Ceylon. Compare the distribution of another equally characteristic Indo-Malayan genus *Draco*.

See note under *R. perforata*, the next species.

33. Rhinocypha perforata perforata (Percheron).

R. perforata, Kirby, *Cat. Odonata*, p. 114 (1890).
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 17.
,, *inas*, Laidlaw, *Proc. Zool. Soc London*, 1902, pp. 88-90, pl. vi, fig. 6.
,, *apicalis*, Laidlaw in *Fascic. Malayenses* (Zoology), part I, p. 196.
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 174.

Not in the Museum collection. The species *inas* from Perak is at best a local race of this species; I am not able to compare series from different localities, but I am inclined to think that the name cannot stand, whereas *whiteheadi*, Kirby, is tolerably well marked, and has been accepted as distinct by Martin. Of the value of Selys variety *limbata* (Kirby, *loc. cit.*) I cannot speak with any certainty, again for lack of material. Kruger (*Stettin Entomol. Zeitung*, 1898, p. 79) has named a species from Sumatra as *R. bisignata*, Hagen ? = *apicalis*, sp. n. Foerster (*in litt.*) has identified therewith my species *inas* which would then become a synonym of *R. apicalis*, Kruger. One may say with conviction that the species *bisignata*, Hagen, does not occur in Sumatra. Kruger's account of *apicalis* is totally inadequate, but Williamson has accepted the species and says (*loc. cit.*) that he cannot separate *inas* and *whiteheadi* therefrom. But as *inas* is I think beyond question a synonym of *perforata* it follows that *apicalis* must take the same place.

34. Rhinocypha perforata whiteheadi, Kirby.

(Pl. II, fig. 7).

R. whiteheadi, Kirby, *Ann. Mag. Nat. Hist.* (7) V, p. 536, pl. xii, fig. 4.
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 17.

A single male from Sibsagar, collected by S. E. Peal ($\frac{6310}{20}$).

This is the most northernly record that I know of for any species of the *fenestrata* group of the genus.

R. whiteheadi would seem to be the northern race of the *perforata* series. It is distinguishable from the typical *perforata* by the following characters :—

(*a*) Absence of the backward prolongation along the costal margin of the fore-wing of the dark colouring.

(*b*) Absence of the hyaline border which lies along the anal margin of the coloured parts of both wings.

Genus **Micromerus**, Ramb.

35. **Micromerus lineatus**, Burm.

M. obscurus, Kirby, *Cat. Odonata*, p. 115.
,, *lineatus*, *id.*, *loc. cit.*
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), p. 62 (1891).
,, ,, Laidlaw in *Fascic. Malayenses* (Zoology), pt. I, p. 197 (1903).
,, ,, Williamson, *Proc. U.S. Nat. Mus.*, XXVIII, p. 171, figs. 5, 6 (1904).

I think that *M. obscurus*, Kirby, is a young specimen of *M. lineatus*. It is at any rate so immature that no determination from a single specimen can be satisfactory. The species ranges from Ceylon through India to Assam and down the Malay Peninsula.

One of the smallest of all the Calopterygidae, it has a more extensive range than any, save a very few.

I have seen a specimen from Gopaldhara, Assam, taken by Mr. Stevens, with the note, 'undoubtedly rare.'

I believe that Martin regards the Ceylon species as worth subspecific rank, and refers to the same subspecies examples from the Andaman Islands.

36. **Micromerus finalis**, Selys.

M. finalis, Kirby, *Cat. Odonata*, p. 115.

A species apparently peculiar to Ceylon.

Micromerus blandus, Selys, from the Nicobar Islands is no doubt a local race of *M. lineatus* and is probably the same as that from Ceylon which Martin regards as subspecifically distinct. I have seen in the British Museum examples labelled by Mr. Martin from Ceylon and from the Andamans, with a varietal name. This name has not been published and is not likely to be for some time. As I do not wish to anticipate Mr. Martin, I will do no more than refer to the matter here.

Genus **Libellago**, Selys.

37. **Libellago asiatica**, Selys.

Libellago asiatica, Kirby, *Cat. Odonata*, p. 112.
,, ,, Selys, *Ann. Mus. Civ. Genova*, (2) X (XXX), pp. 58-59.
,, ,, Martin, *Mission Pavie*, Neuroptères (sep.), p. 17.

I have not seen an example of this species. Williamson (*Proc. U.S. Nat. Mus.*, XXVIII, p. 173) records without reference *L. vittata*, Selys, evidently referring to Sely's report of the species from Burma. I cannot find a reference to *vittata* but Selys (*loc. cit.*) comments on differences between the Burmese specimens and typical examples from the Philippine Islands.

Genus **Epallage**, Charp.

38. **Epallage fatima** (Charp.).

E. fatima, Kirby, *Cat. Odonata*, p. 108.
" ,, Morton, *Trans. Entomol. Soc. London*, 1907, p. 305.

The inclusion of this Mediterranean species serves only to emphasize the strongly Palaearctic character of the Odonate fauna of Kashmir.

EXPLANATION OF PLATE II.

FIG. 1.—Wings of *Caliphaea confusa* ♂.

,, 2.— ,, *Rhinocypha trifasciata* ♂, from Kailana.

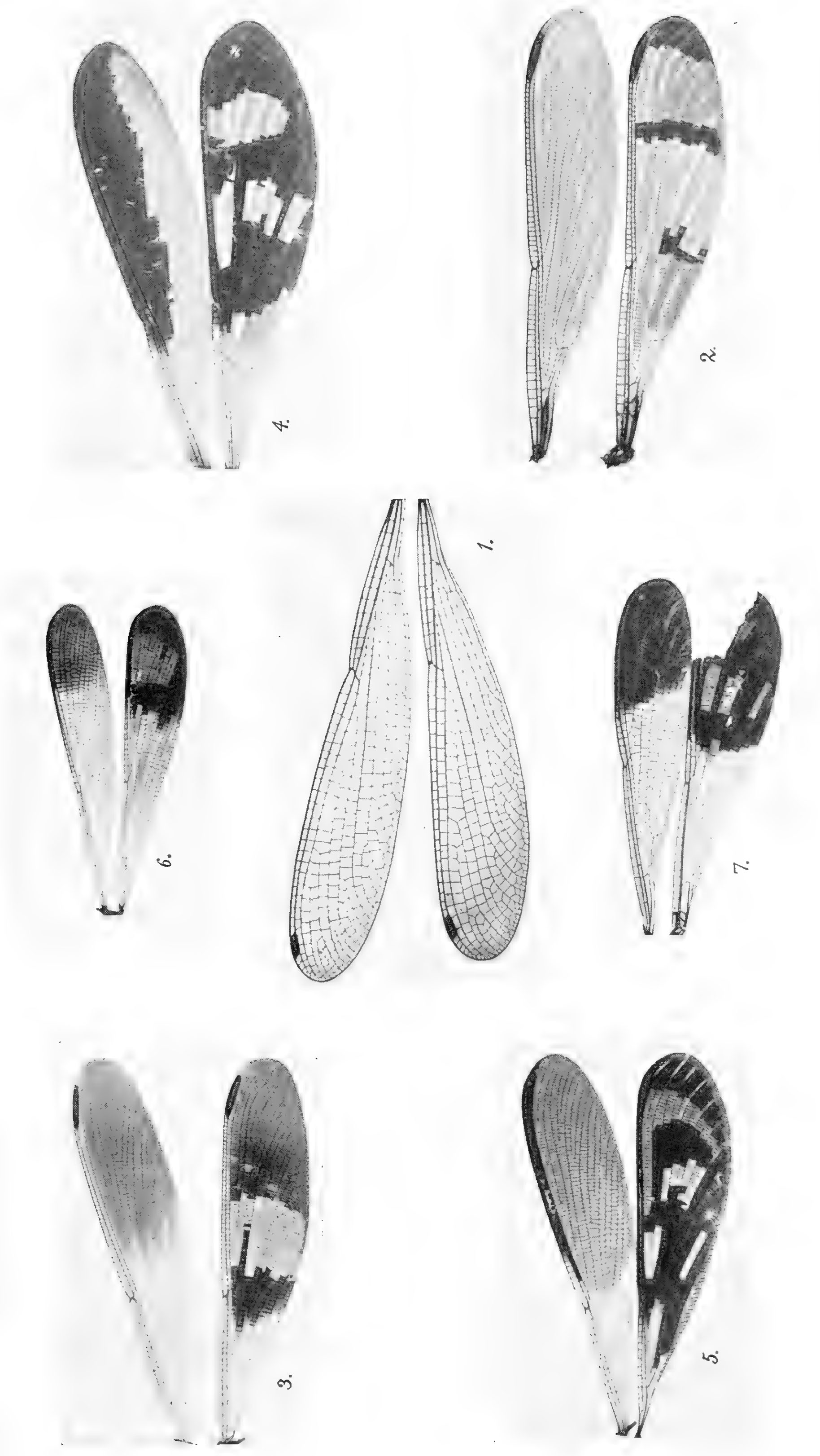
,, 3.— ,, *Rhinocypha unimaculata* ♂, from Darjiling.

,, 4.— ,, *Rhinocypha cuneata*, from Gopaldhara (*H. Stevens*.)

,, 5.— ,, *Rhinocypha iridea* ♂, from specimen in the British Museum.

,, 6.— ,, *Rhinocypha bisignata* ♂, from Cochin State.

,, 7.— ,, *Rhinocypha perforata whiteheadi* ♂.



INDIAN CALOPTERYGIDAE.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

VI. ON TWO NEW SUBSPECIES OF SQUIRREL FROM SOUTHERN INDIA.

By H. C. ROBINSON, *C.M.Z.S.*

Funambulus tristriatus annandalei, subsp. nov.

Type. Adult female. Indian Museum No. 8498, skin and skull (lower mandible missing), collected at Sasthancotta, west side of Western Ghats, Travancore, on 8th November, 1908, by Dr. N. Annandale.

Diagnosis. A large richly coloured form allied to *F. t. tristriatus* (Waterh.), but larger, smaller than *F. t. wroughtoni*, Ryley,[1] from Coorg. Longitudinal stripes on back narrow, whitish, traceable to neck. Saddle black, tail with white tips to hairs exceptionally well developed, anal region and midrib to tip rich chestnut.

Colour. Head and cheeks to behind the eye ferruginous, speckled with black, richest on top of head, rest of upper surface speckled black, greyish and fulvous, the rump with a strong ferruginous suffusion, the longitudinal stripes almost pure white, narrow and well defined except on the back of the neck, "saddle" almost pure black; hands speckled greyish black, feet with a more fulvous tint. Tail black, with broad white tips to the hairs and a buff basal and sub-basal band, when viewed from above; beneath rufous chestnut basally, black mesially, with the apical part broadly white, anal region chestnut, undersurface pure white.

Dimensions. External measurements, taken in the flesh: head and body 170 (195)[2]; tail 161 (172); hindfoot 46[3] (35); ear 20 (18) mm.

Skull. Total length, 43·2 (48); condylo-basilar length, 37·8 (44·2); diastema 10·4 (11·6); length of upper molar series, including *pm.* 8·4 (9·5); zygomatic breadth, 24·5 (26·7); median length of nasals, 14·0 mm.

Specimens examined. Five skins and skulls, four from the type locality, and one from an unknown locality.

Remarks. In default of authenticated specimens from Madras I have taken modern skins from Kanara[4] as typical of

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[1] Ryley, *Journ. Nat. Hist. Soc. Bombay*, XXII, p. 437 (1913).

[2] Measurements in parentheses are those of the type of *Funambulus wroughtoni.*

[3] 40 mm. measured dry.

[4] Since the date of this manuscript, and after I had returned the specimens to India, the description of yet another subspecies of *Funambulus striatus, F. t.*

F. palmarum tristriatus, Waterh., though it is by no means impossible that these will prove to represent yet another form. The present race will probably prove to be confined to the forest country west of the Ghats in Travancore, being the analogue of *F. palmarum comororinus*, Wroughton. The differences in size have already been noted by Wroughton (*Journ. Nat. Hist. Soc. Bombay*, XVI, p. 411, 1905).

Funambulus layardi dravidianus, subsp. nov.

Type of the subspecies. Immature skin and skull. Indian Museum No. 9773, collected by Dr. N. Annandale on the western side of the Western Ghats, Travancore.

Diagnosis. Differs from the type in having the top of the head and cheeks rich rufous orange, and the undersurface yellowish orange instead of dull chestnut. Area between the light bands on the back, deep lustrous black.

Skull. The specimen is quite immature with the deciduous premolars in place, and is much damaged so it is useless giving any measurements.

Remarks. It is unfortunate that there is no original label attached to this specimen and that there are therefore no measurements to be quoted.

It however serves to confirm Jerdon's statement that the species is found in Southern India, and I have therefore ventured to name it. It is to be hoped that further specimens may shortly be available.

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numarius was published by Mr. Wroughton (type from Helwar, Satara District). Kanara specimens are stated to be "clearly intermediates between this form and *tristriatus*, but as they approach more nearly to the present form they may be reckoned as *F. t. numarius*" (*Journ. Nat. Hist. Soc. Bombay*, XXIV, p. 646, 1916).

VII. NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

VIII. The genus *Acetes*, Milne-Edwards.

By Stanley Kemp, *B.A., Superintendent, Zoological Survey of India.*

In attempting to determine a large collection of Decapod Crustacea recently made by Dr. Annandale in Japan, China and Lower Siam, I found it impossible to come to a satisfactory decision regarding the identity of a species of *Acetes*, and it was only after examining the series of unidentified specimens in the Indian Museum that any definite conclusion was reached. It is with the results of this examination that the present short paper is concerned.

In the first of his classical memoirs on the genus *Sergestes* Dr. Hansen remarked,[1] "Of *Acetes* 2 species are known (one of which has not been examined since 1837), but we possess 6 species, the distinctive characters of which are very curious; it is, however, impossible to give a good idea of the species.... without a considerable number of figures." Twenty years have elapsed since this statement was made, but Dr. Hansen has unfortunately not made any further contribution to the subject. Although two additional species have been described, their characters are very imperfectly known and no fresh account of *A. indicus*, the species for which Milne-Edwards founded the genus *Acetes*, has appeared. *Acetes indicus* has indeed been several times recorded from various localities, but it is, I believe, quite impossible to recognize the species from the original description: all definite specific records are therefore open to doubt.

The collection in the Indian Museum is not so rich as that in the University of Copenhagen, but comprises four distinct forms; three of these—all occurring in Indian waters—are in my opinion to be referred to known species, to *A. indicus*, Milne-Edwards, *A. japonicus*, Kishinouye, and *A. erythraeus*, Nobili; the fourth, obtained in Borneo, is undescribed. One described species, *A. americanus*, Ortmann,[2] is not represented in the collection.

The four forms examined show the closest affinity with one another and all agree in the complete suppression of the last two pairs of peraeopods—the character on which Milne-Edwards established the genus.

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[1] Hansen, *Proc. Zool. Soc. London*, 1896, p. 937.
[2] Ortmann, *Decap. Schizop. Plankton-Exped.*, p. 39, pl. ii, fig. 2 (1893).

In distinguishing the species the most important indications are those derived from adult males. The form of the petasma is a most reliable and satisfactory guide and, according to my observations, an absolute criterion of specific identity, while good characters are also to be obtained from the sexual modifications of the external flagellum of the antennule. In three of the four species the ultimate segment of the antennular peduncle of the male is always elongated to a very remarkable degree, a great contrast existing in this respect between the two sexes. It is curious that this very striking feature has not hitherto been noticed. In the fourth species (*A. erythraeus*) the ultimate peduncular segment, in the vast majority of specimens examined, is short in both sexes; but in four males of small size from the vicinity of Penang, it is elongated as in the other species. The specific identity of these individuals is proved beyond doubt by the structure of the petasma. It seems, therefore, that in *A. erythraeus* the males are dimorphic; but it is very strange that no males with a long peduncle occur among several hundreds of specimens from other localities.

The sexual characters of the female are more difficult to observe, but the third thoracic sternite offers distinctive characters in each species; in *A. japonicus* its structure differs widely from that of any of the allied forms.

The species may also be distinguished by characters other than sexual, and these, though for the most part less convenient, are useful in the determination of females and young individuals.[1] Such characters are to be found in the proportions of the eye, in the form of the second segment of the antennular peduncle, in the ultimate segment of the third maxillipede, in the presence or absence of a tooth on the inner margin of the basis of the third peraeopods, in the external border of the outer uropod and in the telson.

It is evident from the collection in the Indian Museum that two species are often found together. In such cases, and when the specimens are numerous, identification is a tedious process, for each individual must be separately and carefully examined.

Kishinouye was mistaken in supposing that the species can be determined by the number of teeth on the rostrum; in the forms I have examined the rostrum is almost identical in structure. This is also true of the toothing and sculpture of the carapace. The proportionate lengths of the segments of the third maxillipedes and legs afford only very slight differences, and I have not been able to find any distinctions in the number or size of the branchiae.

The species of *Acetes* are usually found gregariously, swimming in great numbers in mid-water or near the surface. They are apparently only met with in coastal waters; they occur near

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[1] The petasma is, however, sufficiently developed for accurate identification in specimens less than half the maximum length attained by the species.

the shore in the open sea, and are frequently common in estuaries and backwaters. They are often found where the water is of low salinity, and occasionally in places where it is quite fresh, but penetrate little if at all beyond the reach of tidal influence. The species are fished commercially both in India and Japan, the small size of the individuals being evidently compensated by the great abundance in which they are taken.

In life the greater part of the body is probably transparent in all the species, but the cornea is black, and in one species at least there are red markings on the uropods. The precise distribution of the red pigment is perhaps different in different species, but on this point nothing precise is known. The only notes I possess on the colouration of living examples relate to specimens of *A. japonicus* collected in Mormugao Bay in Portuguese India, my description agreeing exactly with that given by Kishinouye. Dr. Annandale's notes on individuals caught in the Tale Sap in Lower Siam indicate an almost precisely similar colouration, but his collection contains both *A. indicus* and *A. japonicus*, and it is not clear to which of the two species the description refers.

The four species may be recognised by the following characters:—

I. Ciliated and non-ciliated portions of external border of outer uropod separated by a small but distinct tooth; terminal segment of 3rd maxillipede not divided into sub-segments; 3rd thoracic sternite of female not produced backwards as a large plate.

A. Telson reaching beyond middle of inner uropod, its apex pointed, without spinules; a single clasping spine on external antennular flagellum of male.

1. A tooth at distal end of inner margin of basis of 3rd peraeopods; 2nd segment of antennular peduncle fully three times as long as broad; petasma without membranous coupling folds, its internal lobe strongly expanded at its proximal end, the distal portion terminating simply ... *indicus*, Milne-Edwards.

2. No tooth on basis of 3rd peraeopods; 2nd segment of antennular peduncle of female not more than two and a half times as long as broad; petasma with a pair of folded coupling membranes armed with hooks, internal lobe little expanded proximally, its distal portion terminating in two large pointed processes ... ... *erythraeus*, Nobili.

B. Telson not reaching beyond middle of inner uropod, its apex truncate with a spinule on either side; two clasping spines on external antennular flagellum of male [petasma without membranous coupling folds, its internal lobe very strongly expanded and conspicuously emarginate proximally, the distal portion terminating simply] ... *insularis*, sp. nov.

II. Ciliated and non-ciliated portions of external border of outer uropod not separated by a tooth; terminal segment of 3rd maxillipede divided into three sub-segments; 3rd thoracic sternite of female produced backwards as a large plate, the posterior edge of which is free and emarginate [external antennular flagellum of male with two clasping spines; petasma without membranous coupling folds, its internal lobe not expanded proximally, the distal portion with bulbous termination and with a large process on its outer side] ... *japonicus*, Kishinouye.

In *A. erythraeus*, as already noted, the males are dimorphic, a form with a short antennular peduncle, resembling that of the female, being apparently by far the more abundant of the two. In the other three species only one type of male—a form with the ultimate segment of the peduncle greatly elongated—is known to occur.

The four species agree in the following particulars :—

The rostrum is exceedingly short and projects very little beyond the frontal margin of the carapace. It is, however, rather strongly elevated and terminates in a sharp point, behind which are two teeth, the foremost much the smallest. The anterior margin is almost vertical and is sinuous or concave.

The carapace is as long as, or rather longer than the first two and a half abdominal somites; it bears conspicuous post-orbital and hepatic spines. The cervical groove is obsolete and no trace of it exists on the dorsum of the carapace. The upper limit of the branchial region is defined posteriorly by a blunt longitudinal ridge.

The inner antennular flagellum is very long and in both sexes shows the curious flexure described in detail by Kishinouye.

The antennal scale is broadest at the base and is from 3·6 to nearly 4 times as long as wide. The outer margin is rather strongly convex and terminates in a small tooth that reaches almost to or a trifle beyond the distal end of the lamella.

The mandibular palp consists of three segments, the basal one being exceedingly small and inconspicuous. The propodus of the second maxillipedes is a trifle longer than the merus; the carpus is from two-thirds to three quarters its length and is fully three times the length of the dactylus.

The third, fourth and fifth segments of the third maxillipedes are more or less equal in length, while the fifth is from 1·25 to 1·4 times as long as the sixth.[1]

The first three peraeopods increase successively in length, the third pair reaching almost or quite as far as the third maxillipedes. In the first pair the merus is about as long as the chela; the latter segment being from 1·2 to 1·4 times the length of the carpus. In this pair of limbs, at the distal end of the carpus and at the

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[1] The proportionate lengths of the segments appear to show minor specific characters. In *A. japonicus*, *A. erythraeus* and *A. insularis* the third segment is almost equal to, or a little longer than the fifth, whereas in *A. indicus* the former is decidedly shorter than the latter. In *A. erythraeus* the third and fourth segments, taken together, are 1·3 times the length of the fifth and sixth, in *A. insularis* and *A. japonicus* 1·2 times and in *A. indicus* ·94 to 1·1 times.

proximal end of the propodus, there is (in both sexes and in all four species) a patch of short barbed spinules, which, when the segments are flexed, forms a sort of grasping organ.

The merus and carpus of the second pair are about equal in length[1]; the carpus is from 1·1 to 1·3 times as long as the chela. In the third peraeopods the merus is a little shorter than the carpus and a little longer than the chela. The carpus is from 1·3 to 1·4 times the length of the chela. In the male, in the position normally occupied by the fourth pair of legs, there are two bluntly pointed and forwardly directed processes.

The branchiae resemble those found in the genus *Sergestes* and do not appear to afford any specific differences in the four forms under consideration. The formula is:—

	vii	viii	ix	x	xi	xii	xiii	xiv
Podobranchiae ...	ep.	1+ep.	...	...	...	...	...	...
Arthrobranchiae ...	...	...	...	...	...	...	...	...
Pleurobranchiae ...	...	...	1	1	1	1	1	...

This formula agrees with that given by Ortmann[2] except that a small podobranch is present at the base of the second maxillipede. This branchia is perhaps absent in the Atlantic species that Ortmann examined.

Arranged according to length, the order of the abdominal somites is 6, 4, 1, 3, 5, 2; the sixth is about twice the length of the fifth and its greatest breadth is from 1·6 to 2·0 times its length. The sixth somite is provided with a single very small spinule, placed dorsally on the posterior margin. The telson is sulcate above and is much shorter than the inner uropod.

Genus **Acetes**, Milne-Edwards.

1830. *Acetes,* Milne-Edwards, *Ann. Sci. nat., Paris,* XIX, p. 350.
1837. *Acetes,* Milne-Edwards, *Hist. nat. Crust.,* II, p. 429.

Acetes indicus, Milne-Edwards.

(Text-figs. 1*a*,*b*, 2*a*, 3*a*, 4*a*, 5*c*, 7*a*.)

1830. *Acetes indicus,* Milne-Edwards, *Ann. Sci. nat., Paris,* XIX, p. 351, pl. xi, figs. 1-9.
1837. *Acetes indicus,* Milne-Edwards, *Hist. nat. Crust.,* II, p. 430.
? 1852. *Acetes indicus,* Dana, *U.S. Explor. Exped., Crust.,* I, p. 608.
? 1890. *Acetes indicus,* Walker, *Journ. Linn. Soc., Zool.,* XX, p. 112.
? 1893. *Acetes indicus,* Henderson, *Trans. Linn. Soc., Zool.* (2), V, p. 452.
? 1905. *Acetes indicus,* Pearson, *Ceylon Pearl Oyster Rep.,* IV, p. 75.

[1] The merus is a shade longer than the carpus in *A. japonicus* and *A. erythraeus,* a trifle shorter than the carpus in *A. indicus* and *A. insularis.*
[2] Ortmann, *Decap. Schizop. Plankton. Exped.,* p. 39 (1893).

Except for the fact that fig. 9 of his illustrations shows a tooth on the outer margin of the external uropod—a character which indicates that the species is not the same as Kishinouye's *A. japonicus*—there is nothing in Milne-Edwards' description to indicate the precise identity of the form he examined. His material was, however, obtained from the mouth of the Ganges, in which, so far as I am aware, only one species exists, though three occur in the Bay of Bengal. The principal specific characters are as follows:—

The eye is longer than in the other species and is a little more than one-third the length of the carapace. The stalk is rather more slender than usual and its length, in proportion to that of the cornea, is greater.

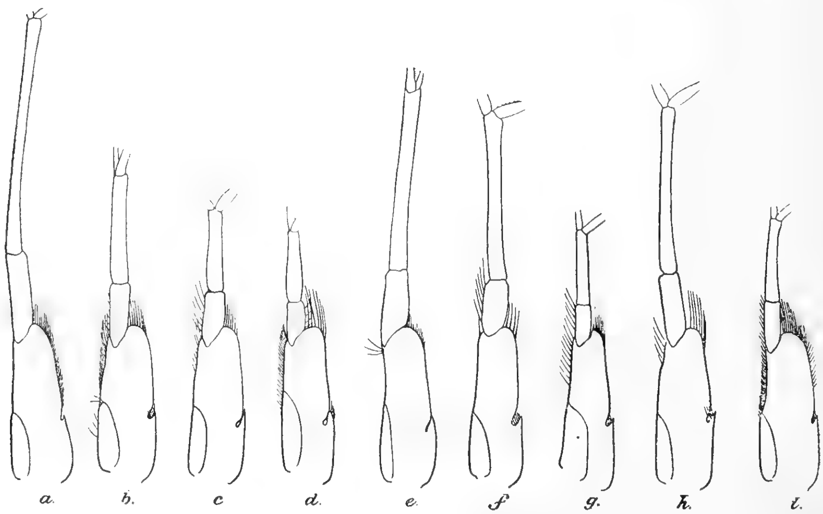


FIG. 1.—Right antennular peduncle in dorsal view.

a. *Acetes indicus*, ♂.
b. ,, ,, ♀.
c. *Acetes erythraeus*, "*low*" ♂.
d. ,, ,, ♀.
e. ,, ,, "*high*" ♂.
f. *Acetes insularis*, ♂.
g. ,, ,, ♀.
h. *Acetes japonicus*, ♂.
i. ,, ,, ♀.

The basal segment of the antennular peduncle in the female is about the same length as that of the two distal segments combined; the second segment is from 3 to $3\frac{1}{2}$ times, and the third segment from 6 to $6\frac{1}{2}$ times as long as broad (text-fig. 1*b*). In the male the second segment is sometimes more slender than in females, but the ultimate segment is always greatly elongated, much longer than the first, and from 10 to 14 times as long as broad (text-fig. 1*a*).

The outer antennular flagellum of the male bears a single large clasping spine, with finely serrate inner margin; on the segment opposite the tip of this spine there is a group of 5 to 7 close-set spinules. The two basal segments of the flagellum are unusually long (text-fig. 2*a*).

The third maxillipedes, when extended forwards, reach a little beyond the tips of the third peraeopods and, in the female, much beyond the end of the antennular peduncle. The ultimate segment is not divided into sub-segments. The basal segments of the third maxillipedes and peraeopods are proportionately stouter than in

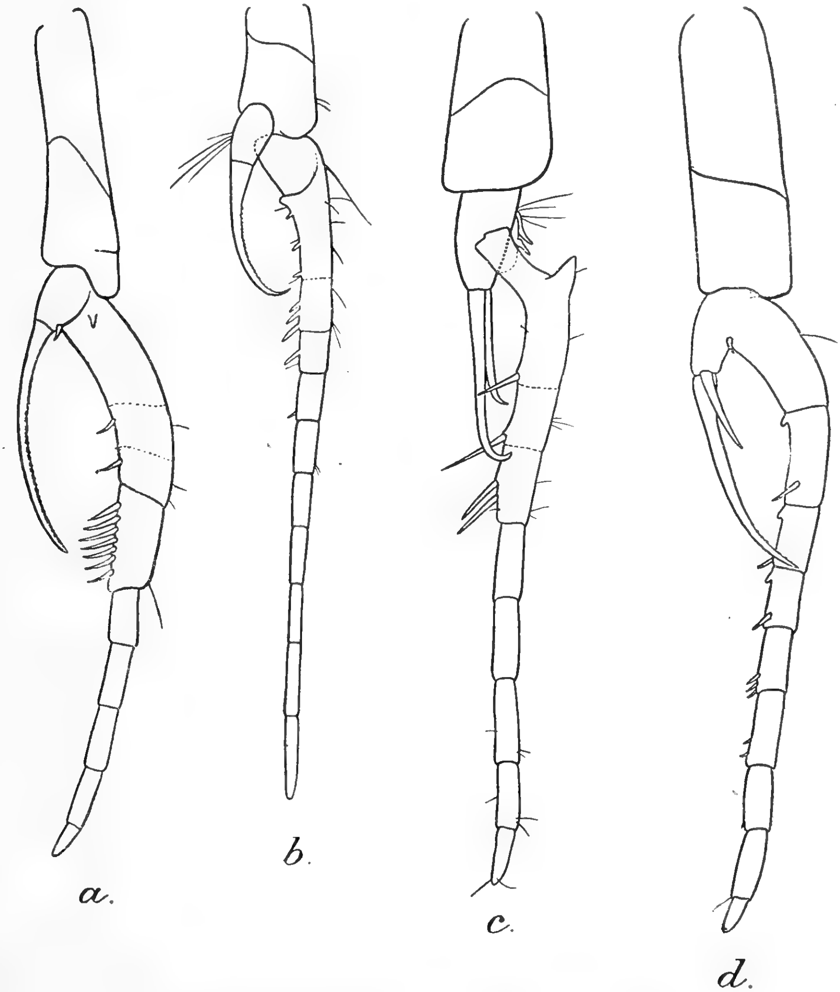


FIG. 2.—Outer antennular flagellum of male.
a. Acetes indicus. *c. Acetes insularis.*
b. Acetes erythraeus. *d. Acetes japonicus.*

other species, and the setae with which the limbs are clothed are longer and more numerous.

The basis of the third peraeopod bears a large tooth on its inner margin close to the insertion of the ischium (text-fig. 3*a*), a character not found in any of the other three species.

The third thoracic sternite of the female is very deeply channelled longitudinally, the channel being continued backwards on to the anterior portion of the fourth sternite. The anterior margin of the third sternite is deeply sunk and transverse or slightly concave. Behind the inner angles of the coxae of the third legs there is, on either side, a conspicuous tubercle (text-fig. 3*a*).

Between the bases of the first pleopods, both in males and females, there is a large procurved tooth.

The outer lobe of each half of the petasma (that is to say the portion nearest the pleopod) is more or less crescentic in shape with the antero-external border strongly thickened; the shape of this portion is similar in all four species. The internal lobe is characteristic in form. At its proximal end it is truncate, much expanded externally and with a small process at its inner angle. Its distal portion is without any large processes, such as are found in certain allied species, and appears to consist of a central style surrounded by a thick coating, rather uneven in outline; its surface has a sort of honey-combed appearance, due to the presence of numerous small pits, each of which contains a modified hooklet (text-fig. 4*a*).

The telson reaches well beyond the middle of the inner uropod and is rather sharply pointed at the apex (text-fig. 5*c*). The angular termination of the lobe at the proximal end of the infero-lateral margin is placed decidedly nearer the base than the apex.[1]

The ciliated and non-ciliated portions of the external border of the outer uropods are separated by a prominent tooth. In adults the proximal non-ciliated part is from 1·1 to 1·3 times the length of the ciliated part (text-fig. 7*a*); in young individuals the proportionate length of the former is rather greater.

Acetes indicus is the largest of the four species; full grown females, measured from the tip of the rostrum to the tip of the telson, reach a length of about 40 mm.

The specimens examined are from the following localities:—

$\frac{9702}{10}$	Panvel Creek, Bombay ...	J. Caunter.	Many.
$\frac{9703}{10}$	Market at Ennur, near Madras ...	N. Annandale.	Several.
$\frac{3525-6}{7}$	Coconada, Madras Pres. ...	G. W. Wicks.	Two.
$\frac{9704}{10}$	Pratapnagore, Lower Bengal ...	Mus. Collr.	Few.
$\frac{9716}{10}$	Near Mud Point, R. Hugli, Gangetic delta	T. Southwell.	Few.
$\frac{9705}{10}$	Matla R., Gangetic delta ...	J. T. Jenkins.	Two.
$\frac{9707}{10}$	Bassein R. estuary, Burma ...	'Investigator.'	Many.
$\frac{9710}{10}$	Haingyi I., off Bassein R. ...	,,	One.
$\frac{9708}{10}$	S. of Purian Pt., Burma ...	,,	Many.
$\frac{9706}{10}$	Mouth of Rangoon R., Burma ...	,,	Several.
$\frac{3430}{10}$	Green I., Amherst, Tennasserim ...	,,	Many.
$\frac{9709}{10}$	Mergui Archipelago, 11°28′ N., 98°36′ E.	,,	Few.
$\frac{9711}{10}$	Mergui Archipelago, 12°0′ N., 98°20′ E.	,,	Several.
$\frac{9712}{10}$	Tale Sap, Gulf of Siam	N. Annandale.	Several.

[1] As in *A. erythraeus*, text-fig. 5*a*.

In several of these localities the species was undoubtedly obtained in brackish water, the lowest specific gravity of which I have a definite record being 1·0015 (corrected) in the case of certain specimens from the Tale Sap. On the other hand the records from Coconada, Green I. and the Mergui Archipelago indicate that the species also occurs in the open sea near land.

A. indicus was found in company with *A. japonicus* in the Tale Sap and in the Mergui Archipelago, and with *A. erythraeus* at Ennur.

The distribution of the species, as far as at present known, may be summarised as,—Bombay, Bay of Bengal and Gulf of Siam. The characters mentioned by Milne-Edwards being insufficient to determine the species with any exactitude, the records by Dana, Walker, Henderson and Pearson are open to doubt. Even if accepted, they would not indicate any marked increase in our knowledge of the distribution of the species.

Acetes erythraeus, Nobili.

(Text-figs. 1*c*-*e*, 2*b*, 3*b*, 4*b*, 5*a*,*d*, 7*b*.)

1905. *Acetes erythraeus*, Nobili, *Bull. Mus. d'Hist. nat., Paris*, p. 394, text-fig. 1.
1906. *Acetes erythraeus*, Nobili, *Ann. Sci. nat., Paris* (9), IV, p. 23, pl. i, figs. 5, 5*a*-*f*.

The eyes are not quite so long as in *A. indicus*, being only about one-third the length of the carapace; the stalk is also stouter and, proportionately to the length of the cornea, rather shorter.

The basal segment of the antennular peduncle of the female is about 1·3 times the length of the two terminal segments combined; the second segment is decidedly stouter than in *A. indicus*, the length being not more than $2\frac{1}{2}$ times the greatest breadth; the third segment is from 4 to $4\frac{1}{2}$ times as long as wide (text-fig. 1*d*). In males a well-marked dimorphism appears to exist in respect of the proportions of the peduncular segments. In four small males from Penang, otherwise practically indistinguishable from the rest of the specimens in the collection, the ultimate segment is greatly elongated, precisely as in *A. indicus*. The second segment in these examples is about 3 times as long as broad, while the third is longer than the first and about $9\frac{1}{2}$ times as long as broad (text-fig. 1*e*). All the other males in the collection differ widely from the Penang individuals and from the males of any of the other three species, the antennular peduncle bearing a close resemblance to that of the female. In such specimens the basal segment is from 1·1 to 1·3 times the length of the two following, the second segment is from 2 to $2\frac{1}{4}$ times and the third from 4 to nearly 5 times as long as broad (text-fig. 1*c*).

The outer antennular flagellum of the male closely resemble that of *A. indicus*, and possesses only one clasping spine; the two basal segments are, however, shorter. In the males from Penang the tip of the large spine is opposed by a group of 5 spinules, exactly as in *A. indicus*; in the others, as shown in text-fig. 2*b*, only 2 or 3 spinules occur in this position. The segment immediately in front of that bearing the clasping spine bears an angular lobule.

The third maxillipedes, when stretched forwards, reach about as far as the third peraeopods, and extend to the end of the antennular peduncle. There is no tooth on the inner border of the basis of the third peraeopods.

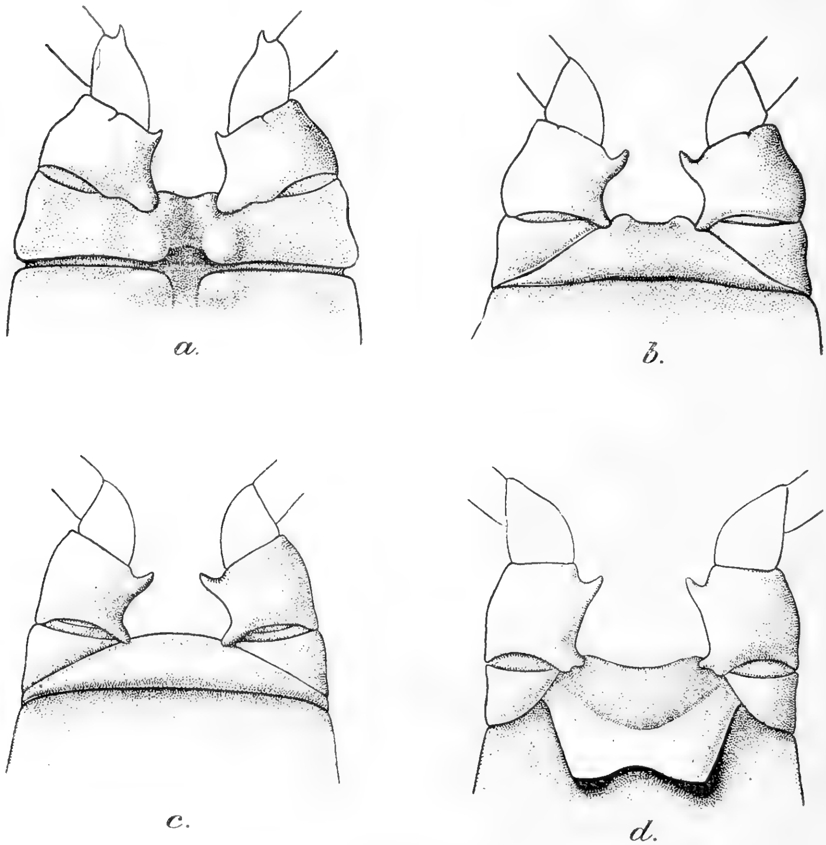


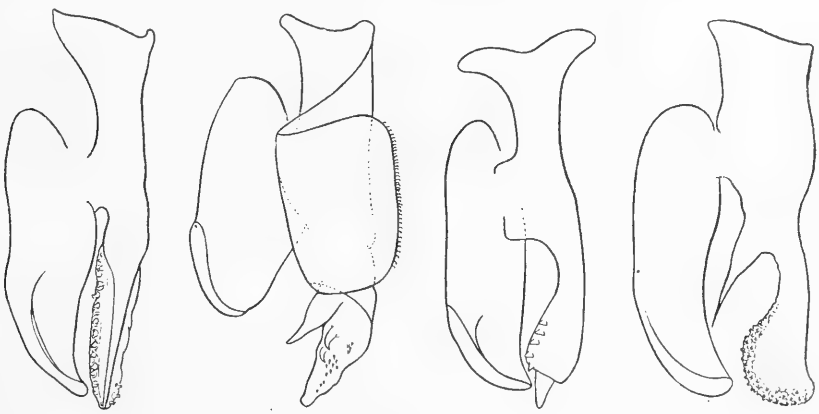
FIG. 3.—Third thoracic sternite and basal segments of third peraeopods of female.

a. Acetes indicus. *c. Acetes insularis.*
b. Acetes erythraeus. *d. Acetes japonicus.*

The third and fourth thoracic sternites of the female show only faint traces of the deep longitudinal channel found in *A. indicus* and the former does not possess the pair of tuberculiform eminences present in that species. The third sternite is broadly triangular in shape; its anterior margin is elevated and is concave in the middle with a small rounded lobe on either side (text-fig. 3*b*).

As in *A. indicus* there is in both sexes a large hooked tooth between the bases of the first pleopods.

The petasma differs from that of any other species examined in the possession of a pair of folded membranes on the anterior surface. The free edge of each is furnished with a series of minute hooks, by means of which the two halves of the petasma are coupled. The internal lobe is truncate and slightly concave at its proximal end, but is not broadly expanded as in *A. indicus*. The distal portion of the same lobe terminates in two large pointed processes with their apices directed obliquely outwards. The inner of these processes is larger and broader than the other and bears on its anterior surface two large falcate spines (text-fig. 4*b*).



a. *b*. *c*. *d*.

FIG. 4.—Right half of petasma, seen from in front.
a. Acetes indicus. *c. Acetes insularis.*
b. Acetes erythraeus. *d. Acetes japonicus.*

The telson resembles that of *A. indicus*, but the tip is not quite so sharply pointed (text-figs. 5*a*, *d*).

The ciliated and non-ciliated portions of the external border of the outer uropod are separated by a small tooth. The non-ciliated portion in adults is from 1·5 to 1·7 times the length of the ciliated part (text-fig. 7*b*), a proportion differing considerably from that found in *A. indicus*.

This species is smaller than *A. indicus*, large females being not more than 28 mm. in length. The males from Penang are only 14 mm. in length, whereas those from other localities may reach 20 mm.

The occurrence of dimorphic males in this species is a feature of considerable interest, but further information is necessary before the phenomenon can be profitably discussed: it is unfortunate that such a small number of specimens are available from Penang. The case does not appear to be one of seasonal sexual dimorphism, for the males from Penang, all of which are of the "high" form, were caught in the month of February, whereas those of the "low" form, exclusively obtained in other localities were obtained in the months of January, February, March and April.

Acetes erythraeus was described by Nobili from the Red Sea; the specimens in the Indian Museum are from the following localities:—

$\frac{9695}{10}$	Market at Ennur, near Madras ...	N. Annandale.	Few.
$\frac{9696}{10}$	Backwater at Vizagapatam, Madras Pres.	S. Kemp.	Many.
$\frac{9697-9}{10}$	Puri, Orissa Coast	N. Annandale, J. Caunter & S. Kemp.	Many.
$\frac{9700}{10}$	Mouth of the Prai R., opposite Penang	N. Annandale.	Four.
$\frac{9701}{10}$	Patani R., below town of Patani, Siamese Malay States ...	,,	Few.

The specimens from the Patani river were found in water that was fresh at the time of their capture, but in a situation subject to tidal influence. Those from Puri were found in the open sea in water having a specific gravity of about 1·0260 (corrected).

The distribution of the species, so far as known, may be given as,—Red Sea, west side of Bay of Bengal, Penang, Gulf of Siam.

Acetes insularis, sp. nov.

(Text-figs. 1*f*,*g*, 2*c*, 3*c*, 4*c*, 5*b*,*e*, 7*c*.)

The eyes are about one-third the length of the carapace and do not differ in any marked degree from those of *A. erythraeus*.

The basal segment of the antennular peduncle of the female is about $1\frac{1}{2}$ times the length of the two ultimate segments combined; the second segment is about $3\frac{1}{3}$ times, and the third from $4\frac{3}{4}$ to 5 times as long as broad (text-fig. 1*g*). In the male the second segment is rather stouter than in the female, not more than $2\frac{1}{2}$ times as long as broad. The third is greatly lengthened, longer than the first and from 9 to 10 times as long as broad (text-fig. 1*f*).

The outer antennular flagellum of the male bears two clasping spines in place of the single one found in *A. indicus* and *A. erythraeus*; one spine is larger than the other, and the inner margins of both are smooth. The two basal segments of the flagellum are short. There is also a curious apparatus not met with in any of the other three species. The segment in advance of that which bears the two large spines bears, on the side remote from the spines, a large angular process pointing backwards and, on the same side, behind the proximal end of the same segment are two small spinules with their tips directed forwards. Judging from their appearance these structures form a subsidiary clasping apparatus that comes into action when the main grasping organ is opened to its fullest extent. The segments opposite the tips of the large spines bear one or two long spinules near their distal ends (text-fig. 2*c*).

The external maxillipedes reach barely to the end of the second segment of the antennular peduncle and are slightly exceeded in length by the third peraeopods. There is no tooth on the inner margin of the basis of the latter pair of limbs.

The third thoracic sternite of the female is broadly triangular in shape; it is not grooved longitudinally and the anterior margin is elevated and more or less transverse (text-fig. 3*c*). The characters are difficult to see owing to the small size of the species.

The large procurved tooth found in *A. indicus* and *A. erythraeus* between the bases of the first pleopods is replaced by a small bluntly pointed process.

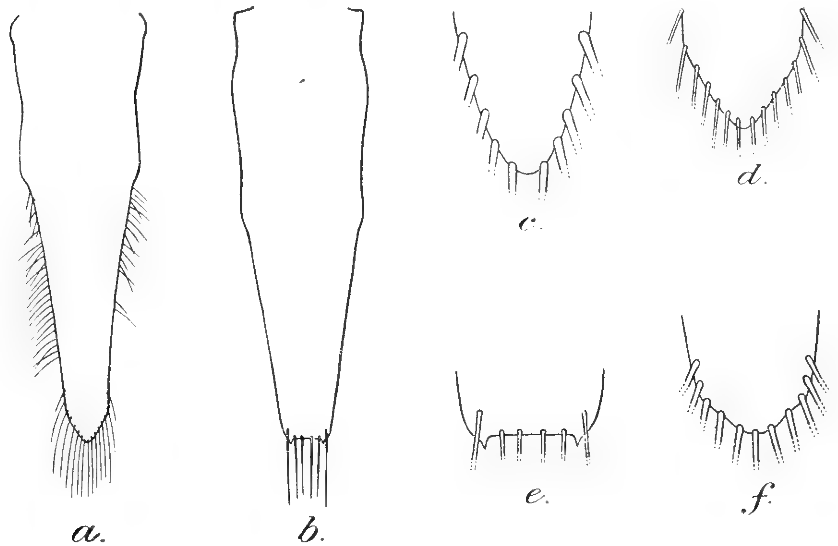


FIG. 5.—Telson in dorsal view.
a. Acetes erythraeus. *b. Acetes insularis.*
Apex of telson in dorsal view.
c. Acetes indicus. *e. Acetes insularis.*
d. Acetes erythraeus. *f. Acetes japonicus.*

The internal lobe of the petasma is very greatly expanded at its proximal end, both internally and externally, and the posterior border is conspicuously emarginate. The distal portion somewhat resembles that of *A. indicus*, but is more swollen. At the tip there is a single great conical tooth and near the outer edge a series of 5 or 6 modified teeth (text-fig. 4*c*).

The telson is characteristic. It is shorter than in either of the two preceding species and reaches barely to the middle of the inner uropod. The angular termination of the lobe at the proximal end of the infero-lateral margin is placed midway between the base and the apex, whereas it is situated much nearer the base in the two preceding species (*cf.* text-figs. 5*a* and *b*). The tip is truncate, straight or very slightly convex, and bears on either side a small tooth (text-fig. 5*e*). Occasionally one or other of these teeth is missing.

The ciliated and non-ciliated portions of the external border of the outer uropod are separated by a small tooth. In adults the non-ciliated part is from 1·2 to 1·4 times the length of the ciliated part (text-fig. 7*c*).

Acetes insularis is a small species, large females not exceeding 18 mm. in length.

The collection contains specimens from one locality only:—

$\frac{9714\text{-}6}{10}$	Mouth of Rajang R., Sarawak, Borneo	Mus. Collr.	Many.

The types bear the number 9714/10 in the register of the Zoological Survey of India.

Acetes japonicus, Kishinouye.

(Text-figs. 1*h*,*i*, 2*d*, 3*d*, 4*d*, 5*f*, 6, 7*d*.)

1905. *Acetes japonicus*, Kishinouye, *Annot. Zool. Japon.*, V, p. 163, text-figs.

The eyes resemble those of the two preceding species but are rather shorter, a little less than one-third the length of the carapace.

The basal segment of the antennular peduncle of the female is about $1\frac{1}{5}$ times the length of the second and third segments combined; the second segment is fully 3 times and the third $5\frac{1}{2}$ times as long as broad (text-fig. 1*i*). In the male the proportions of the second segment are about the same; the third segment is greatly lengthened as in *A. indicus* and *A. insularis*: it is longer than the basal segment and at least 10 times as long as broad (text-fig. 1*h*).

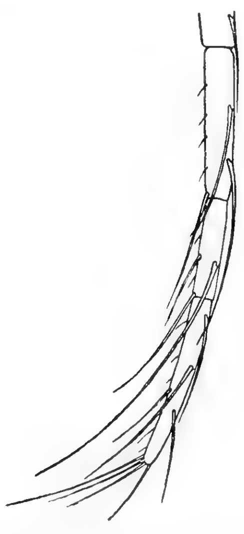


FIG. 6.—*Acetes japonicus*. Terminal segment of outer maxillipede.

The outer antennular flagellum of the female resembles that of *A. insularis* in the possession of two clasping spines, but does not bear the additional apparatus found in that species. One of the two clasping spines is very much longer than the other and is feebly serrate on its inner margin near the apex. The segments opposite the tips of the clasping spines each bear a small blunt process at the proximal end and one or two short spinules distally (text-fig. 2*d*).

The external maxillipedes do not reach quite so far forwards as the third peraeopods and extend to, or a little beyond the apex of the antennal scale. The terminal segment of the external maxillipede differs from that of all the other species in being divided into three sub-segments; of these the middle one is the shortest and the last the longest (text-fig. 6). There is no tooth on the inner margin of the basis of the third peraeopods.

The third thoracic sternite of the female is altogether peculiar; it projects backwards from the base of the third legs in the form of a large plate, posteriorly overlying the fourth sternite. It is slightly depressed in the middle line, its lateral edges are posteriorly convergent and its distal margin, which is free, and in consequence easily visible in lateral view, is conspicuously emarginate (text-fig. 3*d*).

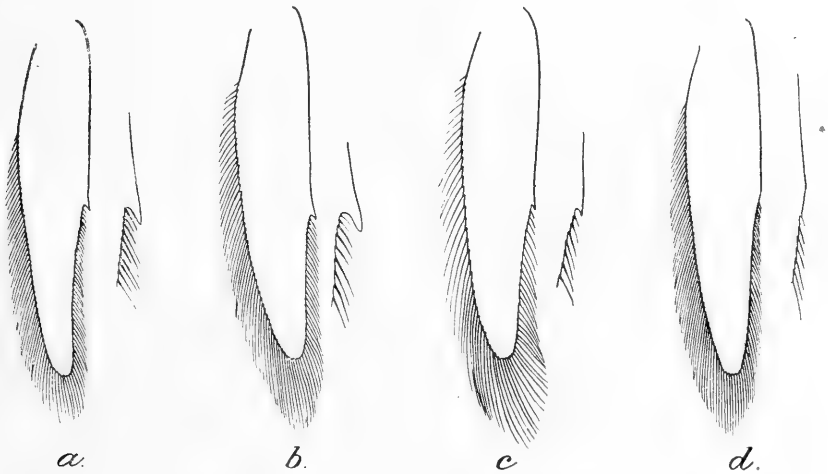


FIG. 7.—Outer uropod, with portion of external margin more highly magnified.
a. Acetes indicus. *c. Acetes insularis.*
b. Acetes erythraeus. *d. Acetes japonicus.*

The large-hooked tooth found in *A. indicus* and *A. erythraeus* between the bases of the first pleopods is replaced, as in *A. insularis*, by a small pointed process.

The internal lobe of the petasma is truncate at its proximal end and scarcely at all expanded. The distal portion is bulbous at the tip and set with numerous minute hooklets; on its outer side it bears a large process usually terminating in a long and very fine point (text-fig. 4*d*). The length of this pointed process is variable; sometimes it reaches to the end of the lobe to which it is attached, while occasionally it terminates abruptly with a blunted apex.

The sixth abdominal somite, in lateral view, is a little more slender than in the other species, its length being usually twice its greatest depth.

The telson resembles that of *A. erythraeus* and *A. indicus*, but the tip is rounded rather than pointed (text-fig. 5*f*). I have not been able to detect the pair of small teeth mentioned by Kishinouye, but the outer corners of the apex are sometimes a little angular.

The external border of the outer uropod differs from that of all the other three species in the complete absence of the tooth between the ciliated and non-ciliated portions. In adults, moreover, the latter part is a little longer than the former, the reverse being the case in the other forms (text-fig. 7*d*). In very young specimens the proportions are rather different, the non-ciliated part being equal to, or even a trifle longer than the ciliated part.

Large specimens reach a length of about 26 mm.

Acetes japonicus was described by Kishinouye from the Inland Sea of Japan and from Korea. Specimens in the Indian Museum are from the following localities :—

$\frac{9684-5}{10}$	Mormugao Bay, Portuguese India ...	S. Kemp.	Many.
$\frac{9686}{10}$	Kilakarai, Ramnad dist., S. India ...	,,	Three.
$\frac{9694}{10}$	Ennur backwater, near Madras ...	N. Annandale.	Three.
$\frac{9687-9}{10}$	Mergui Archipelago, 11°17′—11°28′N., 98°29′—98°36′ E	'Investigator.'	Several.
$\frac{9690}{10}$	Patani R., below town of Patani, Siamese Malay States	N. Annandale.	Six.
$\frac{9691}{10}$	Tale Sap, near Singgora, G. of Siam ...	,,	Many.
$\frac{9692}{10}$	From market, Osaka, Japan ...	,,	Many.
$\frac{9693}{10}$	Niigata, Japan	?	Several.

In the Patani river the species was found in fresh water, but in a situation subject to tidal influence; in Mormugao Bay it was taken in water of specific gravity 1·0165 (corrected), while at Kilakarai it was obtained in pure sea water in the vicinity of a coral reef.

The species was found in the Mergui Archipelago and in the Tale Sap in company with *A. indicus*, and in the Patani river with *A. erythraeus*.

The known distribution may be summarised as,—W. and S. coasts of India, lower parts of Bay of Bengal, Gulf of Siam, Korea, Japan.

VIII. DIPTERA OF THE SIMLA DISTRICT.

By E. Brunetti.

Introductory Note.

Mr. Brunetti has asked me to prefix an introductory note to his paper, which is based on the collections of the Indian Museum (Zoological Survey of India) and of the Imperial Agricultural Institute at Pusa. We have to thank Mr. T. Bainbrigge-Fletcher, Imperial Entomologist, for co-operation in the matter.

The term "Simla District" is not used in any precise geographical or political sense but merely to indicate localities in and at the base of the Himalayas near Simla whence specimens are available. The chief localities are Dharampur (alt. 5,000 ft.)[1], Kasauli (6,300 ft.), Simla (7,000 ft.), Phagu (9,000 ft.), Theog (8,000 ft.), and Matiana (8,000 ft.). The last three are on the Tibet-Himalayan road.

Most of these localities are, therefore, at considerable, but none at very great altitudes. It is important to remember that the Simla Himalayas, at any rate from 7,000 feet upwards, and also to a large extent at lower altitudes, lie practically in the Palaearctic Region. Such plants as the edelweiss flourish by the roadside, with roses, dandelions and primulas; and many of the butterflies are no more at most than races of those with which we are familiar in England. There are no tropical forests, but pine-woods and bare hillsides. It is, I think, important that this fact should be emphasized in dealing with an Indian district so remote in every way from what, in Europe, naturalists would attribute to India.

A large part of the material on which Mr. Brunetti has worked was collected by myself from year to year in the month of May, while I was on duty at Simla as a member of the Board of Scientific Advice, and the spring fauna is, therefore, better represented than that, which is probably richer, of the monsoon rains and early autumn. In the present state of our knowledge of the Indian Diptera, it is advisable to do no more than glance at certain of the groups of Brachycera, for example, the Muscinae Verae, the Asilidae and many of the Acalyptrata. A few conspicuous species may be safely identified, but the majority are best left unnamed until the different forms can be investigated, family by family, from different countries or at any rate from large areas. Much still remains to be done also among the Nemocera. Kieffer has been able merely to touch the fringe of the Chironomidae, and of the other families, which for the most part reach their adult stage in the wet season, Mr. Brunetti is not in a position to examine much material. The Mycetophilidae in particular are very imperfectly represented in collections, whilst the Cecidomyidae are quite unknown. This of course is through no fault of Mr. Brunetti, to whom we are indebted for by far the greater part of such knowledge as we possess of the Indian Diptera.

N. A.

Family MYCETOPHILIDAE.

Subfamily *SCIARINAE.*

Sciara indica, Walk.

Ins. Saund. Dipt., pt. V, p. 419.

Phagu, 21-v-16. Occurs at several Himalayan localities and as far south as Siliguri. It is conspicuous by the reddish or

[1] These altitudes are merely approximate.

yellowish side stripe on the abdomen, which is sometimes broken up into spots.

Sciara luteiventris, Brun.

Faun. Brit. Ind. Dipt., p. 129.

Below Phagu, a unique ♀, 12-v-09.

Sciara rufithorax, Wulp.

For description see Brunetti, *Faun. Brit. Ind. Dipt.*, p. 128.

Simla, x-08 (*F. M. Howlett*).

Sciara setilineata, Brun.

Faun. Brit. Ind. Dipt., p. 138.

Simla, 10-v-09. Occurs also at Darjiling.

Sciara hirtilineata, Brun.

Faun. Brit. Ind. Dipt., p. 142.

Below Phagu, 12-v-09; Simla, 10-v-09.

Sciara nigripennis, Brun.

Faun. Brit. Ind. Dipt., p. 131.

Simla, x-08 (*F. M. Howlett*).

Sciara longipennis, Brun.

Faun. Brit. Ind. Dipt., p. 143.

Valley of the Sutlej River, below Simla, 6-v-10.

Sciara flavofemorata, Brun.

Faun. Brit. Ind. Dipt., p. 130.

Several of both sexes from Simla, x-08 (*F. M. Howlett*).

Sciara flaviseta, Brun.

Faun. Brit. Ind. Dipt., p. 144.

A unique ♀ from Simla, 10-v-09.

Sciara evanescens, Brun.

Faun. Brit. Ind. Dipt., p. 147.

Simla, 9-v-04.

Sciara parallela, Brun.

Faun. Brit. Ind. Dipt., p. 147.

A single ♂ from Simla, 9-v-09.

There are yet two or three small and obscure undetermined species of *Sciara* from the Simla District.

Subfamily *MACROCERINAE*.

Macrocera alternata, Brun.

Faun. Brit. Ind. Dipt., p. 52.

Simla, x-08 (*F. M. Howlett*). One ♀ ; the dark bands on the 2nd and 3rd segments cover the whole hinder half of each segment.

Macrocera brunnea, Brun.

Faun. Brit. Ind. Dipt., p. 53, pl. i, fig. 5.

Phagu, 12-v-09.

Macrocera inconspicua, Brun.

Faun. Brit. Ind. Dipt., p. 54.

Simla, x-08 (*F. M. Howlett*). Three ♂ ♂.

Subfamily *CEROPLATINAE*.

Platyura limbata, nom. nov.

For *P. marginata*, mihi (preocc. Mg. 1804).

Simla, x-08 (*F. M. Howlett*).

Platyura rufescens, Brun.

Isoneuromyia rufescens, Brunetti, *Faun. Brit. Ind. Dipt.*, App. p. 559.

Simla, 20-vii-11. I accept Mr. Edward's opinion (in litt.) that *Isoneuromyia* is not distinct from *Platyura*.

Subfamily *SCIOPHILINAE*.

Mycomyia bifascipennis, Brun.

Faun. Brit. Ind. Dipt., p. 72.

Simla, x-08 (*F. M. Howlett*). The large basal dark patch on the wing in this specimen is interrupted at its middle, so as to form a smaller basal spot and a median stripe composed of two oblong spots placed diagonally, one above the other ; the upper one reaching from the costa, across the tip of the basal cell nearly to the upper branch of the 5th longitudinal vein ; the lower spot is placed immediately below the upper one and is joined at the wing margin to the subapical dark band. In typical specimens, the large basal spot covers about one-third of the wing.

Mycomyia trilineata, Brun.

Faun. Brit. Ind. Dipt., p. 75.

Simla, 10-v-09 (*N. Annandale*); x-11 (*F. M. Howlett*), sweeping roadsides and in dense woods near the Dhobi Ghat.

Mycomyia indefinita, Brun.

Faun. Brit. Ind. Dipt., p. 76.

Simla, x-11, sweeping roadsides. This species is very near *trilineata* and may possibly be identical with it.

Mycomyia indica, Brun.

Faun. Brit. Ind. Dipt., p. 76.

Simla and Phagu, 10—12-v-09.

Subfamily *MYCETOPHILINAE*.

Leia winthemi, Lehm.

For description v. Brunetti, *Faun. Brit. Ind. Dipt.*, p. 97.

Simla, 25-iv-07; 5-v-07; 10-v-09; Matiana, 28—30-iv-07, also occurs at Naini Tal, Darjiling, Manipur, Sumatra, Europe and North America.

Leia nigricoxa, Brun.

Greenomyia nigricoxa, Brunetti, *Faun. Brit. Ind. Dipt.*, p. 87, pl. ii, fig. 8; pl. iii, fig. 9.
Leia spathulata, id., loc. cit., p. 101.

Phagu, 3-v-07, a single specimen.

Leia nigra, Brun.

Faun. Brit. Ind. Dipt., p. 101.

Simla, 9-v-09.

Leia arcuata, Brun.

Faun. Brit Ind. Dipt., p. 99.

Simla, x-08 (*F. M. Howlett*). In this specimen the hind femora are quite blackish except for a broad pale band just beyond the middle. In typical specimens the legs are wholly yellowish.

Rhymosia flavolimbata, Brun.

Faun. Brit. Ind. Dipt., p. 103.

Simla, x-03 (*F. M. Howlett*).

Allodia nigrofasciata, Brun.

Faun. Brit. Ind. Dipt., p. 108.

Simla, 10-v-09 ; Kufri, 8,000 ft., May. Also occurs at Dehra Dun.

Exechia basilinea, Brun.

Faun. Brit. Ind. Dipt., p. 113, pl. ii, fig. 12.

Simla, x-08 (*F. M. Howlett*). Four specimens.

Mycetophila cinctiventris, Brun.

Faun. Brit. Ind. Dipt., p. 115.

Simla, 10-vii-09 (*N. Annandale*) ; x-08 (*F. M. Howlett*).

Mycetophila 4-fasciata, Brun.

Faun. Brit. Ind. Dipt., p. 115, pl. ii, fig. 13.

Simla, 10-v-04, a unique ♂.

Mycetophila suffusa, Brun.

Faun. Brit. Ind. Dipt., p. 117.

Simla, 10-v-09, a single ♀.

Mycetophila himalayensis, Brun.

Faun. Brit. Ind. Dipt., p. 117.

Simla, 10-v-09. Also occurs at Naini Tal.

Mycetophila binotata, Brun.

Faun. Brit. Ind. Dipt., p. 118.

Simla, 10 v-09 (*N. Annandale*) ; 8-x-11 (*F. M. Howlett*), on cow-dung. This species may possibly be synonymous with *himaayensis*. The form *binotata* also occurs at Darjiling and Manipur.

Delopsis brunettii, Edw.

D. collaris, Brunetti, *Faun. Brit. Ind. Dipt.*, p. 119.

Mr. Edwards changes the name [1] of this species to *brunettii*, as *Mycetophila collaris*, Ender., proves to be a *Delopsis*.

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[1] *Ann. Mag. Nat. Hist.* (8) XII, p. 55 (1913).

Family BLEPHAROCERIDAE.

Blepharocera indica, Brun.

Rec. Ind. Mus. IV, p. 316.
Faun. Brit. Ind. Dipt., p. 156, fig. 15.

Phagu, 12—15-v-00. Dr. Annandale found this species not uncommon on bathroom windows in Phagu dak bungalow.

Family BIBIONIDAE.

Subfamily *BIBIONINAE.*

Crapitula melanaspis, Wied.

For description see Brunetti, *Faun. Brit. Ind. Dipt.*, p. 161 (*Pleciomyia melanaspis*).

Theog, 27-iv-07. Occurs freely in the Himalayas, also in Siberia, China and Japan.

Plecia indica, Brun.

Faun. Brit. Ind. Dipt., p. 165.

Theog, 27-iv-07. Also occurs at Mussoorie, Darjiling, Nepal, Manipur and other places.

Plecia fulvicollis, F.

For description see Brunetti, *Faun. Brit. Ind. Dipt.*, p. 163.

Kalka, base of Simla Hills, 2,400 ft., 18-vii-11.

Plecia impostor, Brun.

Rec. Ind. Mus. VII, p. 446.

Simla, 2 ♂♂, 2 ♀♀; x-08 and x-11 (*F. M. Howlett*). In bad condition but evidently this species. I described this species as possessing antennae of only nine joints, but though this is true of the ♂ the last joint being very small (though distinctly larger in one specimen), the ♀, on closer inspection, is found to possess eight flagellar joints, with a trace (in one antenna only) of a very minute apical additional joint, which however may only be apparent, caused by a stricture in the 8th joint.

Plecia dilatata, sp. nov.

♂. This is a species in every way resembling *Crapitula melanaspis*, Wied. (=*Pleciomyia dilatata, mihi*), but with the strict venation of *Plecia*.

It also naturally closely resembles *Plecia impostor* but differs in having a 12-jointed antenna, the last joint much narrower than the penultimate but distinctly longer and quite obvious. Also the hind tibiae are distinctly gradually dilated on the apical half and the hind tarsi are distinctly incrassate. The hind legs in *C. melanaspis* ♂ are similar, but in *P. imposter* there is no trace of any thickening of either tibia or metatarsus.

Two ♂♂, one not in very good condition, from Simla, x-11 (*F. M. Howlett*). Type presented to the British Museum by Mr. T. B. Fletcher, the co-type in the Pusa collection.

Bibio johannis, L.

For description v. Brunetti, *Faun. Brit. Ind. Dipt.*, p. 174.

Matiana, 28—30-iv-07 ; Theog, 2-v-07. Common in Europe.

Bibio obscuripennis, Meij.

Bijd. tot. de Dierk., XVII, p. 86.
Brunetti, *Faun. Brit. Ind. Dipt.*, p. 170.

Matiana, 28—30-iv-07, near flowering crabapple trees, on which however they did not settle. Apparently common at many places in the Himalayas : Nepal ; N E. Burmese Frontier ; Naini Tal. I took it freely at Darjiling, 16-x-05.

Bibio abdominalis, Brun.

Rec. Ind. Mus. IV, p. 276.

Phagu, 11-v-09. A conspicuous species, as the abdomen is wholly black in the ♂ and reddish yellow in the ♀.

Bibio discalis, Brun.

Rec. Ind. Mus. IV, p. 278.

Phagu, 11-v-09. Two ♀♀, taken between Kufri and Phagu, 18—21-v-16 (*N. Annandale* and *S. Kemp*), may be a variety or a closely allied species. The antennal scape, palpi, proboscis, thorax and scutellum are all wholly black, the wings distinctly brownish, the costa darker, the stigma dark brown, conspicuous There are no pale anterior and side margins to the thoracic dorsum.

Bibio hortulanoides, Brun.

Rec. Ind. Mus. IV, p. 274.

Kufri to Phagu, 8,000-9,000 ft., 18-v-16. Very near *B. hortulanus*, a common species in Europe. The ♂ is black and the ♀ reddish, as in *abdominalis*.

Dilophus gratiosus, Big.

Jour. Asiat. Soc. Bengal, LIX, p. 265.
Brunetti, *Faun. Brit Ind. Dipt.*, p. 178.

Simla, x-08 and x-11 (*F. M. Howlett*) ; Theog, 2-v-07 ; Phagu, 11-v-09 ; also occurs in the plains, at Darjiling and Upper Burma and probably Yunnan in South China. It has been taken "at light."

Subfamily *SCATOPSINAE.*

Scatopse nigronitida, Brun.

Rec. Ind. Mus. IV, p. 281.

Dharampur, 5,000 ft., 14-v-08, "on trunks of trees" (*N. Annandale*).

Family SIMULIIDAE.

Simulium indicum, Becher.

Jour. Asiat. Soc. Bengal, LIII, p. 199.
Brunetti, *Faun. Brit. Ind. Dipt.*, p. 191.

Simla, 24-iv-07. Occurs in Mussoorie, Darjiling, Sylhet, the Khasi Hills, and Manipur, probably the most widely distributed species of the genus in India. It is a vicious "biting" fly.

Simulium senile, Brun.

Rec. Ind. Mus. IV, p. 288.

Phagu, 8-v-07, a unique ♂.

Simulium aureohirtum, Brun.

Rec. Ind. Mus. IV, p. 287.

Simla, x-1911, both sexes not uncommon. Occurs also in Assam and Bombay.

Family CHIRONOMIDAE.

Subfamily *CERATOPOGONINAE.*

Ceratopogon (s.g. *Prohelia*) **decipiens**, Kieff.

Mem. Ind. Mus. II, p. 182, pl. xi, fig. 10.

Simla, 10-v-08, a single ♂.

Culicoides montivagus, Kieff.

Mem. Ind. Mus. II, p. 188, pl. viii, fig. 3.

Simla, 11-v-08.

Subfamily *TANYPINAE.*

Tanypus himalayae, Kieff.[1]

Rec. Ind. Mus. VI, p. 333.

Barogh, 10-v-10.

[1] Kieffer has described his species of *Tanypus* under the inadmissible generic name of *Pelopia*.

Tanypus oriplanus, Kieff.

Rec. Ind. Mus. VI, p. 125, ♂ (*Isoplastus*).
Loc. cit., IX, p. 161, ♀.

Simla, 25-iv-07. Only a single pair were known, and the ♂ is now apparently lost.

Tanypus riparius, Kieff.

Rec. Ind. Mus. VI, p. 332.

Barogh, 10-v-10, a unique specimen.

Tanypus saltatrix, Kieff.

Rec. Ind. Mus. VI, p. 330.

Simla, 9-v-10, "in numbers at dusk, males aerial dancing" (*N. Annandale*).

Subfamily *CHIRONOMINAE*.

Metriocnemus callinotus, Kieff.

Rec. Ind. Mus. VI, p. 175.

Simla Hills, 25-iv-07, a unique ♂.

Metriocnemus fusiger, Kieff.

Rec. Ind. Mus. VI, p. 348.

Simla, 12-v-08.

Camptocladius monticola, Kieff.

Rec. Ind. Mus. VI, p. 346.

Simla, 11-v-08. The unique type, a ♀, reduced to a fragment.

Rhopalocladius himalayae, Kieff.

Rec. Ind. Mus. VI, p. 347.

Barogh, 10-v-10. Type completely destroyed.

Orthocladius (s.g. *Trichocladius*) **anomalus**, Kieff.

Rec. Ind. Mus. IX, p. 124.

Valley of Sutlej River, below Simla, 6-v. Also occurs at Darjiling.

Chironomus polius, Kieff.[1]

Rec. Ind. Mus. VI, p. 339.

Kasauli, 16-v-08.

[1] Kieffer has described his species under the inadmissible generic name of *Tendipes*.

Chironomus nepalensis, Kieff.

Rec. Ind. Mus. VI, p. 339.

Simla, 11-v-08. Also occurs in Nepal.

Chironomus stictogaster, Kieff.

Rec. Ind. Mus. VI, p. 341.

Simla, 12-v-08.

Family PSYCHODIDAE.

Subfamily *PHLEBOTOMINAE.*

Phlebotomus major, Annand.

Rec. Ind. Mus. IV, p. 46, pl. v, fig. 4; pl. vi, fig. 4.

Simla, July (*N. Annandale*).

Subfamily *PSYCHODINAE.*

Psychoda bengalensis, Brun.

Rec. Ind. Mus. II, p. 370.

Simla, v-08 (*N. Annandale*); x-08 (*F. M. Howlett*); Phagu, 11-v-09; Barogh, 10-v-10; Dharampur, 13-v-08; Kasauli, 15-v-08. The commonest of the Indian species, extending all over the plains, and to Ceylon and Burma.

Psychoda nigripennis, Brun.

Rec. Ind. Mus. II, p. 376.

Simla, 10-v-08 (*N. Annandale*); x-1911 (*F. M. Howlett*); Phagu, 11-v-09; Kasauli, 15-v-08. Common in Calcutta and many parts of the plains.

Psychoda hirtipennis, Brun.

Rec. Ind. Mus. IV, p. 300.

Simla, x-08, one specimen (*F. M. Howlett*).

Pericoma spinicornis, Brun.

Rec. Ind. Mus. II, p. 378, ♂.
P. appendiculata, Brunetti, *l.c.*, p. 379, ♀.

Simla, May; Phagu, 11-v 09 (*N. Annandale*); x-11 (*F. M. Howlett*). Also occurs at Naini Tal, Darjiling and Siliguri. The sexes originally described by me as two species with the suggestion that they probably represented a single species.

Pericoma margininotata, Brun.

Rec. Ind. Mus. II, p. 381.

P. margininotata var. **bella,** Brun.

Pericoma bella, Brun., *Rec. Ind. Mus.* II, p. 383.

Simla, 25-iv-07; 11-v-08; 9—10-v-09; Phagu, 11—15-v-09; 18—21-v-16. The variety *bella* appears commoner than the typical form.

Pericoma metatarsalis, Brun.

Rec. Ind. Mus. IV, p. 305.

Simla, 9 and 12-v-09; Phagu, 11-v-09.

Pericoma mixta, Brun.

Rec. Ind. Mus. IV, p. 306.

Simla, 6-v-09, a unique ♀.

Family CULICIDAE.

Anopheles barianensis, James & Liston.

Anoph. Mosq. India, 2nd Ed., p. 76.
Christophers, *Ind. Jour. Med. Res.* III, p. 489.

Simla and Kasauli, up to 6,000 and 8,000 ft. Occurs at Murree and elsewhere.

Anopheles turkhudi, Liston.

Ind. Med. Gazette, XXXVI, p. 441.

Kasauli, breeding freely in small pools at 4,000 ft., and found in bungalow at 6,000 ft. Also occurs at Murree and elsewhere.

Anopheles simlensis, James & Liston.

Anoph. Mosq. India, 2nd Ed., p. 41 (*Patagiamyia*).

Kasauli. Also occurs at Murree.

Culex mimeticus, Noe.

Bull. Ent. Soc. Ital., XXXI, p. 240.

Theog, May 2nd, a single specimen, identified by Dr. Annandale.

Family DIXIDAE.

Dixa montana, Brun.

Rec. Ind. Mus. IV, p. 265.

Simla, 10-v-09; Barogh, 10-v-10; Phagu, 11-v-09

Dixa maculipennis, Brun.

Rec. Ind. Mus. IV, p. 266.

Matiana, 28—30-iv-07. Also found at Darjiling.

Dixa bifasciata, Brun.

Rec. Ind. Mus., IV, p. 269.

A single ♀ from Phagu, 12-v-09.

Family TIPULIDAE.

Subfamily *TIPULINAE*.

Tipula brunnicosta, Brun.

Faun. Brit. Ind. Dipt., p. 332.

Simla, 11-v-08; Theog, 13-v-09. Occurs in the Gahrwal District, Western Himalayas, also.

Tipula griseipennis, Brun.

Faun. Brit. Ind. Dipt., p. 321.

Matiana, 28—30-iv-07. Described first from the Gahrwal District.

Subfamily *LIMNOBIINAE*.

Dicranomyia pulchripennis, Brun.

Faun. Brit. Ind. Dipt., p. 376, pl. vii, fig. 8; pl. xi, fig. 2.

Simla, x-08. Also common at Mussoorie, Darjiling, the Kumaon District and other localities, easily recognised by the prettily marked wings.

Geranomyia vinaceobrunnea, Brun.

Rec. Ind. Mus. VI, p. 274.

Simla, x-08 (*F. M. Howlett*). A unique ♀.

Limnobia triangularis, Brun.

Faun. Brit. Ind. Dipt., p. 406.

A unique ♀ from Barogh, 10-v-10, taken at the edge of a small stream (*N. Annandale*).

Rhipidia antennatus, Brun.

Ceratostephanus antennatus, Brun., *Rec. Ind. Mus.* VI, p. 272.
,, ,, *Id.*, *Faun. Brit. Ind. Dipt.*, p. 407, pl. xi fig. 17.

Simla, a unique ♂, 24-iv-07.

Another specimen of *Rhipidia* in bad condition except that the antennae being well preserved proves it to belong to this genus from Simla, x-08 (*F. M. Howlett*).

Antocha indica, Brun.

Faun. Brit. Ind. Dipt., p. 426, pl. viii, fig. 12.

Phagu, 12-v-09 ; Theog, 2-v-97. Also found at Kurseong and on the Assam-Bhutan Frontier.

Rhypholophus pulcher, Brun.

Faun. Brit. Ind. Dipt., p. 442, pl. viii, fig. 16.

Phagu, 11-v-09. Also occurs at Naini Tal.

Molophilus inconspicua, Brun.

Faun. Brit. Ind. Dipt., p. 444.

Simla, 12-v-09. Also occurs at Kurseong and at various localities in Travancore State, South India.

Erioptera grandior, Brun.

Faun. Brit. Ind. Dipt., p. 456, pl. viii, fig. 18.

A single ♀ from Simla, 10-v-09.

Gonomyia flavomarginata, Brun.

Faun. Brit. Ind. Dipt., p. 472.

Simla, 12-v-08. Also occurs at Darjiling and Kurseong.

Symplecta punctipennis, Mg.

Syst. Besch. Europ. Dipt. I, p. 147, pl. v, figs. 2, 3, 7.
Brun., *Faun. Brit. Ind. Dipt.*, p. 486, pl. ix, fig. 15.

Matiana, 28—30-iv-07. Also not uncommon at Darjiling and in many parts of Europe.

Claduroides fascipennis, Brun.

Rec. Ind. Mus. VI, p. 289.
Faun. Brit. Ind. Dipt., p. 505, pl. x, figs. 7, 8.

Phagu, 12-v-09. It has been also taken at Darjiling and Kurseong.

Claduroides sordida, Brun.

Rec. Ind. Mus. VI, p. 290.

Simla, 10-v-09 ; 12-v-09. Also occurs at Kurseong

Trichocera ocellata, Walk.

Ins. Saund. Dipt. pt. V, p. 433.
Brun., *Faun. Brit. Ind. Dipt.*, p. 510.

A single ♀ from Theog, 2-v-07, has been always regarded by me as this species, though no actual corroboration of identity has been possible.

Trichocera punctipennis, Brun

Faun. Brit. Ind. Dipt., p. 511, pl. x, fig. 13.

Simla, 23—25-iv-07, tolerably common.

Rhaphidolabis indica, Brun.

Faun. Brit. Ind. Dipt., p. 519, pl. x, fig. 15.

Theog, 27-iv-07; Matiana, 28—30-iv-07; Phagu, 18—21-v-16.

Rhaphidolabis fascipennis, Brun.

Cladurọides fascipennis, Brun., *Rec Ind. Mus.* VI, p. 289.

Phagu, 12-v-09. Occurs also at Darjiling, Kurseong and in the Kumaon District.

Rhaphidolabis sordida, Brun.

Claduroides sordida, Brun., *Rec Ind. Mus.* VI, p. 290.
,, ,, *Id.*, *Faun. Brit. Ind. Dipt.*, p. 506.

Simla, 10-v-09; 12-v-09. Also occurs at Kurseong.

Eriocera nepalensis, Westw.

Caloptera nepalensis, Westw., *Ann. Soc. Ent. France*, IV, p. 681.
Pterocosmus velutinus, Walk., *List. Dipt. Brit. Mus.* pt. I, p. 79.
For description v. Brun., *Faun. Brit. Ind. Dipt.*, p. 543.

Dharampur, 5,000 ft., 6—8-v-07.

Family RHYPHIDAE.

Rhyphus fenestralis, Scop., var. **indicus**, Brun.

Rec. Ind. Mus. IV, p. 261.

Simla, 24-iv-07; 10-v-09; Matiana, 28—30-iv-07. Also common at Darjiling and Kurseong; it extends to Manipur, Assam. Usually taken on windows of houses and out-houses.

Rhyphus divisus, Brun.

Rec. Ind. Mus. IV, p. 263.
Faun. Brit. Ind. Dipt., p. 557, pl. xii, fig. 7.

Phagu, 12-v-06. An immature specimen is probably this species, which occurs not uncommonly at Darjiling, Kurseong, and Gangtok.

Family STRATIOMYIDAE.

Subfamily *BERINAE.*

Chorisops tibialis, Mg.

Syst. Besh. II, p. 3, pl. xii, fig. 8 (*Beris*).
Verrall, *British Flies*, V (Stratiomyidae, etc.), p. 214.

Kufri to Phagu, 8,000-9,000 ft., 21-v-16.

This European species was first recorded by me as occurring in India (*Rec. Ind. Mus.* VII, p. 456, 1912) on a specimen taken by Mr. Imms of the Forest Research Institute, in the Kumaon District, 28-v-12.

Subfamily *SARGINAE.*

Sargus metallinus, F.

For description see Wied., *Ausser Zweifl. Ins.* II, p. 36.

Pinjore, Patiala State, 17-vii-11 ; Simla, x-11 (*F. M. Howlett*).

Family TABANIDAE.

Subfamily *PANGONINAE.*

Corizoneura longirostris, Hardw.

Trans. Linn. Soc. Lond., XIV, p. 135, pl. vi, figs. 5, 6.
Ricardo, *Rec. Ind. Mus.* IV, p. 365.

Kasauli, 6,300 ft. (*Christophers*).

Subfamily *TABANINAE.*

Tabanus orientis, Walk.

List Dipt. Brit. Mus. pt. I, p. 152.
Ricardo, *Rec. Ind. Mus.* IV, p. 195, pl. xiv, fig. 18 (front view of head).

Simla, 7,000 ft. (*K. T. Pease*); 8-v-10 (*N. Annandale*); Mashobra, Simla Hills, 7,000 ft., 1909 (*K. T Pease*).

Tabanus excelsus, Ricardo.

Ann. Mag. Nat. Hist. (8) XI, p. 543.

Mashobra, Simla Hills, 7,000 ft.

Therioplectes subcallosus, Ricardo.

Rec. Ind. Mus. IV, p. 227.

Mashobra, Simla Hills, 7,000 ft. (*K. T. Pease*).

Therioplectes hirtus, Walk.

Ins. Saund. Dipt., p. 52.
Ricardo, *Rec. Ind. Mus.* IV, p. 228.

Mashobra, Simla Hills, 7,000 ft., 1909 (*K. T. Pease*); Phagu, 18—21-v-16; 11-v-09; Kufri, 11-v-09; Kufri to Phagu, 18-v and 21-v-16; Simla, 16-v-09.

Family BOMBYLIDAE.

Subfamily *ANTHRACINAE*.

Argyramoeba obscurifrons, Brun.

Rec. Ind. Mus. III, p. 216.

Phagu, 14—15-v-09, a single ♀.

Anthrax paniscus, Rossi.

For description see Schiner, *Fauna Austriaca*, I, p. 50; also Verrall, *British Flies*, V, Stratiomyidae, etc., p. 526.
Brun., *Rec. Ind. Mus.* II, p. 452.

Simla, x-06 (*H. M. Lefroy*).

Anthrax himalayensis, Brun.

Rec. Ind. Mus. III, p. 322 (fig.).
Anthrax maura, Brun., *loc. cit.*, II, p. 451.

Phagu, 18—21-v-16; Kufri to Phagu, 18-v-16; Simla, 7,000-9,000 ft., 12—16-v-09. Very near *maura*, L. of Europe, as which I at first recorded it from Naini Tal.

Anthrax aperta, Walk.

Ins. Saund. Dipt., pt. 3, p. 180.

Four from Simla, 16-v-09. Taken on *Sedum* and the common marguerite.

Anthrax approximata, sp. nov.

♀. India, Ceylon, Assam, etc. Long. 11-12 mm.

This species is very close to *clara*, Walk., yet certainly distinct. The scales on the frons and face vary from yellow to snow white; in one specimen being yellow on both parts, in others yellow on frons and white on face, those of the latter colour encroaching to some extent on lower part of frons: in one example snow white on practically the whole of both the frons and the face; sometimes some yellow scales around the mouth parts amidst the white ones.

Abdomen not uniformly pubescent as is probably the case in *clara*, but with distinct transverse bands of yellow or whitish scales at base of segments, those on the 2nd and 4th being widest, extending on the former segment nearly to the middle, and on the latter much further, especially towards the sides. Hind borders of 6th segment with conspicuous snow white scales and a large bunch of longer ones on about the hinder half of each side. Sides of 5th segment and anterior half or more of 6th with long very dark blackish brown scales. Dorsum of abdomen, except for the transverse bands, with black scales, wholly covered with soft fine pubescence, and with a row of black bristles on hind border of 5th, 6th and 7th segments; becoming stronger on each successive segment: a row of fine yellow hairs before the hind border on first four segments and a few fine yellow hairs on dorsum of basal segments. Costal cell clear or faintly obscured, subcostal cell dark brown, the colour not extending further hindward: anterior cross vein a little before middle of discal cell, the exact position apparently rather variable. In all else as in *clara*.

Described from five females in the Indian Museum. Simla, 7-8,000 ft., 28-v-14, *type* (*Capt. Evans*); Simla, 7,000 ft., 16-v-09; Siliguri, base of Darjiling Hills, 28-iii-10; Dawna Hills, Tenasserim, 2,000-3,000 ft., 2—3-iii-08; Kawkareik, Amherst Distr., Tenasserim, 5-iii-08 [1]; 23-iii-10 (all *N. Annandale*). In the British Museum from the Khasi Hills, 1878 (*Chennell*); Trincomalee, Ceylon, 12-x-90; 12-xi-90 (*Col. Yerbury*); Nilaveli, Ceylon, 19-vii-91 (*Col. Yerbury*). The two specimens alluded to by me in my first paper on Bombylidae as allied to *clara*, Walk., are amongst those now referred to *approximata*.

Anthrax fuscolimbata, sp. nov.

♀. Western Himalayas. Long. 15 mm.

Head. Frons forming one-third the width of the head at level of antennae, less than half as wide at vertex; covered with yellowish impressed scales and black pubescence, the scales in the neighbourhood of the antennae sometimes becoming gradually whitish. On the face they are, in the three examples present, wholly snow white in the type, and yellowish white and yellowish respectively in the other two specimens. Antennae black, 1st joint with long black bristles, 2nd with a ring of shorter bristles, 3rd elongate conical, tapering to a rather long style. Proboscis dull yellowish or obscure. Occiput with a border of snow white minute scaly pubescence behind eyes, some small yellow scales on upper part.

Thorax black, covered more or less with small impressed yellow scales; anterior and side margins, shoulders and pleurae covered with dense brownish yellow elongate scales which are paler on the meso- and sternopleurae, or sometimes altogether paler. A fine rather short sparse black pubescence present on dorsum, sometimes remaining after nearly all the yellow scales have been worn off. Scutellum black, with small yellow impressed scales,

[1] Erroneously quoted as 5-ii-08 in *Rec. Ind. Mus.* II, p. 474.

a little fine yellow hair and a row of black bristles on hind margin.

Abdomen black, with transverse bands of yellowish, yellowish grey or whitish small scales, broadest on 2nd and 4th segments where, especially towards the sides, they reach up to or beyond the middle of each segment: a narrow basal band on 3rd segment and a narrow band on hind margins of 5th and 6th. A large bunch of brownish yellow elongate scales towards and on sides of 1st, 2nd and 3rd segments; dorsum of 1st bearing sparse concolorous fine hairs. Sides of 3rd and 4th segments with elongate brownish yellow scaly pubescence which is paler on the latter; sides of 5th and 6th segments with numerous elongate dark brown scales and long black bristles, the posterior part of the side of the 6th segment bearing a conspicuous bunch of elongate snow white scales; 7th segment with black scales only; all the dorsal surface of abdomen, which is not occupied by pale scales, covered with minute impressed black scales; sparse pale fine hairs on about basal half of dorsal surface, replaced on the remainder by black ones, hind margins of segments with a row of black bristles. Belly with a broad transverse band of yellowish scales beyond middle; remaining segments with white scales; whole surface of belly plentifully covered with long yellowish or yellowish grey hairs, with fine black hairs towards tip. Genitalia brownish yellow with circlet of reddish brown blunt spines and black pubescence.

Legs black, coxae with grey or whitish rather long pubescence; femora and tibiae with small white or yellowish grey scales and rows of black bristles.

Wings nearly clear, the brown suffusion on anterior part in type specimen limited to subcostal cell; in the 2nd specimen extending from costa up to but not encroaching on discal cell, dying away towards tip; anterior cross vein just before middle of discal cell; halteres cream yellow.

Described from three paratype ♀♀ in the Indian Museum, neither one of the three being in sufficiently good condition to regard as an ultimate type; Simla, 7-8,000 ft., 26-v-14 (*Evans*); Mussoorie, 6,500 ft. (*Bond*); Guindy, Madras (*Patton*).

Subfamily *BOMBYLINAE.*

Bombylius major, L.

For description see Schiner, *Fauna Austriaca*, I, p. 60, and Verrall, *British Flies*, V (Stratiomyidae, etc.), p. 497.
Brun., *Rec. Ind. Mus.* II, p. 457 (Notes).

Simla Hills, 28-iv-07 and 4-v-07; Simla, 10—13-iv-14 (*Capt. Evans*); Matiana, 28-iv-07; Kufri, 4-v-07; Kodiali, 8,400 ft.

Dischistus resplendens, Brun.

Rec. Ind. Mus. II, p. 481.

Dharampur, 5,000 ft., 6—8-v-07; below Theog, 7,000 ft., 14-v-09. Also occurs in Assam.

Systoechus socius, Walk.

Ins. Saund. Dipt. pt. 3, p. 201.

Near Theog, 7,000 ft., 14-v-09. This seems a fairly well distributed species extending from the Himalayas to Ceylon; Kashmir, Kumaon, Dehra Dun, Sikkim, and the Kangra Valley, and several localities in Ceylon.

Usia sedophila, Brun.

Rec. Ind. Mus. III, p. 227.

Common on *Sedum rosulatum*, the white stone-crop at Simla, 16-v-09, where Dr. Annandale first discovered it. He found it again at Phagu on the same plant, 18—21-v-16. The sexes exhibit some difference in the markings of the head and thorax.

Usia marginata, Brun.

Rec. Ind. Mus. III, p. 228.

A single ♂ taken by Dr. Annandale at Simla in company with the first series of *U. sedophila*.

Empidideicus indicus, sp. nov.

♀. Simla. Long. 1 mm.

♀. Frons apparently about one-fourth the width of the head, yellowish; antennae black; proboscis more than $1\frac{1}{2}$ times height of head.

Thorax black, practically bare; humeri bright yellow;

Abdomen black, hind margins of segments pale yellow, and a yellow transverse line across middle of 1st and 2nd segments.

Legs black, knees and tips of tibiae yellowish.

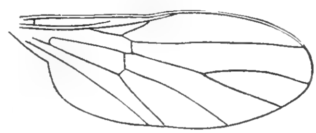

FIG. 1.—*Empidideicus indicus*, sp. nov., wing.

Wings pale grey; auxiliary vein short, ending free: 1st vein ending at middle of costa; praefurca beginning at middle of 1st vein; 2nd vein very short, directed abruptly upwards, ending in 1st vein near tip; 3rd vein in line with praefurca, simple, ending a little before wing tip; 4th vein forked at half its length after quitting basal cells, the portion dividing those cells hardly less distinct; 5th forked, base of upper branch forming lower side of 2nd basal cell; 6th vein reaching wing border. First basal cell a little longer than 2nd; bifurcation of praefurca opposite tip of 2nd basal cell.

Length 1 mm.

Described from four paratype specimens in the Indian Museum in very indifferent condition taken by Dr. Annandale at Simla, 7,000 ft.

The present species conforming to all the generic characters, except the presence of the 2nd vein, may be regarded, at least temporarily, as a true *Empidideicus*. Becker says, "2nd and 3rd veins anastomosed." In his species also, the basal cells are equal in length, and he does not mention the auxiliary vein, which, however, is easily overlooked in *indicus*.

Family NEMESTRINIDAE.

Hirmoneura annandalei, Licht.

Rec. Ind. Mus. IX, p. 333.

Simla, 9-v-10; Kufri, 11-5-59; Kufri to Phagu, 21-v-16.

Hirmoneura opaca, Licht.

Rec. Ind. Mus. IX, p. 334.

Simla.

Hirmoneura cingulata, Licht.

Rec. Ind. Mus. IX, p. 333.

Simla Hills, 9,000 ft., 12-v-09.

Family THEREVIDAE.

Thereva bilineata, sp. nov.

♀. Simla District. Long $11\frac{1}{2}$ mm.

Head. Frons at vertex distinctly more than $\frac{1}{3}$ of the head, at level of antennae, over half the head; its upper two-thirds yellowish brown, the rest, with the face, ash grey; whole frons with scattered black hairs of moderate length; face wholly covered with long pendant whitish grey hair, extending over cheeks and lower part of occiput; some black hairs below or around the mouth; proboscis reddish brown. Antennae black, first two joints with strong black bristles, 3rd as long as 1st. Vertical triangle barely raised; a row of rather strong bristles along upper occipital margin, a second row a short distance behind the first.

Thorax dark brown, nearly black, with two distinct yellowish white well-separated dorsal stripes from anterior to hind margin, and minute yellowish sparse pubescence. A row of five powerful spines behind the humerus, extending towards wing base; two supra-alar (post-sutural), one post-alar; a large and lesser one on each side margin of scutellum and a pair of apical scutellar decussate nearly perpendicular ones. Pleurae ash grey with long whitish grey pubescence. Scutellum ash grey with a large brown spot at base, hind margin with soft yellow hairs as well as the bristles.

Abdomen black; 1st segment grey, with yellow pubescence on hind margin and whitish hairs at sides; rest of segments with distinct ash grey hind border, which is always narrowest in middle, this border bearing some yellow or yellowish white pubescence; sides of 2nd and 3rd segments with whitish hairs; remainder of dorsum and at sides with short black pubescence; 7th segment shining chestnut brown; genitalia the same, marked with yellow, fairly prominent; belly black, all segments except 1st with well-defined bare hind margins.

Legs. Femora black, with depressed white pubescence and a short row of bristles in middle of underside; tibiae brownish yellow, darker at tips, fore pair with three (inner row wanting), posterior pairs with four rows of strong spines; tarsi brownish yellow or dark brown, joints paler at base, shortly pubescent.

Wings pale grey, normal, halteres black.

Described from a unique ♀ in the Indian Museum from Theog, Simla District, 8,000 ft., 1-v-07 (*N. Annandale*).

This species bears some resemblance to my *flavolineata*.

There is an undetermined ♀, a species of *Thereva*, from Phagu, 18—21-v-16, in the Indian Museum.

Family SCENOPINIDAE.

Scenopinus fenestralis, L.

For description see Verrall, *Brit. Flies,* V (Stratiomyidae), p. 597.

Kasauli, 6,300 ft., 15-v-08; Barogh, 5,000 ft., 10-v-09; 10-v-10.

Family EMPIDAE.

Subfamily *EMPINAE.*

Empis rostrata, Brun.

Rec. Ind. Mus. IX, p. 25.

Theog, 1-v-07, a unique ♀.

Pachymeria marginata, sp. nov.

♀. Simla District. Long. 5 mm. to tip of ovipositor.

Head. Frons ash grey, with parallel sides; ocellar triangle large, black; palpi bright orange. Antennae all black, 3rd joint considerably broadened at base, style joints distinct. Occiput bluish grey, with bristles and stiff hairs.

Thorax moderately dark grey with a slight yellowish tinge. Two dark median, well separated narrow stripes from anterior margin to well beyond middle of thorax. An outer stripe each side, foreshortened, enlarged into an irregularly shaped and rather indefinite elongated large spot behind the suture. Dorsum covered with short black hairs except on the stripes. Pleurae concolorous with black hairs; a bunch of bristly hairs on each humerus. Two macrochaetae just in front of the wing base, and a fringe of long stiff black hairs on each side of the metanotum. Scutellum concolorous, with four marginal bristles.

Abdomen moderately dark ash grey; hind margins of segments shining black, the colour extending forwards in the centre nearly or quite to the anterior margin; 5th segment wholly grey, 6th and 7th segments grey, shining black at bases. Belly grey. Ovipositor black.

Legs. Coxae grey, brownish yellow at tips. Femora in no way incrassated, brownish yellow, a brown streak on upper side of fore pair, and traces of such on middle pair. Tibiae and tarsi brownish yellow, tips of joints of latter black. Femora with soft black pubescence, longest on underside of posterior pairs; hind pair with a row of eight or more bristles. Tibiae with soft black pubescence and longitudinal rows of bristles; tarsi pubescent.

Wings very pale yellowish grey; unmarked; stigma absent; halteres brownish yellow.

Described from a single ♀ in the Indian Museum, taken between Kufri and Phagu, 21-v-16 (*N. Annandale* and *S. Kemp*).

This species bears a general resemblance, in the ♀ sex at least, to the common European *P. femorata*, which might well occur in the Himalayas, but is readily distinguished by the hind femora showing no trace of incrassation as in *femorata*.

Rhamphomyia himalayana, Brun.

Rec. Ind. Mus. IX, p. 28.

Matiana, 28—30-iv-07, a unique ♀.

Rhamphomyia unifasciata, Brun.

Rec. Ind. Mus. IX, p. 29.

Simla, 12-v-08. Also occurs at Dehra Dun.

Hilara compacta, Brun.

Rec. Ind. Mus. IX, p. 30.

Simla, 16-v-09; 9-v-09.

Subfamily *HEMERODROMIINAE.*

Clinocera obscura, Brun.

Rec. Ind. Mus. IX, p. 34.

Simla, 10-v-09.

Clinocera glaucescens, sp. nov.

♀. Simla District. Long. $3\frac{1}{2}$ mm.

Head. Frons greyish brown, the colour extended over vertex and in a broad stripe on the occiput. Face, under part of head and rest of occiput, blue grey. Proboscis and the moderately long palpi dark brown. Antennae black, style long, black, curved downwards. Ocellar bristles very long; a row of bristles behind the orbit on the occiput.

Thorax. Dorsum wholly greyish brown, remainder all bluish grey. The chaetotaxy apparently consists of one humeral, one notopleural and four dorso-central bristles. Scutellar apical bristles long.

Abdomen. Dorsum wholly greyish brown under side wholly bluish grey; in one specimen (not the type), the dorsal surface is more or less bluish grey on apical half.

Legs. Coxae bluish grey, remainder black, minutely pubescent.

Wings very pale grey, nearly clear, iridescent.

Described from two ♀♀ in the Indian Museu from Phagu, 18—21-v-16 (*N. Annandale* and *S. Kemp*).

Microdromia dorsalis, Brun.

Chelipoda dorsalis, Brun., *Rec. Ind. Mus.* IX, p. 33.

Barogh, 5,000 ft., 10-v-10, on banks of a small stream (*N. Annandale*).

Dolichocephala 7-notata, Brun.

Rec. Ind. Mus. IX, p. 35.

Simla, 10-v-09, a unique ♂.

Subfamily *TACHYDROMINAE.*

Tachydromia latifascipennis, sp. nov.

♂ ♀. E. and W. Himalayas. Long. $2\frac{1}{4}$-$2\frac{1}{2}$ mm.

Head. Eyes separated above by a moderately broad frons of uniform width, contiguous on underside. Head shining black, bare. Antennal 1st joint moderately long, of usual shape, 2nd shortly conical with long apical bristle, both joints brownish yellow. Proboscis dark brown; palpi rather elongate, with long whitish grey pubescence and a long apical black bristle. Occiput grey. A pair of bristles behind the vertex, a few shorter ones on back of head.

Thorax elongate, as broad as abdomen, humeri not constricted from mesonotum; wholly shining black, bare. Scutellum and pleurae black. A distinct prealar bristle.

Abdomen black, moderately shining, nearly bare, ♂ genitalia large, ♀ abdomen tapering, ovipositor normal.

Legs black; fore coxae distinctly but not greatly enlarged, sometimes with a pale spot on outer side; fore femora greatly incrassated, in some specimens the basal part is brownish yellow, in others there are two pale spots on outer side, near base, in some examples the whole femur is blackish brown. About the basal half of all metatarsi yellowish.

Wings grey, with two broad blackish bands, occupying the greater part of the wing, and extending from costa to hind margin, leaving the middle part of the wing rather narrowly clear, and a moderately wide clear wing tip and base. The blackish bands are darker anteriorly.

Described from a few of each sex in the Indian Museum from Darjiling, 8—11-viii-09, including ♂ *type*, 11-viii-09 (*J. T. Jenkins*), and *type* ♀, 8-viii-09 (*C. A. Paiva*); Dharampur, Simla, 5,000 ft., iv—v-08; Simla, 7,000 ft., 11-v-08 (both *N. Annandale*).

Tachydromia gentilis, Brun.

Platypalpus gentilis, Brun., *Rec. Ind. Mus.* IX, p. 40.

Simla, 10-v-09. I took it at Darjiling in May 1910.

Platypalpus gentilis, Brun.

Rec. Ind. Mus. IX, p. 40.

Simla, 10-v-09. Also taken by me at Darjiling in May.

Tachypeza pallidítibiae, Brun.

Platypalpus palliditibiae, Brun., *Rec. Ind. Mus.* IX, p. 41.

Simla, 11 v-08, a unique ♂.

Tachypeza incisa, Brun.

Platypalpus incisus, Brun., *Rec. Ind. Mus.* IX, p. 41.

Simla, 20 vii-11; a unique ♂.

Family PIPUNCULIDAE.

Pipunculus quartarius, Brun.

A specimen from Simla, 7-v-10, was provisionally referred to this species by me but a closer examination makes the identity very doubtful.

Pipunculus uniformis, sp. nov.

♂. Simla. Long. nearly $2\frac{1}{2}$ mm.

Head. Eyes contiguous for about half the distance from the moderately large vertex to the antennae. Frons and face brownish, silvery white seen from above. Antennae brown, 3rd joint, at least at the narrowed and lengthened tip, with white pubescence, arista black. Occiput moderately puffed out, blackish grey.

Thorax rather dark cinereous brown, sides dull, metanotum grey.

Abdomen rather dark cinereous brown, 1st segment a little greyish on hind corners, 5th segment barely longer than 4th; genitalia concolorous above, large, blacker and shining below, as broad as last segment of abdomen.

Legs mainly black, tips of femora brownish yellow; base and tips of tibiae brownish yellow, apparently to an irregular extent; tarsi more or less brownish yellow, darker towards tips. Hind femora shining black on inner side.

Wings clear, stigma weak, brownish; anterior cross vein at about one-third of the discal cell; halteres dirty yellow.

Described from a unique ♂ from Simla, October, 1908 (*F. M. Howlett*). In the Pusa collection.

Family SYRPHIDAE.

Subfamily *SYRPHINAE*.

Bacha tinctipennis, Brun.

Rec. Ind. Mus. II, p. 51, pl. xi, fig. 6.

Kufri to Phagu, 21-v-16. First described from Bhim Tal.

Paragus indicus, Brun.

Pipizella indica, Brun., *Rec. Ind. Mus.* II, p. 52.
Paragus indica, *id.*, *loc. cit.*, XI, p. 201.

Matiana, 28—30-iv-07. Also occurs in Nepal.

Chilosia nigroaenea, Brun.

Rec. Ind. Mus. XI, p. 204.

A unique pair, the ♂ from Matiana, the ♀ from Simla, 7-v-10.

Chilosia plumbiventris, Brun.

Rec. Ind. Mus. XI, p. 205.

A single ♀ from Simla, 7-v-10.

Syrphus, Fab.

Nearly a dozen species of this extensive Palaearctic genus occur in the Simla District, but in view of the fact that several are identical with European species it would be risky to describe those I cannot satisfactorily determine.

Syrphus balteatus, DeGeer.

For description v. Verrall, *British Flies*, VIII (Syrphidae), p. 390.

Simla, 26-iv-07 (*Capt. Evans*); Theog, 27-iv-07; Valley of Sutlej River, 6-v-10.

A very widely distributed species extending over all Europe, a great part of North America, over North Africa and through Northern Asia to Japan. Common in the plains of India also.

Syrphus pyrastri, L.

For description v. Verrall, *British Flies,* VIII (Syrphidae), p. 334 (*Catabomba*).

Theog, 27-iv-07 ; Simla, 5-vii-07.

Syrphus torvus, Os. Sac.

For description v. Verrall, *British Flies,* VIII (Syrphidae), p. 356.

Two of each sex from Matiana, 28—30-iv-07. Common in Europe and North America.

Syrphus luniger, Mg.

For description v. Verrall, *British Flies,* VIII (Syrphidae), p. 385.

A single ♂ from Theog, 27-v-07. Common in Europe.

Syrphus umbellatarum, F.

For description v. Verrall, *British Flies,* VIII (Syrphidae), p. 409.

One ♂, Matiana. A well known European species.

Syrphus salviae, Wied.

Auss. Zweifl., II, p. 122.

Simla, viii-14 (*Capt. Evans*).

Syrphus, spp.

Several other undetermined species of this genus yet remain, but it is impossible at present to deal with them in view of so many European species being known to occur in the district.

Platychirus albimanus, F.

For description v. Verrall, *British Flies,* VIII (Syrphidae), p. 280.

Theog, 27-iv-07 ; Matiana ; Simla, 9-v-10.

A very common and widely distributed European species. The melanoid or nearly wholly black form is not rare and one such specimen was recorded erroneously by me[1] as *Melanostoma dubium*, Zett.

[1] *Rec. Ind. Mus.* I, p. 168.

Melanostoma mellinum, Linn.

Melanostoma scalare, Fab.

Melanostoma orientale, Wied.

For descriptions see Verrall, *British Flies*, VIII (Syrphidae), pp. 309 and 311, and Wied., *Auss. Zweifl.*, II, p. 139.

The specimens originally referred by me to *scalare* are certainly *orientale*, Wied., and in my second paper on Oriental Syrphidae [1] I have suggested that Wiedemann's species is only a variety of *mellinum*. Assuming the identity, the species has been taken at Theog., 27-iv-07 ; Simla, 24-iv-07 and Matiana, 28—30-iv-07.

Melanostoma ambiguum, Fln.

For description see Verrall, *British Flies*, VIII (Syrphidae), p. 304.

A single ♂, undoubtedly of this species, from Matiana.

Melanostoma dubium, Zett.

For description see Verrall, *British Flies*, VIII (Syrphidae), p. 307.

Erroneously recorded by me from Matiana. See note under *Platychirus albimanus* on previous page.

Sphaerophoria, St. Farg.

As noted in my second paper on Oriental Syrphidae the species in this genus offer exceptional difficulties, beyond the two common ones, *scutellaris*, F. and *javana*, Wied. In that paper I described four " forms," all occurring in the Simla District, to three of which provisional names were given. These are : Form 1, *flavoabdominalis*, Simla, 6—8-v-07 ; Form 2, Simla, 6—8-v-07 ; Form 3, *nigritarsis*, Matiana, 28—30-iv-07 ; Theog, 24-iv-07 ; Kodiala, Simla District ; Form 4, *viridaenea*, Simla, 16-v-09 ; Theog, 2-v-07.

Rhingia laticincta, Brun.

Rec. Ind. Mus. II, p. 58.

Simla, 7-v-10 ; Phagu, 18—21-v-06. Occurs also at Mussoorie and Darjiling.

Rhingia angusticincta, Brun

Rec. Ind. Mus. II, p. 59.

Theog, 27-iv-07 ; between Kufri and Simla, 4 (?14)-v-10.

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[1] *Rec. Ind. Mus.* XI, p. 201 (1915).

Subfamily *VOLUCELLINAE.*

Graptomyza flavonotata, sp. nov.

Simla District. Long. 3½ mm.

Head wholly lemon yellow, sparsely beset with short pale hairs; vertical triangle black, ocelli red; tip of snout with a few black stiff hairs; proboscis brownish yellow, black towards tip. Antennae with 1st two joints dark brown, bristly, upper half of 3rd joint dark brown, lower half brownish, yellow arista microscopically pubescent; antennal prominence shining brownish yellow with some stiff black hairs.

Thorax lemon yellow. Whole dorsum from anterior to posterior margins, but leaving fairly broad side margins, shining black, with rather dense short pale yellow pubescence. Two small oval, well separated, lemon-coloured spots on hind margin, placed longitudinally. Scutellum yellow, with a slightly brownish tinge and a marginal fringe of long stiff pale bristly hairs. Sides of thorax black; an inverted pear-shaped pale lemon yellow spot of considerable size on sternopleura, with two smaller oval ones placed longitudinally lower down, one under the larger spot, the other under the wing base. A round pale yellow spot on the propleura.

Abdomen brownish yellow, darker brown on apical half; 2nd segment with three black spots on hind margin, the outer two oval, placed longitudinally and clear of the side margin, the middle one roughly triangular, the apex pointing forward; 3rd segment with two similar oval side spots, the oval middle one placed nearly on anterior margin; 4th segment with a pair of oval side spots considerably obscured by the brownish ground colour. Whole abdomen minutely pale pubescent.

Legs lemon yellow, hind coxae and tips of tarsi blackish; tip of hind femora broadly and hind tibiae and tarsi wholly black. The minute pubescence is yellow or black respectively, following the ground colour.

Wings almost clear, stigma pale brown, halteres lemon yellow.

Described from a single specimen in the Indian Museum taken between Kufri and Phagu, 21-v-16 (*N. Annandale* and *S. Kemp*).

Subfamily *ERISTALINAE.*

Eristalis, Latr.

The species of this genus in the East are very numerous and much further study is required even of those already described before we can consider them at all well known. Many were described from unique specimens, and do not appear to have been met with since, whilst probably some of Walker's types have been lost. Many are very closely allied and require to be studied from numerous or at least several specimens of each, side by side with their congeners. Only five species can be definitely identified from Simla.

Eristalis tenax, L.

This world-wide species is probably to be found all through the summer months, occurring freely at all the Himalayan places of resort. The dates of the specimens before me are Phagu, 18—21-v-16 (*N. Annandale* and *S. Kemp*) ; Simla, 12—13-v-13 (*N. Annandale*), and Matiana.

Eristalis himalayanus, Brun.

E. ursinus, Big., preocc. Jaen.

One ♀ from Phagu, 18—21-v-16 (*N. Annandale* and *S. Kemp*).

Eristalis solitus, Walk.

Simla, 12—13-v-13 (*N. Annandale*); Kasauli, 6,300 ft., 15-v-08 (*N. Annandale*).

This species is apparently found all along the 5,000 to 9,000 ft. level of the Himalayas, being common at Darjiling, Mussoorie and Naini Tal. It extends through the East apparently, as I took specimens in Yokohama in May 1906, and Dr. Annandale found it at Otsu near Kyoto in October 1915. The transverse light and dark bands on the thorax are less distinct in the ♀ than the ♂, being sometimes almost indistinguishable ; the abdominal bands are often pinkish, the 2nd (overlapping hind margin of 2nd and base of 3rd segment) sometimes comparatively broad, occasionally nearly as broad as the 1st band. The eyes are rather densely pubescent, the hair being brown above and whitish on their lower part ; the arista long plumose for half its length, on both sides, there generally being two or three hairs more on the lower side.

Eristalis albibasis, Big.

One ♀, Simla, 16-v-09 (*N. Annandale*), agrees perfectly with Bigot's description.

Eristalis arvorum, F.

This common Indian species occurs at Simla, Matiana, Theog, Phagu and Kufri.

It is a fairly distinct species in both sexes, and like *tenax* and *solitus* is tolerably easy to recognize when once it is understood. Meijere gives *quadrilineatus*, F., as a synonym.

Eristalis sp.

Two ♂ ♂ and a ♀ from Kasauli, 15-v-08 and Phagu, 18—21-v-16, must approximate to *kobusi*, Meij., but the abdominal marks are quite different. The principal point of resemblance is a long black bare streak on each side of the face, reaching from about the base of the antennae nearly to the mouth border. A further specimen from Kumaon is in the Indian Museum.

Subfamily *MILESINAE.*

Eumerus halictoides, Brun.

Rec. Ind. Mus. XI, p. 242.

Simla, 9-v-09. Also occurs at Darjiling.

Eumerus aeneithorax, Brun.

Rec. Ind. Mus. XI, p. 244.

A unique ♂ taken by Capt. Evans at Simla in August, 1914.

Eumerus perpensa, sp. nov.

♀. Simla District. Long. 7 mm.

Head. Frons and face æneous black, seen to be grey dusted when viewed at a low angle; frons with rather dense dark brown and yellow hairs; face with white pubescence. Antennae moderately dark brown on outer side, pale brown on inner side, arista black, bare. Mouth parts pale brown. Occiput black, the margin white dusted.

Thorax æneous blue black, shining, with two narrow whitish well separated median stripes ending some distance before the scutellum, which latter is blue black. Dorsum of thorax with yellow pubescence, that on the scutellum is greyish A little yellowish pubescence on anterior half of side margins of thorax. Sides of thorax æneous black, with greyish pubescence, except for a fan-shaped row of bright yellow hairs in front of the wing base.

Abdomen shining æneous blue black with minute greyish pubescence, which is only obvious at the side margins and on the spots. The usual three pairs of sublunate spots placed on the hinder half of the 2nd, 3rd and 4th segments, only the latter pair extending over the side margins. The spots are of about equal width, the 3rd pair more indistinct; all being white haired. Each pair of spots begins at about the middle of the segment, well separated at their inner upper ends; the 2nd pair terminating a little further from the hind margin of the segment than the 1st pair; whilst the 3rd pair terminate still further from the hind margin than the 2nd pair. Belly more or less pale brown. Some longer white pubescence at sides of 2nd segment.

Legs mainly æneous black, shining. Tips of femora rather narrowly, about basal half and inner sides of anterior tibiae and base of hind tibiae, also tips of all tibiae, brownish yellow. Tarsi brown with pale pubescence, hind pair with gold brown pubescence on underside. A row of six small black spines below hind femora near the tip.

Wings vitreous, iridescent; stigma brown, small, distinct; halteres brownish yellow.

Described from a single perfect ♀ in the Indian Museum from Phagu, 18—21-v-16 (*N. Annandale* and *S. Kemp*).

Eumerus perplexa, sp. nov.

♀. Simla. Long. just over 7 mm.

Allied to *perpensa* but shewing the following differences. Antennae blackish, with greyish bloom, not lighter on inner side. Dorsal pale thoracic stripes appear to be less distinct. Abdomen deeper blue black and the white pubescence on the spots and sides of abdomen a little more conspicuous. Middle tibiae and tarsi wholly orange, latter a little obscure on upper side; hind tarsi more orange than in *perpensa*. Wing distinctly grey.

In length barely longer, but a stouter built species.

A unique ♀ in the Indian Museum, Simla, 12—13-v-13 (*Annandale*).

Myiolepta himalayana, Brun.

Rec. Ind. Mus. XI, p. 233, pl. xiii, figs. 12, 13.

Matiana, marked " S. 15 " (probably meaning Sept. 15th).

Criorhina dentata, Brun.

Rec. Ind. Mus. II, p. 87.

Kodiali, Simla Hills, 8,000 ft., a unique ♂. This species may possibly require the erection of a new genus to receive it.

Subfamily *CHRYSOTOXINAE.*

Chrysotoxum 6-fasciatum, Brun.

Rec. Ind. Mus. II, p. 89, ♀ ; XI, p. 254, ♂.

Simla, 9-v-10 Originally described from the United Provinces, India.

Family CONOPIDAE.

Occemyia atra, Fab.

For description see Schiner, *Faun. Austr.* I, p. 382.

Kufri to Phagu, 21-v-16.

Family MUSCIDAE.

Subfamily *MUSCINAE.*

At least three of the commonest, almost cosmopolitan species may be presumed to occur in all parts of the Simla District, throughout the summer as in most other parts of the Indian hills.

Calliphora vomitoria, Linn.

For description see Schiner, *Faun. Austr.* I, p. 584.

Matiana; Simla. One of the common blowflies.

Calliphora erythrocephala, Mg.

For description see Schiner, *Faun. Austr.* I, p 584.

Simla; Theog. The commonest species of blowfly.

Stomoxys calcitrans, L.

For description v. Brun., *Rec. Ind. Mus.* IV, p. 68.

Simla, x-11. The common stable fly.

Bdellolarynx sanguinolentus, Aust.

Ann. Mag. Nat. Hist. (8) III, p. 290.

Described from specimens from India, Ceylon and Assam, the type ♂ being taken by me near Calcutta, now in the British Museum. A good series of both sexes from Pusa, in the Pusa collection, taken from October to March (both inclusive). One headless immature specimen is labelled "reared from eggs laid 7-i-14; hatched 9-i-14; pupated 19-i-14; emerged 29-i-14, C.S.S. Pusa." Also taken "on buffalo at Annandale, Simla District, x-1911; Simla, x-1911 [*Howlett*]; Kasauli, 8-viii-15 (*Mitter*).

If *Bdellolarynx* is really generally distinct from *Haematobia* the best character is the greater width of the frons, there being always a distinct though narrow space between the eye margins, whereas these latter in *Haematobia* usually almost touch one another for an appreciable distance, and in some specimens they actually do touch. Austen's description of the legs in *sanguinolentus* is rather indefinite, as he does not specially mention the tibiae, which from inference would therefore be included in the general description of the fly as "mouse-grey or slate-grey." The tibiae are usually brownish yellow varying in shade, and in some examples, especially if somewhat immature, they and the femora also are pale brown. Mr. Mitter has described its life-history (*Ind. Journ. Med. Res.*, III, p. 583, 1916).

Haematobia sanguisugens, Aust.

Ann. Mag. Nat. Hist. (8) III, p. 288.
Haematobia rufipes, Brun, *Rec. Ind. Mus.* IV, p. 65.

This species was described from males only, and my *H. rufipes* from females only. Mr. Mitter has called my attention both in his paper and personally to *rufipes* being synonymous with Austen's species, and an examination of further specimens of both sexes proves this to be the case. In the ♂ the legs are black or nearly so, except for the narrow pale bases of all the tibiae. In the ♀ all the tibiae and the posterior femora are brownish yellow, the fore femora usually blackish grey, except at the tips, but these may conceivably be pale also in some individuals.

Both sexes were bred by Mr. Mitter at Kasauli. The unique type of my *rufipes* is from Darjiling, 29-ix-08, taken by me. The species occurs also at Simla, x-1911, ♂ ♀ (*Howlett*); Kasauli, 7-ix-16 (*Mitter*).

This species is closely allied to the European *H. stimulans*, Mg. from which Mr. Austen distinguished it. It should also be near *tibialis*, Rob. Desv., of Europe, but in that species the anterior tarsi are orange as well as the tibiae, and the hind tibiae are brown. *Tibialis* is only 3 mm. in length, *sanguisugens* 5 to 6 mm.

Interesting notes on the breeding habits are given by Mr. Mitter (*Ind. Journ. Med. Res.*, III, p. 530, 1916).

Stygeromyia maculosa, Aust.

Ann. Mag. Nat. Hist. (7) XIX, p. 445.

This species also has been bred by Mr. Mitter at Kasauli, the examples presented by him to the Indian Museum, 1 ♂ and 4 ♀ ♀, being dated 10-viii-16. The life history is described by him (*loc. cit.*, III, p. 395, 1915).

Graphomyia sp.

One ♀ taken from Kufri to Phagu, 21-v (*N. Annandale* and *S. Kemp*), which bears considerable resemblance to the *G. maculata*, Scop. of Europe.

In all probability several other common European muscinids will be found to occur in and around Simla, *Musca corvina*, Fab., for instance, recorded already from various parts of India, one or more species of *Lucilia*, *Pollenia rudis*, Fab., *Curtoneura stabulans*, Fln., and one or both of the known Indian species of *Lyperosia*.

Subfamily *ANTHOMYINAE*.

Numerous European species will almost certainly be found to occur in the Simla District. Some years ago I sent all my Oriental Anthomyinae to Prof. Stein, most of which were collected by me in Mussoorie and Darjiling, and though they have not been returned, he acknowledged their safe arrival, noting in a postcard that several species were identical with Palaearctic forms. The four species definitely identified by me are as follows :—

Homalomyia canalicularis, Linn.

For description see Schiner, *Faun. Austr.* I, p. 654.

Simla District; Matiana, 28—30-iv-07; Theog, 2-v-07.

Limnophora tonitrui, W.

Auss. Zweifl. II, p. 429.
Brun., *Rec. Ind. Mus.* I, p. 381.

Dharampur, 13-v-08.

Spilogaster himalayensis, Brun.

Rec. Ind. Mus. I, p. 382 (*Limnophora*); II, p. 107 (correction).

Phagu, 18—21-v-16; Theog, 2-v-07; Dharampur, 6—8-v-07.

Anthomyia pluvialis, Linn.

For description see Schiner, *Faun. Austr.* I, p. 647.

Simla, x-08 (*F. M. Howlett*); viii-14 (*Capt. Evans*); Theog, 2-v 07.

MUSCIDAE ACALYPTRATA.

Subfamily *CORDYLURINAE.*

Scatophaga stercoraria, Linn.

For description see Schiner, *Faun. Austr.* II, p. 18.

Simla, 24-iv-07; 5-v-07.

The very common dung-fly of Europe, North America, and North Asia. Two other species of *Scatophaga* occur in the district, but they have not yet been identified.

Subfamily *HELOMYZINAE.*

Dryomyza formosa, Wied.

Auss. Zweifl. II, p. 447 (*Scatophaga*).
Dryomyza maculipennis, Macq., *Dipt. Exot.* Supp. IV, p. 273.

Simla District, 24-iv-07; Phagu, 18—21-v-16; Simla.

I took this species at Mussoorie, and it occurs also at Darjiling and other places, extending as far east as Japan.

Sepedon ? plumbellus, Wied.

Auss. Zweifl. II, p. 577.

Simla District; Dharampur, 6—8-v-07.

Not uncommon around Calcutta near water from January to July. The Vienna Museum dipterologist returned specimens of this form as probably incorrectly identified.

Sepedon crishna, Walk.

Proc. Linn. Soc. London, V, p. 191.

Matiana, 28—30-iv-07.

Subfamily *HETERONEURINAE.*

Trigonometopus montanus, sp. nov.

♂ ♀. Simla. Long. 4 mm.

Head about twice as deep in profile as eyes. Frons and vertex brownish yellow, lower part of frons covered with very short black bristles; an indistinct pale brown median stripe, and traces of one on each side towards anterior margin, contiguous to eyes; 3

fronto orbital, 1 vertical, 1 postvertical and 1 ocellar bristle. Occiput blackish, eye margins with a row of strong bristles with shorter ones behind them. Vertical triangle black, ocelli distinct. A small dark brown oval mark on each side from eye margin to base of antenna. Lower part of head whitish; a row of strong bristles on cheeks from back of head nearly to antennae. Antennae yellowish, 2nd joint with a circlet of strong black bristles, and additional ones; 3rd joint with pale microscopic pubescence and long black dorsal arista, yellowish at base. Proboscis rather long, thick, pale, yellowish, the very small slender palpi at the middle, with three or four long black bristles.

Thorax dull brownish yellow, dorsum with four pale mauve brown stripes, the two median ones continued to tip of the pale yellow scutellum. Pleurae brownish; 3 dorso-central, 2 notopleural, 1 pteropleural; a basal and apical scutellar bristle.

Abdomen, ground colour dull brownish yellow with short pubescence, but the hind margins of the segments broadly brown; in fact this colour covers most of the dorsum, leaving a central pale space occupying most of the 2nd and 3rd segments. Belly yellowish. In what I take to be the ♂ specimen is a globular process at the tip of the abdomen bearing two comparatively large conical protuberances below. In the other specimen no genitalia are visible.

Legs pale yellowish, microscopically bristly; tarsi tips blackish; fore femora with a row of long bristles on upper, outer and under sides; subapical tibial bristle prominent.

Wings pale brownish yellow, paler posteriorly; both cross veins narrowly but distinctly suffused; halteres dirty yellowish, knobs blackish.

Described from two specimens in the Indian Museum taken between Kufri and Phagu, 21-v-16 (*N. Annandale* and *S. Kemp*).

Both my *trilineatus* and the rather widely distributed European *frontalis* seem closely allied to the present species. The unmarked wing in the latter easily distinguishes it from *trilineatus*, whilst *frontalis* possesses the rudiment of an additional cross-vein.

Subfamily *HELOMYZINAE*.

Helomyza unicolor, sp. nov.

♂ ♀. Simla. Long. 5 mm.

♀. Wholly brownish yellow, almost orange; lower part of frons brighter, almost chrome yellow; upper part and vertex a little deeper. Under side of head pale whitish yellow or yellowish. Antennae deep orange, arista black, pale at extreme base, pubescent. Sides of thorax paler; pleurae with almost whitish reflections in certain lights.

Abdomen with a blackish band on hind margin of all segments, sometimes indistinct on 2nd segment, the band varying in intensity and width, sometimes filling nearly all the apical segments; a row of strong bristles on hind margin of each segment. The colour of the abdomen varies to more brownish or to pinkish brown;

genitalia concolorous, in ♂ globular, hairy, rather large; in ♀ smaller and normal.

Legs yellowish, tips of tarsi black; hind tibiae a little darkened just beyond base. Fore femora with a row of about 6 long bristles on upper side, a row of long thin hairs, curved at tips, on inner side, and long stiff black hairs on under and outer sides. Middle femora with a row of black bristles on inner side, two rows of closely placed small black spines on under side, with several very long hairs towards base. Hind femora the same, but the small bristles on under side more numerous, and the long basal hairs absent. Tibiae uniformly pubescent, subapical bristle conspicuous; apical spur on middle pair. Some longer stiff bristles on under side of fore tarsi at base.

Wings pale grey; halteres orange.

Described from several specimens in good condition from Phagu, 9,000 ft., 18—21-v-16 (*N. Annandale* and *S. Kemp*).

Subfamily *SCIOMYZINAE.*

Sciomyza costalis, sp. nov.

Simla District. Long. $5\frac{1}{2}$ mm.

Head cinereous grey, a bare, moderately broad olive grey stripe on each side of frons from upper corner of eye, the stripes uniting a little below the lowest ocellus, the colour then becoming merged in the more yellowish lower part of frons, which is covered with very short bristly hairs. A moderately distinct short brownish streak placed diagonally towards each lower corner of the frons; the lower margin itself with some silvery white shimmerings here and there. Ocelli distinct, red. Upper sides of frons, and the ocellar triangle with small bristly hairs. A brownish yellow band across the face at level of antennae, with a black spot filling the space between the antenna and the eye margin. Face, underside of head and mouth opening pale yellowish, nearly bare except for short bristly hairs around the latter and extending towards the occiput. Antennae brownish yellow, 3rd joint paler below, first two joints with a whitish shimmer seen from above; 3rd joint as long as 1st and 2nd together; arista black, distinctly plumose on upper and under sides nearly to tip. Proboscis brownish yellow; 2 fronto-orbital, 2 ocellar, 1 vertical and 2 post-vertical bristles.

Thorax cinereous grey, thickly beset with very short black bristles; mesopleura and propleura pale yellowish grey; rest of pleurae nearly ash grey. Sternopleura with minute soft hairs; 1 humeral, 1 presutural, 2 notopleural, 3 supra-alar, 1 inter-alar just behind the suture with a much smaller one just in front of it; a weak propleural and 2 strong pteropleural. Scutellum with 1 basal, placed near the side margin, and 1 apical.

Abdomen cinereous grey, with a broad angular dorsal black stripe composed of a large subquadrate spot in the middle of each segment, broader on anterior than on posterior margin; whole dorsal surface of abdomen with short black bristles. Belly cinereous grey with shorter black pubescence.

Legs brownish yellow, entirely covered with short black stiff hairs; tips of femora with traces of a dark brown ring; tips of tibiae, whole of front tarsi and last joints of posterior tarsi black.

Wings pale grey; anterior margin (except costal cell) with a moderately dark brown band, the colour limited by the 2nd longitudinal vein up to middle of wing, beyond which it extends a little behind that vein; it is sharply delimited a little before the wing tip, leaving the tips of the submarginal and 1st posterior cells practically clear. The colour from the tip of the 2nd longitudinal vein dying away gradually hindward. In this darker grey part are traces of two or three paler spaces in the neighbourhood of the posterior cross-vein. Anterior cross-vein just perceptibly diffused. Halteres brownish yellow.

Described from a single perfect specimen taken between Kufri and Phagu, 21-v-16 (*N. Annandale* and *S. Kemp*), in the Indian Museum.

Subfamily *SAPROMYZINAE.*

Several species of the genus *Sapromyza* have been collected, but not yet identified. The Indian Museum collection in this group is at present being worked out by Prof. Bezzi.

Subfamily *TRYPETINAE.*

Vidalia cervicornis, sp. nov.

♂ ♀ . Simla. Long. 4-5 mm.

Head brownish yellow, frons sometimes a little deeper; face and underside of head whitish yellow; ocellar triangle black. Proboscis, palpi and antennae brownish yellow, arista black, microscopically pubescent. Eyes green. Occiput brownish yellow, with four thin brown perpendicular lines; the inner pair short, the outer ones reaching upper corners of eyes and sometimes bifid.

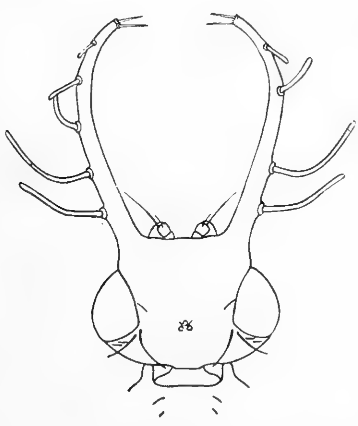

FIG. 2.—*Vidalia cervicornis*, sp. nov., head.

The ♂ has the frons produced on each side in the form of horns (generic character), and only the upper pair of fronto-orbital bristles occur on the frons, the remainder being placed on the horn-like appendages, one horn bearing five, the other four, whilst the tip of each bears two such bristles.

The ♀ has five long fronto-orbital bristles (two upper, three lower), the lower pair decussate.

The other head bristles (in both sexes) are: 2 vertical; 1 post vertical, small; 1 ocellar, very small; the occipital row normal.

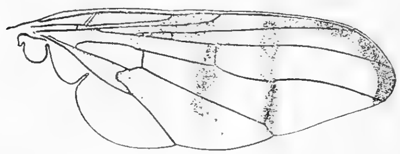

FIG. 3.—*Vidalia cervicornis*, sp. nov., wing.

Thorax brownish yellow, two thin, darker, well separated median lines, the space between with a slight greyish yellow tinge, the anterior end of this stripe sometimes brown; 1 humeral, 1 dorsocentral, 1 presutural, 1 prescutellar, 2 notopleural, 3 supra-alar (*i.e*, 1 pre-alar, 1 supra-alar, 1 post-alar), 1 mesopleural, 1 pteropleural, 1 sternopleural. Scutellum concolorous, with 1 basal and 1 apical bristle. Metanotum shining black, with a narrow yellow median stripe.

Abdomen conical; brownish yellow with short black pubescence and bristles on the sides, also on the hind margins of at least the last two segments.

Legs brownish yellow, shortly pubescent; tibiae and tarsi a little paler, a row of long bristles on upper and outer sides of front femora; all coxae with several bristles.

Wings pale grey; costa yellowish before tip of 1st vein, the colour extending hindwards as a narrow yellowish stripe to hind border, embracing anterior cross-vein. A second stripe, narrow, blackish, extends from costa to hind margin, embracing the posterior cross-vein. Costa blackish from the costal end of this stripe to beyond wing tip, the tips of the 2nd, 3rd and 4th veins narrowly black infuscated. Anterior cross-vein exactly at middle of discal cell, posterior cross-vein perpendicular or even slightly recurrent. Anal cell sometimes yellowish. Halteres pale yellow.

Described from 2 ♂♂ and 4 ♀♀ from Phagu, Simla Hills, 18—21-v-16 (*N. Annandale* and *S. Kemp*).

In the second ♂ specimen, the horns are only half as long as in the type, they bear only one bristle each, and two at the tip of each; also the single fronto-orbital bristle on the frons is extremely small and weak.

Bezzi says the anterior cross-vein is placed after the middle of the discal cell and describes the arista as "short pilose," whilst Desvoidy describes it as plumulose. These minor distinctions do not seem to prevent the species being placed in *Vidalia*, the principal character of which are the horn-like processes on the head.

Vidalia melanonotum, sp. nov.

♀. Simla District. Long. 4½-5 mm.

Head all brownish yellow, occiput streaked with brown on upper part; face with a little whitish shimmer; edges of frons very slightly elevated; ocellar spot black; proboscis, palpi and antennae brownish yellow, arista pubescent. Chaetotaxy complete.

Thorax and scutellum brownish yellow, a large quadrate black spot in middle of anterior margin of former; dorsum appearing a little white-dusted when viewed from in front. Metanotum wholly brilliantly shining black with a small spot on each side below. Chaetotaxy complete.

Abdomen brownish yellow; last segment shining black; a blackish spot towards the sides of the three previous segments; genitalia brownish yellow.

Legs pale yellow. Fore femora with seven long bristly hairs on underside; middle tibiae with one spur; hind tibiae with row of bristly hairs behind (all generic characters).

Wings clear, with blackish brown marks. The costal section between tips of auxiliary and 1st veins blackish, the colour extending hindwards as a moderately narrow band which embraces the anterior cross-vein. An isolated rounded spot on 2nd vein half way between this band and the apical spot. Wing tip broadly blackish from a little before tip of 2nd vein to just beyond tip of 4th vein; a clearer space towards the tip of each of the embraced cells. An irregular streak from bifurcation of 2nd and

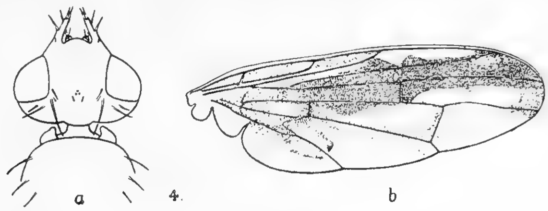

FIG. 4.—*Acidia discalis*, sp. nov.
a. Head. *b*. Wing.

3rd veins, extending along basal side of discal cell and apical side of anal cell. Posterior cross-vein rather broadly infuscated. Halteres brownish yellow.

Described from 3 ♀ ♀ in the Indian Museum, Phagu, 18—21-v-16 (*type*); between Phagu and Kufri, 21-v-16.

Though no male is present, the characters of this species coincide with those of *Vidalia* except that there is no trace of bristles on the 3rd longitudinal vein. The anterior cross-vein is barely at the middle of the discal cell, whereas it should be at or just beyond the middle. It has a *Spilographa*-like appearance.

Acidia discalis, sp. nov.

Simla District. Long. 4 mm.

Head pale chrome yellow, occiput with brownish streaks on upper part. Proboscis, palpi and mouth-opening a little brownish. Antennae pale yellow, arista minutely pubescent; 2 upper, 3 lower fronto-orbital bristles, 1 ocellar, 2 vertical (inner nearly perpendicular, outer depressed), 1 post-vertical, perpendicular; ocellar row normal; some bristly hairs on lower part of side of head.

Thorax brownish yellow, pleurae pale, major part of dorsum gold-dusted and with a whitish shimmer seen from in front. Chaetotaxy: 1 humeral, 1 praesutural, 1 dorso-central, 1 praescutellar, 3 supra-alar, 2 notopleural, 2 mesopleural, 1 pteropleural, 1 sternopleural. Scutellum, 1 basal, 1 apical bristle.

Abdomen shining chestnut brown, a little darker here and there, pubescent, with bristly hairs along sides. Belly concolorous.

Legs very pale yellow, tarsi tips a little brighter yellow; fore femora with seven long bristly hairs on underside; middle femora with some smaller bristly hairs towards tip.

Wings pale grey; costal cell nearly clear, yellowish for a short distance before tip of 1st vein. A long brown streak from near base of wing, the upper edge reaching a little above the 2nd vein, meeting the costa at tip of 2nd vein and extending round tip of wing to tip of 3rd vein; the lower edge of the streak encroaching a little on basal half of discal cell, thence extending only a little below the 3rd vein, leaving the 1st posterior cell with a broad brown tip, so that approximately the lower half of that cell is clear except at base and tip; 3rd and 4th veins and posterior cross-vein broadly though rather indistinctly suffused with yellow. Basal part of wing, including anal cell, brownish. Halteres brownish yellow.

Described from a unique specimen in the Indian Museum taken between Phagu and Kufri, 21-v-16 (*N. Annandale* and *S. Kemp*).

Acidia rioxaeformis, Bezzi.

Mem. Ind. Mus. III, p. 143.

Simla, 20-vii-11.

Oxyna sororcula, Wied.

Auss. Zweifl. II, p. 509 (*Trypeta*).

Kufri, Simla Hills, 8,000 ft., 11-v-09.

Paralleloptera pterocallaeformis, Bezzi.

Mem. Ind. Mus. III, p. 155, pl. x, fig. 58.

Dharampur, 14-iv-08 (*N. Annandale*); x-11 (*F. M. Howlett*).

Tephritis zonogastra, Bezzi.

Mem. Ind. Mus. III, p. 164.

Simla, x-08 (*F. M. Howlett*).

Subfamily *ORTALINAE.*

Chloria aenea, F.

For description see Wied., *Auss. Zweifl.* II, p. 566.
Ulidia aenea, Auct.

Phagu, 18—21-v-16. A widely distributed bright green metallic fly, throughout the East. I have taken it in the Phillipines, in Rangoon and various parts of India.

Subfamily *MICROPEZINAE.*

An unnamed species of *Calobata.*

Subfamily *SEPSINAE.*

Sepsis cynipsea, L.

For description see Schiner, *Faun. Austr.* II, p. 178.

Simla, 11-v-08; 16-v-09; 9-v-10; Phagu, 11—13-v-09; Theog, April and May; Dharampur, 28-iv—3-v-08; Matiana, 28—30-iv-07; Kufri, 11-v-09; Sutlej Valley.

Sepsis himalayensis, Brun.

Rec. Ind. Mus. III, p. 345.

Simla, 12—13-v-13 (*N. Annandale*); x-11 (sweeping in grass).

Sepsis rufibasis, Brun.

Rec. Ind. Mus. III, p. 348.

Barogh, 10-v-10.

Sepsis fulvolateralis, Brun.

Rec. Ind. Mus. III, p. 349.

Simla, 16-v-09; 9-v-10; Phagu, 11-v-09; Matiana, 28—30-iv-07.

Sepsis rufa, Macq.

Dipt. Exot. Supp. IV, p. 296.

Simla, Oct. 08 (*F. M. Howlett*).

Sepsis spectabilis, Meij.

Ann. Mus. Nat. Hung. IV, p. 178.

Barogh, 10-v-10.

Sepsis bicolor, Wied.

Auss. Zweifl. II, p. 468.

Simla, 11-v-08; 10-v-09 (*N. Annandale*); x-1911 (*F. M. Howlett*). Extremely common at Darjiling.

Sepsis humeralis, Brun.

Rec. Ind. Mus. III, p. 362.

Simla, Oct. 08 (*F. M. Howlett*). A very common species, described originally from China.

Sepsis viduata, Thoms.

Eugen. Resa, p. 586.

Simla, x-1911 (*F. M. Howlett*).

Sepsis lineatipes, Brun.

Rec. Ind. Mus. III, p. 354.

Simla, x-1911.

Enicita annulipes, Mg.

Syst. Besch. V, p. 292.

Simla 24-iv-07; 12—13-v-13; 11-v-08; vii-11; below Simla, 16-v-09 (all *N. Annandale*); Simla, x-11 (*F. M. Howlett*); Phagu, 3-v-07; Barogh, 10-v-10; Kufri, 11-v-09. Apparently common at all the hill stations.

Four specimens in the Indian Museum belong to a genus near *Madiza* that I am unable to recognise. They are from Simla, 12—13-v-13 and Theog, 2-v-07.

Subfamily *OSCININAE.*

Chlorops nigricornis, sp. nov.

North-West India. Long. 2 mm.

Head bright yellow; ocellar spot small, black, generally produced forward into a fine line. The configuration of the large impressed triangle, so common to many species, is more or less emphasised by very narrow brownish outlines. Antennae yellowish, 3rd joint black, arista black, yellow at base. Proboscis a little brownish, palpi pale yellow. Occiput yellow, centre part black. The head appears in certain lights to glisten with a brilliant silver hue in many places.

Thorax deep yellow, with the three usual stripes shining bright brown or dark brown, sometimes barely separated. The outer ones in some specimens very nearly attaining the front margin, none of them quite reaching the hind margin. Three distinct black spots on the pleurae. Scutellum pale yellow, a little blackish at base in the middle.

Abdomen blackish, base rather broadly more or less yellowish, sometimes towards sides only, sometimes to the extent of its full width. Abdomen tip pale yellow, margin of segments narrowly yellow, belly yellowish.

Legs all yellow except the brownish tarsi tips; none of the femora thickened.

Wings clear, normal; 2nd and 3rd longitudinal veins parallel, the latter ending some distance before the wing tip, slightly curved upwards at its end; 2nd vein lying closer to the 1st for some distance from its base than in the other species; 3rd and 4th veins diverging. Posterior cross-vein distant from one to one and a half times its own length from anterior cross-vein, which latter is opposite tip of 1st vein. Halteres pale yellow.

Described from six specimens in the Indian Museum from Bhachkahi, Bahraich District, United Provinces, 15-iii-09; and Simla, 11—12-v-08 (*N. Annandale*).

Elachiptera brevicornis, sp. nov.

Simla District. Long. $1\frac{1}{2}$ mm.

Head bright chrome yellow; frontal triangle large, black; antennae chrome yellow, 3rd joint shorter than in the other species of *Elachiptera*; upper side black, arista densely black pubescent, a little longer than the joint.

Thorax, including scutellum, dark blackish grey; shoulders dull yellowish, sides obscurely blackish.

Abdomen blackish, belly obscurely yellow.

Legs all yellow, hind femora not at all incrassate.

Wings clear; 3rd and 4th veins practically parallel; anterior cross-vein opposite tip of 1st vein, posterior cross-vein distant twice its own length (or nearly) from anterior cross-vein. Halteres yellowish.

Described from 8 specimens in the Indian Museum from Barogh, Simla District, 5,000 ft., 10-v-10 (*N. Annandale*).

Subfamily *GEOMYZINAE.*

Geomyza tripunctata, Fln.

For description see Schiner, *Faun. Austr.* II, p. 287.

A single specimen from Simla, 9-v-10, may be this not uncommon European species.

Of the remainder of the Acalyptrate Muscidae there are two or three species of Ephydrinae, a Phytomyzid and one or two Limosinae.

Family PHORIDAE.

Trineura ? aterrima, Fab.

Four specimens from Simla, x-08 (*F. M. Howlett*), closely resemble this European species, but possess an inner row of four frontal bristles on each side from half to three quarters as large as the outer row, whereas in *aterrima* these inner bristles are quite small. The specimens probably represent a different, and undescribed species.

IX. CONTRIBUTIONS TO A KNOWLEDGE OF THE ORIENTAL DIPLOPODA ONISCOMORPHA.

I. The Family Glomeridae.

By F. Silvestri (*Portici, Italy*).

The authorities of the Indian Museum have kindly sent me a collection of Oriental, especially Indian, Diplopoda for identification. From these I began the study of the Oniscomorpha with a view to attempt a revision of the group and to catalogue the extra-European species described up to date. I treat in this paper of the family Glomeridae, of which I have been able to examine specimens of 26 species out of a total of 34 that are at present known, including those described by me as new in this paper.

In my opinion all the genera I deal with in this paper are true Glomeridae and all have the special characters of the family, as I shall show in the description of one of them, *viz. Apiomeris.* I would particularly like to note that all the Oriental Glomeridae have the latero-posterior incisura of the first tergite (figs. IV-V) shorter than the European *Glomeris, s. l.* (*p. e. G. connexa*, C. Koch), and consequently the praeincisural part of the same tergite is longer than the supraincisural part and the posterior point of the sub-incisural part is very near to the posterior border of the tergite. The second tergite of the Oriental Glomeridae has the latera narrower than in European *Glomeris.*

I refer the species of Oriental Glomeridae known to me to 4 genera, *viz. Apiomeris*, O. F. Cook, *Rhopalomeris*, Verh., *Hyperglomeris*, nov., *Dinoglomeris*, nov., of which *Apiomeris* comprises 4 subgenera[1] and *Rhopalomeris* two. Of the four genera *Apiomeris* is the richest in species, in the subgenus *Hyleoglomeris* alone numbering about two-thirds of all the known species of Oriental Glomeridae. *Rhopalomeris* contains 4 species and a variety, *Hyperglomeris* and *Dinoglomeris* one species each.

In regard to distribution I note that *Apiomeris* (subgenus *Hyleoglomeris*) is well distributed in North and East India, Burma, Siam and the Malay Archipelago to Celebes, it has not been collected up to the present in Ceylon and in South-West India; *Apiomeris* (*s. s.*) and *Malayomeris* in Sumatra; *Apiomeris* (subgen. *Aphero-*

[1] The difference of grade between genera and subgenera I follow at present is that in the case of genera we have one or more characters to distinguish the females, but in the case of subgenera we are unable to ascribe a species to one or to another subgenus unless we know the male also.

meris) in Java; *Hyperglomeris* and *Dinoglomeris* in Tonkin; *Rhopalomeris* in Burma, Malacca and adjacent islands and Tonkin.

Conspectus generum Glomeridarum orientalium.

a. Collum pone marginem anticum transverse bistriatum [1]).
Tergitum ultimum interne lateraliter haud carinatum.
c. Antennae conis sensitivis apicalibus quatuor ... ... Gen. *Apiomeris*, O. F. Cook.
d. Antennae conis sensitivis apicalibus numerosis ... ... Gen. *Rhopalomeris*, Verh.
b. Collum pone marginem anticum striis transversis tribus majoribus et aliis minoribus instructum. Tergitum ultimum interne lateraliter, parum longe a basi, carinatum.
e. Caput quam collum parum latius, trunci tergiti primi parte laterali laminari antica, ut cetera superficies, perpendiculari, facie externa ... ... Gen. *Hyperglomeris*, nov.
f. Caput quam collum haud latius; trunci tergiti primi parte laterali laminari antica introrsum directa ita ut ejusdem facies antica sit ... Gen. *Dinoglomeris*, nov.

Gen. **Apiomeris**, O. F. Cook.

Glomeris, Pocock, ex p., Max Weber's *Zool. Ergebn. Reise Niederl. Ost.-Ind.* III, p. 323 (1894).
" Silvestri, *Ann. Mus. Genova* (2) XIV, p. 720 (1895).
" Attems, *Abh. Senckenb. naturf. Ges.* XXIII, p. 480 (1897).
Malayomeris, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 243 et 246.
Hyleoglomeris, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 245.
Nesoglomeris, Carl, *Revue suisse d. Zool.* XX, p. 100 (1912).

Corpus capite, collo,[2] trunco 11-segmentato et segmento anali constitutum, subsemicylindraceum, arco dorsuali a tergitis, facie ventrali a paratergitis et sternitis formata, in globum contractile.

Caput (Fig. I, 1-6) parum minus quam duplo latius quam longius, clypeo unidentato, incisura postico-laterali clypei longa et a margine antico laterali retrorsum (haud introrsum) directa, media fronte convexiuscula et postice longitudinaliter parum carinata, ad verticem transverse carinata, circum Tömösvaryi organum et torulum depressa, vertice brevi, medio dorso postice in processum triangularem producto, processu pseudoccipitali externo brevi, processu pseudoccipitali interno magno.

Oculi serie ocellorum paucorum parum arcuatim (convexitate externa) secundum frontis marginem lateralem disposita et ocello alio externo ad ocellos posteriores approximato compositi.

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[1] In specie una tantum inter omnes mihi notas, *A.* (*Hyleoglomeris*) *beccarii*, Silv., pone strias duas typicas stria alia et aliquantum diversa adest.

[2] Nomenclaturam *vide* in: F. Silvestri, *Classis Diplopoda*, vol. I, Anatome (Portici, 1903).

Tömösvaryi organum bene evolutum, ferri-equini instar dispositum.

Antennae (Fig. VI, 1) in faciei parte submediana, inter sese spatio latiusculo remotae, insertae sunt, 8-articulatae, articulis 1-4 sursum et extrorsum, articulis 5-8 deorsum et extrorsum directis, articulo sexto quam ceteris singulis longiore, articulo tertio quam sextus breviore, articulis 1°, 2°, 4° et 5° brevibus inter sese subaequalibus, articulo septimo breviore, articulo octavo brevissimo articulum septimum vix vel haud superante, articulorum superficie setis brevissimi plerumque numerosis aucta et seta brevi ad apicem inferum articuli primi et ad apicem inferum et superum articulorum 3-6 et seta nonnulla brevi ad apicem articuli septimi instructa, superficie apicali articuli octavi conis sensitivis quatuor aucta.

Mandibulae (Fig. II, 1-4) supra ab epicranio omnino obtectae et antice et lateraliter ab eodem aliquantum superatae, cardine a stipite tantum incisura profunda (haud integra) distincto, praemandibula dente apicali bene evoluto, lamina 4-dentata, laminis pectinatis 8-9, praemola brevi et brevissime setosa, mola bene evoluta antice parum concava, cetero convexo, supra et subtus serie longitudinali acicularum brevissimarum instructo.

Hypostoma (Fig. III, 1-3) basilari bene arcuato, infrabasilari integro sed medio minus spisso, divisionem simulante, postice a basilaris basi parum remoto, pseudocardine utrimque singulo magno, inframaxillari integro, subtrapezoideo, postice sinuato, stipitibus maxillaribus externis (internis haud praesentibus) antice quam postice latioribus, palpulorum maxillarium altero (exteriore) quam alter interior aliquantum minore.

Collum (Fig. I, 7) transverse subsemiellipticum postice rotundatum margine antico ad frontis carinam posticam transvexalem pertinens et vertice obtegens, capitis latitudinem aequans, supra vix convexum et pone marginem anticum transverse bistriatum.

Truncus segmentis 11 compositus, quorum primus et ultimus quam ceteri singuli majores sunt, segmento singulo tergito in arcum dorsualem (tergitum s. s. vel melius mesotergitum) et paratergitum diviso, segmentis 1-3 sterno simplici et pedum pare singulo, segmentis 4-10 sternis et pedum paribus duobus, segmento 11° pedibus nullis.

Tergitum primum (Fig. IV, 1-2) magnum, medium antice sinuatum, colli marginem rotundatum circumdans, lateribus longis et deorsum aliquantum magis quam tergita cetera pertinens, postice ad marginem inferum incisura longitudinali antrorsum directa, affectum, quae quam dimidia longitudo lateris ejusdem segmenti aliquantum brevior est ita ut pars praeincisuralis quam supraincisuralis longior sit, parte subincisurali postice parum longe a tergiti margine postico pertinente; ejusdem tergiti superficie supera ad marginem sini antici striis transversalibus tribus, quarum postica plus minusve longe ad latera secundum marginem anticum pertinet, pone strias dictas, postmarginales appelatas striis aliis superis 3-6 lateraliter integris vel divisis usque ad incisuram posticam lateralem pertinentibus, pone marginem anticum lateraliter parte laminari plus minusve evoluta et pone partem laminarem striis transversalibus 5-14, quarum nonnullae in dorsum ut striae superae continuant.

Tergitum secundum (Fig. V, 1-2) quam tergita cetera deorsum parum minus productum, lateribus inferis angustatis stria una vel nonnullis instructis.

Tergitum tertium lateribus quam eadem tergiti secundi paullum latioribus, tergiti quarti quam eadem tergiti tertii parum latioribus, tergiti quinti quam eadem tergiti quarti aliquantum latioribus, tergiti sexti quam eadem tergiti quinti parum latioribus, tergiti septimi quam eadem tergiti sexti in angulo antico vix latioribus, tergitorum 8-10 gradatim paullum vel parum minoribus et angulo postico retrorsum parum producto; tergitum ultimum margine postico late rotundato, medio haud vel vix sinuato, facie interna laeva (haud carinata).

Paratergitum (= *pleura* auctorum!) segmenti primi quam cetera minus est, paratergita sequentia 2-10 subaequalia integra, transverse subretangularia, antice striis transversalibus tribus exarata.

Pedes omnes (Fig. VI, 2), ungue terminali incluso, 7-articulati, articulo sexto quam ceteri longiore, articulo tertio quam sextus parum breviore, articulis primo et secundo brevibus, longitudine parum diversis articulis quarto et quinto inter sese subaequalibus et quam secundus brevioribus, ungue terminali simplici robusto.

Mas. Tergitum ultimum eidem feminae simile vel ab eodem aliquantum diversum.

Pedum paria 19, quia segmentum praeanale (trunci ultimum) pedum paribus duobus etiam instructum est.

Pedes paris 17^i (Fig. VI, 3) 5-articulati (vel 6-articulati si seta apicalis ut unguis obsoletus considerata est) articulo primo plus minusve laminae instar deorsum et extrorsum dilatato, articulis 2-4 brevibus.

Pedes paris 18^i (Fig. VI, 4) 5-articulati, articulo primo ceteris majore cum opposito coalito vel non, articulis 2-5 brevibus.

Pedes paris 19^i (Fig. VI, 5) 4-articulati, articulis robustis antice et postice vel tantum postice processibus nonnullis, ut in subgenerum descriptione scribo, instructis.

Sternum inter pedes parium 1-18 perparvum, inter pedes paris 19^i magnum infra productum, processu mediano lato et utrimque processu angusto terminatum.

Observatio. Genus *Apiomeris* ab O. F. Cook sine descriptione, sed cum speciei typicae (*Glomeris infuscata*, Pocock) nomine, propositum accepto, quia semper pro supervacuo habeo nomen genericum novum speciei eidem dare, quae jam sub nomine generico alio indicata est, etsi genus nondum descriptum sit.

CONSPECTUS SUBGENERUM GENERIS *APIOMERIS.*

a. Pedes paris 18^i articulo primo cum opposito coalito.

c. Pedes paris 19^i articulis 4 omnibus inter sese distinctis, articulis secundo et tertio processu postico conico tantum instructis ... Subgen. *Apiomeris,* O. F. Cook. Typus: *A. infuscata* (Poc.)

d. Pedes paris 19^i articulo tertio a secundo antice tantum lateraliter separato, articulo secundo processu basali et processu apicali internis latis longis, articulo tertio tuberculo perparvo postico ... Subgen. *Malayomeris,* Verh. Typus: *Malayomeris martensi,* Verh.

b. Pedes paris 18^i articulo primo ab opposito sejuncto; pedes paris 19^i articulis 4 distinctis.

e. Pedes paris 19^i articulis 1-2 processu subconico setigero apicali interno bene evoluto, articulo tertio tantum seta apicali antica (interdum haud distincta), articulis 2-3 processu postico interno carnoso plus minusve evoluto et articulo tertio etiam processu postico subapicali tuberculiformi Subgen. *Hyleoglomeris,* Verh. Typus: *Hyleoglomeris multilineata,* Verh.

f. Pedes paris 19^i articulis 2-3 tantum processu carnoso postico interno instructis ... ... Subgen. *Apheromeris,* nov. Typus: *Apheromeris partialis,* sp. n.

Subgen. **Hyleoglomeris,** Verh.

Glomeris, Pocock, ex p., Max Weber's *Zool. Ergebn. Reise Niederl. Ost.-Ind.* III, p. 323 (1894).
,, Silvestri, *Ann. Mus. Genova* (2) XIV, p. 720 (1895).
,, Attems, *Abh. Senckenb. naturf. Ges.* XXIII, p. 480 (1897).
Hyleoglomeris, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 245.
Nesoglomeris, Carl, *Revue suisse d. Zool.* XX, p. 100 (1912).

Mas. Pedes paris 18^i articulo primo ab opposito sejuncto; pedes paris 19^i 4-articulati, articulis omnibus distinctis, articulis 1-2 processu subconico setigero apicali interno bene evoluto, articulo tertio tantum seta apicali antica (interdum haud distincta), articulis 2-3 processu postico interno carnoso plus minusve evoluto et articulo tertio processu postico subapicali tuberculiformi instructis.

Apiomeris (Hyleoglomeris) multilineata, Verh.

Sitz. Ber. Ges. nat. Freunde 1910, p. 248, taf. ix, abb. 1-2.

Corpus totum pallide ochroleucum. Caput ocellis 7-8+1, antennis (Fig. VI, 1) articulo sexto parum minus quam duplo longiore quam latiore.

Truncus. Tergitum primum (Fig. IV, 1) area mediana striis superis 6 lateraliter continuantibus, lamina laterali antica perparva, area postlaminari striis 10. Tergitum secundum (Fig. V, 1) lateribus angustatis stria integra et stria abbreviata instructis; tergitum ultimum postice late rotundatum.

Pedes (Fig. VI, 2) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

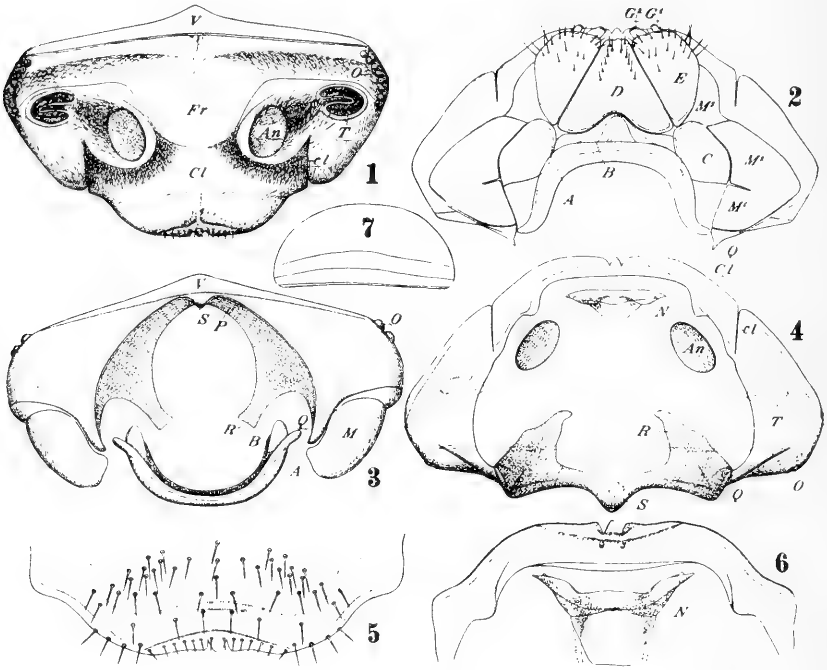

FIG. I.—*Apiomeris (Hyleoglomeris) multilineata.*

1. caput pronum; 2 caput supinum; 3 caput a facie postica inspectum; 4. epicranium subtus inspectum; 5. clypeus pronus; 6. clypeus supinus; 7. collum pronum.

A. basilare; *An*. torulus; *B*. infrabasilare; *C*. pseudocardo; *Cl*. clypeus; *cl*. incisura postico-lateralis clypei; *D*. inframaxillare; *E*. stipites maxillares; *Fr*. frons; *G*¹. et *G*². palpuli maxillares; *M*. mandibula; *M*¹. ejusdem cardo; *M*². ejusdem stipes; *M*³. ejusdem praemandibula; *N*. lamina palatina; *O*. ocelli; *P*. phragma pseudoccipitalis; *Q*. processus pseudoccipitalis externus; *R*. processus pseudoccipitalis internus; *S*. processus verticis medianus; *T*. Tömösvaryi organum; *V*. vertex.

Long. corp. mm. 17, lat. 8·5, long. antennarum 3·6, pedum paris decimi 5·5.

♂ Pedes paris 17^i, 18^i et 19^i *vide* fig. VI, 3-6.

Habitat. Borneo: Bengkajong (Mus. Berlin).

Apiomeris (Hyleoglomeris) crebristriata, sp. n.

Corpus totum testaceum antennarum articulis 5° et 6° brunneis.

Caput ocellis 7+1 (in latere laevo abnormaliter ocellis 1 interno, 8 in serie arcuata et 1 externo), antennis (Fig. VII, 1) articulo sexto duplo longiore quam latiore.

Truncus. Tergitum primum area mediana striis 8 lateraliter

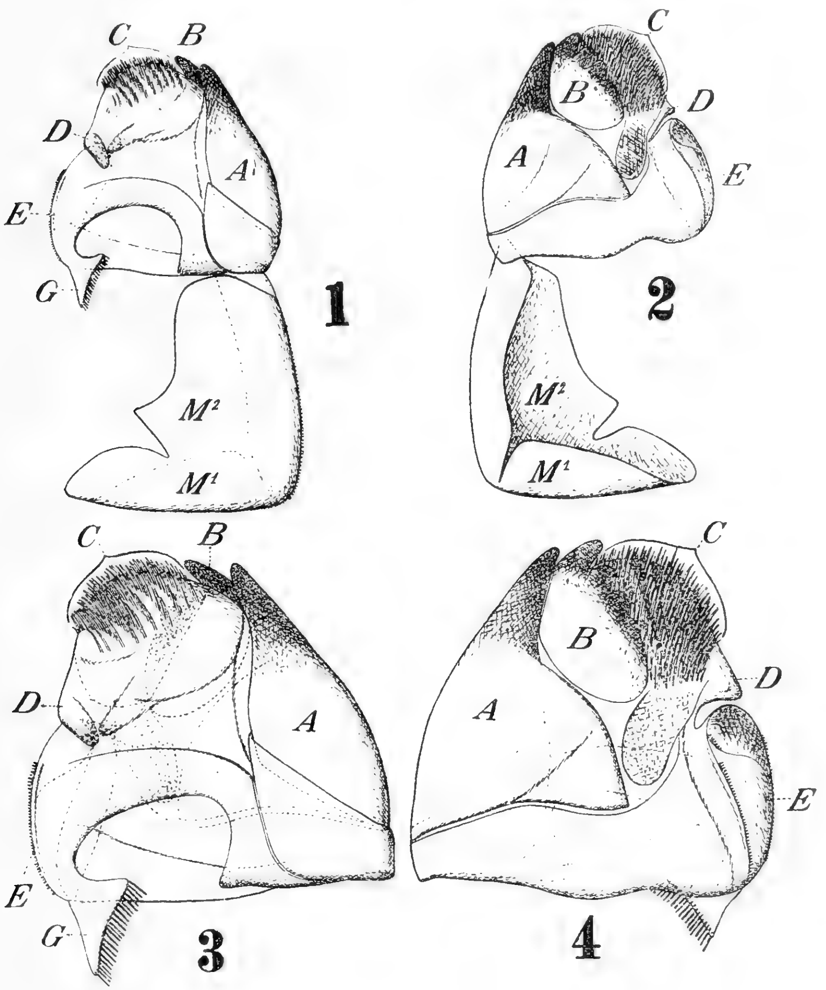

FIG. II.—*Apiomeris (Hyleoglomeris) multilineata.*

1. mandibula laeva supina; 2. eadem prona; 3-4. ejusdem praemandibula supina et prona magis ampliata.

A. dens apicalis; *B.* lamina dentata; *C.* laminae pectinatae; *D.* zona praemolaris; *E.* mola; *G.* apodema; *M*¹. cardo; *M*². stipes.

continuantibus, lamina laterali antica perparva, area postlaminari parum convexa striis crebris 13-14 instructa, quarum 8 supra continuant. Tergitum secundum lateribus angustatis praeter striam postmarginalem striis duabus; tergita cetera praeter striam postmarginalem stria una, tergitorum 3° et 4° lateribus angustatis, sequentium sat latis angulo antico rotundato, postico gradatim parum acuto; tergitum ultimum antice striis duabus, postice late rotundatum.

Pedes (Fig. VII, 2) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

Long. corp. mm. 10·5, lat. 5, long. antennarum 2·20, pedum paris decimi 3.

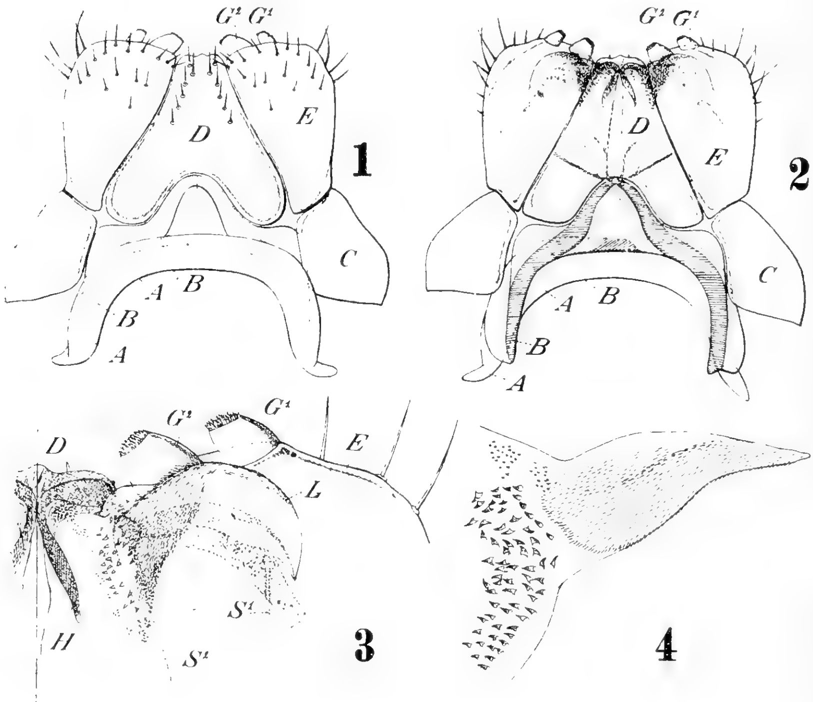

FIG. III.—*Apiomeris (Hyleoglomeris) multilineata.*

1. hypostoma supinum; 2. hypostoma pronum; 3. dimidia pars hypostomatis prona (a facie interna) inspecta; 4. dimidia pars laminae palatinae.

A. basilare; *B.* infrabasilare; *C.* pseudocardo; *D.* inframaxillare; *E.* stipites maxillares; *G*¹. et *G*². palpuli maxillares; *H.* laminae chitineae inframaxillares anteriores; *L.* laminae maxillares internae; *S*¹. ductus glandulae salivalis; *S*². ductus glandulae maxillaris.

Mas ignotus.

Habitat. Borneo: Sarawak.

Observatio. Species haec ab *Hyl. multilineata*, Verh. magnitudine minore (exemplo descripto certe adulto!) et trunci tergiti primi striis magis numerosis et crebrioribus distinguenda est; ab *Hyl. atricornis*, Silv., trunci tergiti primi striis lateralibus magis numerosis et crebrioribus, pedum articuli primi angulo infero externo obtuso facile distinguenda.

Apiomeris (Hyleoglomeris) zonifera, sp. n.

Corpus cremeum trunci tergitis 4-6 fuscis, tergito septimo antice fusco, postice gradatim pallidiore, margine postico cremeo, antennis articulis 3-7 brunneis, pedibus cremeis.

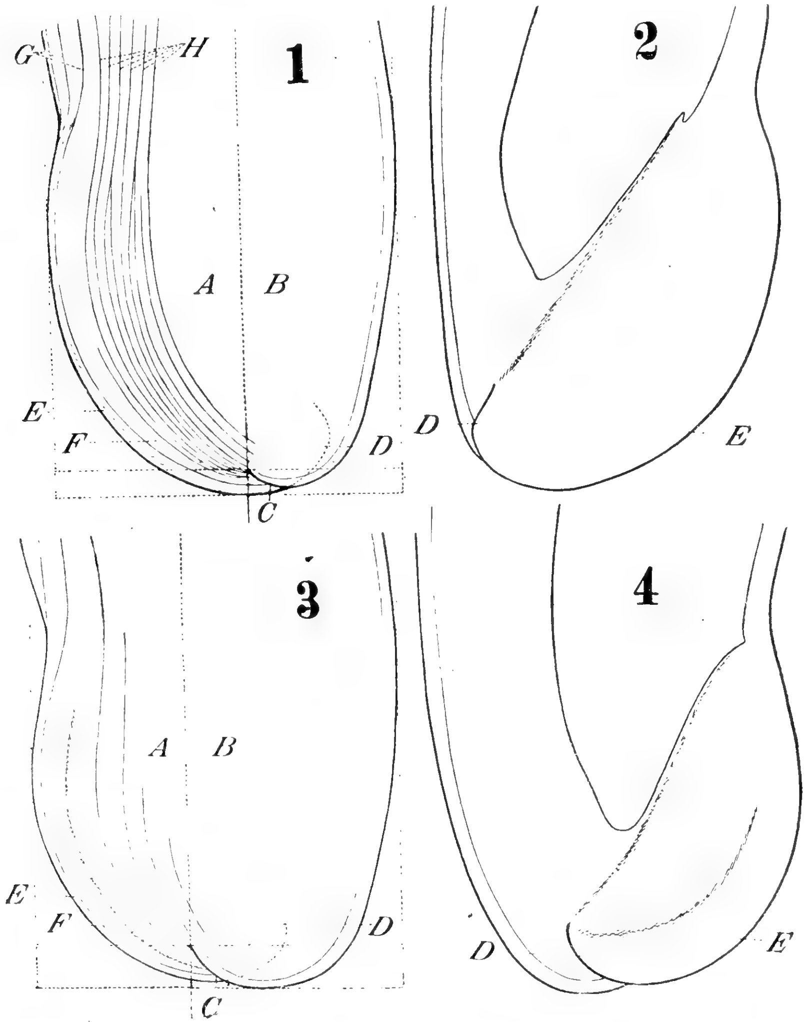

FIG. IV.

1-2. *Apiomeris* (*Hyleoglomeris*) *multilineata*: trunci dimidium tergitum primum lateraliter externe et subtus inspectum; 3-4. *Glomeris connexa paucistriata*: trunci dimidium tergitum primum lateraliter et subtus inspectum.

A. tergiti pars praeincisuralis; *B*. pars supraincisuralis; *C*. linea supraincisuralis; *D*. linea subincisuralis; *E*. margo anterior; *F*. lamina antica; *G*. striae anticae medianae postmarginales; *H*. striae medianae superae lateraliter continuantes.

Caput media fronte convexiuscula postice subcarinata, oculis ocellis 7+1 vel 6+1 compositis, antennis (Fig. VIII, 1) articulo sexto fere duplo longiore quam ad apicem latiore.

Truncus. Tergitum primum (Fig. VIII, 2) area mediana striis superis 4-5 lateraliter continuantibus, margine antico sublaterali latissime rotundato, lamina antica parva, area postlami-

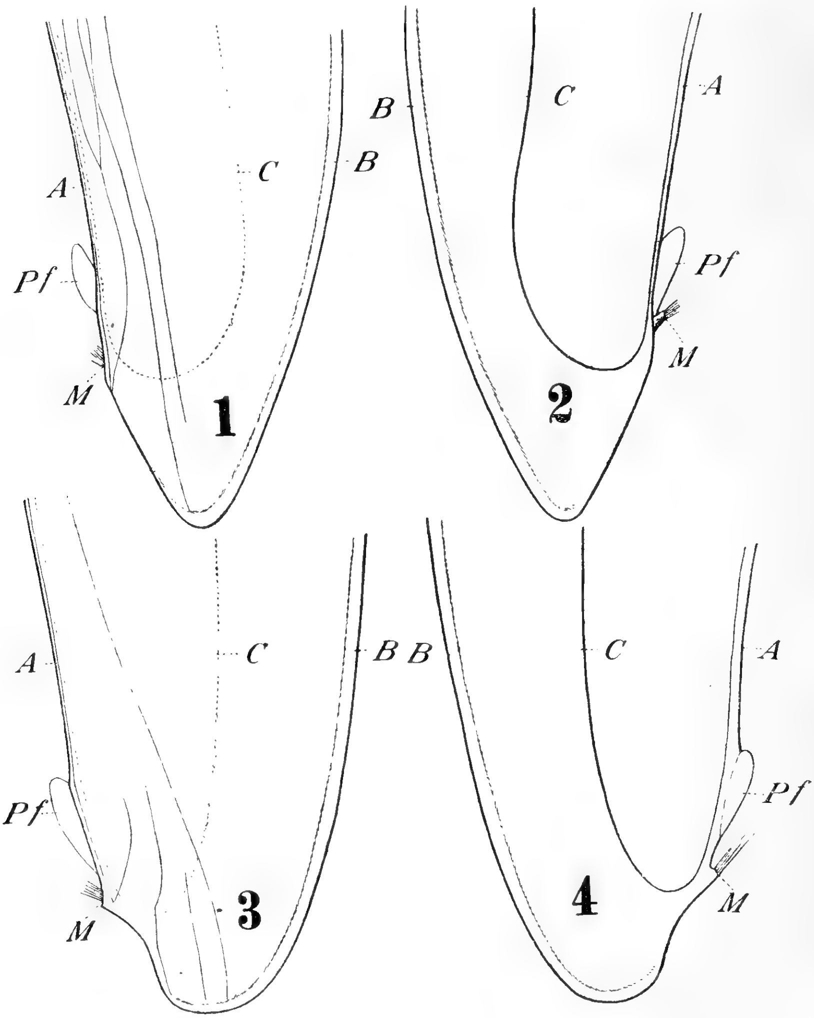

FIG. V.

1-2. *Apiomeris* (*Hyleoglomeris*) *multilineata*: trunci dimidium tergitum secundum lateraliter externe et subtus inspectum; 3-4. *Glomeris connexa paucistriata*: trunci dimidium tergitum secundum lateraliter externe et subtus inspectum.

A. margo anterior; *B.* margo posterior; *C.* margo posticus internus; *M.* apofisis praezonitica; *Pf.* praefragma.

nari convexiuscula striis 8 instructa. Tergitum secundum (Fig. VIII, 3) lateribus angustatis striis duabus integris instructis. Tergita cetera lateribus parum latioribus, praeter striam postmarginalem stria alia instructis, et a tergito sexto angulo postico acute parum producto; tergitum ultimum postice latissime rotundato.

Pedes (Fig. VIII, 4) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

Long. corp. mm. 9, lat. 4·8, long. antennarum 2·20, pedum paris decimi 3.

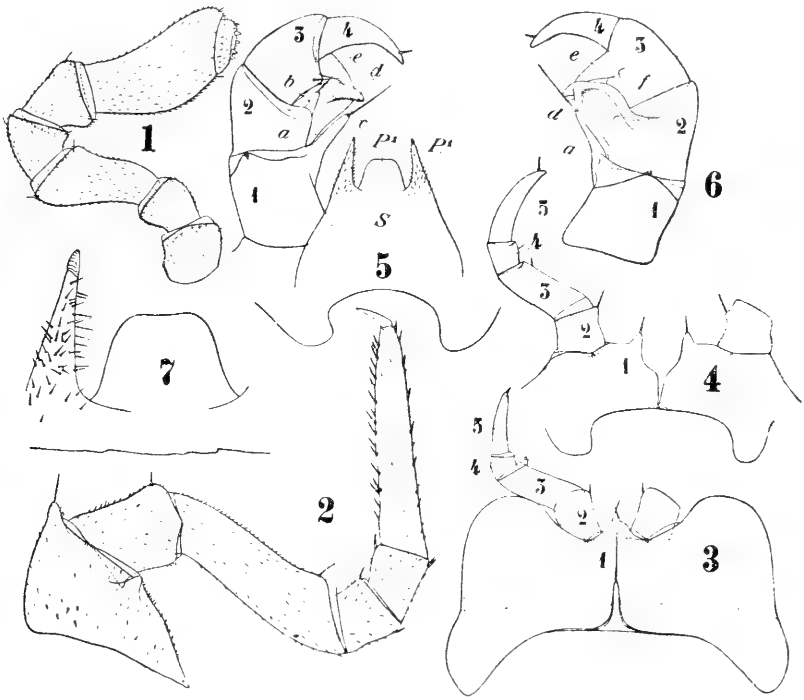

FIG. VI.—*Apiomeris* (*Hyleoglomeris*) *multilineata*.

1. antenna; 2. pes paris decimi; 3. maris pedes paris 17^i; 4. maris pedes paris 18^i; 5. maris pedes paris 19^i antice inspecti cum sterno; 6. pes alter paris 19^i postice inspectus; 7. sterni praeanalis processus medianus et processus alter lateralis.

Nos. 1-5 in figuris 3-6 articulos indicant; *a.* processus apicalis internus anticus articuli primi; *b.* processus apicalis internus anticus articuli secundi; *c.* seta apicalis interna antica articuli tertii; *d.* processus internus posticus articuli secundi; *e.* processus internus posticus articuli tertii; *f.* tuberculus posticus articuli tertii; P^1. sterni processus laterales; P^2. sterni processus medianus; *S* sternum.

Habitat. Borneo: Mt. Matang.

Observatio. Species haec ad *A.* (*H.*) *crebristriata* et *atricornis* proxima, sed colore distinctissima est.

Apiomeris (Hyleoglomeris) atricornis, sp. n.

Corpus totum ochroleucum antennarum articulis 3-5 fulvo-umbrinis, apice articuli quinti praesertim et ariculis 6° et 7° atris.

Caput ocellis 7+1, antennis (Fig. IX, 1) aliquantum elongatis, articulo sexto paullum magis quam duplo longiore quam latiore.

Truncus. Tergitum primum (Fig. IX, 2) area mediana striis 4 lateraliter continuantibus, quarum posticae partim confluentes sunt, lamina laterali antica minima, area postlaminari convexiuscula striis 8-10 instructa. Tergitum secundum (Fig. IX, 3) lateribus angustatis, striis integris duabus instructum; tergita cetera praeter striam postmarginalem lateribus bistriatis, angulo antico rotundato, postico gradatim corporis partem posticam versus, magis acuto. Tergitum ultimum antice lateraliter striis duabus instructum, margine postico late rotundato.

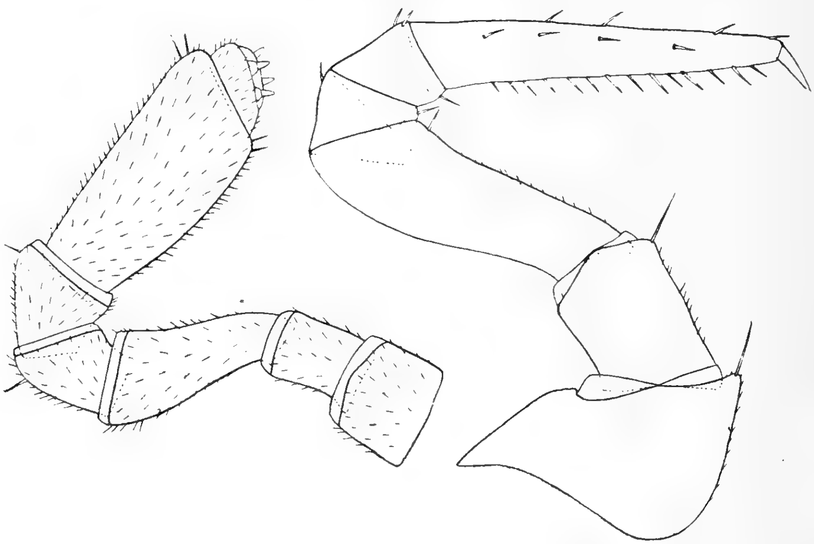

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FIG. VII.—*Apiomeris* (*Hyleoglomeris*) *crebristriata*.
1. antenna; 2. pes paris decimi.

Pedes (Fig. IX, 4) articuli primi angulo infero externo rotundatim aliquantum producto, articuli sexti spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. IX, 5-9.

Long. corp. mm. 13, lat. 6, long. antennarum 2·5, pedum paris decimi 3.

Habitat. Borneo: Mt. Mulu (*Baram*).

Observatio. Species haec ab. *Hyl. multilineata*, Verh., magnitudine, antennarum colore, trunci tergiti primi striis superis magis numerosis, tergitis II-XI lateraliter praeter striam postmarginalem, striis duabus instructis (in *Hyl. multilineata* stria una), pedum articuli primi, angulo infero externo infra rotundatim producto (in *Hyl multilineata* obtuso) bene distincta est; tergitorum striarum numero ad *Hyl. concolor*, Poc. similis est, sed ocellorum numero et forsan antennarum colore (Pocock antennarum colorem ab eodem corporis diversum haud notat) saltem distinguenda.

Apiomeris (Hyleoglomeris) paucilineata, sp. n.

Corpus alutaceum tergitorum parte postica parum obscuriore.

Caput ocellis 6+1, antennis (Fig. X, 1) articulo sexto *c.* 3/5 longiore quam latiore.

Truncus. Tergitum primum area mediana striis 4 lateraliter continuantibus, lamina laterali perparva, area postlaminari striis 5-6, quarum 4 supra continuant. Tergitum secundum lateribus angustatis praeter striam postmarginalem, stria abbreviata et stria integra instructum, tergita cetera lateribus praeter striam postmarginalem stria alia; tergitum ultimum postice late rotundatum.

Pedes (Fig. X, 2) articuli primi angulo infero externo valde obtuso, articuli sexti spinis vide figuram.

Long. corp. mm. 22, lat. 10, long. antennarum 5, pedum paris decimi 6.

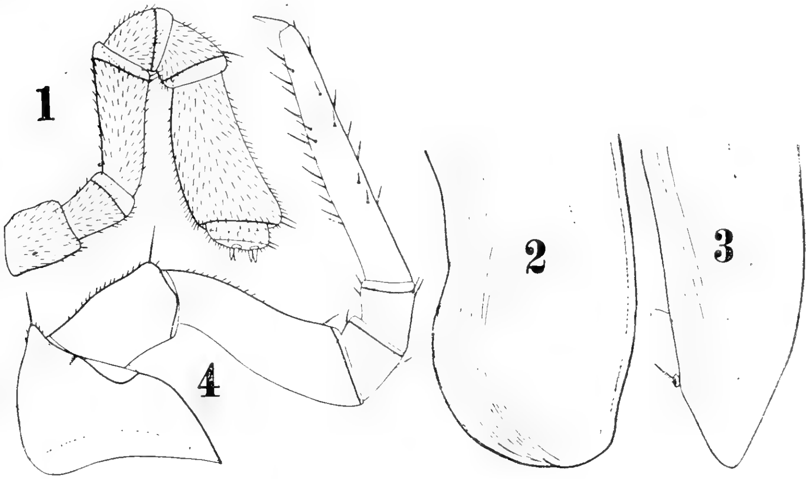

FIG. VIII.—*Apiomeris* (*Hyleoglomeris*) *zonifera.*

1. antenna; 2. trunci dimidium tergitum primum et 3. trunci dimidium tergitum secundum lateraliter externe inspecta; 4. pes paris decimi.

Exemplum juvenile corpore toto stramineo ocellis 5+1. Long. corp. mm. 15, lat. 7·5.

Habitat. Borneo: Kari Orang, Kutei (Borneo merid.-orient., *M. Schmidt* legit. Mus. Berlin).

Observatio. Species haec ad *Hyl. multilineata*, Verh., proxima est, sed magnitudine, ocellorum numero, trunci tergiti primi striis distincta est.

Apiomeris (Hyleoglomeris) minuta, Verh.

Sitz. Ber. Ges. nat. Freunde 1910, p. 248, taf. ix, abb. 3-4.

Corpus totum cremeum. Caput ocellis 6—7+1, antennis (Fig. XI, 1) articulo ultimo parum minus quam duplo longiore quam latiore.

Truncus. Tergitum primum (Fig. XI, 2) area mediana striis superis 4 lateraliter continuantibus, lamina laterali antica perparva, area postlaminari striis 8-9; tergitum secundum (Fig. XI, 3) lateribus angustatis stria integra instructis; tergitum ultimum postice late rotundatum.

Pedes (Fig XI, 4) articuli primi angulo infero externo subrecto, articuli sexti spinis vide figuram.

Long. corp. mm. 8, lat. 5, long. antennarum 1·7, pedum paris decimi 2·4.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XI, 5-10.

Habitat. Borneo: Mt. Radjang, Klawang (Mus. Berlin).

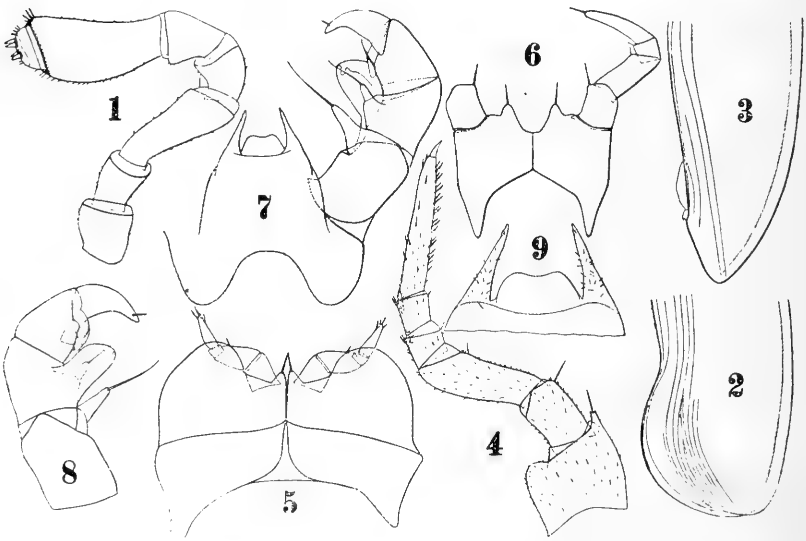

FIG. IX.—*Apiomeris (Hyleoglomeris) atricornis.*

1. antenna; 2. trunci dimidium tergitum primum et 3. dimidium tergitum secundum lateraliter externe inspecta; 4. pes paris decimi; 5. pedes paris 17^i; 6. maris pedes paris 18^i; 7. maris pedes paris 19^i cum sternum antice inspecti; 8. pes paris 19^i postice inspectus; 9. maris sterni inter pedes paris 19^i pars infera.

Apiomeris (Hyleoglomeris) siamensis, sp. n.

Corpus fuscum cremeo marmoratum et trunci tergito primo, praeter lineam submarginalem posticam et maculas duas submedianas posticas fuscas cremeo, tergitorum sequentium 2-10 medio dorso fere toto, spatio lato, cremeo, tergito ultimo, praeter maculas duas laterales anticas et lineam posticam submarginalem, cremeo, faciei parte infera, ventre et pedum articulis 1-3 cremeis, antennis et pedum articulis 3-6 plus minusve fuscis.

Caput media fronte convexiuscula postice vix carinata, oculis ocellis 7 + 1, antennis (Fig. XII, 1) articulo sexto *c.* 1/4 longiore quam latiore, articulo septimo brevi.

Truncus. Tergitum primum (Fig. XII, 2) area mediana striis superis tribus lateraliter continuantibus, margine antico sublaterali perlate rotundato, lamina laterali minima, area postlaminari convexiuscula striis 7 instructa. Tergitum secundum lateribus angustatis, praeter striam postmarginalem stria abbreviata et stria integra instructis; tergita sequentia praeter striam postmarginalem stria alia integra laterali instructa. Tergitum ultimum margine postico late rotundato.

Pedes (Fig. XII, 3) articuli primi angulo infero externo exciso, obtuso, articuli sexti spinis vide figuram.

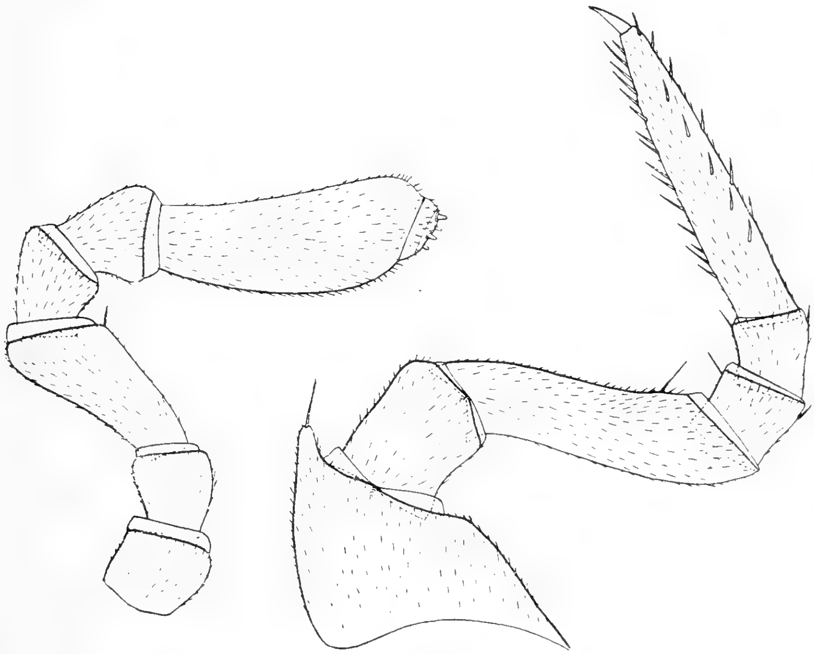

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FIG. X.—*Apiomeris (Hyleoglomeris) paucilineata.*
1. antenna; 2. pes paris decimi.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XII, 4-7.

Long. corp. mm. 10, lat. 5, long. antennarum 1·90, pedum paris decimi 2·60.

Habitat. Siam: Meetaw, Raheng, 2000 ft. (*C. S. Barton* legit).

Apiomeris (Hyleoglomeris) venustula, sp. n.

Corpus atro-nigrescens collo macula plus minusve parva (vel nulla) transversa, mediana ochroleuca, trunci tergito primo utrimque macula magna semilunari antice a margine laterali usque ad dorsi partem submedianam extensa et retrorsum, interne tantum fere usque ad marginem posticum pertinente et macula parva postica ochroleucis, tergitis 2-10 macula mediana postica et maculis duabus sublateralibus, quarum antica parva et segmentis contractis obtecta, postica transverse ovali, nec non macula parva antica laterali submarginali ochroleucis notatis, tergito ultimo macula magna mediana ochroleuca, marginem anticum breve spatio haud attingente, instructo, antennis nigrescentibus, ventre pedibusque fulvo-umbrinis.

Caput ocellis 7 + 1, antennis (Fig. XIII, 1) articulo sexto c duplo longiore quam latiore.

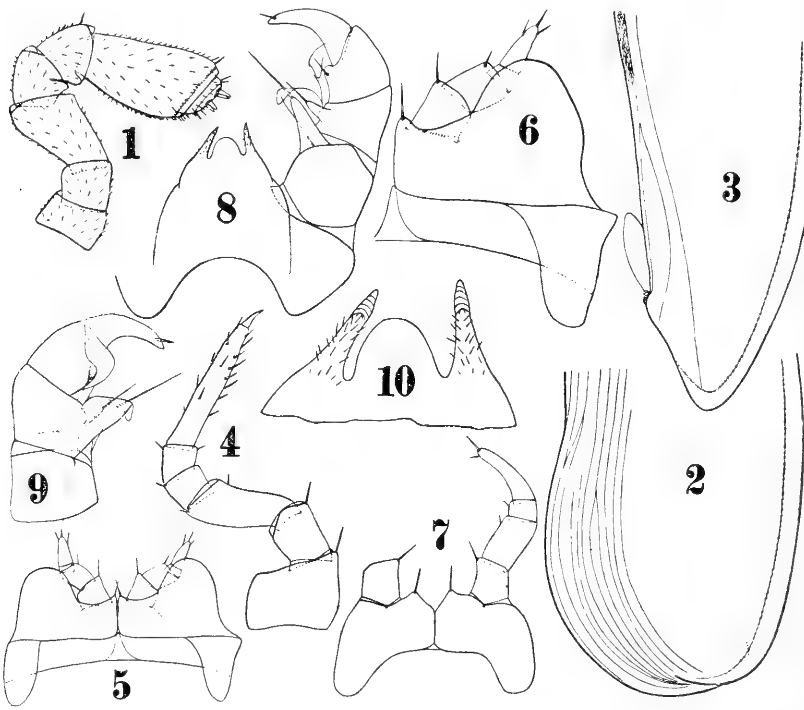

FIG. XI.—*Apiomeris* (*Hyleoglomeris*) *minuta*.

1. antenna; 2. trunci dimidium tergitum primum et 3. dimidium tergitum secundum lateraliter externe inspecta; 4. pes paris decimi; 5. maris pedes paris 17^i; 6. maris pes paris 17^i magis ampliatus; 7. maris pedes paris 18^i; 8. maris pes paris 19^i cum sterno antice inspectus; 9. maris pes paris 19^i postice inspectus; 10. maris sterni inter pedes paris 19^i pars infera.

Truncus. Tergitum primum (Fig. XIII, 2) area mediana striis tribus lateraliter continuantibus, margine antico sublaterali late rotundato, lamina laterali minima, area postlaminari convexiuscula striis 7-8, quarum 3 integrae sunt. Tergitum secundum lateribus angustatis rotundatis, stria postmarginali una instructis, tergita cetera angulo postico in segmentis posticis gradatim parum magis acuto; tergitum ultimum margine postico late rotundato.

Pedes (Fig. XIII, 3) articuli primi angulo infero laterali valde obtuso, articuli sexti spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XIII, 4-8.

Long. corp. mm. 7, lat. 3·7, long. antennarum 1·90, pedum paris decimi 2·35.

Habitat. India: Sadiya (N.E. Assam ; Abor Expedition, xi-1911).

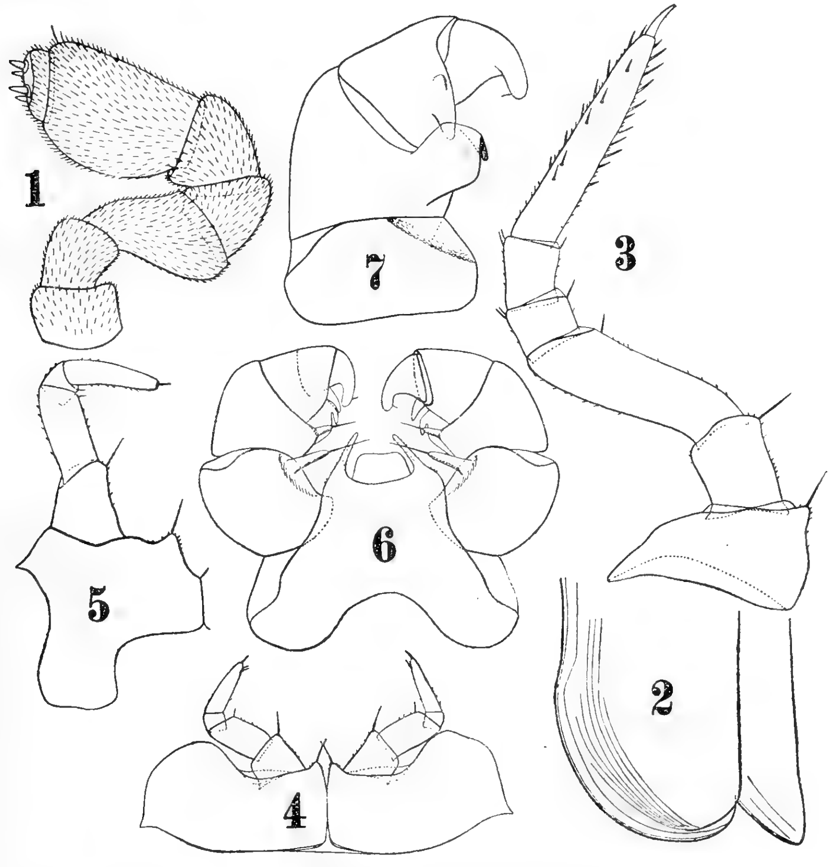

FIG. XII.—*Apiomeris (Hyleoglomeris) siamensis.*

1. antenna; 2. trunci dimidium tergitum primum et secundum lateraliter externe inspecta; 3. pes paris decimi; 4. maris pedes paris 17^i; 5. maris pes paris 18^i; 6. maris pedes paris 19^i cum sterno antice inspecti; 7. maris pes paris 19^i postice inspectus.

Observatio. Species haec ad *A.* (*Hyl.*) *siamensis*, Silv., proxima est et ab eadem colore, antennarum articuli sexti forma, nec non maris pedibus paris 17^i et 19^i bene distincta est.

Apiomeris (Hyleoglomeris) electa, sp. n.

Corpus nigrescens trunci tergito secundo maculis duabus submedianis posticis nigrescentibus cremeo, tergitis 2-10 macula mediana obtriangulari cremea in segmento quinto majore, a segmento sexto gradatim minore et macula sublaterali transversa, subpostica cremea instructis, tergito ultimo macula mediana magna trapezoidea cremea, faciei parte inferiore, ventre et pedum articulis 1-2 cremeis, antennis nigrescentibus, paratergitis et pedum articulis 3-6 fuscis.

Caput media fronte convexiuscula postice vix carinata, oculis ocellis 7 + 1 compositis, antennis (Fig. XIV, 1) articulo sexto 1/3 longiore quam latiore.

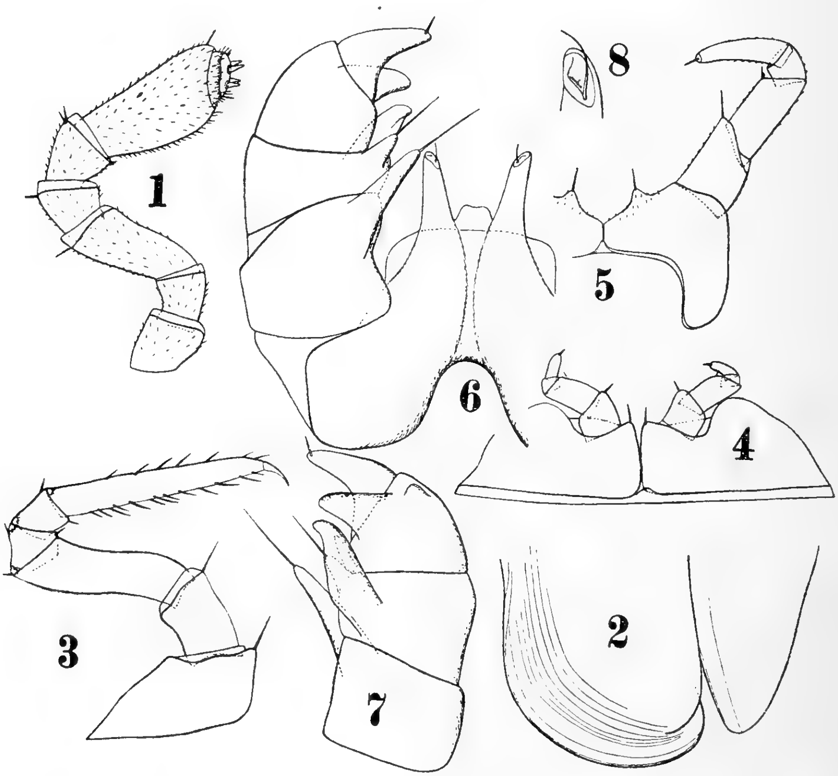

FIG. XIII—*Apiomeris (Hyleoglomeris) venustula.*

1. antenna; 2. trunci dimidium tergitum primum et secundum lateraliter inspecta; 3 pes paris decimi; 4. maris pedes paris 17; 5. maris pes paris 18; 6. maris pes paris 19 cum sterno antice inspectus; 7. maris pes paris 19 postice inspectus; 8. apex processi laterali sterni inter pedes paris 19.

Truncus. Tergitum primum (Fig. XIV, 2) area mediana striis tribus lateraliter continuantibus, margine antico sublaterali perlate rotundato, lamina laterali minima, area postlaminari convexiuscula striis 8, quarum postica brevissima est. Tergitum secundum lateribus angustatis, stria postmarginali et stria alia integra instructis; tergitum ultimum margine postico late rotundato.

Pedes (Fig. XIV, 3) articuli primi angulo infero externo exciso, articuli sexti spinis vide figuram.

Long. corp. mm. 7·6, lat. 3·8, long. antennarum 1·82, pedum paris decimi 2·10.

Habitat. India: Ghumti, Darjiling distr., 1500-5000 ft. (*Carmichael* legit).

Observatio. Species haec ad *A.* (*Hyl.*) *siamensis* proxima est et ab eadem colore et praesertim antennarum articulo sexto longiore et minus lato facile distinguenda; ab *A.* (*Hyl*). *venustula* etiam colore, trunci tergiti primi margine sublaterali latiore rotundato distincta est.

Apiomeris (Hyleoglomeris) modesta, sp. n.

Corpus nigrescens facie, tergitorum fascia mediana longitudinali in segmento singulo antice et in segmento ultimo postice etiam

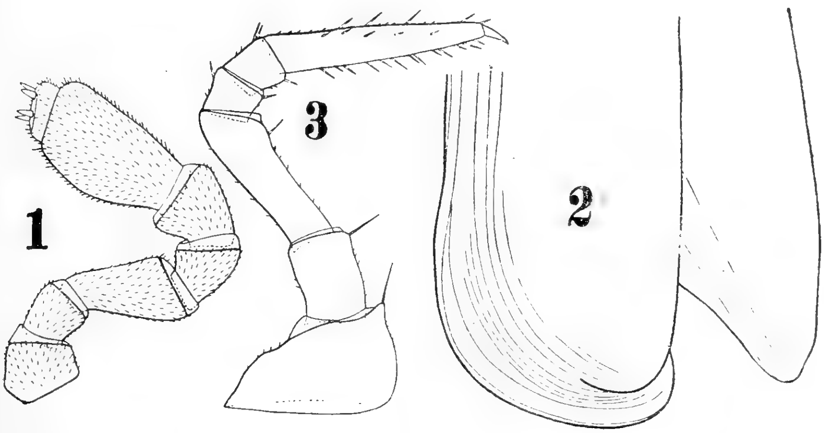

FIG. XIV.—*Apiomeris* (*Hyleoglomeris*) *electa.*

1. antenna; 2. trunci dimidium tergitum primum et secundum lateraliter inspecta; 3. pes paris decimi.

dilatata, macula sublaterali transverse subovali et marginibus posticis et inferis flavo-stramineis, colli parte mediana late flavo-marmorata, ventre pedibusque etiam flavo-stramineis.

Caput ocellis 4 + 1, antennis (Fig. XV, 1) articulo sexto *c.* 1/3 longiore quam latiore.

Truncus. Tergitum primum (Fig XV, 2) area mediana striis 5 lateraliter continuantibus, lamina laterali latiuscula, area postlaminari parum convexa striis 7-8, quarum 5 supra continuant. Tergitum secundum lateribus angustatis rotundatis, stria postmarginali una abbreviata et stria integra instructis; tergita cetera angulo postico rotundato in segmentis IX-X subacuto; tergitum ultimum margine postico late rotundato.

Pedes (Fig. XV, 3) articuli primi angulo infero laterali obtuso, articuli sexti spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XV, 4-9.

Long. corp. mm. 6, lat. 3, long. antennarum 1·56, pedum paris decimi 1·70.

Habitat. India: Kobo, 400 ft. (Abor Expedition, xi—xii-1911).

Observatio. Species haec ab *A.* (*Hyl.*) *venustula* colore, trunci tergiti primi striarum numero, ejusdem lamina antica latiore, maris pedum paris 17^i articuli primi lamina infera majore et inter pedes paris 19^i sterni processuum lateralium forma, pedum paris

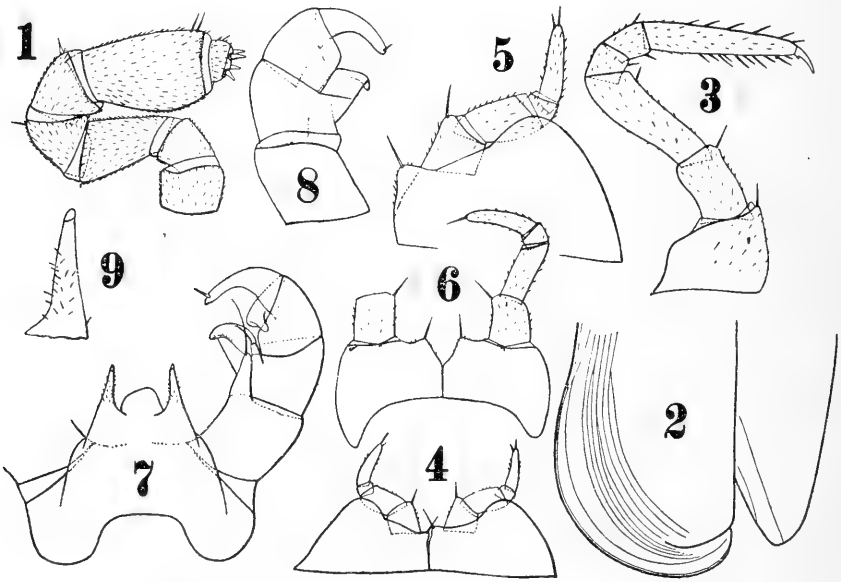

FIG. XV.—*Apiomeris* (*Hyleoglomeris*) *modesta*.

1. antenna; 2. trunci dimidium tergitum primum et secundum lateraliter inspecta; 3. pes paris decimi; 4. maris pedes paris 17^i; 5. maris pes paris 17^i magis ampliatus; 6. maris pedes paris 18^i; 7. maris pes paris 19^i cum sterno antice inspectus; 8. maris pes paris 19^i postice inspectus; 9. sterni inter pedes paris 19^i processus lateralis.

19^i articuli secundi processu postico simplici et articulo quarto magis elongato distinctissima est.

Apiomeris (Hyleoglomeris) jacobsoni, sp. n.

Corpus fuscum, tergitorum margine postico, ventre pedibusque isabellinis.

Caput media fronte convexiuscula postice vix carinata, oculis ocellis 6+1 compositis, antennis (Fig. XVI, 1) articulo sexto 1/3 longiore quam ad apicem latiore.

Truncus. Tergitum primum (Fig. XVI, 2) area mediana striis superis 4 lateraliter continuantibus, margine antico sublaterali latissime rotundato, lamina antica parum lata, subplana, area postlaminari convexiuscula striis 10 instructa. Tergitum secundum lateribus angustatis et ut eadem tergitorum sequentium praeter striam postmarginalem stria alia instructis; tergitum ultimum margine postico late rotundato.

Pedes (Fig. XVI, 3) articuli primi angulo infero externo exciso rotundato, articuli sexti spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XVI, 4-7.

Long. corp. mm. 6, lat. 3; long. antennarum 1·36, pedum paris decimi 1·82.

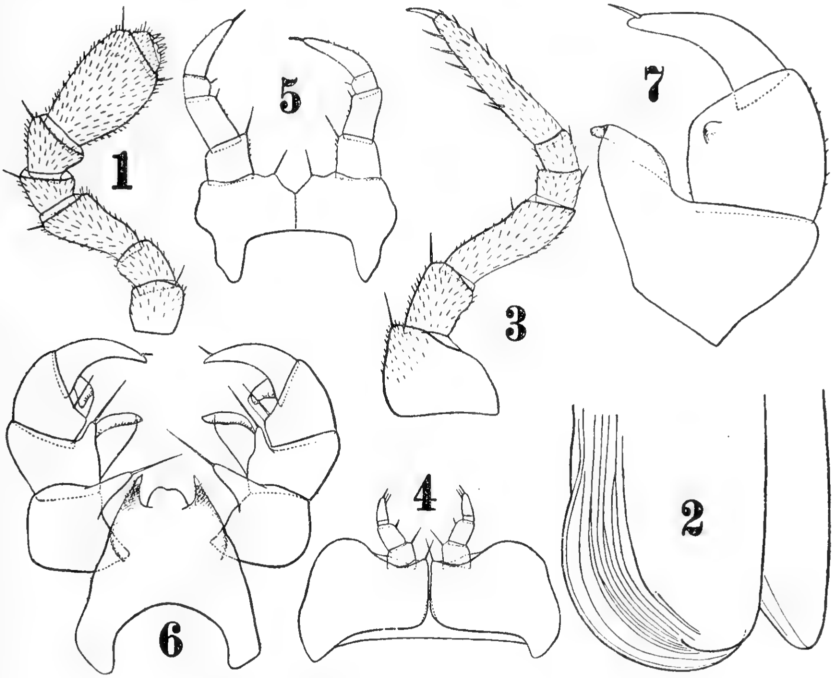

FIG. XVI.—*Apiomeris* (*Hyleoglomeris*) *jacobsoni*.

1. antenna; 2. trunci dimidium tergitum primum et secundum lateraliter inspecta; 3. pes paris decimi; 4. maris pedes paris 17^i; 5. maris pedes paris 18^i; 6. maris pedes paris 19^i cum sterno antice inspecti; 7. maris pes paris 19^i postice inspectus.

Habitat. Java: Nongkodjadjar (*E. Jacobson* legit).

Observatio. Species haec ad *A.* (*Hyl.*) *modesta*, Silv., proxima est et colore, ocellorum numero, nec non pedum paris 17^i articuli primi forma facile distinguenda est.

Apiomeris (Hyleoglomeris) modiglianii (Silv.).

Glomeris modiglianii, Silvestri, *Ann. Mus. Genova* (2) XIV, p. 720 (1895).

Corpus flavum tergitis 3° et 4° macula singula mediana, lata nigra signatis (an semper? vel conservationis haud optimae causa ? exempla typica in 1894 descripta corpore, ut scripsi, colore affecto, in 1915 valde diverse colorata sunt : exemplum alterum corpore ochraceo toto, antennis fuscis, exemplum alterum corpore ochraceo tergitis 3° et 4° macula nigra latiore tergita tota fere occupante, in medio dorso interrupta).

Caput ocellis 6+1, antennis (Fig. XVII, 1) articulo sexto *c.* 1/3 longiore quam latiore.

Truncus. Tergitum primum area mediana striis tribus superis lateraliter continuantibus, angulo antico sublaterali late rotundato,

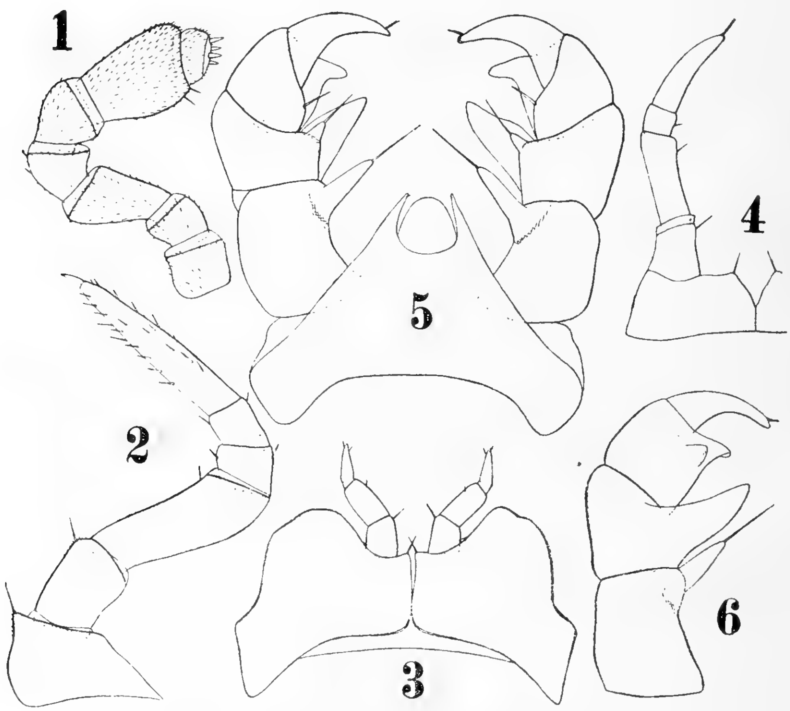

FIG. XVII.—*Ap omeris (Hyleoglomeris) modiglianii.*

1. antenna; 2. pes paris decimi; 3. maris pedes paris 17^{i}; 4. maris pes paris 18^{i}; 5. maris pedes paris 19^{i} cum sterno antice inspecti; 6. maris pes paris 19^{i} postice inspectus.

lamina laterali perparva, area postlaminari convexiuscula striis 8-9 instructa. Tergitum secundum lateribus angustatis, praeter striam postmarginalem stria alia instructis, tergita cetera praeter striam postmarginalem stria alia integra et a quinto etiam stria breviore instructa, angulo antico rotundato, postico subrecto, in corporis parte posteriore parum acuto; tergitum ultimum margine postico medio vix sinuato.

Pedes (Fig. XVII, 2) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

♂ Feminae similis.

Pedes paris 17^i, 18^i et 19^i vide fig. XVII, 3-6.

Long. corp. mm. 8, lat. 3·5, long. antennarum 1·62, pedum paris decimi 2·28.

Habitat. Nias: Lelemboli (Mus. Genova).

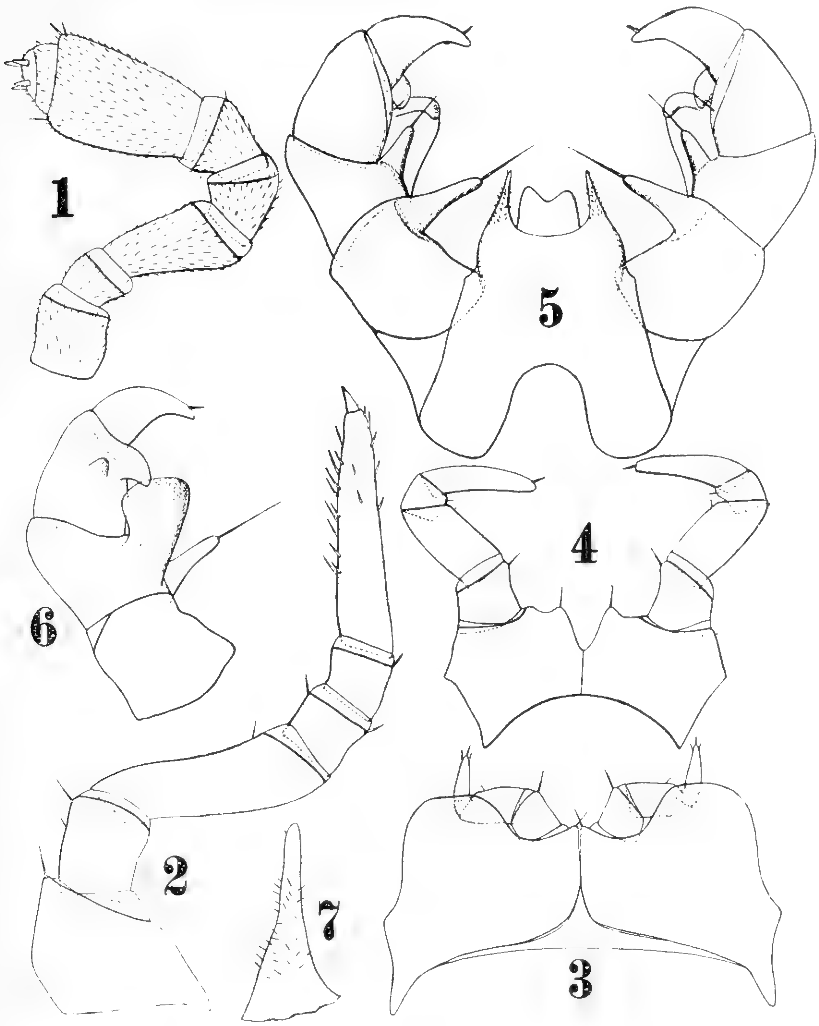

FIG. XVIII.—*Apiomeris* (*Hyleoglomeris*) *formosa.*

1. antenna; 2. pes paris decimi; 3. maris pedes paris 17^i; 4. maris pedes paris 18^i; 5. maris pedes paris 19^i cum sterno antice inspecti; 6. maris pes paris 19^i postice inspectus; 7. maris sterni inter pedes paris 19^i processus lateralis.

Apiomeris (Hyleoglomeris) formosa, Silv.

Glomeris formosa, Silvestri, *Ann. Mus. Genova* (2) XIV, p. 720 (1895).

Corpus nigrescens, colli margine postico, trunci tergito primo toto, tergiti ultimi macula mediana postica latiore ochraceis, tergitorum ceterorum margine postico umbrino, ventre pedibusque pallide umbrinis.

Caput ocellis 6+1, antennis (Fig. XVIII, 1) articulo sexto *c.* 1/3 longiore quam latiore.

Truncus. Tergitum primum area mediana striis 4 lateraliter continuantibus, angulo antico sublaterali latissime rotundato, lamina laterali minima, area postlaminari convexiuscula, striis 8-9

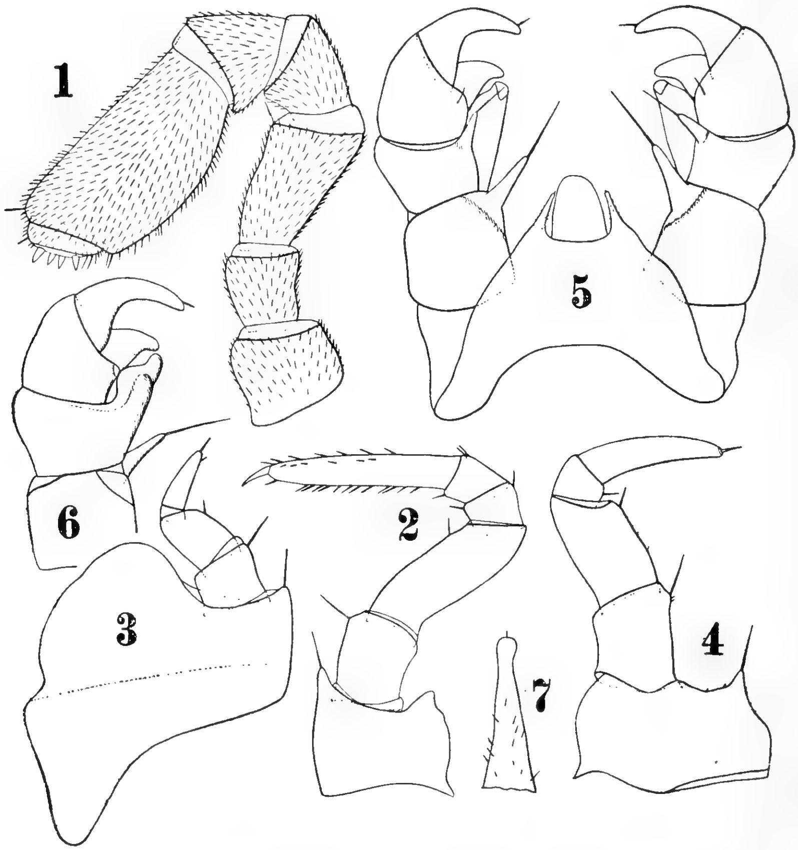

FIG. XIX.—*Apiomeris (Hyleoglomeris) diversicolor.*

1. antenna; 2. pes paris decimi; 3. maris pes paris 17^i; 4. maris pes paris 18^i; 5. maris pedes paris 19^i cum sterno antice inspecti; 6. maris pes paris 19^i postice inspectus; 7. maris sterni inter pedes paris 19^i processus lateralis.

instructa. Tergitum secundum lateribus aliquantum angustatis praeter striam postmarginalem stria alia instructis; tergita cetera praeter striam postmarginalem stria alia integra et stria brevissima instructa, angulo antico rotundato, postico a tergito 8° ad 10^{um} parum acuto. Tergitum ultimum margine postico medio paullum sinuato.

Pedes (Fig. XVIII, 2) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

♂ Tergitum ultimum margine postico parum magis quam idem feminae sinuato.

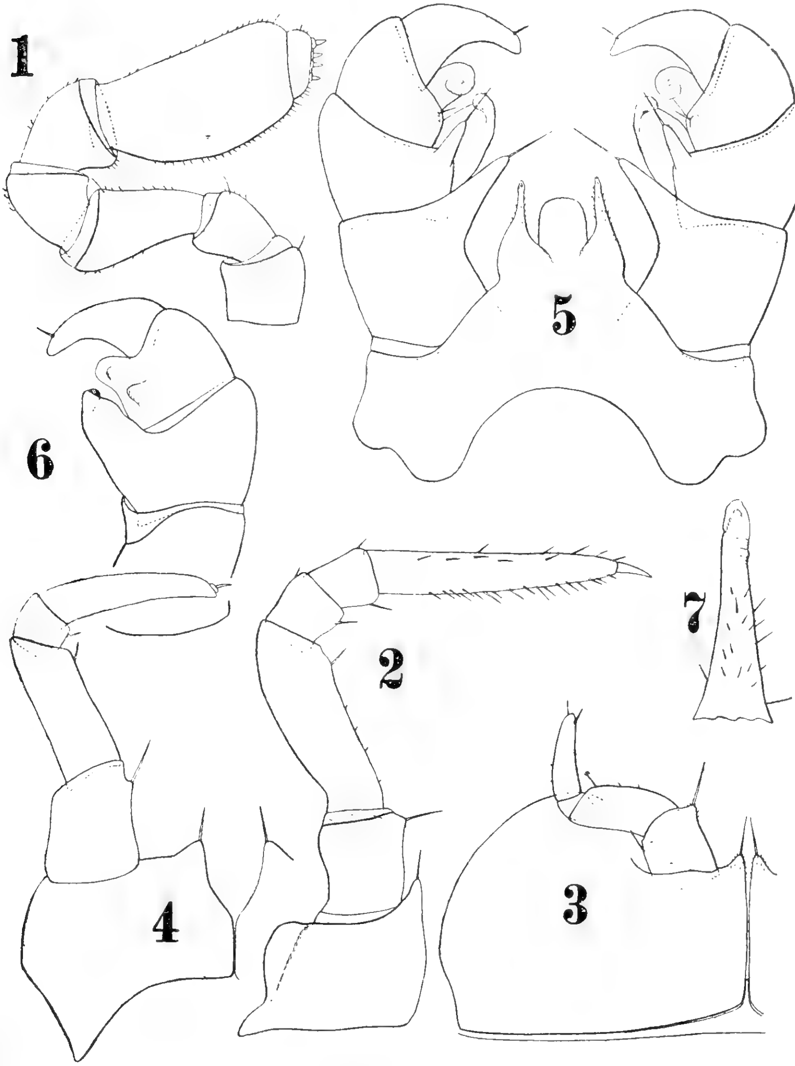

FIG. XX.—*Apiomeris* (*Hyleoglomeris*) *beccarii.*

1. antenna; 2. pes paris decimi; 3. maris pes paris 17^i; 4. maris pes paris 18^i; 5. maris pedes paris 19^i cum sterno antice inspecti; 6. maris pes paris 19^i postice inspectus; 7. maris sterni inter pedes paris 19^i processus lateralis.

Pedes paris 17^i, 18^i et 19^i vide fig. XVIII, 3-7.

Long. corp. mm. 10, lat. 4·2, long. antennarum 1·95, pedum paris decimi 2·73.

Habitat. Sumatra: Benkoelen (Mus. Genova).

Apiomeris (Hyleoglomeris) diversicolor (Silv.).

Glomeris diversicolor, Silvestri, *Ann. Mus. Genova* (2) XIV, p. 721 (1895).

Corpus subtestaceum, tergitorum margine postico et parte laterali infera, antennis, ventre pedibusque subcremeis.

Caput media fronte convexiuscula postice vix carinata, oculis ocellis 8+1 compositis, antennis (Fig. XIX, 1) articulo sexto fere duplo longiore quam latiore.

Truncus. Tergitum primum area mediana striis 10 superis

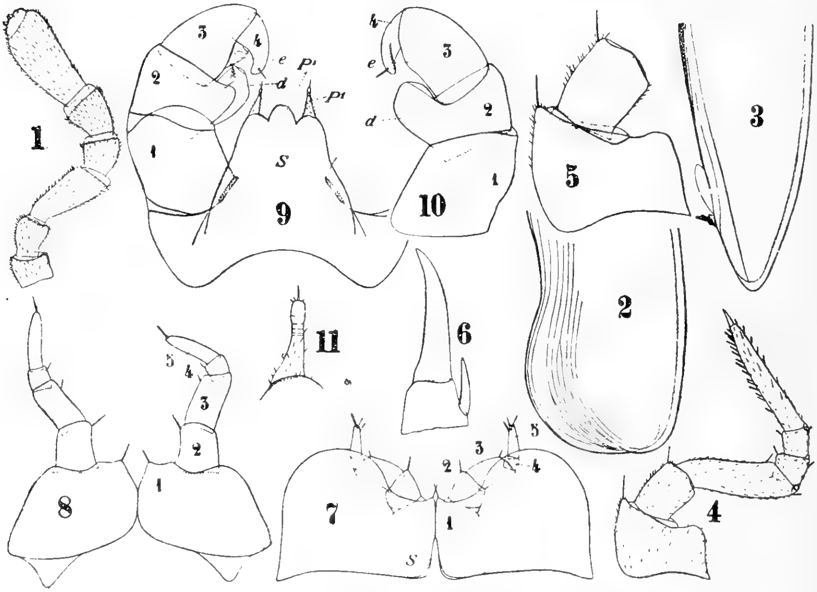

FIG. XXI.—*Apiomeris (Apheromeris) partialis.*

1. antenna; 2. trunci dimidium tergitum primum et 3. tergitum secundum lateraliter inspecta; 4. pes paris decimi; 5. ejusdem articuli primus et secundus; 6. ejusdem pars apicalis; 7. maris pedes paris 17^i; 8. maris pedes paris 18^i; 9. maris pes paris 19^i cum sterno antice inspectus; 10. maris pes paris 19^i postice inspectus; 11. maris sterni inter pedes paris 19^i processus lateralis.

Litterae ut in fig. VI, pag. 113.

lateraliter continuantibus, angulo antico sublaterali late rotundato, lamina laterali perparva, area postlaminari convexiuscula striis 11-12 instructa. Tergitum secundum lateribus angustatis, praeter striam postmarginalem, stria alia instructis; tergita cetera angulo postico in medio corpore subrecto, in corporis parte postica acute parum producto, facie laterali infera striis duabus instructa. Tergitum ultimum margine infero medio vix sinuato.

Pedes (Fig. XIX, 2) articuli primi angulo externo plus minusve acute infra aliquantum producto, articuli sexti spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XIX, 3-7.

Long. corp. mm. 14, lat. 6, long. antennarum 3, pedum paris decimi 4.

Habitat. Sumatra: Si-Rambè (Mus. Genova).

Observatio. Species haec inter ceteras mihi notas pedum articuli primi angulo externo acute producto distinctissima est.

Apiomeris (Hyleoglomeris) beccarii, sp. n

♂ Corpus nigrescens tergitorum margine postico anguste, eorumdem parte infera spatio fere mm. 1 aequante, antennis, ventre pedibusque pallide isabellinis.

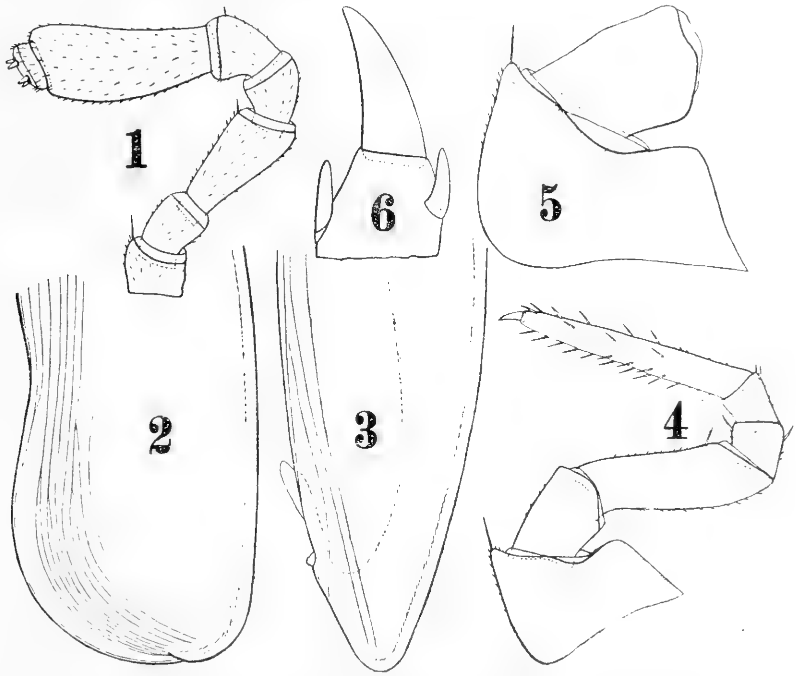

FIG. XXII.—*Apiomeris* (? *Apheromeris*) *totalis.*

1. antenna; 2. trunci dimidium tergitum primum et 3. tergitum secundum lateraliter inspecta; 4. pes paris decimi; 5. ejusdem articuli primus et secundus; 6. ejusdem pars apicalis.

Caput media fronte postice paullum carinata inter antennas convexiuscula, oculis ocellis 7+1, antennis (Fig. XX, 1) articulo sexto parum minus quam duplo longiore quam latiore.

Collum pone marginem anticum striis transversis consuetis duabus et stria alia transversali profunda lateraliter bifurcata instructum.

Truncus. Tergitum primum area mediana striis 5 superis lateraliter continuantibus, angulo antico sublaterali late rotundato, lamina laterali perparva, area postlaminari convexiuscula striis 9 instructa. Tergitum secundum lateribus angustatis, praeter striam postmarginalem stria alia instructis; tergita cetera lateribus gradatim latioribus et angulo postico gradatim a forma rotundata ad rectam et in corporis partem posteriorem ad acutam evoluto Tergitum ultimum margine postico medio vix sinuato.

Pedes (Fig. XX, 2) articuli primi latere externo subrecto, parum rotundato, articuli sexti spinis vide figuram.

Pedes paris 17^i, 18^i et 19^i vide fig. XX, 3-7.

Long. corp. mm. 12, lat. 5·6, long. antennarum 3·2, pedum paris decimi 3·8.

Habitat. Sumatra: Mt. Singalan (Mus. Genova).

Observatio. Species haec ad *A.* (*Hyl.*) *diversicolor*, Silv., proxi-

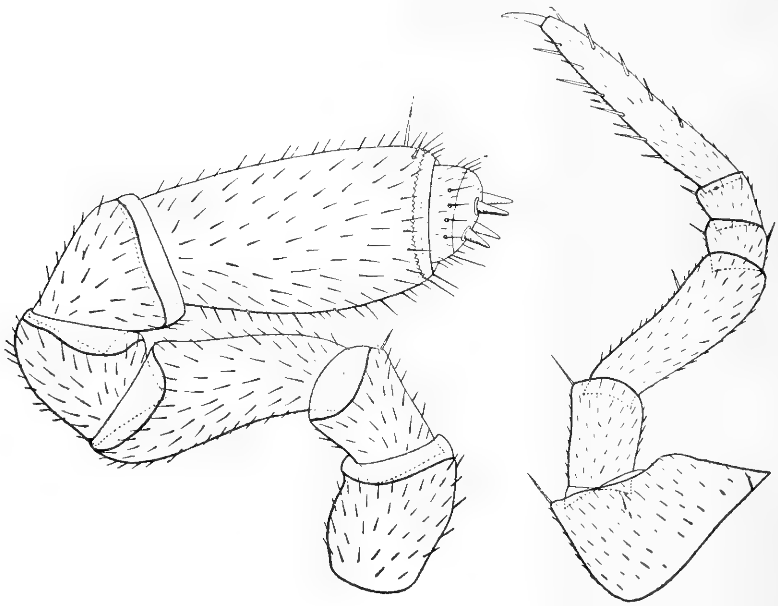

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FIG. XXIII.—*Apiomeris* (? *Apheromeris*) *parvella*.
1. antenna; 2. pes paris decimi.

ma est, sed pedum articuli primi angulo externo subrecto et tergiti primi striis minus numerosis facile distinguenda est; ad *A.* (*Hyl.*) *albicornis* (Poc.) secundum ejusdem descriptionem proxima videtur, sed ad veram differentiam vel identitatem statuendam exempla typica comparanda sunt.

Subgen. **Apheromeris**, nov.

Mas. Pedes paris 18 articulo primo ab opposito sejuncto; pedes paris 19 4-articulati, articulis omnibus distinctis, articulis 2-3 tantum processu carnoso postico interno instructis.

Apiomeris (Apheromeris) partialis, sp. n.

Corpus atrum lateribus parum pallidioribus, dorso a tergito quinto ad decimum macula parva mediana postica ochroleuca, tergito ultimo immaculato, ventre pedibusque alutaceis.

Caput ocellis 7+1, antennis (Fig. XXI, 1) articulo sexto *c.* duplo longiore quam latiore.

Truncus. Tergitum primum (Fig. XXI, 2) area mediana striis 3-4 lateraliter continuantibus, lamina laterali perparva, area

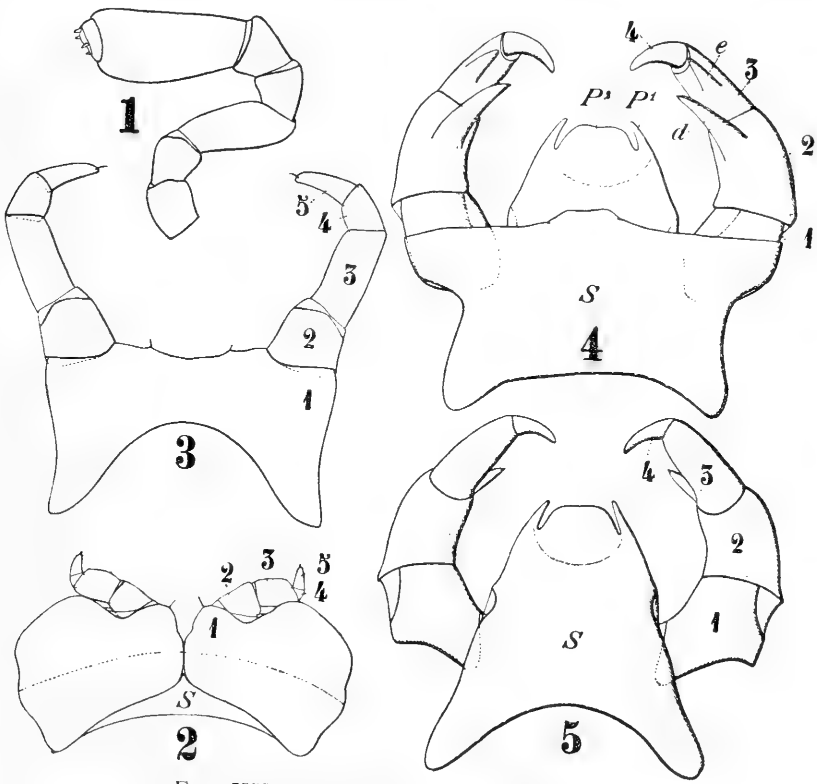

FIG. XXIV.—*Apiomeris (s.s.) infuscata.*
1. antenna; 2. maris pedes paris 17^i; 3. maris pedes paris 18^i; 4. maris pedes paris 19^i cum sterno antice inspecti; 5. iidem postice inspecti. Litterae ut in fig. VI, pag. 113.

postlaminari convexiuscula striis 7-9 instructa, quarum 3-4 supra continuant. Tergitum secundum (Fig. XXI, 3), ut tergita sequentia, lateribus praeter striam abbreviatam stria una instructis. Tergitum ultimum postice late rotundatum.

Pedes articuli primi angulo infero externo (Fig. XXI, 5) late rotundato, infra vix producto, articuli sexti spinis vide fig. XXI, 4, ungue terminali (Fig. XXI, 6) longo, attenuato.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XXI, 7-11.

Long. corp. mm. 11·5, lat. 6, long. antennarum 3, pedum paris decimi 3·90.

Habitat. Java: Pengalengan. Exempla duo ♀♀ ex Gedè cum exemplis ex Pengalengan bene congruunt.

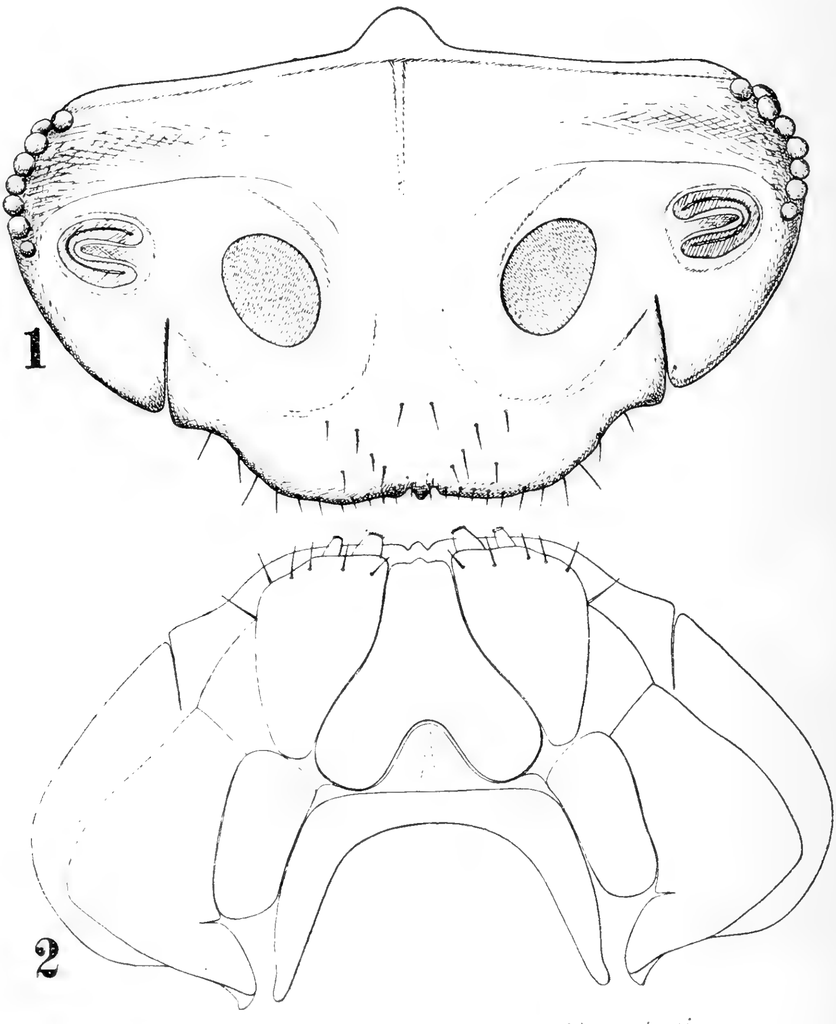

FIG. XXV.—*Apiomeris (Malayomeris) martensi.*
1. caput pronum; 2. caput supinum.

Apiomeris (Apheromeris) totalis, sp. n.

Corpus atro-nigrescens trunci dorso serie mediana macularum obtriangularium plus minusve magnis et serie sublaterali macularum anticarum transverse ovalium, plus minusve manifestarum, mellearum ornato, tergito ultimo macula mediana magna subtriagularis luride mellea, tergitorum omnium marginibus melleis, ventre pedibusque articulis 3-6 plus minusve fuscis exceptis rufo-umbrinis.

Caput ocellis 7+1, antennis (Fig. XXII, 1) articulo sexto paullo magis quam duplo longiore quam latiore.

Truncus Tergitum primum (Fig. XXII, 2) area mediana striis 5 lateraliter continuantibus, lamina laterali perparva, area postlaminari convexiuscula striis 9-10 instructa, quarum 5 supra continuant. Tergitum secundum (Fig. XXII, 3) lateribus angustatis et praeter striam postmarginalem striis duabus integris et

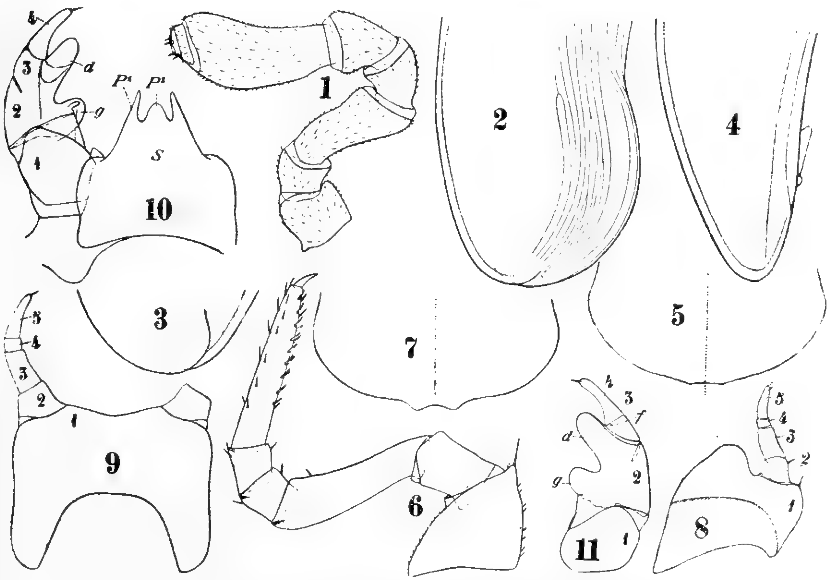

FIG. XXVI.—*Apiomeris (Malayomeris) martensi.*

1. antenna; 2. trunci dimidium tergitum primum lateraliter inspectum; 3. ejusdem pars inferior subtus inspecta; 4. trunci dimidium tergitum secundum lateraliter inspectum; 5. feminae tergitum ultimum postice inspectum; 6. pes paris decimi; 7. maris tergitum ultimum postice inspectum; 8. maris pes paris 17^i; 9. maris pes paris 18^i; 10. maris pes paris 19^i cum sterno antice inspectus; 11. maris pes paris 19^i postice inspectus.

Litterae ut in fig. VI, pag. 113.

stria altera abbreviata instructis, tergita cetera lateribus praeter striam postmarginalem stria una instructis; tergitum ultimum postice late rotundatum.

Pedes articuli primi (Fig. XXII, 5) angulo infero externo infra parum rotundatim paullum producto, articuli sexti spinis vide fig. XXII, 4, ungue terminali (Fig. XXII, 6) robusto brevi.

Mas ignotus.

Long. crop. mm. 11, lat. 5·6, long. antennarum 1·80, pedum paris decimi 3·75.

Habitat. Java: Pengalengan.

Observatio. Species haec ab *A.* (*Aph.*) *partialis*, Silv. colore, trunci tergiti primi striarum numero, pedum articuli primi angulo externo minus rotundato et ungue breviore distincta est.

Apiomeris (? Apheromeris) parvella, Silv.

Corpus atrum, trunci tergiti primi parte antica usque ad incisuram, tergitorum omnium marginibus et tergitorum serie sublaterali macularum anticarum melleis, ventre pedibusque alutaceis.

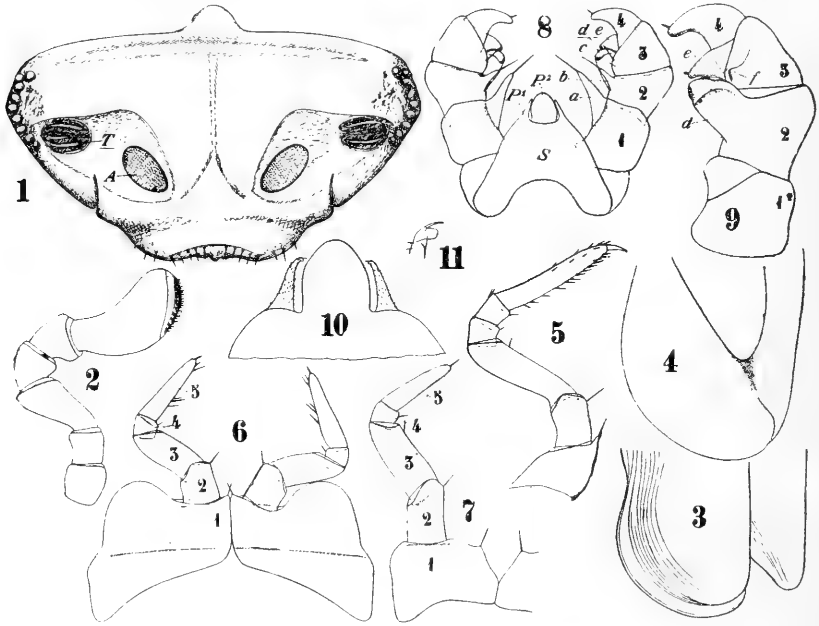

FIG. XXVII.—*Rhopalomeris carnifex.*

1. caput pronum; 2. antenna; 3. trunci dimidium tergitum primum et secundum lateraliter inspecta; 4. trunci tergiti primi pars lateralis subtus inspecta; 5. pes paris decimi; 6. maris pedes paris 17^{i}; 7. maris pes paris 18^{i}; 8. maris pedes paris 19^{i} cum sterno antice inspecti; 9. maris pes paris 19^{i} postice inspectus; 10. maris sterni inter pedes paris 19^{i} pars infera; 11. ejusdem processi lateralis apex magis ampliatus.

Litterae ut in fig. VI, pag. 113.

Caput ocellis 7+1, antennis (Fig. XXIII, 1) articulo sexto fere duplo longiore quam latiore.

Truncus. Tergitum primum area mediana striis 7 lateraliter continuantibus, lamina laterali antica parva, margine antico sublaterali antrorsum late rotundatim parum producto (magis producto quam in *A. totalis* et *A. partialis*) area postlaminari striis 11-12 crebris, quarum 7 supra continuant. Tergitum secundum lateribus angustatis, praeter striam postmarginalem, striis duabus instructum, tergita cetera praeter striam postmarginalem stria una instructa; tergitum ultimum postice late rotundatum.

Pedes (Fig. XXIII, 2) angulo infero externo parum obtuso vel vix rotundato, articuli sexti spinis vide figuram, ungue terminali longo, attenuato.

Long. crop. mm. 6, lat. 3, long. antennarum 1·56, pedum paris decimi 1·80.

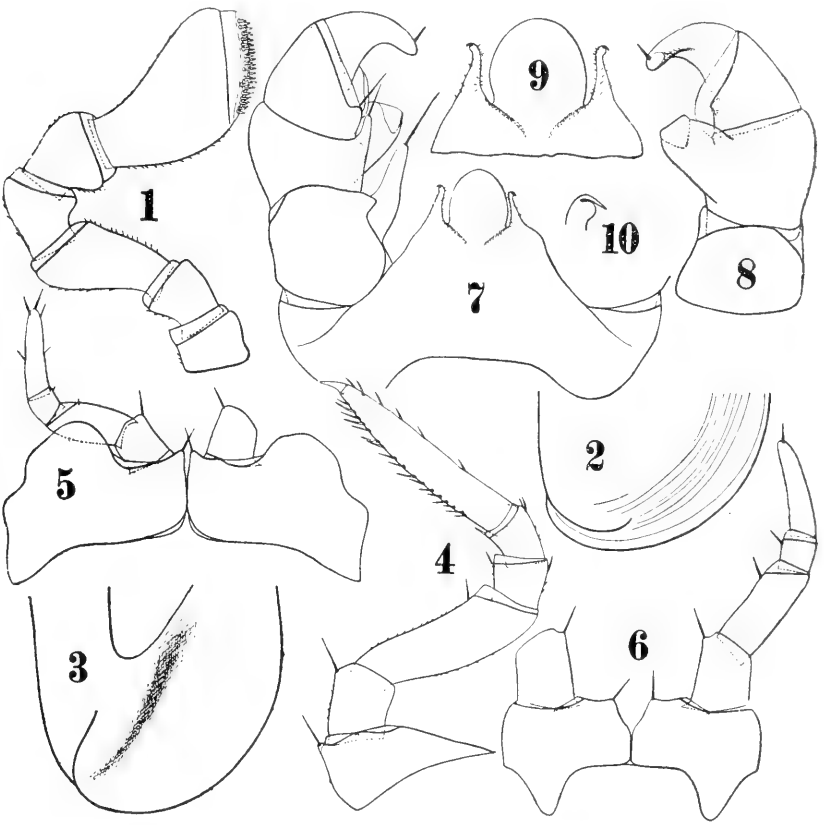

FIG. XXVIII.—*Rhupalomeris carnifex* v. *pallida*.

1. antenna; 2. trunci tergiti primi pars lateralis externe inspecta; 3. eadem subtus inspecta; 4. pes paris decimi; 5. maris pedes paris 17^i; 6. maris pedes paris 18^i; 7. maris pes paris 19^i cum sterno antice inspectus; 8. maris pes paris 19^i postice inspectus; 9. maris sterni inter pedum paris 19^i pars infera; 10. ejusdem processi lateralis apex magis ampliatus.

Mas ignotus.

Habitat. Java: Gedè.

Observatio. Species haec ab *A. totalis*, Silv. et *A. partialis*, Silv., magnitudine, colore, trunci tergiti primi margine antico sublaterali aliquantum magis producto et striis magis numerosis distincta est.

Subgen. **Apiomeris**, O. F. Cook.

Glomeris, Pocock, ex p., Max Weber's *Zool. Ergebn. Reise, Niederl. Ost.-Ind.* III, p. 323 (1894).
Apiomeris, O. F. Cook, *Brandtia* X, p. 45 (1896).

Subgenus hoc characteribus plerisque ad subgen. *Hyleoglomeris* aequale est, differt tergito ultimo margine postico medio vix sinuato, maris tergito ultimo margine postico medio sinuato, pedibus paris 18^{i} articulo primo cum opposito coalito.

Pedes paris 19^{i} articulis 4 omnibus inter sese distinctis, articulis secundo et tertio processu postico conico tantum instructis.

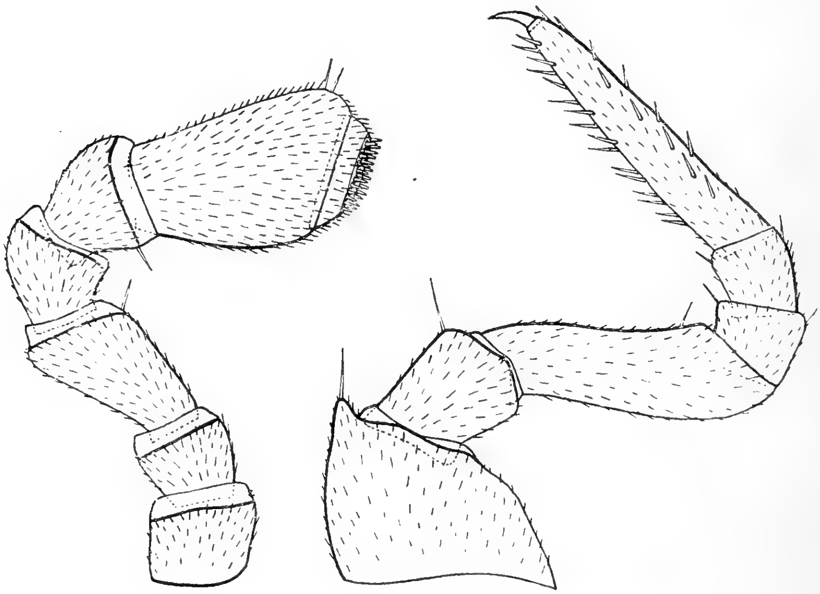

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FIG. XXIX.—*Rhopalomeris monacha.*
1. antenna; 2. pes paris decimi.

Apiomeris (*s.s.*) **infuscata** (Poc.) O. F. Cook.

Glomeris infuscata, Pocock, ex p., Max Weber's *Zool. Ergeb. Reise Niederl. Ost.-Ind.* III, p. 324, pl. xix, fig. 10-10*b* (1894).
Apiomeris infuscata, O. F. Cook, *Brandtia* X, p. 44 (1896).

Speciei huius antennam et maris pedes paris 17^{i}, 18^{i} et 19^{i} vidi et delineo (Fig. XXIV, 1-5). Pococki descriptio haec est:

Colour.—The upper surface a dark slate grey, the extreme edges of the tergites paler; in the posterior half of the body there is a feebly marked pale spot in the middle of the hinder edge of the tergites; ventral surface pale; legs lightly infuscate.

Eyes composed of seven ocelli; six in a longitudinal series and one external to this series.

Nuchal plate (1st tergite) marked by two consipicuous arched grooves which cross it from corner to corner.

Second dorsal plate marked laterally with from nine to twelve striae, most of which cross the summit of the plate; the rest of the tergites marked laterally and inferiorly with two or three striae. All the tergites smooth but marked with exceedingly small, close-set punctures.

Anal tergite in the female convex from side to side, nearly straight from above downwards; in the male, with the hinder

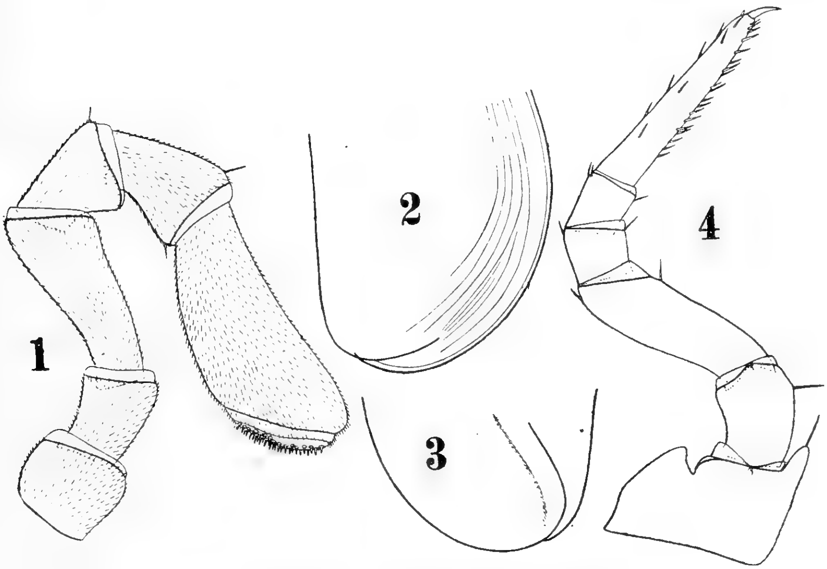

FIG. XXX.—*Rhopalomeris tonkinensis.*

1. antenna; 2. trunci tergiti primi pars lateralis externe inspecta; 3. ejusdem pars inferior subtus inspecta; 4. pes paris decimi.

border emarginate in the middle and with a conspicuous depression just above the emargination.

In the male the 17th pair of legs are exceedingly short, the 18th are much longer than the 17th but shorter than the 19th or copulatory pair; the coxal lamina is long and piriform, projecting as far as the distal margin of the second segment of the copulatory feet, with a short and slender process on each side; the first segment of the copulatory feet is long and bears no process, the second is produced posteriorly into a digitiform prolongation, the apex of which extends as far as the apex of a similar but much smaller digitiform prolongation from the third segment, which is somewhat compressed; the distal or fourth segment is spiniform, *i.e.*

stout at the base then abruptly narrowed, the distal three-fourths tapering gradually to a point.

Length 10·5 mm.

Sumatra: Mount Singalang, several specimens.

Subgen. **Malayomeris**, Verh.

Malayomeris, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, pp. 243 et 246.

Caput (Fig. XXV, 1-2) eidem subgen. *Hyleoglomeris* simile est.

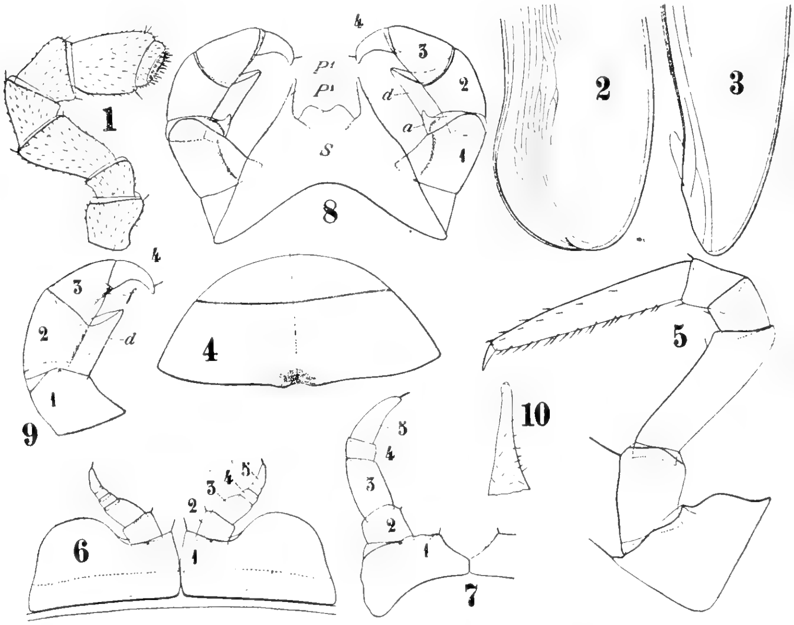

FIG. XXXI.—*Rhopalomeris* (*Peplomeris*) *demangei*, mas.

1. antenna; 2. trunci dimidium tergitum primum et 3. tergitum secundum lateraliter inspecta; 4. tergitum ultimum postice inspectum; 5. pes paris decimi; 6. pedes paris 17^i; 7. pes paris 18^i; 8. pedes paris 19^i cum sterno antice inspecti; 9. pes paris 19^i postice inspectus; 10. sterni inter pedes paris 19^i processus lateralis.

Litterae ut in fig VI, pag. 113.

Feminae tergitum ultimum margine postico medio parum sinuato instructum.

♂ Tergitum ultimum margine postico medio quam idem feminae magis sinuato.

Pedes paris 18^i articulo primo cum opposito coalito; pedes paris 19^i articulo tertio a secundo antice tantum lateraliter separato, articulo secundo processu basali et processu apicali internis latis longis, articulo tertio tuberculo perparvo postico.

Apiomeris (Malayomeris) martensi, Verh.

Malayomeris martensi, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 244, taf. ix, abb. 5-7.

Corpus totum subochraceum. Caput ocellis 7+1, antennis (Fig. XXVI, 1) articulo sexto parum magis quam duplo longiore quam latiore, subtus parum convexo et supra parum concavo, articulo septimo brevi.

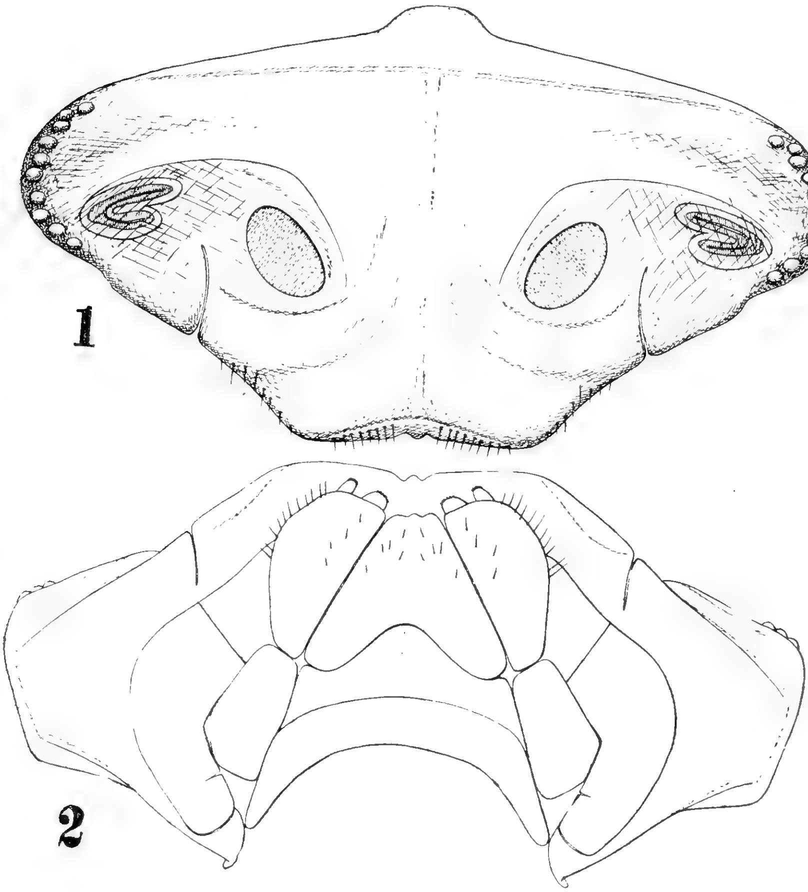

FIG. XXXII.—*Hyperglomeris lamellosa.*
1. caput pronum ; 2. caput supinum.

Truncus. Tergitum primum (Fig. XXVI, 2-3) area mediana supera striis 6 lateraliter continuantibus, margine antico sublaterali late rotundato, lamina antica parva area postlaminari striis 9-10; tergitum secundum (Fig. XXVI, 4) lateribus angustatis stria una integra instructis; tergitum ultimum (Fig. XXVI, 5) margine postico medio parum sinuato.

Pedes (Fig. XXVI, 6) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

Long. corp. mm. 17, lat. 8, long. antennarum 4·4, pedum paris decimi 4·6.

♂ Tergitum ultimum (Fig. XXVI, 7) margine postico medio quam idem feminae magis sinuato et ad sinum latera aliquantum producto.

Pedes paris 17^i, 18^i et 19^i vide fig. XXVI, 8-11.

Habitat. Sumatra: Kepatiang (Mus. Berlin).

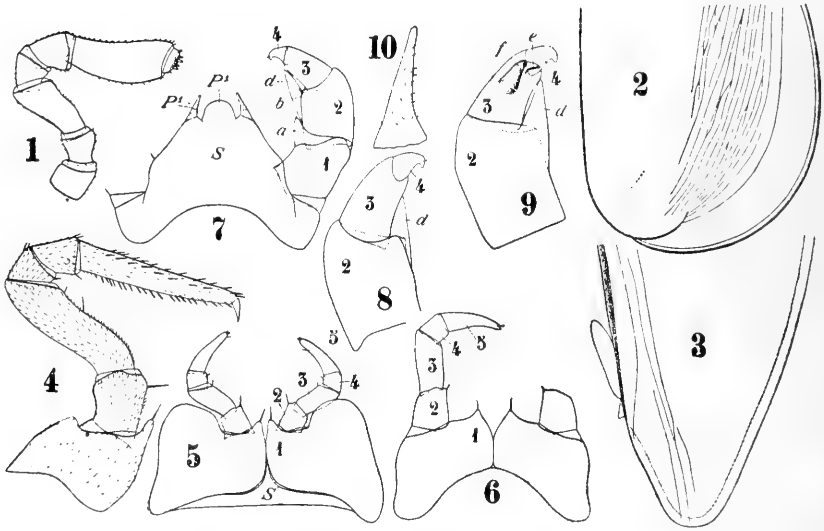

FIG. XXXIII.—*Hyperglomeris lamellosa.*

1. antenna; 2. trunci dimidium tergitum primum et 3. tergitum secundum lateraliter inspecta; 4. pes paris decimi; 5. maris pedes paris 17^i; 6. maris pedes paris 18^i; 7. maris pes paris 19^i cum sterno antice inspectus; 8. maris pedis paris 19^i articuli 2-4 antice inspecti; 9. iidem postice inspecti; 10. sterni inter pedes paris 19^i processus lateralis.

Litterae ut in fig. VI, pag. 113.

Gen. **Rhopalomeris**, Verh.

Glomeris, Pocock, *Journ. Linn. Soc.* XXI, p. 290 (1889); *Idem*, *Ann. Mus. Genova* (2) X, p. 385 (1890).

Rhopalomeris, Verhoeff, *Archiv f. Naturg.* LXXII, p. 188 (1906); *Idem*, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 241, taf. ix, abb. 8-9.

Characteres feminae (saltem exteriores) generis huius eisdem gen. *Apiomeris*, O. F. Cook aequales sunt antennarum forma excepta, quae apicem latiorem habent et conis sensitivis numerosis instructum. Mares pedibus parium 17^i, 18^i ad eosdem subgen. *Hyleoglomeris*, Verh. aequales sunt, pedibus paris 19^i aequales vel processibus diversi et ad subgenera duo referendi sunt:

a. Pedes paris 19^{i} ut in *Apiomeris* (Subgen. *Hyleoglomeris*) conformati... ... Subgen. *Rhopalomeris*, Verh. Typus: *Rh. carnifex* (Pocock).

b. Pedes paris 19 articulo primo processu apicali interno brevi conico, articulo secundo processu triangulari postico interno, articulo tertio processu postico brevi instructis ... ... Subgen. *Peplomeris*, nov. Typus: *Peplomeris demangei*, sp. n.

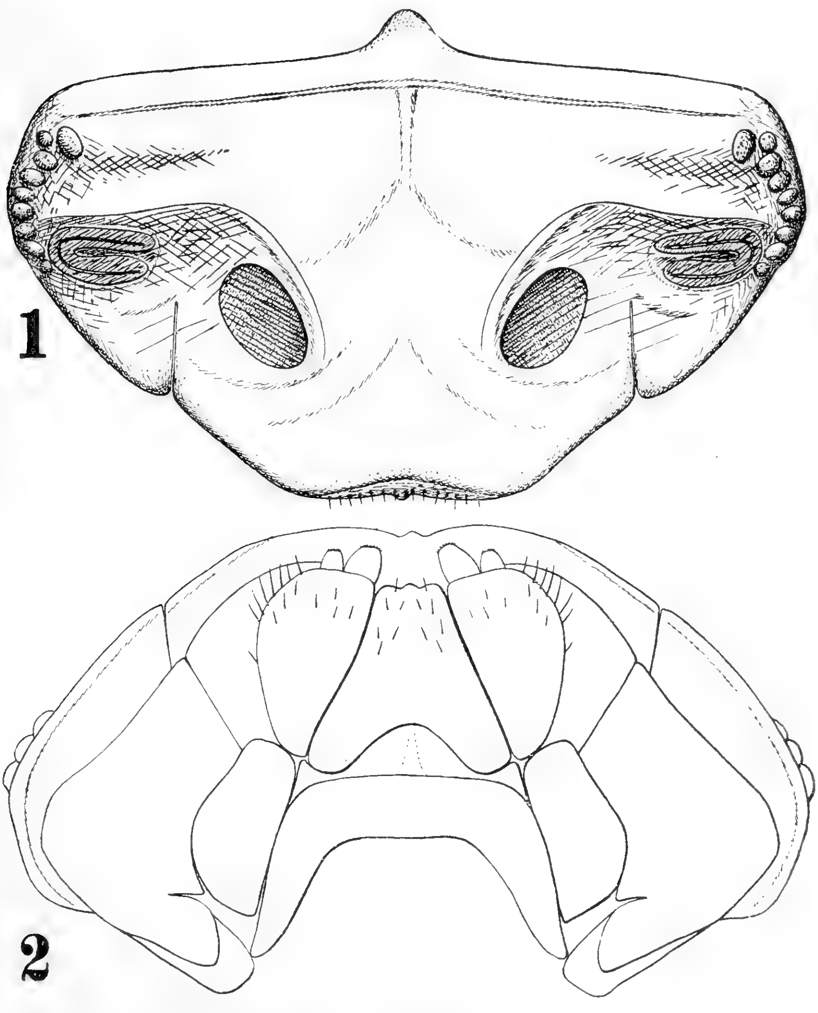

FIG. XXXIV.—*Dinoglomeris dirupta*.
1. caput pronum; 2. caput supinum.

Rhopalomeris (*s.s.*) carnifex (Poc.).

Glomeris carnifex, Pocock, *Journ. Linn. Soc.* XXI, pp. 290 et 301 (1887); *Idem*, *Ann. Mus. Genova* (2) X, p. 385 (1890).

Corpus atrum capitis facie testaceo aliquantum maculata, colli margine laterali et parte postica, trunci tergitorum margine postico, linea mediana et parte infera laterali, tergiti ultimi parte postica rubescentibus, antennis fuscis, ventre pedibusque testaceis.

Caput ocellis 8+1, antennis (Fig XXVII, 2) articulo sexto *c.*

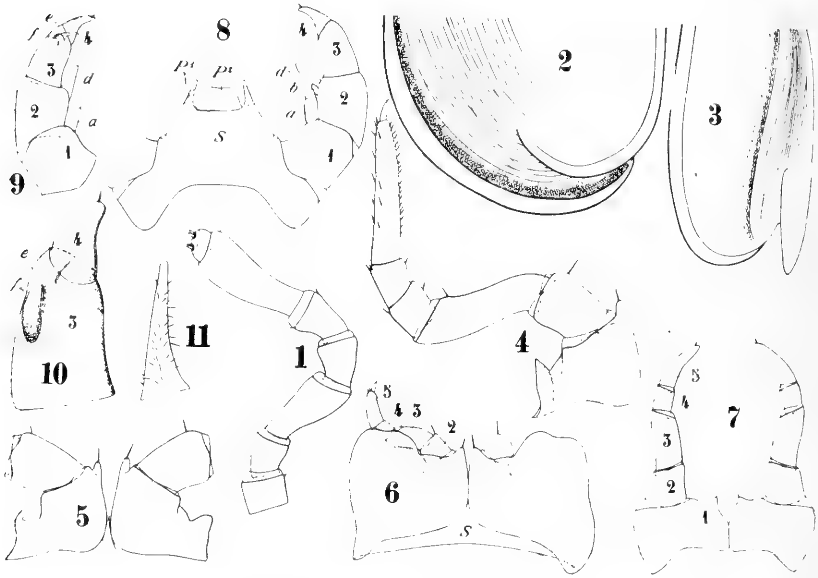

FIG. XXXV.—*Dinoglomeris dirupta.*

1. antenna; 2. trunci tergiti primi pars inferior a facie laterali inspecta; 3. trunci tergiti primi pars lateralis a facie antica-inferiore (haud interna) inspecta; 4. pes paris decimi; 5. pedes paris decimi primi, quarum alter articuli primi angulo externo anomalo; 6. maris pedes paris 17^i; 7. maris pedes paris 18^i; 8. maris pes paris 19^i cum sterno antice inspecti; 9. maris pes paris 19^i postice inspectus; 10. maris pedis paris 19^i articuli tertius et quartus postice inspecti magis ampliati; 11. maris sterni inter pedes paris 19^i processus lateralis.

1/3 longiore quam ad apicem latiore, apice quam basis magis quam duplo latiore, articulo septimo brevissimo, lato, conis sensitivis apicalibus numerosis brevibus. Collum pone marginem anticum striis duabus transversis instructum.

Truncus. Tergitum primum (Fig. XXVII, 3-4) area mediana antica striis tribus anticis abbreviatis et striis aliis 6-7 superis, lateraliter continuantibus, lamina antica perparva, area postlaminari striis 9. Tergitum secundum lateribus angustatis praeter striam postmarginalem striis duabus abbreviatis et duabus integris instructis; tergita cetera lateribus striis duabus integris et tergitorum anticorum etiam stria nonnulla abbreviata instructa; tergitum ultimum postice late rotundatum.

Pedes (Fig. XXVII, 5) articuli primi angulo externo obtuso, articuli sexti spinis vide figuram.

♂ Tergitum ultimum margine infero vix sinuato.

Pedes paris 17^i, 18^i et 19^i vide fig. XXVII, 6-11.

Long. corp. mm. 16, lat. 8, long. antennarum 4·50, pedum paris decimi 5·30.

Habitat. Tenasserim: Malwoon (*Fea*) et Tenasserim austr. (*Oates*).

Rhopalomeris (*s.s.*) carnifex (Poc.) var. pallida, Poc.

Glomeris carnifex v. *pallida*, Pocock, *Journ. Linn. Soc. Zool.* XXI, pp. 290 et 300, pl. xxiv, figs. 7, 7*a* (1887).

Rhopalomeris bicolor, Verhoeff, *Archiv f. Naturg.* LXXII, p. 189 (1906) (nec *Glomeris bicolor*, Wood); *Id.*, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 241, taf. ix, abb. 8-9.

Corpus atrum, capitis faciei maculis nonnullis, colli margine laterali et postico, trunci tergitorum margine postico, linea mediana et parte infera laterali, tergiti ultimi parte postica ochraceis, antennis nigrescentibus, ventre pedibusque subochraceis.

Caput ocellis 8+1, antennis (Fig. XXVIII, 1) articulo sexto aliquantum minus quam 1/3 longiore quam ad apicem latiore, apice quam basis magis quam duplo latiore, articulo septimo brevissimo lato, conis sensitivis apicalibus numerosis brevibus.

Truncus. Tergitum primum (Fig. XXVIII, 2-3) area mediana striis superis 5 lateraliter continuantibus, lamina antica perparva, area postlaminari striis 7. Tergitum secundum lateribus angustatis praeter striam postmarginalem striis duabus abbreviatis et duabus integris instructum; tergita cetera lateribus striis 3-5 partim abbreviatis instructa; tergitum ultimum postice late rotundatum.

Pedes (Fig. XXVIII, 4) articuli primi angulo externo obtuso, articuli sexti spinis vide figuram.

♂ Tergitum ultimum margine infero vix sinuato.

Pedes paris 17^i, 18^i et 19^i vide fig. XXVIII, 5-10.

Long. corp. mm. 16, lat. 8, long. antennarum 4·5, pedum paris decimi 5·30.

Habitat. Mergui Archipelago: Ins. Elphinstone; Malacca: Ins. Salanga.

Rhopalomeris (*s.s.*) monacha, sp. n.

Caput, collum, trunci tergitum primum ochracea, tergita cetera nigrescentia, fascia mediana longitudinali ochracea, marginibus anguste ochraceis, tergito ultimo fascia mediana longitudinali lata ochracea, ventre pedibusque pallide ochraceis.

Caput ocellis in oculo altero 9+1, in oculo altero 11+1, antennis (Fig. XXIX, 1) articulo sexto *c.* 2/7 longiore quam latiore, articulo septimo breviore, conis sensitivis apicalibus numerosis.

Truncus. Tergitum primum area antica mediana striis superis 5 lateraliter continuantibus, lamina laterali perparva, area postlaminari striis 9, quarum 5 supra continuant. Tergitum cetera lateraliter striis 3-4 instructa. Tergitum ultimum postice late rotundatum.

Pedes (Fig. XXIX, 2) articuli primi angulo infero externo obtuso, articuli sexti spinis vide figuram.

Long. corp. mm. 12, lat. 6, long. antennarum 2·48, pedum paris decimi 3·40.

Mas ignotus.

Habitat. Malay Peninsula: Perak (Mus. Berlin).

Observatio. Species haec a *R. carnifex* v. *pallida* (Poc.) saltem colore et antennarum forma distincta est.

Rhopalomeris (*s.s.*) **tonkinensis**, sp. n.

Corpus nigrum colli margine postico, trunci tergiti primi marginibus omnibus, tergitorum sequentium margine antico et postico sat anguste et in medio dorso breviter angulatim, macula transversali antica nigro marmorata, et parte laterali spatio latiusculo ochroleucis, tergiti ultimi margine postico parum late ochroleuco, antennis, praeter dimidiam partem distalem articuli sexti gradatim magis infuscatam, ochroleucis, ventre pedibusque ochroleucis.

Caput ocellis 8+1, antennis (Fig. XXX, 1) articulo sexto duplo longiore quam latiore, articulo septimo breviore, conis sensitivis apicalibus numerosis. Collum pone marginem anticum lineis duabus transversis parallelis instructum.

Truncus. Tergitum primum (Fig. XXX, 2-3) area antica mediana striis tribus abbreviatis marginalibus et striis aliis 4 lateraliter continuantibus, lamina laterali perparva, area postlaminari convexiuscula striis 7 instructa. Segmentum secundum lateribus aliquantum angustatis, praeter striam postmarginalem striis duabus instructis; segmenta sequentia lateribus ut eadem tergiti secundi striata angulo antico rotundato, angulo postico gradatim rotundato, subrecto et in segmentis VIII-X acuto; tergitum ultimum margine postico latissime rotundato medio vix sinuato, lateribus interne haud carinatis.

Pedes (Fig. XXX, 4) articuli primi angulo infero externo parum acute vel subacute (interdum anormaliter rotundatim) infra aliquantum producto, spinis vide figuram.

Long. corp. mm. 20, lat. 11, long. antennarum 5, pedum paris decimi 6·5.

Habitat. Tonkin: Montes Mauson, 2-3000 ft. alt. s/m.

Observatio. Species haec magnitudine et colore et antennarum forma a *Rhopalomeris carnifex*, Poc. distincta est.

Subgen. **Peplomeris**, nov.

Caput quam collum haud latius, antennis articulo septimo brevi, subcirculari, conis sensitivis apicalibus sat numerosis instructis. Collum pone marginem anticum striis transversalibus duabus instructum.

Truncus. Tergitum primum et secundum ut in gen. *Apiomeris*; tergitum ultimum margine postico medio paullum sinuato instructum et supra sinum aliquantum depressum.

Pedes paris 17^i et 18^i quam ceteri minores, articulo primo ab opposito sejuncto; pedes paris 19^i 4-articulati, articulo primo processu apicali interno brevi conico, articulo secundo processu triangulari postico interno, articulo tertio processu postico brevi instructis.

Typus : *Peplomeris demangei*, sp. n.

Observatio. Subgenus hoc a *Rhopalomeris* (*s.s.*) maris tergiti ultimi forma nec non ejusdem pedibus paris 19^i facile distinguendum est.

Peplomeris demangei, sp. n.

♂ Corpus fuscum colli margine postico et trunci tergitorum omnium margine postico, margine laterali infero, tergitorum 1-10 macula mediana postica triangulari et macula submediana antica, tergiti ultimi macula mediana postica isabellinis, ventre pedibusque etiam isabellinis.

Caput media fronte convexiuscula postice vix carinata, oculis ocellis 7+1 compositis, antennis (Fig. XXXI, 1) articulo sexto apicem versus gradatim parum latiore, duplo longiore quam latiore, articulo septimo brevissimo, conis sensitivis apicalibus sat numerosis (*c.* 15) et sat longis. Collum pone marginem anticum striis transversis duabus instructum.

Truncus. Tergitum primum (Fig. XXXI, 2) area mediana antica striis tribus anticis abbreviatis et striis aliis 7+8 superis lateraliter continuantibus vel nonnullis posticis inter sese confluentibus, margine antico sublaterali late rotundato, lamina antica perparva, area postlaminari convexiuscula striis 8-9 instructa. Tergitum secundum (Fig. XXXI, 3) et tergita sequentia lateribus angustatis, praeter striam postmarginalem, striis duabus aliis abbreviatis vel integris instructis; tergitum sextum angulo postico subrecto; tergita cetera angulo postico parum subacute producto; tergitum ultimum (Fig. XXXI, 4) parum longe a basi transverse depressum, margine infero medium paullum sinuato, ad [illegible]i latera rotundatim paullum producto et supra sinum aliquantum depressum.

Pedes (Fig. XXXI, 5) articuli primi angulo infero laterali obtuso rotundato, articuli sexti spinis vide figuram.

Pedes paris 17^i, 18^i et 19^i vide fig. XXXI, 6-10.

Long. corp. mm. 11, lat. 5, long. antennarum 2·5, pedum paris decimi 3·5.

Habitat. Tonkin: Hanoi (*v. Demange* legit).

Gen. **Hyperglomeris**, nov.

Caput (Fig. XXXII, 1-2) quam collum parum latius, epicranio lateraliter mandibularum stipites spatio sat magno superante, oculis ocellorum serie arcuata et ocello alio compositis, Tömösvaryi organum bene evolutum, antennis conis sensitivis apicalibus 4 instructis. Collum pone marginem anticum striis tribus parallelis et aliis minoribus exaratum.

Truncus. Tergitum primum incisura postico-laterali modice profunda ita ut pars praeincisuralis quam supraincisuralis longior sit, superficie praeincisurali striis numerosis exarata, lamina antica fere ut superficies cetera subperpendiculari (haud introrsum vergente); tergitum secundum lateribus modice angustatis, rotundatis stria integra instructis; tergitum ultimum margine postico late rotundato, lateribus interne parum supra basim carinatis

♂ Tergitum ultimum margine postico medio vix sinuato.

Pedes paris 17^i et 18^i 5-articulati, articulo primo ab opposito sejuncto; pedes paris 19^i 4-articulati, articulo primo processu subconico apicali, antico interno, articulo secundo pro processu apicali antico interno tantum seta brevi instructo et processu postico interno longo, articulo tertio processu apicali postico interno et processu postico brevibus.

Typus: *Heperglomeris lamellosa*, sp. n.

Observatio. Genus hoc ab *Apiomeris*, O. F. Cook, colli et trunci tergiti primi striis magis numerosis, tergiti primi lamella magis evoluta et praesertim capite latiore et tergitum ultimum interne lateraliter carinatum distinctissimum est.

Hyperglomeris lamellosa, sp. n.

Corpus nigrescens, colli margine postico, trunci tergiti primi marginibus antico laterali et laterali spatio latiusculo, margine postico spatio angustiore, tergitorum sequentium margine postico spatio angustiore et parte laterali inferiore spatio latiusculo ochroleucis nec non tergitis II-X macula antica sublaterali brunnea nigro marmorata plus minusve manifesta, antennis atris, ventre pedibusque plus minusve pallide ochroleucis.

Caput ocellis 8+1, antennis (Fig. XXXIII, 1) elongatis, articulo sexto parum magis quam duplo longiore quam latiore, articulo septimo brevi, conis sensitivis apicalibus 4. Collum striis tribus transversis parallelis integris et pone has stria alia transversa integra vel subintegra et striis aliis minoribus abbreviatis irregularibus fere usque ad marginem posticum instructum.

Truncus. Tergitum primum (Fig. XXXIII, 2) area mediana antica striis abbreviatis 3 et striis aliis numerosis crebris transversis usque fere ad medium segmentum pertinentibus, anticis 4-5 integris, ceteris plus minusve divisis et gradatim minus profundis, lamina antica laterali magna (majore quam in Glomeridarum speciebus hucusque mihi notis) aliquantum concava, margine late rotundato et extrorsum parum vergente, area postlaminari parum convexa striis *c.* 12-15 instructa. Tergitum secundum (Fig. XXXIII, 3) lateribus angustatis praeter striam postmarginalem striis aliis duabus, infra et praesertim postice in striis minoribus divisis, media superficie dorsuali postica vix carinata, tergita cetera medio dorso vix carinulato, striis secundo similia, angulo antico laterali rotundato, postico subacuto, gradatim retrorsum parum magis producto. Tergitum ultimum postice late rotundatum margine medio vix depresso et vix sinuato, lateribus interne carina longa robusta auctis.

Pedes (Fig. XXXIII, 4) articuli primi angulo infero externo lato, laminari infra rotundatim parum producto, articulo sexto infra spinis numerosis brevibus, robustis et supra spinis sat numerosis instructo, ungue sat longo, attenuato, parum arcuato.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XXXIII, 5-10.

Long. coip. mm. 21, lat. 11, long. antennarum 6, pedum paris decimi 6·2.

Habitat. Tonkin: Montes Mauson, 2-3,000 ft. alt. s/m (*H. Fruhstorfer* legit).

Gen. **Dinoglomeris**, nov.

Caput (Fig. XXXIV, 1-2) quam collum haud latius, epicranio lateraliter mandibularum stipites spatio minimo superante, notis ceteris ut in *Hyperglomeris.*

Trunci tergitum primum lamina laterali magna, haud perpendiculari ut superficies cetera, sed introrsum directa ita ut facies lateralis antica sit; tergitum secundum et ultimum ut in *Hyperglomeris.*

Tergitum ultimum margine postico medio haud sinuato.

Pedes paris 19^i ab iisdem generis *Hyperglomeris* articulo secundo processu brevi apicali antico interno instructo differunt.

Typus : *Dinoglomeris dirupta*, sp. n.

Observatio. Genus hoc ab *Hyperglomeris* capite quam collum haud latiore, trunci segmenti secundi laminae anticae forma differt.

Dinoglomeris dirupta, sp. n.

Corpus atrum vel nigrescens isabellino vel fulvo-ochraceo, antice parum postice magis, marmoratum, ventre pedibusque alutaceis.

Caput ocellis 8+1 (in exemplo uno oculo altero ocellis 9+1), antennis (Fig. XXXV, 1) elongatis, articulo sexto aliquantum magis quam duplo longiore quam latiore, articulo septimo brevi, conis sensitivis apicalibus 4. Collum pone marginem anticum lineis transversis tribus parallelis et pone lineam tertiam lineis aliis 1-2 medio collo in ramis minoribus plus minusve numerosis usque ad brevem spatium longe a margine postico divisis.

Truncus. Tergitum primum (Fig. XXXV, 2-3) valde singulare, area antica mediana striis tribus anticis abbreviatis et striis 5-6 integris vel subintegris et striis aliis numerosis crebris subtilioribus, divisis et confluentibus usque ad segmentum medium pertinentibus, lamina laterali magna, laevi, introrsum vergente, ita ut superficies lateralis antica sit, area postlaminari striis *c.* 16 instructa. Tergitum ultimum breve, latum, medium transverse parum sinuatum, parte postica aliquantum declive, margine postico late rotundato, lateribus interne carina longa auctis.

Pedes (Fig. XXXV, 4) articuli primi angulo infero externo in processum conicum sat longum infra producto [in pede nonnullo processu dictu interdum plus minusve abbreviato vel abnormaliter (Fig. XXXV, 5) conformato] articulo sexto spinis vide figuram.

♂ Pedes paris 17^i, 18^i et 19^i vide fig. XXXV, 6-11.

Long. corp. mm. 22, lat. 12, long. antennarum 6, pedum paris decimi 7.

Juvenis. Corpus nigrescens ochraceo multo marmoratum, ventre pedibusque ochroleucis; oculi ocellis 6+1 vel 5+1. Collum pone marginem lineis tribus parallelis instructum.

Truncus. Tergitum primum eidem adulti simile est; tergitum ultimum transverse haud sinuatum.

Long. corp. mm. 10, lat. 5·8.

Habitat. Tonkin: Montes Mauson, 2-300 ft. alt. s/m (*H. Fruhstorfer* legit).

CATALOGUS GLOMERIDARUM ORIENTALIUM HUCUSQUE DESCRIPTARUM.

Gen. *Apiomeris*, O. F. Cook.

Brandtia X, p. 45 (1896).

Subgen. *Hyleoglomeris*, Verh.

Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 245; Silvestri, *Ibi*, p. 107.

albicornis, Pocock, Max Weber's, *Zool. Ergeb. Reise Niederl. Ost.-Ind.* III, 1894, p. 323 (*Glomeris*).	Sumatra.
alticola, Carl, *Revue suisse Zool.* XX, 1912, p. 103 (*Nesoglomeris*).	Celebes.
atricornis, Silvestri, *Ibi*, p. 113	Borneo.
beccarii, Silvestri, *Ibi*, p. 129	Sumatra.
concolor, Pocock, *Ann. Nat. Hist.* 1889, p. 474 (*Glomeris*).	Borneo.
crebristriata, Silvestri, *Ibi*, p. 108	Borneo.
diversicolor, Silvestri, *Ann. Mus. Genova* (2) XIV, 1895, p. 721 (*Glomeris*); *Id.*, *Ibi*, p. 128.	Sumatra.
electa, Silvestri, *Ibi*, p. 119	India.
eremita, Carl, *Revue suisse Zool.* XX, 1912, p. 102 (*Nesoglomeris*).	Celebes.
formosa, Silvestri, *Ann. Mus. Genova* (2) XIV, 1895, p. 720 (*Glomeris*); *Id*, *Ibi*, p. 125.	Sumatra.
jacobsoni, Silvestri, *Ibi*, p. 122	Java.
kirropeza, Attem, *Abh. Senckenb. naturf. Ges.* XXIII, 1897, p. 480 (*Glomeris*); Carl, *Revue suisse Zool* XX, 1912, p. 102 (*Nesoglomeris*).	Celebes.
modesta, Silvestri, *Ibi*, p. 121	India.

modiglianii, Silvestri, *Ann. Mus. Genova* (2) XIV, 1895, p. 720 (*Glomeris*); *Id.*, *Ibi*, p. 123. — Nias.
multilineata, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 248, taf. ix, abb. 1-2; Silvestri, *Ibi*, p. 107. — Borneo.
minuta, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 248, taf. ix, abb. 3-4; Silvestri, *Ibi*, p. 115. — Borneo.
paucilineata, Silvestri, *Ibi*, p. 115 .. .. Borneo.
sarasinorum, Carl, *Revue suisse Zool.* XX, 1912, p. 101, taf. vi, fig. 36 (*Nesoglomeris*). — Celebes.
siamensis, Silvestri, *Ibi*, p. 116 .. .. Siam.
venustula, Silvestri, *Ibi*, p. 117.. .. .. India.
zonifera, Silvestri, *Ibi*, p. 111 .. .. .. Borneo.

Subgen. *Apheromeris*, Silv.

Silvestri, *Ibi*, p. 130.

partialis, Silvestri, *Ibi*, p. 131 .. .. .. Java.
parvella, Silvestri, *Ibi*, p. 134 .. .. .. Java.
totalis, Silvestri, *Ibi*, p. 132 .. .. .. Java.

Subgen. *Apiomeris* (*s.s.*), O. F. Cook.

Brandtia X, p. 45 (1896); Silvestri, *Ibi*, p. 136.

infuscata, Pocock, Max Weber's *Zool. Ergeb. Reise Niederl.Ost.-Ind.* III, 1894, p. 324, pl. xix, fig. 10-10b (*Glomeris*); O. F. Cook, *Brandtia* X, p. 44 (1896); Silvestri, *Ibi*, p. 136. — Sumatra.

Subgen. *Malayomeris*, Verh.

Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 243, taf. ix, abb. 5-7; Silvestri, *Ibi*, p. 138.

martensi, Verhoeff, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 244, taf. ix, abb. 5-7 (*Malayomeris*); Silvestri, *Ibi*, p. 139. — Sumatra

Gen. *Rhopalomeris*, Verh.

Glomeris, Pocock, *Journ. Linn. Soc.* XXI, 1887, p. 290; *Idem*, *Ann. Mus. Genova* (2) X, 1890, p. 385; *Rhopalomeris*, Verhoeff, *Archiv f. Naturg.* LXXII, 1906, p. 188; *Id.*, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 241, taf. ix, abb. 8-9; Silvestri, *Ibi*, p. 140.

Subgenus *Rhopalomeris*, Verh.

carnifex, Pocock, *Journ Linn. Soc.* XXI, 1889, p. 290 et 301 (*Glomeris*); *Id.*, *Ann. Mus. Genova* (2) X, 1890, p. 385 (*Glomeris*); Silvestri, *Ibi*, p. 142. — Burma.

carnifex v. *pallida*, Pocock, *Journ Linn. Soc. Zool.* XXI, 1887, pp. 290 et 300, pl. xxiv, figs. 7, 7*a* (*Glomeris*); *bicolor*, Verhoeff (nec Wood), *Arch. f. Naturg.* LXXII, 1906, p. 189; *Id.*, *Sitz. Ber. Ges. nat. Freunde* 1910, p. 241, taf. ix, abb. 8-9; Silvestri, *Ibi*, p. 143.	Ins. Elphinstone et Ins. Salanga.
monacha, Silvestri, *Ibi*, p. 143	Perak.
tonkinensis, Silvestri, *Ibi*, p. 144	Tonkin.

Subgen. *Peplomeris*, Silv.

Silvestri, *Ibi*, p. 144.

demangei, Silvestri, *Ibi*, p. 145	Tonkin.

Gen. *Hyperglomeris*, Silv.

Silvestri, *Ibi*, p. 145.

lamellosa, Silvestri, *Ibi*, p. 146	Tonkin.

Gen. *Dinoglomeris*, Silv.

Silvestri, *Ibi*, p. 147.

dirupta, Silvestri, *Ibi*, p. 147	Tonkin.

Gen. *Glomeris*, Latr.

=in p. Gen. *Apiomeris* et *Rhopalomeris*.

albicornis, Pocock, =*Apiomeris* (*Hyleoglomeris*) *albicornis*	
bicolor, Wood, *Proc. Acad. Nat. Sci. Philad.* 1865, p. 172=?	China.
carnifex, Pocock=*Rhopalomeris carnifex*.	
carnifex v. *pallida*, Pocock=*Rhopalomeris carnifex* v. *pallida*.	
concolor. Pocock=*Apiomeris* (*Hyleoglomeris*) *concolor*.	
diversicolor, Silv.=*Apiomeris* (*Hyleoglomeris*) *diversicolor*.	
formosa, Silv.=*Apiomeris* (*Hyleoglomeris*) *formosa*.	
infuscata, Pocock=*Apiomeris* (s.s.) *infuscata*.	
kirropeza, Attems=?*Apiomeris* (*Hyleoglomeris*) *kirropeza*.	
modiglianii, Silv.= *Apiomeris* (*Hyleoglomeris*) *modiglianii*.	
sinensis, Brolemann, *Mem. Soc. Zool France* IX, 1896, pl. xiii, fig. 19-22= ?	Tibet et China.

Gen. *Malayomeris*, Verh.

=Gen. *Apiomeris*, subgen. *Malayomeris*, Verh.

martensi, Verh.=*Apiomeris* (*Malayomeris*) *martensi*.

Gen. *Nesoglomeris*, Carl.

=Gen. *Apiomeris*, subgen. *Hyleoglomeris*, Verh.

alticola, Carl=*Apiomeris* (*Hyleoglomeris*) *alticola*.
eremita, Carl=*Apiomeris* (*Hyleoglomeris*) *eremita*.
sarasinorum, Carl=*Apiomeris* (*Hyleoglomeris*) *sarasinorum*.

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X. A REVISION OF THE INDIAN SPECIES OF *MERETRIX*.

By JAMES HORNELL, *Marine Biologist to the Government of Madras.*

(Plates IV-VII.)

PRELIMINARY.

The genus *Meretrix* was split off from *Cytherea* to accommodate a number of strongly marked species distinguished characteristically by the possession of an elongate and finely striate (or granulate) posterior lateral tooth—the nympha of older writers—in each valve. They frequent estuaries and none of those found on the coasts of Continental India live beyond the influence of land drainage; they have about an equal tolerance with the backwater oyster (*Ostrea virginiana*) for an occasional declension in the salinity of the water of their habitat. They can also endure considerable increase in salinity. This tolerance is of limited time-duration in both cases. Within my knowledge both of the common species can survive, at least for some days, a lowering of salinity to 1·010 S.G. and again can endure a concentration during the dry season that may reach as high as 1·030 S.G. How long such extremes can be borne we do not know, but it appears certain that vitality is lowered in either case and if the abnormal conditions be not modified within a certain period, widespread death supervenes in the beds. The optimum range of salinity favoured ranges from 1·025 to 1·027 S.G.

My attention was directed to this genus during an investigation of Indian mollusca of economic value; the examination of large numbers of these shells showed that great variation exists and when attempting to identify the various forms it became apparent that this liability to vary widely, both in form and colouration, has resulted in great taxonomic confusion and the undue multiplication of species. Examination of the Indian Museum collections, kindly placed at my disposal by Dr. Annandale, emphasized the need for a revision of Indian species and the consideration of what value and limits should be placed upon the many variations which obviously exist.

The material which has furnished the data for this revision was derived in the main from the shell collections in the Indian Museum, especially that obtained during the zoological survey of the Chilka Lake, and from extensive collections which I have made specially for this enquiry at Sonapur (Ganjam district), Pulicat Lake, Palk Bay, Tuticorin, and the Tambraparni delta, and from the prolific backwaters of the Malabar district where these shells flourish in greatest abundance.

The chief conclusions at which I have arrived are that no multiplicity of species exists; that there are indeed only three really good species of *Meretrix* living in the waters of Continental India, namely *M. meretrix*, *M. attenuata*, and *M. casta*, and that while the two former exhibit great variation in colouration, they are remarkably stable in size and shape when mature, whereas the third species exhibits a marked susceptibility to the influence of environmental conditions, resulting in the production of numerous varieties and local races. The conditions in east coast backwaters being very different from those on the west coast, it results that the main varieties of *M. casta* are similarly divergent, those of the east coast being usually true to the type within narrow limits, whereas those of the west coast, even when living within the same estuary, may exhibit as many as three well-marked variations, connected by a host of intermediate forms, merging so insensibly into one another that it is practically impossible definitely to allocate many to one particular group.

Another notable fact brought out is the peculiar *discontinuity of distribution* shown by one of the species (*M. attenuata*) and by one variety of another (*M. casta* var. *ovum*). The former is known only from specimens from the Nicobar Islands and from Gwadar, on the Baluchistan coast; whereas in the case of *M. casta ovum*, we find it (*a*) widely distributed in the backwaters of the west coast of India, and (*b*) on the west coast of the Malay Peninsula and in Arakan. What may be the explanation in the case of *M. attenuata* we cannot at present say: possibly it is a decadent form once more widely distributed; if so, palaeontology may be able to assist. With regard to *M. casta ovum* the similarity of climatic and physical conditions between the west coasts of India and the Malay Peninsula probably supplies the reason. Between these two localities lies the east coast of India, an area differing greatly in climate, particularly in rainfall, from either of the other two. Hence I believe that the formation of the varietal form is due to the influence of divergent environment. That in two widely separated localities, having however similar physical features and climate, a parallelism of form should be maintained by the variety is significant, and seems to be an instance where the influence of similar environment in the production of identical varieties is indicated.

The following key to the Indian species and varieties summarises my conclusions:—

GENUS *MERETRIX*.

1. *Pallial sinus very shallow and without an acutely projecting ventral horn.*

A. Anterior cardinal tooth of left valve distinctly notched; size of shell large, usually attaining over 60 mm. in antero-posterior length.

	Species.	Characteristics.	Sections.
Valves trigono-sub-orbicular.	*Meretrix meretrix* (Linn.)	Valves with or without obscure and discontinuous broad rays; vulva obscure, margin indefinite.	1. Type.
		Valves without rays; vulva dark, very conspicuous, with clean-cut margin.	2. Var. *impudica* (Chemnitz).
		Colour uniform chestnut... ...	3. Var. *castanea* (Lamarck).
		Valves rayed with *numerous* continuous bands of dark colour, some broad, others narrow.	4. Var. *aurora*, var. nov.
		Valves rayed with *two* wide brown bands, often incomplete.	5. Var. *morphina* (Lamarck).
		Valves concentrically zoned either with solid or with zig-zag chevron-shaped dark bands.	6. Var. *zonaria* (Lamarck).

B. Anterior cardinal tooth in left valve entire; length of shell usually less than 50 mm.

Valves usually trigono-cordate; sometimes ovate to oblong.	*M. casta* (Chem.)	Shells large and ventricose, cordate; without colour bands, except rarely upon the umbones.	1. Type.
		Shell ovate to oblong with or without two obscure and often imperfect radial bands; hinges elongate; umbones nearly medium, curved straight inwards, usually eroded.	2. Var. *ovum* (Hanley).
		Shell corbiculiform; extremely thick; hinge short; teeth very stout. Subfossil only.	3. Var. *satparaënsis* (Preston).

II. *Pallial sinus deep, almost semi-circular, with a ventral horn ending in an acute point.*

Valves sub-cuneate.	*M. attenuata*, Dunker.	Shell concentrically zoned with chevron-shaped markings.	1. Type.
		Shell unicoloured, except occasionally on the umbones.	2. Var. *flava*, var. nov.

1. Meretrix meretrix (Linn.).

1758. *Venus meretrix*, Linn., *Syst. Nat.*, 10th ed., p. 686.
1782. ,, ,, seu *impudica*, Chemnitz, *Conch. Cab.*, Vol. VI, pl 33.
1835. *Cytherea meretrix*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 300.
1835. ,, *impudica*, Lamarck, *ibid.*, p. 299.
,, ,, *castanea*, Lamarck, *ibid.*, p. 299.
,, ,, *zonaria*, Lamarck, *ibid.*, p. 299.
.. ,, *graphica*, Lamarck, *ibid.*, p. 300.
,, ,, *morphina*, Lamarck, *ibid.*, p. 300.
1864. ,, *graphica*, *castanea*, *zonaria*, *impudica*, and *morphina*, Reeve, *Conch. Icon.*, XIV, *Cytherea*, figs. 1, 6, 9, 10 and 12.
1869. *Meretrix meretrix*, Römer, *Monographie der Molluskengattung Venus, Linne*, Band I, Sub-genus *Cytherea*, p. 27, pl. viii, all figs.
1915. ,, *casta*, Preston (in part), *Rec. Ind. Mus.*, Vol. XI, p. 300.
,, ,, *ovum*, Preston, *ibid.*, p. 300.
1916. ,, *meretrix*, Annandale and Kemp, *Mem. Ind. Mus.* Vol. V, p. 351.
1916. ,, *ovum*, Annandale and Kemp, *ibid.*, p. 352.

This species is easily distinguished from *M. casta* and its varieties by the greater superficial dimensions of its valves when fully grown, by its less ventricose and more compressed form, particularly marked in young specimens, and by the delicacy and comparative weakness of the hinge region. Apart from these differences, an unfailing distinction is found in the form of the anterior cardinal tooth of the left valve. In *M. meretrix* this tooth has the summit distinctly notched, recalling in some degree the bifid form characteristic of *Tapes*; in *M. casta* it is invariably entire. Apart from colouration, this species is remarkably stable in form and general proportions; how it could be confounded with *M. casta* and *M. casta satparaënsis* by Preston is difficult to understand. That it was, is shown by reference to the specimens identified by this authority now in the Calcutta Museum and by reference to the article cited above, where Preston gives the size of one individual as 73 × 67 mm., a size never attained by *M. casta*, whereas these are the normal adult dimensions in the case of *M. meretrix*.

Outline and size of the valves. The valves are sub-trigonal and vary from a broadly cordate to a sub-orbicular form, the anterior angle being always well-rounded while the posterior is distinctly but bluntly angular. It is exceedingly difficult to describe in words the form of the shell in the different species and varieties of this genus sufficiently clearly to convey an adequate comprehension of the differences between them. Hence reference must be made to the figures which accompany this note. The dimensions of the shell attained by *M. meretrix* when fully grown are remarkably constant; the largest noted (Tuticorin) is $77 \times 65 \times 42\frac{1}{2}$ mm. thick; others from the same locality measure $77 \times 64 \times 41$ mm. thick and $74 \times 65 \times 40$ mm., while three from the outer channel of the Chilka Lake measured respectively 73×67 mm. (M. 9582/2), $68 \times 60\frac{1}{2} \times 42$ mm. (M. 9762/2), and $65 \times 58 \times 40\frac{1}{2}$ mm. (M. 9763/2). The average of size at full maturity for the valves appears to range from 58 to 60 mm. in depth by 65 to 70 mm. in length. Shells of these dimensions are those most commonly found when collecting; the animal at this size has reached its limit of growth and this again coincides closely with the age-limit of its life. Having spawned after attaining this size, its vitality appears to ebb and I have noted the death of large numbers at Tuticorin after the September spawning; during October the sand flats in the lagoon are thickly dotted with dead and gaping shells of full-grown size. It is noteworthy that small and medium-sized dead shells are conspicuous by their absence, although living individuals are present in their usual numerical proportion beneath the surface of the sands. The average ratios between length, depth and thickness as deduced from the average of 20 large and medium-sized individuals from 8 localities is 100 to 85·56 (depth) and 57·89 (thickness).

Colour varieties. Of the various colour varieties, the three principal (apart from the type), *viz. impudica*, *castanea* and *aurora*, are all of very definite and stable colouration, and so well defined in their respective markings that unless one has opportunity to examine a large number of individuals from one locality where the various colour forms are present, it can readily be understood how Lamarck and others came to make separate species of simple colour varieties. As long ago as 1835, Deshayes and Milne-Edwards pointed out that Lamarck was in error in doing so in regard to what are merely colour varieties of the large species of *Meretrix* which Linnaeus termed *Venus meretrix*. They pointed out that in any extensive collection of the large species of *Meretrix* gradations can be readily traced between Lamarck's species. To quote their own words :—

" On nous demandera sans doute sur quoi nous nous fondons pour faire de tels changements, et nous répondrons sur l'observation : en examinant en effet un grand nombre d'individus parmi lesquels se trouvent toutes ces espèces de Lamarck, nous avons trouvé à la charnière et l'impression palléale des caractères spécifiques constants, et de plus nous avons vu de nombreux passages entre les variétés. Dans quelques individus, nous avons même observé sur une seule coquille les dispositions de couleurs d'après lesquelles Lamarck avait fait deux espèces."

This conclusion is undoubtedly correct for even in the case of var. *impudica*, where in the vast majority of cases there is no difficulty in separating at a glance this variety from the type, there are occasional individuals where an intermingling of the colour designs proper to *impudica* and the type bridges the gap ; others show hybrid markings connecting with varieties *morphina* and *zonaria*.

The least emphatic of the colour varieties is that which I term *morphina*. Occasionally a shell well-marked with two distinct rays is found, but the variety has none of the stability of *impudica* and *aurora* and gradations to the type and to the var. *impudica* are so frequently met with that it scarcely deserves to be treated separately ; true *zonaria* is seldom seen in specimens from any Indian locality, but among immature shells of var. *impudica*, individuals are often to be found with well-zoned bands coinciding with Lamarck's description and the figures by Römer and by Reeve of *Cytherea zonaria* ; Lamarck's var. *graphica* is also very rare in India and may, I consider, be fused with *M. zonaria*.

Habitat and distribution. *M. meretrix* has a restricted and most definite habitat. It is purely an estuarine and backwater species, never found to my knowledge in the open sea. Its home is in the sands adjacent to the main channels leading from backwaters to the sea. It lies buried in a shallow burrow or pit with only the extreme posterior point projecting above the surface when the tide is in, covering these sand flats. At low tide when the sands are uncovered it withdraws entirely below the surface and is then most difficult to locate.

When young this *Meretrix* is extremely active, preferring to live in estuarine sands swept by rapid currents. The foot is large and very muscular ; by a variety of movements it is able to make its way rapidly over or through the sand and so is able to recover its position and foothold whenever dislodged from its temporary burrow. Its favourite mode of progression is to protrude the foot considerably, bend it into a deep curve with the point pressed against the sand close to the shell, then by suddenly straightening the foot the shell is jerked in the opposite direction. By a variation of the movement it can also throw its shell over upon the opposite valve.

With increase of size, individuals gradually move to more sheltered sands and become sluggish and sedentary in their habits.

Spawning occurs about the beginning of September at Tuticorin; probably also about May.

It is common in the outer channel of the Chilka Lake, in the Cuddalore estuary (S. Arcot), at the entrance to the Silavathurai Lagoon, Tuticorin, in the delta of the Tambraparni, and near the mouth of the river at Tellicherry in Malabar. I have also collected it in the sub-fossil condition from shell-pits in the Surla swamps of the Sonapur backwater, Ganjam, and from the subfossil shell strata at Korampalam, Tuticorin; there is little doubt that it lives at the mouths of the majority of estuaries and backwaters in Southern India. The type form and the variety *impudica*, both pale in colouring, are about equally common at Chilka and Tuticorin, *i.e.* on the East Coast. In the Tellicherry river the dark-coloured heavy-rayed variety *aurora* is the only form seen.

In addition to the foregoing, numerous examples of this shell from other localities are present in the Indian Museum collections submitted to me for identification; the particulars are as follows:—

Tavoy Coast, Burma (M. 398). 11 shells, comprising 6 of the type, 1 of var. *impudica*, 1 var. *castanea*, 2 var. *zonaria* and 1 var. *morphina*.
Malacca (M. 10487/2). All of type form.
Arakan (M. 10851/2 and M. 10855/2). 5 of var. *impudica*, and 1 small one of type form.
False Point, Orissa (M. 10845/2). 2 small specimens.
Trincomalie, Ceylon (M. 10842/2). 5 of var. *castanea*, 1 of var. *impudica*.
(?) Andamans (M. 10858/2). One fine example of var. *impudica*. There appears to be some doubt as to the origin of this shell as this is queried upon the label.
Bombay (M. 10836/2). 5 shells comprising 3 of var. *impudica*, 1 of var. *castanea*, and 1 of the type form.

(*a*) Type.

(Plate V, fig. 13.)

1835. *Cytherea meretrix*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 300.

By removal of all forms distinctively or peculiarly coloured, we get a numerous residue which may be considered as representing the generalised central form, the type assemblage of the species. When the periostracum is present, the ground colour varies usually from a pale to a dark grey; frequently as at Chilka Lake it is of a pale straw colour, at others a light rufous yellow. This general colour is modified considerably in the majority of individuals by raying, zoning and staining upon the shell substance in the umbonar region, and by a more or less extensive and well-defined dark area on the upper posterior portion of the shell, where it often forms a lanceolate blotch termed the vulva by Lamarck. The colour of this area varies from a dark cloudy olivaceous brown to a livid purplish brown, exhibiting much variation in tint and in intensity. In all cases in the type the edges of this patch are indefinite, merging insensibly into the adjacent ground colour, which is usually rather darker than the remainder of the shell.

In many individuals the umbones are minutely spotted with pale brown, seen only with the aid of a hand lens. There may also be concurrently a couple of narrow divergent and usually discontinuous brownish rays. These are sometimes well defined and conspicuous and may be composed of short straight bars or of minute chevrons. This umbonar raying seldom extends further than half an inch from the hinge; beyond that distance the raying either disappears, or in colour variety *morphina* is continued as two dull and usually diffuse broad bands, having the appearance of a stain within the substance of the shell, rather than surface markings as in the case of the colouring upon the umbones. These distal bands are most variable; sometimes they form two broad fairly well-defined bands reaching to the ventral margin; more frequently they are discontinuous and form blotches having only a vague radial arrangement; often they are entirely wanting.

In yet another series of colour variations there is distinct concentric zoning of the umbonar region. This may or may not occur in individuals with spotted and rayed umbones; there is infinite variety in these combinations. The zones are usually formed by the alternation of very narrow chestnut or livid tinted zones with grey or yellowish ones.

Römer was of opinion that Lamarck's *C. impudica*, as represented by the form shown in Römer's figs. 1-1c, pl. viii, of a pale coloured shell with a dark vulva *having sharply defined margin* and without decorated umbones, should be regarded as the true colour type of Linnaeus' *Venus meretrix*. He considered Lamarck's *C. meretrix* to be a closely connected variation of the type. Taking Römer's pale type and Reeve's *C. impudica* (*loc. cit.* fig. 10, pl. iii) with similar vulva and bold chevron-shaped umbonar markings as representing two colour designs common to the form, Römer claims these to connote the central or true type. I am convinced after examining several hundred specimens that this view is incorrect. By far the greater number, usually slightly over 50 per cent. (*cf.* next paragraph), are of quite different colour scheme, characterized by a pale indefinite tint with dark vulva *fading gradually at its margin into the ground colour* and with the umbones generally minutely dotted with brownish yellow; the variety coloured as in Reeve's figure of *C. impudica* is much less numerous, averaging not more than 25 per cent. of the total number. Hence it is more reasonable and convenient to constitute the former group as the type and the latter as a variety, especially as there is nothing in Lamarck's description to contradict this. Further, Römer's figs. 1 to 1*b*, pl. viii are not even typical of the *impudica* variety in India, although they agree exactly with Lamarck's description. They evidently represent a pale and comparatively rare variation of the true *impudica* of which Reeve's figure, though coarse, is a better rendering.

The type form is particularly plentiful in the Tuticorin lagoon. Out of 117 adult individuals examined therefrom, 65 belong to this group, 22 to the closely related var. *morphina*, while 29 belong to variety *impudica*, one only to variety *castanea* and none to var. *aurora*; while of 32 large specimens from the Tambraparni delta, exactly half belonged to the type form with 8 to *morphina* and 8 to *impudica*. Among 17 from the Chilka Lake, the majority (9) were of the *impudica* variety, and only 4 out of the whole lot were of the type form. The four remaining Chilka individuals consisted of two var. *morphina*, one most typical and very beautifully rayed, the other obscurely rayed, and of two bridging the differences between varieties *impudica* and *morphina*; both showed the typical sharply defined *impudica* vulva, together with two well-marked radial bands of the *morphina* type. A notable feature among the Chilka and Tuticorin shells is the frequency with which the *impudica* variety shows conspicuous chevron-shaped markings, boldly painted on the umbonar region as shown in plate vii, fig. 39. Also from Arakan, Tavoy (Burma), Malacca, and Bombay.

Of the shells from Tellicherry and Trincomalie, none belonged to the type, all being variety *aurora* in the former case and chiefly to *castanea* in the latter.

(*b*) Variety **impudica** (Chemnitz).

(Plate V, figs. 14-18; plate VII, figs. 39 and 40.)

1782. *Venus meretrix* seu *impudica*, Chemnitz, *Conch. Cab.*, Vol. VI, pl. 33.
1835. *Cytherea impudica*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 299.
1861. ,, ,, Reeve, *Conch. Icon.*, XIV, *Cytherea*, pl. iii, fig. 10.
1915. *Meretrix ovum*, Preston, *Rec. Ind. Mus.*, Vol. XI, p 300.
1916. *Meretrix ovum*, Annandale and Kemp, *Mem. Ind. Mus.*, Vol. V, p. 350.

This is the variety by far the most abundant on the coasts of India. The periostracum is normally a pale grey colour, rarely pale cream or yellow; when removed, the shell appears porcelain white, except in the postero-dorsal region where the dark coloured lanceolate area, the vulva, occurs. This varies from very deep blackish brown to a more frequent bluish grey of varying intensity. Although albino individuals devoid of vulva and of umbonar marks are sometimes met with in the Chilka Lake, normally the vulva is well marked *with sharply defined margin*. The great majority of individuals show considerable decoration of the umbones; this most frequently takes the form of conspicuous chevron-shaped markings either arranged in zonar manner or limited to two short radial lines. These markings are much more conspicuous in *impudica* than are the umbonar dots and rayed marks of the type. Fig. 39 shows a well-marked example of the zone pattern, while in fig. 18 we have a rare combination of the *impudica* colour scheme of clearly defined vulva with the discontinuous rayed blotching seen frequently in var. *morphina*. Young individuals of 15 to 18 mm. in length are frequently much decorated with dark chevron markings, such as are depicted in figs. 14 to 17, pl. V. Such conspicuously marked individuals are common in the outer channel of the Chilka Lake. They were incorrectly identified as *M. ovum* by Preston.

Localities.—Common in the outer channel, Chilka Lake (*Annandale* and *Kemp*); in the sands immediately within the mouth of Silavathurai lagoon, Tuticorin, and in the delta of the Tambraparni, Tinnevelly district (*J. H.*). A sub-fossil valve from Surla shell-pits, Ganjam. Also Tavoy (Burma), Arakan, Trincomalie (Ceylon), Bombay and ? Andaman Islands; all in the Indian Museum collection.

Dimensions.—The largest Chilka specimen measures $65 \times 57\frac{1}{4} \times 40$ mm., while the largest of the Tuticorin ones is $74 \times 64 \times 40$ mm.

(*c*) Variety **castanea** (Lamarck).

(Plate IV, fig. 12.)

1835. *Cytherea castanea*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 299.

1906. *Meretrix castanea*, Standen and Leicester in *Ceylon Pearl Oyster Fisheries*, Pt. V, p. 293.

Distinguished from all other varieties by its uniform brown or chestnut colouration; the vulva is not sharply demarcated, but the colouring in this region is usually darker than over the rest of the shell. There are no definite umbonar markings to be made out. On some shells an obscure and irregular zoning can be observed due to some of the growth zones being darker in tint than adjoining ones.

This is a well-marked variety seemingly of rare occurrence as I have found a single specimen only at Tuticorin and another in the Tambraparni delta, while out of the whole Indian Museum collection of *Meretrix*, nine only are of this colouration. Of these latter two (No. 4788) are labelled Indian Ocean, one is included in a collection of 11 shells (M. 398) from the Tavoy Coast, Burma, another (M. 10836/2) is from Bombay, while so many as five (M. 10842/2) are from Trincomalie, Ceylon. Standen and Leicester also report this variety from Trincomalie and Tampalakam, so it would appear to be relatively more abundant there than in any other locality. Reeve records it from China and the Philippine Islands.

Dimensions.—The largest individual seen (Ind. Mus. coll. No. 4788) measures $68 \times 61 \times 42\frac{1}{2}$ mm. Five other large specimens measure respectively :—

	Millimetres.	*Respective Ratios.*
Trincomalie (M. 10842/2)	64 × 55 × 39	= 100 to 85·94 to 60·94
	60 × 53½ × 36½	= 100 to 89·17 to 60·83
	59½ × 50½ × 33	= 100 to 84·87 to 55·46
Tavoy (M. 398)	49 × 42½ × 31¼	= 100 to 86·73 to 63·78
Bombay (M. 10836/2)	55¼ × 47¼ × 31¼	= 100 to 85·52 to 56·56
	No. 4788 (*ut sup.*)	= 100 to 89·71 to 62·50
	Average of ratios	= 100 to 86·99 to 60·01

(*d*) Variety **aurora**, var. nov.

(Plate IV, figs. 9-11.)

This is a strongly marked colour variety which rises to the importance of a local race in Malabar in the estuaries of the Anjarkandi and Tellicherry rivers, Tellicherry. The colouring consists of continuous bands of varying width and number radiating from the umbo to the ventral margin. The primitive number of these radial bands appears to have been two, as this agrees with the number of vestigial bands seen in other varieties of *M. meretrix* as well as in certain varieties of *M. casta*; also because the banding system in many shells can be resolved into two band groups representing the two original bands. In such (figs. 9 & 10) the two original bands become very wide as they approach the ventral margin, and in addition a number of narrow non-widening rays are intercalated in the space between the two great rays. From this well-defined pattern we pass to shells where the whole surface is covered with closely set rays. The colour of the latter is dark purplish brown when the periostracum is present, otherwise it is duller and more livid in tint. Internally these shells are yellowish beyond the pallial line; within this they have a pale pinkish tinge when quite fresh. Like so many other coloured shells, all the species of *Meretrix* fade considerably with time and exposure to light and this must be allowed for when examining shells from an old collection. Sometimes young individuals of var. *morphina* show a suffused pinkish tinge in the substance of the shell and it is probably from such a stock that *aurora* has been derived.

Occasionally a broadly-rayed large specimen of *M. casta* var. *ovum* shows raying and a general superficial resemblance to *aurora*, but the absence of a pink colour within, the acuter posterior angle and the absence of a bifid anterior cardinal tooth in the left valve are clearly-cut distinguishing differences.

The largest of the Tellicherry specimens is 55 mm. long by 49 mm. deep; the majority average 44 × 39 × 26½ mm., equivalent to the ratios of 100 to 88·64 to 60·23.

(*e*) Variety **zonaria** (Lamarck).

1835. *Cytherea zonaria*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 299.
,, ,, *graphica*, Lamarck, *ibid.*, p. 300.
1864. ,, ,, Reeve, *Conch. Icon.*, XIV, *Cytherea*, pl. i, fig. 1.

1864. *Cytherea zonaria*, Reeve, *ibid.*, pl. iii, figs. 9*a* and *b*.
1869. ,, *meretrix* var. *zonaria*, Römer, *Monog. der Molluskengatt. Venus*, Band I, sub-gen. *Cytherea*, pl. viii, fig. 1*e*. (*non* Römer's *graphica*, which I consider to pertain to the type form).

Lamarck's *zonaria* and *graphica* intergrade to such an extent that it is often impossible to differentiate between them, hence as they are at best merely colour varieties they are better merged into a single group. The main characteristic is that the more conspicuous markings form a zonal pattern characteristically of concentric rows of zig-zag lines, or more rarely, and this only in immature individuals, of concentric brown bands often broken and incomplete. In all cases these markings tend to be suppressed with increasing age.

(*f*) Variety **morphina** (Lamarck).

(Plate IV, figs. 5-8.)

1835. *Cytherea morphina*, Lamarck (in part), *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 300.
1864. ? *Cytherea morphina*, Reeve, *Conch. Icon.*, XIV, *Cytherea*, pl. iv, fig. 12.
1869. *Meretrix meretrix* var. *morphina*, Römer, *Monog. der Molluskengatt. Venus*, Band I, pl. viii, fig. 1*g*.

This is, I consider, a variety so indefinite in its markings that it might well be suppressed, and included under the type form. However, as its main character, which I consider to be the presence of two narrow divergent dark radial bands extending from the umbo to the ventral edge, is sometimes distinctly shown, I retain it for convenience to include all shells marked more or less clearly with two radial bands of dark colour. As the posterior margin (vulva) of the shell is sometimes darkly tinted, the shell then appears to be marked in a triradiate manner, which explains why Lamarck put *Venus triradiata*, Gmelin, as probably synonymous. Usually the ground colour of this shell when denuded of its periostracum is either pale or dark grey, but occasionally the shell is tinted yellowish or orange pink and such shells agree fairly well with Reeve's description : " ash white and orange flesh colour radiately tinged with violet, especially on the posterior side." Strangely enough Römer considered Reeve's *morphina* to belong to var. *graphica* which in the absence of zig-zag markings would cause confusion.

2. **Meretrix attenuata**, Dunker.

1858. *Meretrix attenuata*, Dunker, *Beschreibung und Abbildung neuer oder wenig gekannter Meeres-Conchylien*, p. 53, t. xvii, figs. 7-9.
1869. ,, ,, Römer, *Monog. der Molluskengattung Venus*, Band I, sub-gen. *Cytherea*, p. 36, t. x, fig. 4.

The two specimens (Nos. 4865 and M. 10833/2 of the Indian Museum collection) from the Nicobar Islands, and the larger one

(M. 10857/2) from Gwadar, Baluchistan, which have come under my notice, show this species to be a most interesting link between the species inhabiting the estuaries of continental India and those from further east, notably the giant Japanese *Meretrix* called "Hamaguri," *M. lusoria* (Chemn.). The true Indian species, except in the extreme forms of *M. casta ovum*, tend to assume shortness in the antero-posterior axis and incline either to a cordate or to a sub-orbicular outline. In *M. attenuata*, on the other hand, the shell is very definitely produced posteriorly into an acute angle, giving the shell a distinctly subcuneate outline, emphasized by the straightness of the sharply declivous margin between the hinge and the posterior extremity. In this elongation and straightness of the upper posterior margin *M. attenuata* approaches the large Japanese species, which however is considerably more elongated. These two species agree in nearly every detail of the hinge region; in both the anterior tooth is inserted on a shelf set at an angle of about 45 degrees to the ventral edge of the main hinge plate No such great obliquity occurs either in *M. casta* or *M. meretrix*. Further, although the anterior cardinal tooth both in *M. attenuata* and the Japanese species is marked by a very slight striation on the apex, this is so obscure and weak as not to be observable except under a lens of considerable power; there is no approach to the sub-bifid form seen in *M. meretrix*.

This species is so rare in collections that the three specimens possessed by the Indian Museum deserve careful attention, especially as Dunker and Römer appear to have based their diagnosis upon a single specimen of unknown origin.

The smaller of the two Nicobar specimens agrees in almost all particulars with the described form and is almost of the same size, its dimensions being $53 \times 43 \times 25$ mm. against Dunker's $59 \times 40\frac{1}{2} \times 25$ mm. The colouration is almost identical with that of Dunker's and Römer's figures, the shell being covered with concentric bands or zones of broken chevron markings of a chestnut tint that remind one of the *graphica* form of var. *zonaria* in *M. meretrix*. The periostracum is thin, somewhat dull and olivaceous yellow. Internally the shell is white with violet staining along the posterior declivous margin. The hinge plates are malformed, due to the fusion of the anterior and median cardinals of the right value. Apart from this, in one important point the hinge differs from the type description; Dunker states the nymphae are "*tenerrime granulatae nec denticulatae*," which Römer varies by saying "*tenerrime granulatae nec transversim sulcatae*." Now in this smaller Nicobar specimen the nymphae are quite distinctly marked by closely-set transverse ridges, each of which does however show signs of being composed of a row of fine granulations

The larger of the Nicobar specimens and the single one from Gwadar in Baluchistan are quite differently coloured, but in all essential particulars otherwise agree. In both, the valves are virtually bereft of markings and are covered with a thin and pale straw-coloured periostracum. Anteriorly there is a considerable amount of extraneous black staining, and on the umbones of the Gwadar shell are several imperfect zones of chevron marks. Internally the posterior declivous margin is characteristically stained violet.

In both, the nymphae conform more closely with Dunker's and Römer's descriptions than does the smaller Nicobar specimen ; the transverse character of the striae has become obscured and the granulations are apparently irregularly disposed ; only here and there can a faint suggestion of transverse disposition be seen. The second cardinal tooth of the left valve of the Gwadar shell is abnormally weak, and it is noteworthy that out of three specimens the cardinal tooth of two depart from the normal.

In all three specimens the pallial sinus is similar. It is strongly marked, deep and almost semicircular. The ventral horn ends in an acute and downwardly turned point approaching closely the form seen in *M. lusoria* but more inclined ventrally.

From the above it is obvious that both Dunker's and Römer's descriptions require amendment in two points, namely, sculpturing of the nymphae and the external colouration of the valves. From what I see in this species, reinforced by examination of a very large series of *M. meretrix* as also of several large *M. lusoria*, I am able to say that the sculpturing of the nymphae, in those species of *Meretrix* which attain relatively large size, undergoes distinct degeneration with increase of size and age. In young shells the nymphae are marked by coarse transverse ridges, very distinct and set comparatively widely apart. With advance in age the ridges decrease in prominence while increasing rapidly in number and become more closely set. Finally the ridges begin to break up into rows of granulations, and in the final stage, marking old age, the parallel arrangement in rows of the granulations may even disappear entirely, and nothing remain except an area closely set with extremely fine and exceedingly numerous minute granulations without pattern or order.

As there appear to be two distinct colour varieties of this species I propose to separate the nearly unicoloured form under the name *flava* diagnosed as follows :—

Var. **flava**, var. nov.

(Plate VII, figs. 41 and 42.)

Similar to the type in all particulars except in the external colouration of the valves, the zones of zig-zag markings characteristic of the latter being suppressed except sometimes partially upon the umbones ; general tint pale straw colour due to the tint of the thin investing periostracum.

Habitat.—Nicobar Islands and Gwadar, Baluchistan (Indian Museum collection).

Dimensions.—The larger Nicobar shell, 63×50 mm.; Gwadar shell, 64×52×35 mm., the latter giving the ratio of 100 to 81·25 to 54·69.

3. **Meretrix casta** (Chemnitz).

(Plate V, fig. 22; plate VI, figs. 30-33.)

1782. *Venus casta*, Chemnitz, *Conch. Cab.*, Vol. VI, p. 349, pl. 33.
1835. *Cytherea casta*, Lamarck, *Anim. sans. Vert.*, 2nd ed., Vol. VI, p. 301.
1845. ,, *ovum*, Hanley, *Proc. Zool. Soc. London*, 1845, p. 21.
1869. *Meretrix casta*, Römer, *Monographie der Molluskengattung Venus, Linne*, Band I, subgenus *Cytherea*, p. 31, pl. xii, fig. 2.
,, ,, *ovum*, Römer, *ibid.*, p. 38, pl. xi, fig. 4.
,, ,, *exilis*, Römer, *ibid.*, p. 35, pl. xi, fig. 3.
1914. *Corbicula* (*Velorita*) *satparaënsis*, Preston, *Rec. Ind. Mus.*, X, p. 306, figs. 22 and 22*a*, p. 308.
1915. *Meretrix casta*, Preston, *ibid.*, XI, p. 300 (not his large valve 67×73 mm. which is *M. meretrix*).
,, ,, *ovum*, Preston, *ibid.*, p. 300.
,, ,, *morphina*, Preston, *ibid.*, p. 300.
1916. ,, *casta*, Annandale and Kemp, *Mem. Ind. Mus.*, V, p. 351 (not their *M. ovum* which is *M. meretrix impudica* juv.).

This species is exceedingly variable and ignorance of this fact has caused great confusion over its nomenclature; in *M. meretrix* the variation is limited largely to the colour design of the valves; in *M. casta*, the form of the shell and the proportionate development of the hinge elements are subject to a wide range of variation, apart from and in addition to much diversity in the surface colour scheme of the valves.

The form desciibed by Chemnitz and by Lamarck under the name *casta* may be considered the type of the species, as the latter's definition accurately summarises the characters of the predominant form found in east coast backwaters and estuaries from the Chilka Lake to Tuticorin. According to Lamarck the shell is "cordato-rotundata, gibba, crassa, alba; pube anoque ovatis, convexis, glaucescentibus; intus violaceo maculata." Shells agreeing with this description never have well developed radial bands, but on some medium-sized individuals from the Chilka Lake (M. 10589/2 A and B) two short unmistakable rays can be made out on each umbo, and in one case I can trace one of these bands continued as a faint dusky clouding for a considerable distance towards the margin. In variety *ovum* from Malabar the rays are less frequently suppressed (pl. IV, figs. 3 and 4). Hanley's *Cytherea ovum* is a subequilateral variation, whilst Römer's *M. exilis* is nothing but a young stage of the same variety.

The distributional range of the type form is limited to the east coast of India, where it is found, often in densely stocked beds, in the majority of the backwaters and estuarine channels from Orissa to Cape Comorin. The sub-species *ovum* on the other hand is not found except in occasional and rare individual cases within these limits, but is exceedingly common upon the west coast of India from Cape Comorin to Bombay and again on the west coast of the Malay Peninsula.

The type form attains a larger size than any of the local races of the living sub-species to be described later; in the outer channel of the Chilka Lake, where conditions seem particularly favourable to its growth, it attains a length of 51 mm. by a depth of 47 mm. while its thickness, due to its ventricose shape, is as much as 33·5 mm.

The following measurements of individuals of different ages from the three chief localities where the type is found exhibit the great breadth (depth) of the shell as compared with the length. In variety *ovum* the ratio is considerably less owing to its frequent greater elongation. The thickness of the complete shell shows little difference in the two forms. The dimensions are :—

		Millimetres.	*Respective Ratios.*
Chilka Lake	...	51 × 47 × 33·50	= 100 to 92·16 to 65·70
Pulicat	...	44 × 38 × 28	= 100 to 86·36 to 63·63
,,	...	40 × 33 × 23	= 100 to 82·50 to 57·50
Madras	...	39 × 32 × 21·25	= 100 to 82·05 to 54·48
,,	...	21·5 × 17·75 × 12·50	= 100 to 82·56 to 58·14
,,	...	20 × 17·75 × 12	= 100 to 88·75 to 60·00
		Average of ratios	= 100 to 85·73 to 59·91

The outline of each valve is distinctly cordate (as shown in figs. 30-31), but this varies considerably even in the Chilka Lake individuals and some show a distinct tendency to elongation posteriorly; these connect with Hanley's *M. ovum* (pl. V, fig. 23).

The periostracum in most of the Chilka specimens is olive grey, thin and strongly adherent; smooth and inclined to dullness, it never possesses the brilliant varnish-like polish characteristic of that of *M. meretrix.* In a few Chilka shells it appears much stained with a deep rufous brown, and in one this passes into a blackish brown. Shells from the bed of Pulicat Lake and Ennur backwater scarcely ever retain the olive grey tinge which I believe to be the natural tint of the periostracum in this species; they are almost all deeply stained with rusty brown. The single Tuticorin shell obtained alive was olive grey.

Very marked variation is noticeable in the thickness of the valves, in the strength of the hinge plate, and in the size of the cardinal and lateral teeth in specimens from the east coast of India; the series shown on plate VI, figs. 30-33, illustrate the range in form better than any verbal description. In no case, however, is the shell and hinge so massive as in the sub-fossil variety described below as var. *satparaënsis.*

On the west coast of India from Travancore as far north at least as Bombay, a variety of *M. casta* is found in every estuary and backwater in such immense numbers that it has acquired a position of considerable economic importance among the fishing community, of whom hundreds engage in its collection during the dry season when the level of water is low in the channels. The lower classes esteem it because of its cheapness and tastiness, and its shells, owing to their solidity, have considerable value to the local lime-burners as a source of lime. The inherent variability already noted as of considerable range on the east coast is greatly intensified on the west coast. This is due to two factors: (*a*) the much more diversified conditions under which the species exists on the latter coast, and (*b*) the vastly greater numbers of individuals involved.

On the west coast the rainy season is much more prolonged and the rainfall much heavier than on the east; as a consequence the backwaters, even close to their seaward entrances, have a low salinity for months in the year—during the height of the floods it is difficult to conceive of the water in even the lowest reaches being anything but wholly fresh Hence, to survive requires in any estuarine mollusc marked power of adaptability to rapidly altering physical conditions. This quality is considerable in *M. casta* and is assisted by its numerical abundance, which furnishes the requisite numbers for the successful intervention of natural selection in the problem. The struggle for existence under these conditions is obviously a hard one and the west coast races of *M. casta* show the effects thereof in several characteristics. They seldom exhibit vigorous growth; dwarfing is the rule; extreme variations in form are to be counted as favoured if not induced by these conditions. Malformations are numerous and corrosion of the umbonar region is nearly always present. Complete adaptability has not even yet been attained; mortality is excessive every flood season, and the vast majority of each generation do not survive to a second year of existence.

In the biological survey of such an estuary as that of the Baliapatam river in North Malabar, it is most significant to notice that only at the mouth are large and vigorous examples of *M. casta* found strictly comparable with the type form inhabiting the seaward channels of Chilka and Pulicat Lakes, where the duration of river floods is short and where tidal influence is never wholly lost except for a comparatively short period in each year. The most seaward beds in the Baliapatam estuary yield shells almost exactly similar to poorly grown east coast ones. In both, the ventricose and cordate form is emphasized; the colour of the Baliapatam shells is stained rufous red as in Pulicat shells, and the main distinctions to be noted in average shells are that the elongation of the posterior angle of the shell is slightly more pronounced, while neither the escutcheon nor the vulva or coloured area of the upper posterior region show more than a trace of the elevation or reflection in the median line, which is usually present in most east coast individuals. On the other hand, the differences between selected specimens of the east and the west coast forms are less than the differences between the extremes met with in purely east coast or in purely west coast shells.

In sheltered creeks where a fairly high salinity is maintained for several months after spawning, individuals grow rapidly and retain their olive grey periostracum free of stain. These shells grow uninterruptedly, show no rest phases, become stout in substance, and show no corrosion of the umbones; not infrequently two radial lines, sometimes of chevron-shaped marks, are apparent in the umbonar region. The latter approximate to the colouration seen in young specimens of *M. meretrix* var. *morphina*, while the undecorated ones approach Hanley's *M. ovum*. These forms never seem to attain a larger size than 35 mm. in length, as they either die off when the great floods come or else become stained and corroded and pass thereafter as variations of the large form described from the seaward channels.

Further up the backwater, conditions become less favourable for *M. casta*; the bottom is less sandy and more muddy, the action of the rapid flow of the river current becomes a new factor, low salinity continues over a greater length of time, while, finally, the appreciable amount of organic acids present in the drainage from the hills and adjacent rice fields causes rapid corrosion of the shell, especially upon and around the umbones. One of the most marked effects of these altered conditions, and of the efforts made to give accommodation to them, is a change in the form of the shell. From being cordate and ventricose, the shape changes to one which is distinctly compressed laterally and of pronounced elongation in the antero-posterior axis. The young shells are almost almond-shaped, so extreme is the compression and accompanying elongation. With age they become blunter at either end and in their extreme phase exhibit a distinct convergence in outline and general shape to that of the freshwater mussel (*Lamellidens marginalis*). The umbones show considerable modification during these changes; in typical *M. casta* they are set obliquely, their apices directed forwards and inwards; in the riverine forms, now being noted, they are usually straightly incurved (*cf.* Hanley's *M. ovum*—"*natibus recte incurvatis*"), and as their points usually disappear through corrosion, this distinction becomes still more emphasized; even in cases also where the umbones originally were curved forwards, this appearance becomes obscured and is eventually lost by the effects of corrosion.

So greatly specialised is this form that it appears worthy of being given a varietal name, for the sake of clearness. As Hanley's *M. ovum* occupies a fairly central position in the chain of gradations to be grouped in the new variety, I propose to retain *ovum* as a suitable name for this assemblage. I must say, however, that no clear line of distinction can be drawn between this and the more estuarine forms. Every gradation can be found between both sections, and a complete series of examples can easily be formed, showing every step in the change from a short ventricose cordate form through a roundly ovate stage to an elongated somewhat laterally compressed elliptical form, totally unlike that standing at the other end of the series.

The substance of shells from west coast estuaries is distinctly thinner than that of those from the east coast, due possibly to a smaller lime content in the west coast rivers. Here I should mention that much of the variation found in the form and proportions of the umbones and hinge region of *M. casta*, is due to the effect upon the size and relative relationship of these parts, caused by the exceedingly variable rates at which the shell increases in thickness under different conditions. Exceptionally rapid growth in thickness tends to produce a humped and corbicular shape, while rapid growth in length and breadth with slow deposits of lime salts give a compressed form with flat umbonar region. Under certain conditions not now prevailing, but which existed at the very recent geological period when the shell-pits of swamps round the margins of the larger backwaters of the eastern coast were being formed, the deposit of lime salts must have progressed at a greater rate than the most rapid now existing, for in these sub-fossil deposits we got an immensely massive form of *M. casta*. This shell at first sight appears so different in hinge form and in general shape from the type of *M. casta* that one does not hesitate to treat it as a different species. Hence we find Preston describing it as a *Cyrenid* under the name of *Corbicula* (*Velorita*) *satparaënsis*. He saw cause to modify this opinion later and in *Rec. Ind. Mus.*, XI, p. 300, he rightly assigned it to *M. casta*. In this I agree with him, after a comparison of a long series of young individuals of the massive form as opposed to those of the type. This gave conclusive evidence of identity, as the extreme comparative solidity of the variety is rapidly lost as we descend in the series till at last among small individuals of the type and of the variety, of $\frac{3}{4}$ inch in length, we attain practical identity and it becomes impossible to differentiate the one from the other.

Another factor which has a determining influence in modifying the form of the shell is current action. In channels and creeks where the current is slow and weak, the inflated cordate and ovate forms persist; where the current is strong, the form tends to become abnormally elongate and flattened. Such condition and effect are seen wherever *M. casta* has managed to establish itself in the main channel of the west coast rivers at a relatively considerable distance from the sea. Elongation is particularly strong in case of young individuals. This change is an adaptation to counteract the danger which a rotund form such as that of the type would be subject to when exposed to strong current influence. The flattened form is less liable to be rolled along, just as this same general shape has similar utility in the case of *Donax cuneata* which lives in the surf-troubled sands of our beaches, where a rounded form would subject it to the peril of being rolled forwards and backwards on the beach with every alternate surfbreak and backwash.

Distribution of M. casta (*type*).—East coast of India, from the Chilka Lake to Tuticorin in backwaters and connecting canals. Also Ceylon and Singapore according to Römer; it certainly occurs in Ceylon, but I am very doubtful in regard to Singapore as all the specimens in the Indian Museum collection from this locality undoubtedly belong to var. *ovum*.

It also occurs sub-fossil at various places in the east coast of India from Ganjam to Tuticorin.

Below are descriptions of the two varieties which I now propose :—

(*a*) Variety **ovum** (Hanley).

(Plate IV, figs. 1-4; plate V, figs. 23-26; plate VI, figs. 34-38).

1845. *Cytherea ovum*, Hanley, *Pro. Zool. Soc. London*, 1845, p. 21.
1869. *Meretrix exilis*, Römer, *Monographie der Molluskengattung Venus, Linn.*, Band I, p. 35.

Shell variable in form, ranging from elongate ovate to oblong, not usually inflated, moderately compressed, fairly solid, equivalve, sub-equilateral, white, with or without two more or less complete narrow divergent brown bands radiating from the umbo to the ventral margin—these bands very frequent in young specimens but usually suppressed in the adult; covered with a thin, dull olive or yellowish grey periostracum often stained with brown; umbones centrally disposed, weak, not prominent, little curved or else bent straight inwards, the latter appearance commonly emphasized by corrosion which may extend to a considerable extent around each umbo; dorsal margin on each side of umbo inclined to convexity, thin and usually without reflected margin; ventral margin varies from convex to nearly straight, entire; anterior side rounded; posterior side produced rather more than the anterior, sometimes sub-angular, upper margin stained exteriorly with greenish grey; escutcheon ovate, sub-obsolete; interior surface white, stained violet along the upper posterior margin, also frequently along the ventral edge of the hinge plate, and sometimes above the anterior adductor scar; hinge as in the type except that it is weaker, narrower and more elongate in consonance with the lengthening of the entire shell; surface of the escutcheon flattened and not elevated along the median line as in the type; pallial sinus shallow as in type. Dimensions variable, usually not exceeding 43 mm. in length by 35 mm. in depth and 26 mm. in thickness in vigorously grown individuals; generally the size is smaller and $37 \times 30 \times 22$ mm. may be taken as a fair average.

The main points of difference between this variety and the type are: (*a*) the more pointed outline of the posterior angle of the shell; (*b*) the frequent presence of radial banding; (*c*) the narrower and more elongated form of the hinge; (*d*) the flattened surface of the escutcheon as opposed to its convex form in the type, whereby in the latter the edge of the shell immediately above the anterior lateral dental pit in the left valve is reflected outwards as a prominent lip.

Dimensions.—The following table gives particulars of the length and breadth of the valves in 18 individuals from 6 different localities, with in addition the maximum transverse diameter of the entire shell in 14 instances. The relative ratios of these dimensions have also been worked out to permit of accurate comparison.

		Millimetres.	*Respective Ratios.*
Malacca (M. 10847/2)	...	31×25	=100 to 80·05
		30×25	=100 to 83·33
		30×24	=100 to 80·00
		31×25	=100 to 80·65
Singapore (M. 10837/2)	...	$49 \times 39 \times 28$	=100 to 79·59 to 57·14
Mahé	...	$35 \times 27\frac{1}{2} \times 20\frac{1}{4}$	=100 to 78·57 to 57·86
		$30 \times 27 \times 21\frac{3}{4}$	=100 to 90·00 to 72·5
Tellicherry	..	$41 \times 34 \times 25\frac{1}{4}$	=100 to 82·93 to 61·58
		$26\frac{1}{2} \times 19\frac{1}{2} \times 13$	=100 to 73·58 to 49·05
		$37\frac{1}{2} \times 29 \times 20\frac{1}{2}$	=100 to 77·33 to 54·67
		$29 \times 21\frac{1}{4} \times 14\frac{1}{2}$	=100 to 73·28 to 50·00
		$33\frac{1}{4} \times 26 \times 18\frac{1}{2}$	=100 to 78·20 to 55·64
Mangalore	...	$39\frac{1}{2} \times 31 \times 22\frac{1}{2}$	=100 to 78·48 to 56·96
		$37 \times 32\frac{1}{4} \times 22\frac{3}{4}$	=100 to 87·16 to 61·49
		$29\frac{1}{4} \times 24\frac{1}{4} \times 17\frac{3}{4}$	=100 to 82·91 to 60·68
		$27\frac{1}{4} \times 22\frac{1}{2} \times 18$	=100 to 82·57 to 66·06
Madagara	...	$39\frac{1}{2} \times 34\frac{1}{2} \times 26\frac{1}{2}$	=100 to 87·34 to 67·09
		$38\frac{1}{2} \times 34\frac{3}{4} \times 25$	=100 to 90·26 to 64·94
		Average of ratios	=100 to 81·49 to 59·69

The above figures bespeak a very considerable degree of variability among these shells, ranging in the ratios of the three dimensions from 100 : 73·28 : 50 to 100 : 90·26 : 64·94 in the case of two extreme forms. The average ratios deduced from the above 18 examples work out however at 100 : 81·49 : 59·69 which are not far removed from those of the type form—100 : 85·73 : 59·9. This approximation of the averages of the two groups furnishes contributory evidence in favour of the view that their differences are insufficient to warrant separation as distinct species; at the most, even when we take into consideration the divergences in outline, in the structure of the hinge and in the position of the umbones, the west coast group can be accounted only a variable variety of the type.

Localities.—The inner sections of tidal estuaries and backwaters on the west coast of India from Cape Comorin to Bombay. Very rarely from the east coast where higher saline conditions favour the predominance of the type form (No. 4792 Ind. Mus. coll., from Tinnevelly, and some among No. 10588/2 from the beach at Vizagapatam; the latter are however probably of sub fossil origin). It appears again on the western coastline of the Malay Peninsula, typical specimens coming from Malacca and Singapore (Ind. Mus. colln. M. 10847/2 and 10837/2). Further north, a specimen from Arakan (M. 10841/2), size $44 \times 36·75$ mm., appears to be intermediate between the type and this variety; in it the characters of the two seem fairly evenly balanced, but after careful analysis of each character, I am satisfied it should be assigned to var. *ovum.* Hence I expect that eventually it will be found that this variety is as characteristic of the whole of the eastern shores of the Bay of Bengal as it is of the west coast of Peninsular India.

(*b*) Variety **satparaënsis** (Preston).

(Plate V, figs. 19-21 ; plate VI, figs. 27-29).

1914. *Corbicula* (*Velorita*) *satparaënsis*, Preston, *Rec. Ind. Mus.*, X, p. 306.

Preston's description above cited is sufficiently accurate for the fully grown shell. Between this and the young form of about 25 mm. in length, where individuality as a variety is lost in identity with the type, there is a perfect series of gradations ; advancing from the early stage at which divergence begins we see the type form gradually altering in the ratio of length to breadth. With rapid increase in stoutness, the shell assumes a shorter and deeper form, the valves become highly convex or rather humped and the umbones strongly beaked, altering completely the general appearance.

Dimensions.—The largest valve I have seen is a water-worn one from False Point, Orissa (No. M. 10845/2 Ind. Mus.). This measures $57\frac{1}{2} \times 53$ mm., giving a ratio of 100 to 92·15. Another particularly large one I obtained from the Surla shell-pits in Ganjam. This measures 57 mm. long by over 50 mm. deep, equivalent to the ratio of 100 to 87·72 (deposited in the Calcutta Museum). Five other shells from Korampalam shell-pits, Tuticorin, with their valves undisplaced, measured :—

Millimetres.	*Respective Ratios.*
$39 \times 38 \times 30\frac{1}{2}$	=100 to 97·44 to 78·21
$38\frac{3}{4} \times 36\frac{3}{4} \times 30$	=100 to 94·84 to 77·42
$31 \times 29\frac{3}{4} \times 23\frac{1}{4}$	=100 to 95·97 to 75·00
$30\frac{1}{4} \times 27\frac{3}{4} \times 22\frac{1}{2}$	=100 to 91·74 to 74·38
$43 \times 40\frac{1}{2} \times 32$	=100 to 94·19 to 74·42
Average of Ratios	=100 to 94·84 to 75·89

Localities.—This variety is common everywhere in the shell deposits of sub-fossil age on the borders of Chilka Lake, Sonapur backwater (Ganjam), Pulicat Lake and Sadras backwater (Chingleput) ; in shell-pits in the Mandapam Peninsula (Ramnad district) and also at Korampalam near Tuticorin ; a water-worn valve from False Point, Orissa.

Variety *satparaënsis* is found only in the sub-fossil condition ; no living individuals appear to assume this excessively stout form. This would seem to indicate that the conditions favouring an extremely rapid deposit of lime salts have deteriorated appreciably since the time the sub-fossil deposits were formed, or that the variety had found it a disadvantage to be possessed of special ability to secrete large quantities of lime in its shells.

EXPLANATION OF PLATE IV.

Photographs of valves of the two Indian species of *Meretrix* to show the frequency and the range of radial colour banding.

Meretrix casta var. *ovum* (Hanley).

FIGS. 1 and 2.—Two examples from Tellicherry with two narrow and widely separated rays. (These do not show clearly in the photographs.)

FIG. 3.—A small shell from the same locality showing two strong widening rays, a common type among young individuals of this variety.

FIG. 4.—A half-grown specimen showing two strong rays, which in the umbonar region have coarse chevron-shaped marks superadded. Baliapatam River, Malabar.

Meretrix meretrix var. *morphina* (Lmk.).

FIGS. 5, 6, 7 and 8.—Four valves showing the wide variations in the typical colour scheme of two radial bands widening as they pass away from the umbo.

FIG. 5 is the most perfect, the two bands strongly marked throughout their course, and with the umbo conspicuously marked with linear brown markings more or less chevroned.

FIGS. 6 and 7 approach the pattern form of No. 5, but here the radii are discontinuous and strong only upon the umbones, where both show chevron-spotting superadded. Tuticorin.

FIG. 8. A typical valve from Tuticorin showing the modification of the rays found in fully adult individuals. Here the rays are discontinuous, blotchy and obscure, buried partly within the shell substance and showing chiefly as two dark clouded areas close to the anterior and posterior angles of the ventral margin. (These areas do not show well in the photograph).

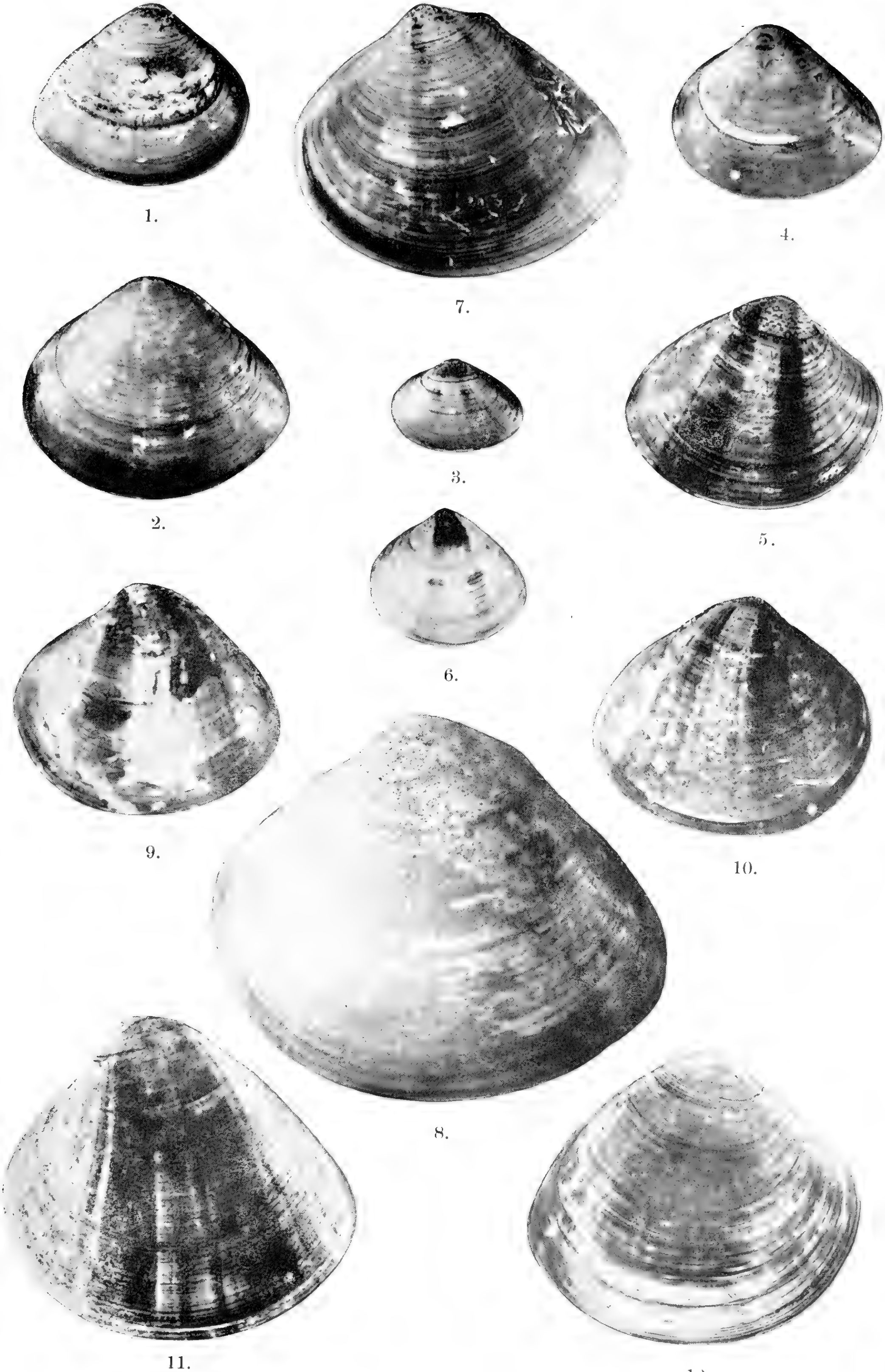
Meretrix meretrix var. *aurora*, var. nov.

FIGS. 9, 10 and 11.—Three shells from Tellicherry showing the multiple raying characteristic of this variety.

Meretrix meretrix var. *castanea* (Lmk.).

FIG. 12.—A typical specimen from the Tambraparni delta, Tinnevelly.

All the figures are natural size.



D. N. Bagchi, Photo.

INDIAN MERETRIX.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

EXPLANATION OF PLATE V.

Meretrix meretrix (Linn.). Type.

FIG. 13.—An adult specimen from Tuticorin. Observe the faint spotting on the umbo, the absence of rays and the indistinct margin of the dark coloured posterior margin or "vulva."

Meretrix meretrix var. *impudica* (Chemn.).

FIGS. 14, 15, 16 and 17.—These young shells show the rayed and zoned colouring characteristic of this variety in the very young condition.

FIGS. 14 and 15 (Chilka Lake) were identified with *M. ovum* by Preston, but comparison with fig. 39, pl. vii, shows clearly that they develop into typical *M. meretrix* var. *impudica*.

FIGS. 16 and 17 are from Tuticorin. The sharply margined dark vulva is clearly shown in all four figures.

FIG. 18.—A shell showing colouring hybrid between var. *morphina* and var. *impudica*. Locality, Chilka Lake.

Meretrix casta var. *satparaënsis* (Preston).

FIGS. 19, 20 and 21.—Three typical left valves from Korampalam shell-pits, Tuticorin. Note the emphatic "hooding" of the umbo in all, and the gradation of figs. 19 and 20 into the type of *M. casta* as seen in figs. 22 and 23.

Meretrix casta (Chemn.). Type.

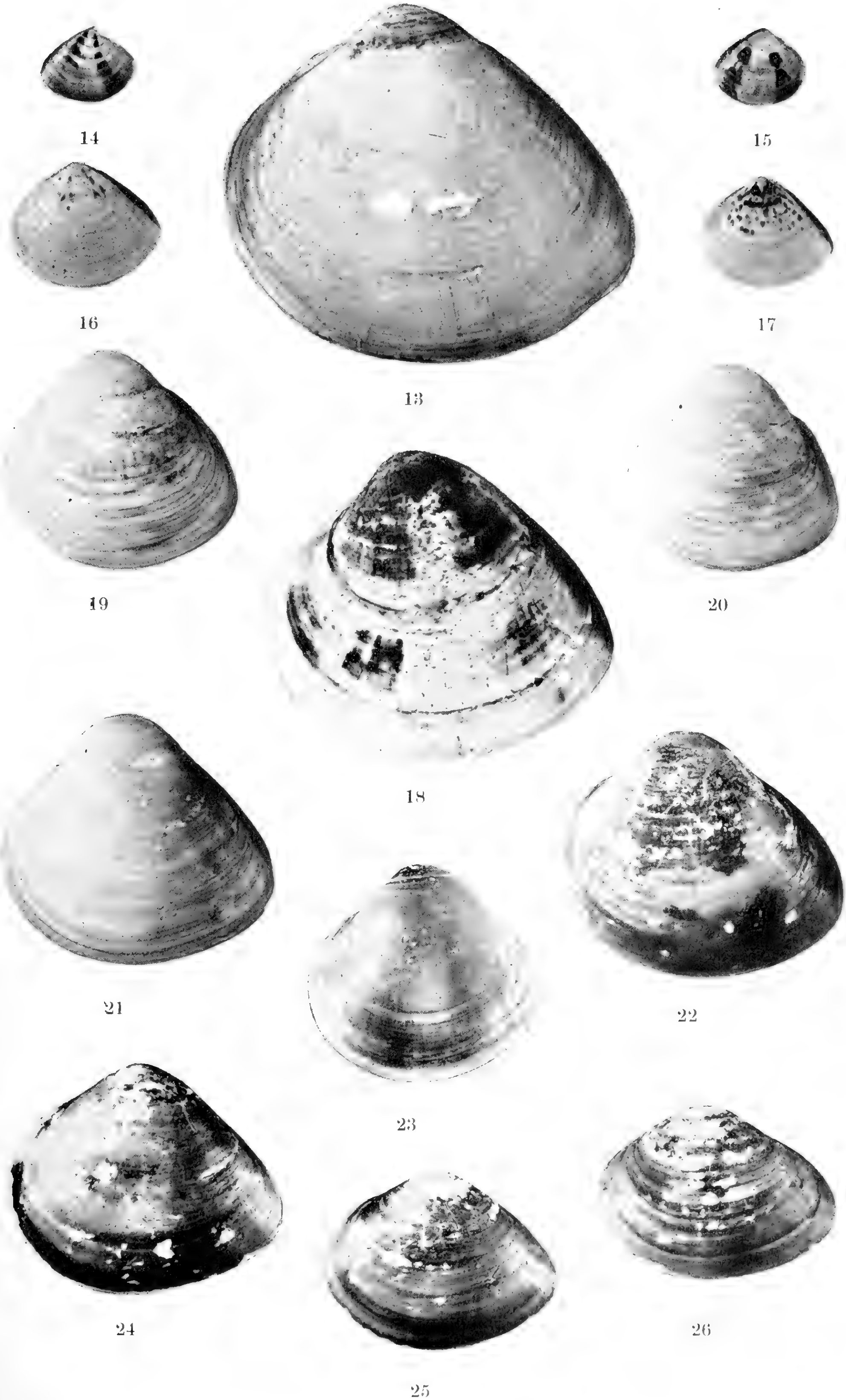
FIG. 22.—A large specimen from Pulicat Lake with elongated posterior suggesting transition to the var. *ovum* form seen in fig. 24.

Meretrix casta var. *ovum* (Hanley).

FIG. 23.—A stout shortened form from the mouth of the Baliapatam River, North Malabar. It approaches closely in outline to the central type as seen in Chilka and Pulicat Lakes.

FIGS. 24, 25 and 26.—Three forms of this variety exhibiting the gradual lengthening of the shell, and the ultimate assumption of an *Unio*-like outline, very different from the cordate form of fig. 23. All from Tellicherry.

All the figures are natural size.



D. N. Bagchi, Photo.

INDIAN MERETRIX.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

EXPLANATION OF PLATE VI.

Meretrix casta var. *satparaënsis* (Preston).

FIGS. 27 to 29.—All from Korampalam, Tuticorin. Fig. 29 is a transition form to the true *casta*, the hinge being weaker than normal, but with the umbo typically hooded.

Meretrix casta (Chemnitz). Type.

FIGS. 30 and 31 are very typical, with heavy hinge and short cordate outline; the second is the more common form and shows some tendency to elongation posteriorly. (Fig. 30 is from Tuticorin, 31 from Pulicat).

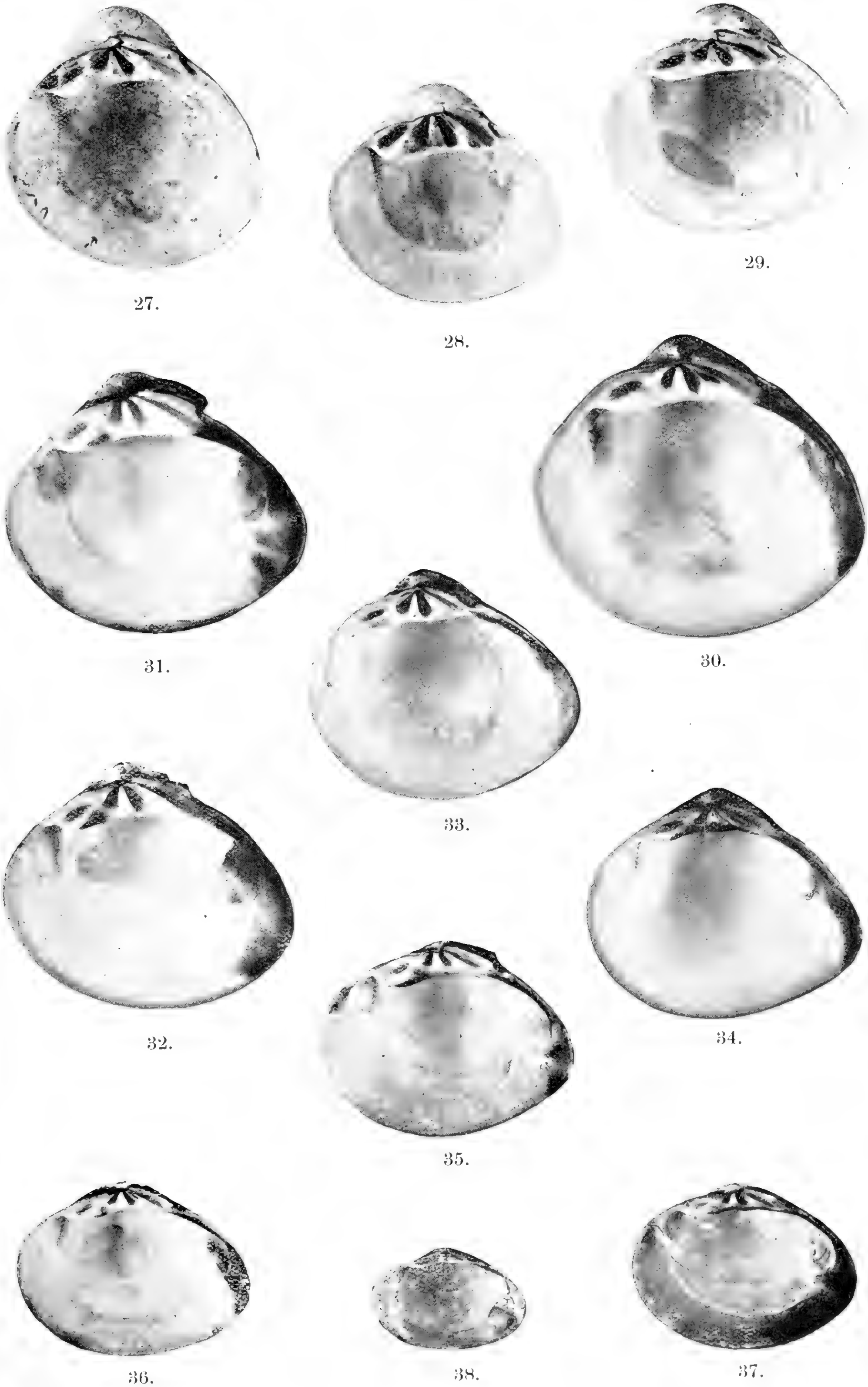
FIGS. 32 and 33 (Pulicat and Ennur) show more emphatic elongation posteriorly and in fig. 33 we have a form approaching the *ovum* form such as is seen in fig. 34.

Meretrix casta var. *ovum* (Hanley).

FIGS. 34 to 38 show part of the range in shape shown by this very variable variety, extending from the comparatively short stout form of fig. 34, to the narrow elongated form of fig. 38. Compare with figs 23 to 26, pl. V. All from Tellicherry except fig. 38, from Mahé, Malabar.

FIGS. 27-38 are all inner views of the right valve in *M. casta* and its two varieties, showing the great range in variation exhibited by these shells and the gradations linking together these three main forms.

All the figures are natural size.



D. N. Bagchi, Photo.

INDIAN MERETRIX.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

EXPLANATION OF PLATE VII.

Meretrix meretrix var. *impudica* (Chemn.).

FIGS. 39 and 40.—Outer and inner view of left valve. The former shows the coarse chevron marks upon the umbo so characteristic of this variety. The margin of the vulva does not show in this photograph. The inner view is to show the characteristic shallow form of the pallial sinus in *Meretrix meretrix* as distinct from the deep sinus of *M. attenuata* and *M. lusoria*.

Meretrix attenuata var. *flava*, var. nov.

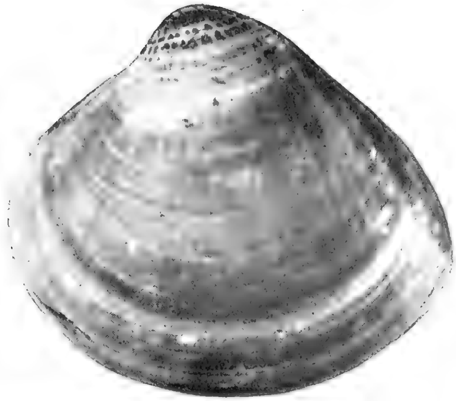
FIGS. 41 and 42.—From the Nicobar Islands. No. 4865 of the Indian Museum collection. Note the total absence of the characteristic chevron markings described by Dunker and Römer.

Meretrix lusoria (Chemn.).

FIG. 43.—A left valve from Japan. This shell is occasionally more elongated posteriorly than in this specimen and this causes the pallial sinus to be less open than in the latter, where it is characteristically almost semi-circular in outline.

All the figures are natural size.

41.



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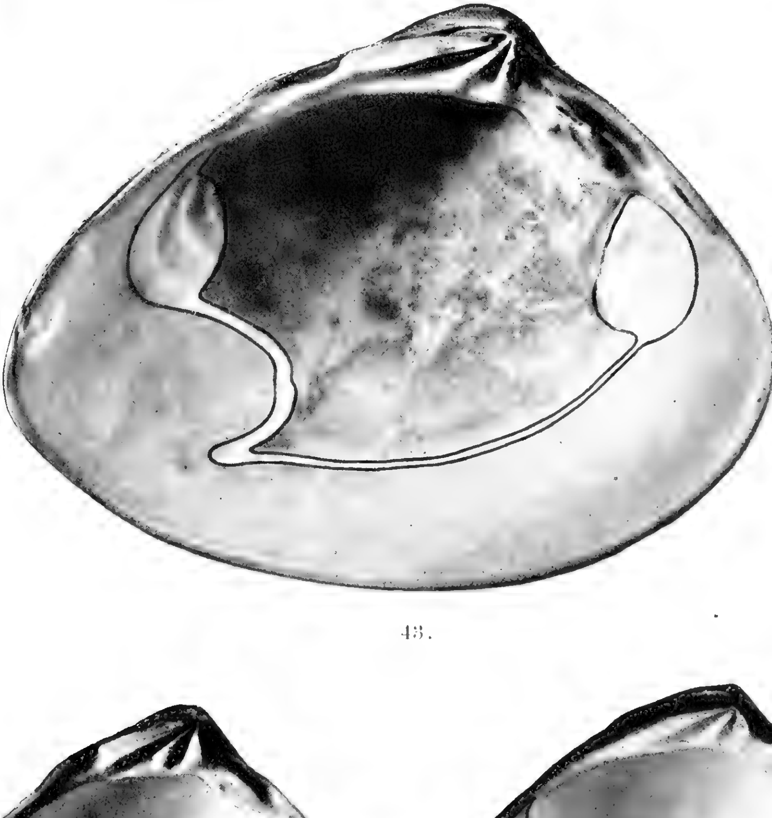

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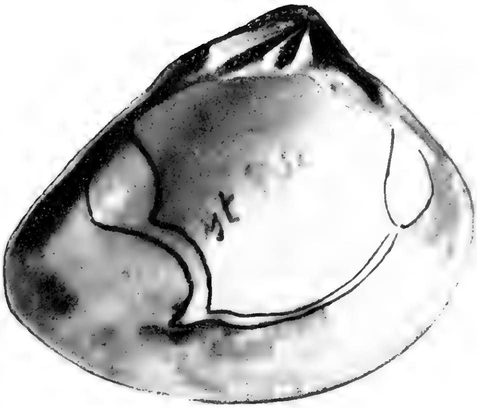

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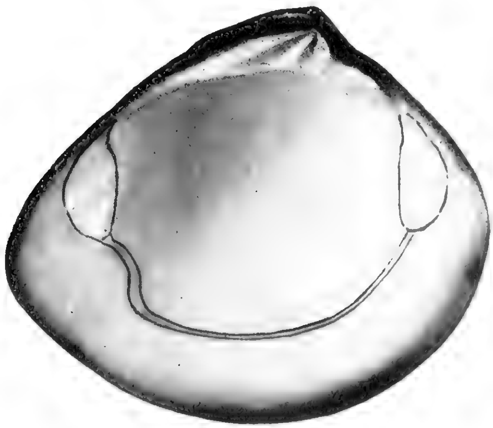

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D. N. Bagchi, Photo.

INDIAN MERETRIX.

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XI. NOTES ON SOME INDIAN APHIDES

By P. van der Goot, *Salatiga* (*Java*).

During the latter half of 1916, I had the pleasure through the courtesy of Mr. F. H. Gravely of receiving from the Indian Museum at Calcutta a new lot of Indian Aphides, in all 27 tubes, most of them collected in the Himalayas. Amongst them were several apparently new species, the descriptions of which are given in the following pages, together with a list of the remaining species contained in the collection.

Macrosiphum gravelii, sp. nov.

Apterous viviparous female.

Measurements.

Length of body	.. ..	3·95 mm.
Breadth of body	.. ..	1·85 ,,
Length of antennae	.. ..	4·05 ,,
Length of siphunculi	.. ..	1·25 ,,
Length of cauda	.. ..	0·68 ,,

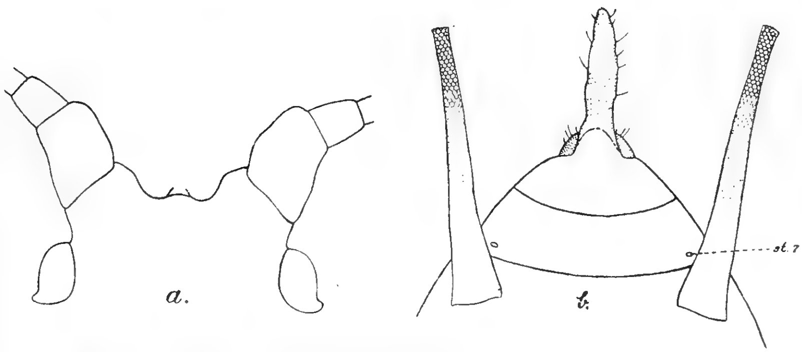

FIG. 1.—*Macrosiphum gravelii*, sp. nov.

a. Head of apterous female (dorsal view). × 65.
b. Hind part of abdomen of apterous female (dorsal view). × 35.

Colour.—Body light yellow or light brownish. Eyes red. Antennae light yellowish-brown, the last three joints brownish-black. Legs yellowish-white, tarsus black. Siphunculi dark brown. Cauda light yellow. (Notes from specimen in alcohol).

Morphological characters. — Body elongate-ovate, slightly arched; the dorsum with transverse rows of very short spiny hairs.

Antennae slightly longer than the body; relative lengths of the five last antennal joints about as: 59. 52. 40. 10. 53. The third joint bears on its basal fourth some 3–5 circular sensoriae. Frontal tubercles well developed, not gibbous or protruding on the innerside; frons slightly arched.

Rostrum reaching to the second pair of coxae.

Siphunculi very long, thin, cylindrical, but distinctly expanded towards the base; the apex with a distinct reticulation, the remainder very faintly imbricated. Cauda elongate, ensiform, about half as long as the cornicles.

Legs long and thin, with small but strong spiny hairs. (Described from numerous wingless specimens).

Food-plant unknown.

Locality.—Soom (Darjiling district), 4,000—5,000 feet, 16-vi-1914 (*F. H. Gravely*).

Types in the collection of the Indian Museum, Calcutta; No. 5597/H. I.

Rhopalosiphum indicum, v. d. G.

Alate viviparous female.

Measurements.

Length of body	.. ..	4·70 mm.
Breadth of body	.. ..	2·25 ,,
Length of antennae	.. ..	4·85 ,,
Length of siphunculi	.. ..	1·00 ,,
Expanse of wings	.. ..	13·50 ,,
Length of cauda	.. ..	0·43 ,,

Colour.—Head and thorax yellowish-brown; abdomen dirty yellowish. Eyes and antennae black. Legs black, base of femur light yellow. Siphunculi dark brown. Cauda light yellowish. Pterostigma of forewing and all veins with a brownish tinge. (Notes from specimen in alcohol).

Morphological characters.—Body broadly ovate, nearly naked.

Antennae a little longer than the body; relative lengths of the five last antennal joints about as: 60. 42. 33. 12. 65. The third joint bears on its whole length some 65 small circular sensoriae; the fourth joint shows from 0-3 sensoriae. Frontal tubercles small, slightly protruding on the inner side.

Rostrum reaching to the second pair of coxae.

Siphunculi moderately long, thick, only slightly swollen in the middle but considerably constricted at the apex, with a distinct reticulation at the tip. Cauda club-shaped, about half as long as the cornicles.

Wings with normal venation; the second fork of media I fairly long. Hooking-hairs 4 in number. (Described from 3 partly damaged winged females, in separate tubes).

Food-plant unknown.

Localities.—Birch Hill (Darjiling district), 6,000—7,000 feet, 1-vii-1914 (*Carmichael* coll.); Soom to Birch Hill (Darjiling distr.), 5,000—6,000 feet, 2-vii-1914 (*Carmichael* coll.); Soom to Darjiling (East Himalayas), 4,500—7,000 feet, 14-vi-1914 (*F. H. Gravely*).

Types in the collection of the Indian Museum, Calcutta; Nos. 5595/H. I., 5598/H. I., 5602/H. I.

I have little hesitation in considering the winged forms described above, apparently caught on the wing, to be identical with the wingless specimen I described in an earlier paper on Indian Aphides (*Rec. Ind. Mus.*, vol. XII, 1916, pp. 1—5).

The reticulation of the cornicles is very rare in *Rhopalosiphum*, the only species showing this character being *Rh. aconiti*, v. d. G.

Rhopalosiphum vagans, sp. nov.

Alate viviparous female.

Measurements.

Length of body	2·60 mm.
Breadth of body	1·08 ,,
Length of antennae	3·15 ,,
Length of siphunculi	0·54 ,,
Expanse of wings	7·90 ,,
Length of cauda	0·25 ,,

Colour.—Head and thorax black, abdomen brownish. Eyes dark. Antennae black. Legs yellowish; tarsus, tip of tibia and femur (except the base) blackish. Siphunculi dark brown. Cauda darkish. Pterostigma of forewings brownish. (Notes from specimen in alcohol).

Morphological characters.—Body nearly naked, without any lateral tubercles.

Antennae distinctly longer than the body; relative lengths of the five last antennal joints about as: 34. 28. 21. 9. 35. The third antennal joint bears from 21–31 circular sensoriae on nearly its whole length. Frontal tubercles fairly small, protruding on the inner side, with a few short hairs.

Rostrum reaching to the second pair of coxae.

Siphunculi moderately long and thin, distinctly swollen, with the surface quite smooth. Cauda ensiform, about half as long as the cornicles.

Wings with normal venation; the second fork of media 1 moderately large. Hooking-hairs 3 in number.

Legs long and thin, with a few short spines. (Described from a single winged female).

Food-plant unknown.

Locality.—Soom to Darjiling, 4,500-7,000 feet, 16-vi-1914 (*F. H. Gravely*).

Type in the collection of the Indian Museum, Calcutta; No. 5600/H. I.

Trichosiphum dubium, sp. nov.

Apterous viviparous female.

Measurements.

Length of body	..	.. 2·88 mm.
Breadth of body	..	.. 1·62 ,,
Length of antennae	..	.. 1·26 ,,
Length of siphunculi	..	.. 0·76 ,,

Colour.—Body dirty yellowish. Eyes red. Antennae light yellow, with blackish apex. Legs light yellowish-brown. Siphunculi dark brown. Cauda light brownish. (Notes from specimen in alcohol).

Morphological characters.—Body broad ovate; the whole dorsum covered with numerous strong, moderately long spines, which are always simple at the apex.

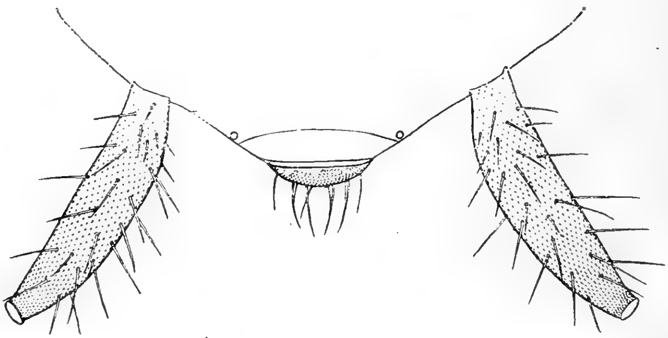

FIG. 2.—*Trichosiphum dubium*, sp. nov.
Hind part of abdomen of apterous female (dorsal view). × 60.

Antennae less than half as long as the body, with a few long spines, relative lengths of the five last joints about as: 29. 9. 13. 11. 24. Primary sensoriae without hair-rim.

Rostrum long, reaching to the third pair of coxae.

Siphunculi moderately short, thick, distinctly broadest towards the middle, with many fairly long bristles; the integument covered with numerous "spinule-rows." Cauda obsolete; the last abdominal segment broadly rounded, not prolonged into a distinct small point. Rudimentary gonapophyses very close together, with a few short hairs; their number not distinct, apparently 3.

Legs slender, with some long hairs. (Described from 4 apterous females, together with numerous larvae and a few nymphs).

Food-plant unknown.

Locality.—Birch Hill (Darjiling district), 6,000—7,000 feet, 30-vi-1914 (*Carmichael* coll.).

Types in the collection of the Indian Museum, Calcutta No. 5590/H. I.

The species described above shows much resemblance to the genus *Greenidea*, Schout., especially by the broad body and the short cornicles. The absence of an acute point to the last abdominal segment, however, necessitates it being placed in *Trichosiphum* (Perg.) v. d. G.

Trichosiphum montanum, sp. nov.

Alate viviparous female.

Measurements.

Length of body	..	..	3·05 mm.
Breadth of body	..	..	1·15 ,,
Length of siphunculi	..	..	1·98 ,,
Expanse of wings	..	..	8·10 ,,

Colour.—Head and thorax dark brown ; abdomen brownish-yellow. Eyes red (?). Antennae blackish. Legs light yellow,

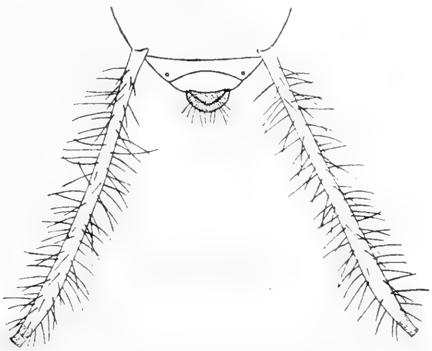

FIG. 3.—*Trichosiphum montanum*, sp. nov.
Hind part of abdomen of alate female (dorsal view). × 25.

tarsus and tibia dark brown. Shiphunculi dark brown. Cauda brown. Pterostigma of forewings brown. (Notes from specimen in alcohol).

Morphological characters.—Body elongate ovate; head, thorax and margin of abdomen with long and fine hairs, the dorsum of the abdomen with shorter hairs.

Antennae broken off in the specimen examined. The third antennal joint bears some 17 sensoriae on its basal three-fourths; the sensoriae are broadly oval, occupying nearly half of the antennal circumference.

Rostrum reaching to the third pair of coxae.

Siphunculi very long, thin, cylindrical, with many long hairs and with distinct "spinule-rows" only on the extreme tip. Cauda nearly obsolete, broadly rounded, slightly conical.

Wings with normal *Trichosiphum* venation. Hooking-hairs 3–5 in number.

Legs fairly long, the tibia and femur with moderately long and fine hairs. (Described from a single winged female).

Food-plant unknown.

Locality.—Soom to Darjiling, 4,500—7,000 feet, 16-vi-1914 (*F. H. Gravely*).

Type in the collection of the Indian Museum, Calcutta; No. 6968/H. I.

Although only a single damaged alate female was available, this species is sufficiently distinct from other species of *Trichosiphum* (*Tr. minutum*, v. d. G. and *Tr. querci*, v. d. G.) in the number and distribution of sensoriae on the third antennal joint.

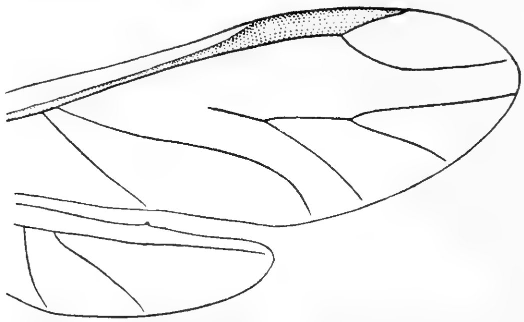

FIG. 4.—*Trichosiphum montanum*, sp. nov. Fore and hindwing of alate female. (× 25).

Lachnus himalayensis, sp. nov.

Apterous viviparous female.

Measurements.

Length of body	..	.. 4·50 mm.
Breadth of body	..	.. 2·35 ,,
Length of antennae	..	.. 1·80 ,,
Siphunculi (diam.)	..	.. 0·14 ,,

Colour.—Body dirty grayish, without blackish spots. Eyes black. Antennae grayish-white. Legs brownish-black. Siphunculi gray, with a brownish top-rim. Cauda light brown. (Notes from specimen in alcohol).

Morphological characters.—Body broad ovate, slightly arched, covered with numerous fine, moderately short hairs.

Antennae less than half as long as the body, with numerous fine hairs; relative lengths f the four last antennal joints about as: 33. 13. 17. 12. Sensoriae are present as follows: III 0. IV 2. V 1+1. VI 1(+4). The primary sensoriae are large, the secondar y ones very small and circular.

Rostrum short, reaching to the second pair of coxae.

Siphunculi scarcely elevated above the body, nearly reduced to pores. Cauda obsolete, the last abdominal segment broadly rounded. Rudimentary gonaphophyses 3 in number, the middle one often double.

Legs moderately long, covered with numerous thin, long hairs.

Alate viviparous female.

Measurements.

Length of body	..	.. 4·95 mm.
Breadth of body	..	.. 1·98 ,,
Length of antennae	..	.. 1·85 ,,
Siphunculi (diam.)	..	.. 0·13 ,,
Expanse of wings	..	.. 13·15 ,,

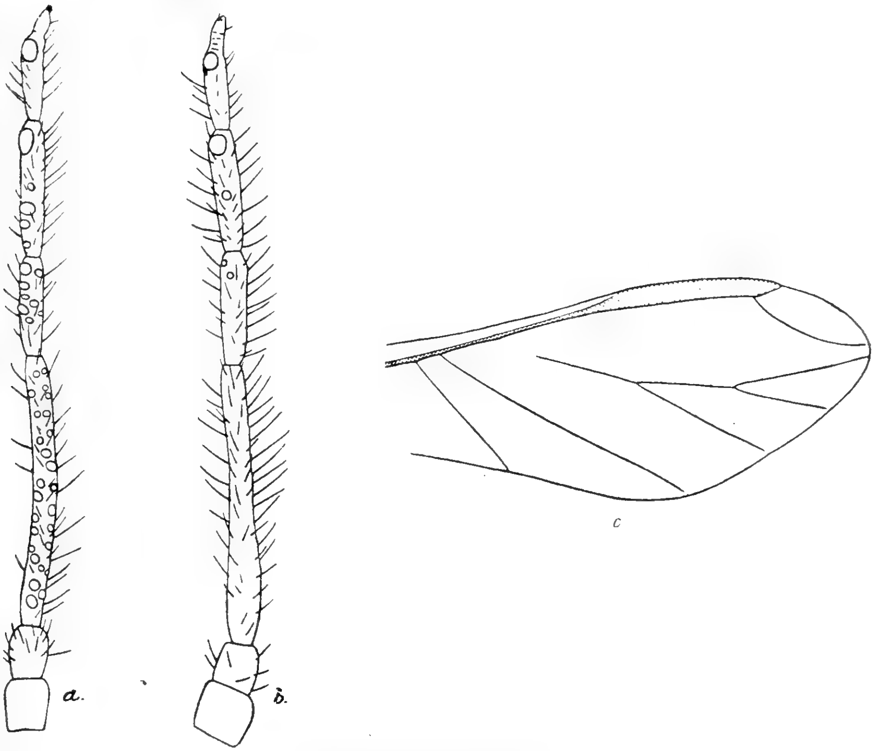

FIG. 5.—*Lachnus himalayensis*, sp. nov.
a. Antenna of alate female. (×60).
b. Antenna of apterous female. (×60).
c. Forewing of alate female. (×17).

Colour.—Body of the same colour as the apterous female; pterostigma of forewings grayish. (Notes from specimen in alcohol).

Morphological characters.—Head, thorax and abdomen covered with numerous, fine, moderately short hairs.

Antennae less than half as long as the body; relative lengths of the four last antennal joints about as: 33. 12. 16. 13. Sensoriae are present as follows: III 45. IV 10. V 7+1. VI 1 (+4). Secondary sensoriae circular, moderately large, tuberculate.

Rostrum, siphunculi, etc., as in the apterous female.

Wings with normal *Lachnus*-venation; media I twice forked. Hooking-hairs 6 in number. (Described from a number of wingless and winged females).

Food-plant unknown.

Locality.—Birch Hill (Darjiling District), 6,000—7,000 feet, 6-vii-1914 (*Carmichael* coll.).

Types in the collection of the Indian Museum, Calcutta; No. 5601/H. I.

The species described above is distinct from all other species of *Lachnus* known to me by the numerous sensoriae on the third antennal joint in the winged female.

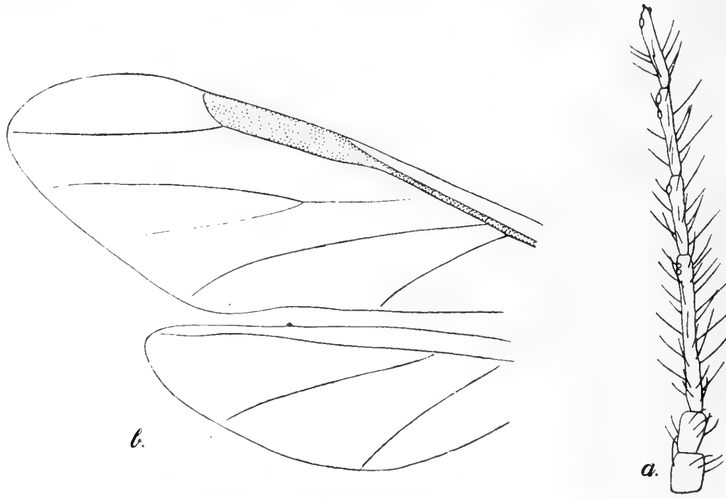

FIG. 6.—*Lachnus similis*, sp. nov.
a. Antenna of alate female. (× 45).
b. Fore and hindwing of alate female. (× 15).

Lachnus similis, sp. nov.

Alate viviparous female.

Measurements.

Length of body	..	..	4·70 mm.
Breadth of body	..	..	2·16 ,,
Length of antennae	..	..	1·65 ,,
Siphunculi (diam.)	..	..	0·13 ,,
Expanse of wings	..	..	16·20 ,,

Colour.—Head and thorax black; abdomen dirty grayish with four longitudinal rows of dark brown spots. Eyes red. Antennae brownish-yellow, the tips of all joints blackish. Legs light yellowish; tarsus, tip of tibia and the femur except the base brownish-black. Siphunculi black. Cauda darkish. Pterostigma of forewings dark brown. (Notes from specimen in alcohol).

Morphological characters.—Body robust, head and thorax with numerous, fine, very long hairs, the abdomen less hairy.

Antennae about 1/3 the length of the body, with numerous, fine, long hairs; relative lengths of the four last antennal joints about as: 35. 17. 19. 17. Sensoriae are present as follows: III 1—2. IV 1. V 1+1. VI 1 (+4). Secondary sensoriae circular, moderately small, of about the same size as the primary ones.

Rostrum reaching to the third pair of coxae.

Siphunculi broadly conical, but little elevated above the level of the body. Cauda obsolete.

Wings with the typical *Lachnus*-venation; media 1, however, only once forked.

Legs fairly long, with numerous fine hairs. (Described from a single winged female with damaged hind-wings).

Food-plant unknown.

Locality.—Phagu, 9,000 feet, Simla Hills, W. Himalayas; 18-v-1916 (*N. Annandale* and *S. Kemp*).

Type in the collection of the Indian Museum, Calcutta; No. 3825/H. 1.

Although described from a single specimen only, I feel little hesitation in considering this a distinct species. It shows some resemblance to *Lachnus pineti*, Koch, but is sufficiently different in the distribution of the sensoriae on the antennal joints, as well as by media 1 being only once forked.

List of remaining species in the collection examined.

Macrosiphoniella sanborni, Gill.; Calcutta.

Toxoptera aurantii, Boyer; Darjiling, Birch Hill; Calcutta.

Aphis gossypii, Glov. (?); Salt Lakes, Calcutta.

Aphis medicaginis, Koch.; Dinapore, Bihar; Calcutta (maidan).

Aphis malvacearum, Das; Soom (Darjiling District).

Aphis malvae, Koch (?); Calcutta.

Aphis merri, Boyer (=*A. asclepiades*, Pass.); on *Callotropis gigantea* and *Tylophora asmatica* (?); Calcutta; Barkuda Island, Chilka Lake (Madras).

Siphonaphis midis, Fitch; on maize flowers; Siripur, Bihar.

Siphonaphis nympheae, L.; on water-hyacinth; Rambha, Madras.

Siphonaphis padi, L. (?); in grass; Paksey, Bengal.

Siphocoryne pseudobrassicae, Davis; Dinapore, Bihar.

Pterocomma populea, Kalt (?); Bhim Tal, W. Himalayas (4,500 feet).

XII. INDIAN FLIES OF THE SUBFAMILY RHINIINAE.

By CHARLES H. T. TOWNSEND, *Ph.D.*,
Custodian of Muscoid Diptera, U.S. National Museum.

The family Muscidae (syn. Calliphoridae) divides into two subfamilies, the Muscinae and the Rhiniinae. The Muscinae are numerously represented in all habitable parts of the globe; but the Rhiniinae are strictly confined to the Old World, with the sole exception of *Pollenia* which has reached America almost certainly through the agency of man.

The material considered in this paper was submitted to me for determination by the Indian Museum. The following synoptic table will enable the identification of the genera of this subfamily known to me, a few genera not represented in the Indian collection being included with their localities. In order to complete this survey of the Rhiniinae, there are appended at the end of the table notes on seven genera probably belonging to this subfamily but not known to me in material, some of which may be found to occur in the Indian region.

GENERA OF RHINIINAE.

1.	Epistoma *Rhinia*-like, strongly warped forward	2
	Epistoma *Phasia*-like, projected downward rather than forward...	11
2.	Arista plumose, ciliate both above and below	3
	Arista ciliate only above	6
3.	Mesoscutum and abdomen finely pubescent, the disk of former without macrochaetae ...	*Borbororhinia*, gen. nov.
	Mesoscutum with macrochaetae on disk ...	4
4.	Apical cell widely open	*Cosmina*, R. D.—Africa.
	Apical cell closed or extremely short-petiolate	5
5.	Arista long-plumose to tip; frontalia of male pinched out by the nearly contiguous eyes, the parafrontalia reduced to a line ...	*Synamphoneura*, Big.
	Arista plumose on basal two-thirds or so, but tip bare; frontalia of male reduced to a line, the parafrontalia broadly present and eyes well separated	*Eusynamphoneura*, gen. nov.—Africa.
6.	Apical cell petiolate	7
	Apical cell not petiolate	9
7.	Petiole of apical cell rather long and practically in line with third vein	8
	Petiole of apical cell short, in line with final course of fourth vein	*Idielliopsis*, gen. nov.
8.	Abdomen as broad as long; male hypopygium large	*Chlororhinia*, gen. nov.
	Abdomen longer than broad; male hypopygium small	*Rhinia*, R. D.

9.	Apical cell widely open	*Stomorhina*, Rdi.
	Apical cell closed or very narrowly open ...	10
10.	Facial carina rather narrow; male frontalia broadly present throughout	*Idiella*, B. B.
	Facial carina broad, tubercular, fading below; male frontalia pinched out	*Euidiella*, gen. nov.
11.	Arista bare or at most only microscopically pubescent	12
	Arista plumose or long-pubescent, ciliate above and below	16
12.	Facial carina weak but distinct	*Metallea*, Wulp.
	Facial carina quite absent	13
13.	Apical cell widely open	14
	Apical cell closed or very narrowly open ...	15
14.	Disk of mesoscutum with macrochaetae ...	*Trichometallea*, gen. nov.
	Disk of mesoscutum without macrochaetae; male scutellum greatly swollen, far over-reaching the base of abdomen	*Stegosoma*, Lw.—Africa.
15.	Preacrostichals present; frontals descending below base of antennae (see note below) ..	*Rhyncomya*, R. D.—Mediterranean Region.
	No preacrostichals; frontals stopping at base of antennae	*Rhynchomyiopsis*, gen. nov.
16.	No discals on anal segment	17
	Erect or suberect, short or long discals on anal segment, at least laterally	18
17.	Epistoma very narrow; hypopygium of moderate size...	*Thoracites*, B. B.
	Epistoma not unusually narrowed; hypopygia of both sexes greatly enlarged	*Chloroidia*, gen. nov.
18.	Fourth vein evenly rounded at bend, more or less like that of *Muscina*	*Strongyloneura*, Big.
	Fourth vein not evenly rounded (see *S. viridana*, sp. n.) ...	19
19.	Arista pubescent about two-thirds way ...	*Metalliopsis*, gen. nov.
	Arista plumose practically to tip	20
20.	Facial carina absent	21
	Facial carina present	22
21.	Epistoma of ordinary width ...	*Synamphoneuropsis*, gen. nov.
	Epistoma very narrowed	*Nitellia*, R. D.—Europe.
22.	Epistoma very broad	23
	Epistoma narrow	24
23.	Short straight erect spines on scutellum ...	*Apollenia*, Bezzi.—Africa.
	No spines on scutellum	*Thelychaeta*, B. B.
24.	Facial carina narrow, sharp	*Pollenia*, R. D.
	Facial carina rather broad, flattened ...	25
25.	Lateral discals on all abdominal segments ...	*Dexopollenia*, gen. nov.
	Lateral discals not present on all segments ...	*Polleniopsis*, gen. nov.

NOTES.

Rhyncomya, R. D.—The characters in the table are drawn from *impavida*, Rossi (syn. *columbina*, Meig.). The genotype is *Musca ruficeps*, Fab., with which *impavida* seems to be congeneric. The main characters of *impavida* are: Facial carina absent; epistoma rather *Phasia*-like, broad and rather strongly protuberant; arista microscopically pubescent; apical cell very narrowly open, almost closed; male eyes nearly contiguous, frontalia pinched out; male hypopygium rather large, claws not very long; bristles on margin of last two segments; front tarsi of female slightly widened; palpi subphylliform; no differentiated proclinate fronto-orbitals in female.

Strongyloneura, Big.—The characters in the table are drawn from *S. nepalana*, sp. n. The genotype is *S. prasina*, Big., Japan, with which *nepalana* seems to be congeneric. The main characters of *nepalana* are: Facial carina absent; epistoma *Phasia*-like, quite broad; arista long-plumose nearly to tip; apical cell open, fourth vein evenly rounded at bend like *Muscina*; macrochaetae marginal, short erect discals in transverse row on anal segment; front tarsi of female moderately widened; palpi club-shaped; female vertex less than eye-width, two strong proclinate fronto-orbitals; strong preacrostichals present; male hypopygium not extremely large but rather conspicuous and elongate; male eyes not contiguous, but frontalia nearly or quite pinched out.

Arrhinidia, B. B.—The genotype is *Rhyncomya aberrans*, Sch., China. Would run out at couplet 12 of the table, on character of the arista. Facial carina present; epistoma apparently *Phasia*-like, but little projected; arista short-ciliate above only; apical cell open; male eyes practically contiguous; male hypopygium large; macrochaetae marginal; front tarsi widened; palpi phylliform.

Stomina, R. D.—The genotype is *S. rubricornis*, R. D., Europe. A probable synonym is *Gymnostylina*, Mcq. Would run out with *Metallea*. Facial carina weak but probably broad, as description states that the antennae of female are separated thereby; epistoma probably *Phasia*-like, stated to be somewhat rostriform; arista pubescent; apical cell open; macrochaetae of abdomen weak or absent; thorax villous, without macrochaetae on disk.

Beria, R. D.—The genotype is *B. inflata*, R. D., Africa. Would run to 14, and probably out with *Stegosoma*. Head inflated somewhat after the style of *Salmacia* (*Gonia*); facial carina absent; epistoma *Phasia*-like; arista bare; apical cell open; male eyes nearly contiguous; macrochaetae weak; palpi subphylliform, widened at tip.

Pararhynchomyia, Becker.—The genotype is evidently *P. varifrons*, Beck., Africa, but I have been unable to find the original reference in the literature and get my information from Bezzi's 1911 paper on African "Miodarii Superiori." Would run out at 16 on apical cell petiolate. Facial carina not developed; epistoma *Phasia*-like; arista bare; apical cell petiolate; further characters not stated by Bezzi.

Idiopsis, B. B.—The genotype is *I. prasina*, B. B., Mediterranean Region. Would run to 18 apparently. Facial carina absent; epistoma *Phasia*-like, moderately broad; arista long-plumose; apcial cell open; male eyes nearly contiguous, the upper facets enlarged; male hypopygium large, claws not very long; macrochaetae marginal on segments one to four; front tarsi of female scarcely widened; palpi club-shaped, probably widened; four or more short, equal proclinate fronto-orbitals in female; female vertex wide.

Anastellorhina, Big.—The genotype is *A. bicolor*, Big., Australia. Said by Brauer to be near *Idiopsis*. Would probably run to 18 with *Idiopsis*. Facial carina not developed at all; epistoma probably *Phasia*-like, though face is stated to be strongly concave; arista long-plumose to tip; apical cell open; long marginal macrochaetae on third and anal segments; female with two proclinate fronto-orbitals; very long lower border of head.

Tricyclopsis, T.—The genotype is *Rhyncomya dubia*, Mcq., Australia. Placed by Brauer near *Thelychaeta*. Would probably run to 22. Facial carina absent; epistoma probably *Phasia*-like; arista very long-plumose; facialia ciliate over half way up; parafacialia with short bristly hairs; palpi club-shaped. This and the preceding are doubtful members of this subfamily.

DESCRIPTIONS AND RECORDS.

The Indian Museum collection sent me contains 243 specimens of Rhiniinae, which are here reported on. The diagnoses of all the genera that follow have been drawn from the genotypes, personally studied by me in material, only five of these genera not being represented in the Indian collection.

Borbororhinia, gen. nov.

Genotype, *Borbororhinia pubescens*, sp. n.

Facial carina very weak, showing only as a low knife-like edge between antennae; epistoma *Rhinia*-like, but projected only a little below vibrissae; arista thinly plumose, ciliate above and below; apical cell narrowly open, very narrowed on terminal portion; male eyes widely separated, the frontalia wide and continuing full width throughout, the parafrontalia narrow but distinct; male hypopygium moderately large, extruded posteriorly, giving tip of abdomen a tapered form; male claws elongate; thorax and abdomen finely pubescent, abdomen with very fine hair-like marginals; disk of mesoscutum without chaetae, one postsutural behind with a shorter one just in front of it, and one postacrostichal behind; front tarsi of male very slightly widened; palpi phylliform.

Borbororhinia pubescens, sp. nov.

Length of body, 5 to 6 mm.; of wing, 4 to 4·5 mm. Two males, Parambikulam, Cochin State, 1,700-3,200 ft., Sept. 16-24, 1914 (*F. H. Gravely*).

Pallid testaceous. Frontalia, first two antennal joints and palpi obscure fulvous; third antennal joint pale fulvous. Parafrontalia and upper half of parafacialia thinly silvery, lower half of latter shining black. Facial plate and facialia polished, the latter with large shining black area confluent with that of parafacialia. Epistoma shading to brown on sides. Cheeks with shining dark brown or black area. Sternum, pleurae and anterior half or so of venter very pale yellowish or straw-colour; mesoscutum, scutellum, abdominal tergum and posterior half of venter fulvous, shaded more or less with fuscous; mesoscutum showing thinly silvery, with four brown or black vittae, the two inner ones widely separated. Legs pale fulvous, the tarsi dusky except the whitish-yellow metatarsi. Pile of body short, black, very soft and fine. Wings slightly tinged with smoky-yellow, more so on costal portion. Tegulae smoky-yellow.

Holotype in Ind. Mus. Paratype, No. 21022 U.S. Nat. Mus.

Two apparently new genera near *Borbororhinia* are represented in the Indian collection by two male specimens from Margherita, Assam, and Mergui, Lower Burma (*W. Doherty*). They are not in sufficiently good state of preservation to serve as holotype specimens; hence I do not name them.

Cosmina, R. D.

(Syn. *Seseromya*, Rdi.)

Genotype, *Musca punctulata*, Wied.—Africa, (syn. *Cosmina fuscipennis*, R. D.).

Facial carina present but weak; epistoma *Rhinia*-like but not very strongly projected; arista plumose on both sides, tip more or less bare; apical cell widely open; male eyes nearly contiguous, the frontalia completely pinched out; male hypopygium large; weak macrochaetae on anal segment, practically only marginal.

I am unable to refer any of the forms in the Indian collection to this genus. Indian and East Indian species have been referred here by Walker and Bigot, probably incorrectly.

Synamphoneura, Bigot.

Genotype, *S. cuprina*, Big.—Java.

Facial carina not developed; epistoma *Rhinia*-like, broad; arista long-plumose; apical cell closed in margin or extremely short-petiolate; male eyes nearly contiguous, frontalia pinched out; male hypopygium rather large, claws elongate but not very strong; strong macrochaetae on margin of anal segment, weak ones on margins of other segments; front tarsi not widened in either sex, female claws very short and weak; palpi phylliform but not very wide.

Synamphoneura cuprina, Big.

Fourteen specimens, both sexes, from Java, Assam and Burma.

Eusynamphoneura, gen. nov.

Genotype, *Idia seriepunctata*, Lw.—Mozambique, (syn. *Cosmina depressa*, Karsch).

Facial carina very weak in the male, almost undeveloped in the female; epistoma *Rhinia*-like, broad; arista plumose on both sides, except tip; apical cell closed in the margin or very short-petiolate; male eyes not contiguous, well separated, the parafrontalia broad, the frontalia reduced to a line; male hypopygium not large, of moderate size; weak marginal macrochaetae on anal segment, and bristle rows on margins of second and third segments.

This genus appears to be confined to East Africa.

Idielliopsis, gen. nov.

Genotype, *Idielliopsis similis*, sp. n.

Facial carina broadly developed, widely separating the antennae; epistoma *Rhinia*-like; arista ciliate on upper side only; apical cell short-petiolate, the petiole about half as long as small crossvein and in line with final course of fourth vein; male eyes nearly contiguous, the frontalia completely pinched out; male hypopygium small; weak bristle-like macrochaetae on margin of anal segment; female vertex about one-fifth of head-width.

Idielliopsis similis, sp. nov.

Length of body, 9 to 9·5 mm.; of wing, 6·5 to 7 mm. Three males: Dhikala, Naini Tal District, United Provinces of Agra and Oudh, April 22, 1908 (*R. H.*); Mazbat, Mangaldai District, Assam, Oct. 11-15, 1910 (*S. Kemp*); Paresnath, Chota Nagpur, 4,000-4,400 ft., April 13, 1909 (*N. Annandale*); one female, Katihar, Purneah District, Bihar, March 23, 1909 (*C. Paiva*).

Differs in coloration from *Idiella mandarina*, Wd. practically only as follows: Less black on abdomen, male showing same on anal segment and posterior third to half of preceding segment in addition to the median vitta; the female lacks the black entirely, even the median vitta being lost. The red of abdomen is somewhat darker, rather reddish-orange. Mesoscutum and scutellum quite distinctly dark green. Tegulae deeper yellowish. Legs wholly brown to black, only the metatarsi lighter; the bases of tibiae light brown.

Holotype (male) and allotype (female) in Ind. Mus. Paratype, No. 21023 U.S. Nat. Mus., male.

Rhinia, R. D.

(Syn. *Beccarimyia*, Rdi.)

Genotype, *R. testacea*, R. D.—Mauritius, (syn. *Becc. glossina*, Rdi.).

Facial carina broad; epistoma strongly warped forward, well projected; arista ciliate above only; apical cell petiolate, the petiole rather long and about in line with third vein; male eyes nearly contiguous, the frontalia practically pinched out, and the parafrontalia reduced almost to a line; male hypopygium small; no abdominal macrochaetae, only bristles; front tarsi widened in both sexes; palpi phylliform.

Rhinia testacea, R. D.

Four specimens, from Bombay, Puri, Malavni, and Ceylon (5,291 ft.). The species occurs from North Africa through the Orient to the Pacific Is.

Chlororhinia, gen. nov.

Genotype, *Chlororhinia viridis*, sp. n.

Facial carina narrow, weak; epistoma *Rhinia*-like, but produced beyond vibrissal angles only about as far as length of second antennal joint; arista very short-ciliate, merely pubescent, on upper side only; apical cell petiolate, the petiole as in *Rhinia*; male eyes nearly contiguous, the frontalia pinched out, the parafrontalia reduced to a line; male hypopygium rather large, abdomen rather wider on first two segments than its length on median line; no abdominal macrochaetae; front tarsi not widened; pollinose-pilose band of cheeks and pleurae wanting.

Chlororhinia viridis, sp. nov.

Length of body, 4 mm.; of wing, 3 mm. One male, Shillong, Khasi Hills, Assam (*H. H. Godwin-Austen*); also a specimen with head and abdomen missing, but evidently this species, Ukhrul, Manipur, 6,400 ft. (*W. Pettigrew*).

Wholly bright metallic green in body and head integument, including clypeus and epistoma. Frontalia black, antennae pale fulvous, palpi blackish, base of haustellum metallic green. Parafacialia silvery pollinose on upper end, opposite second antennal joint. A thin beard, some pleural hair and hairs on edge of scutellum tawny. Mesoscutum, scutellum and tergum of abdomen blackish-punctate, the dots marking origins of microchaetae; no thoracic vittae. Abdominal tergum blackish on disk, extended widely along the three segmental incisures and more or less confluent; the hairs of this region smaller and more closely placed, the blackish dots on sides of abdomen larger and less closely placed. No dot-punctation on head. Legs very pale fulvous, the femora brownish except front pair which are metallic green. Wings faintly tinged with smoky-yellowish throughout. Tegulae a little more deeply tinged with fuscous.

Holotype in Ind. Mus.

Stomorhina, Rdi.

(Syn. *Idia*, Wied. preocc.)

Genotype, *Musca lunata*, Fab.—Madeira, (syns. *Idia cinerea*, R. D., *I. fasciata*, Meig., *Stomorhina maculata*, Rdi.).

Facial carina broadly developed; epistoma *Rhinia*-like; arista ciliate above only; apical cell widely open; marginal bristles on last two abdominal segments; male eyes actually contiguous; male mesoscutum, scutellum and abdomen with thin erect black pile, that of scutellum longer than that of thorax, the female lacking such pile; male hypopygium not large, claws not very long; parafacialia hairy.

Stomorhina lunata, Fab.

Three males and eight females, from Darjiling (7,000 ft.), Sukhwani (Nepal), Coonoor (Nilgiris), Horai (Naini Tal, west base of Himalayas), and Maritime Alps.

Idiella, B. B.

Genotype, *Idia mandarina*, Wied.—China, (syn. *Idia nigricauda*, Bigot).

Facial carina well developed, sharp; epistoma *Rhinia*-like; arista long-ciliate on upper side only; apical cell closed or narrowly open; male eyes well separated, the frontalia broadly persistent throughout; male hypopygium large, claws long; weak macrochaetae on margin of anal segment.

Idiella mandarina, Wied.

Twenty-six specimens, both sexes, from Burma, Cochin State, Assam, Calcutta, and various localities in India from sea-level up to 6,400 feet.

Euidiella, gen. nov.

Genotype, *Musca discolor*, Fab.—Java, (syns. *Stomorhina muscina*, Rdi., *S. scalaris*, Big.).

Facial carina developed, broad, tubercle-like, widely separating the antennae, fading out below; epistoma *Rhinia*-like, broad; arista thinly long-ciliate above only; apical cell closed in margin or narrowly open; male eyes contiguous, even the parafrontalia practically pinched out; male hypopygium small, claws short; abdominal macrochaetae not developed; front tarsi widened in both sexes.

Euidiella discolor, Fab.

Twenty-seven specimens, both sexes, from Java, Lower Burma, Assam, Nepal, Western Ghats, Sind, and various localities in India from sea-level at Calcutta up to 7,000 feet in the Himalayas. One male was taken at light, and two males were taken hovering in the air.

The yellow of second abdominal segment may be either uninterrupted on the median line, as described by Rondani under the name *muscina*, or rather broadly interrupted on same.

Euidiella quadrinotata, Big.

(*Idia quadrinotata*, Big.—Borneo).

Two females, Mujang, Sarawak, Borneo, July 12, 1910 (*C. W. Beebe*). This is evidently a good species. It is closely allied to *discolor*, F., from which it differs in having the abdomen black except the narrow base and the restricted lateral spots on second and third segments. It is also a little more narrowed in form.

Euidiella unicolor, sp. nov.

Length of body, 5·5 to 6·25 mm.; of wing, 4 to 4·5 mm. Three females, Mujang, Sarawak, Borneo, July 12, 1910 (*C. W. Beebe*); Parambikulam, Cochin State, 1,700-3,200 ft., Sept. 16-24, 1914 (*F. H. Gravely*); and Mangaldai District, N.E., Assam-Bhutan Frontier, Dec. 26, 1910 (*S. W. Kemp*).

Differs from *quadrinotata*, Big., by the still more narrowed form, and the wholly dark green abdomen. The legs and antennae are darker also. The second and third specimens mentioned above have the front appreciably shorter and broader than in the Bornean specimen.

Holotype in Ind. Mus., Sarawak. Paratype, No. 21025 U.S. Nat. Mus., Assam-Bhutan Fr.

Euidiella purpurea, sp. nov.

Length of body, 8 to 9 mm.; of wing, 6 to 7 mm. Three males and two females: Three on board ship, 10 miles off Masulipatam, Madras Coast, June 4-5, 1908 (*C. Paiva*); one Sukna, Eastern Himalayas, 500 ft., July 1, 1908 (*N. Annandale*); and one Kurseong, Eastern Himalayas, 5,000 ft., August 13-15, 1909 (*J. T. Jenkins*).

Shining black, with greenish thorax. Parafrontalia honeycombed with yellowish pollen. Parafacialia with silvery or yellowish bar across upper end, extending over upper part of facialia, and a yellowish fleck below on cheek-grooves next eye. Antennae light brownish. The usual broad stripe of pale yellow pollen and pile on cheeks and pleurae. Mesoscutum and scutellum metallic greenish-cupreous, light golden pollinose, punctate with blackish. Abdomen with decided purplish-cupreous shade on sides and covering whole of anal segment. Venter pollinose, with punctations. Legs subfulvous; femora black with purplish tinge, especially front ones; tips of tarsi dusky. Wings nearly clear, base and especially tips smoky. Tegulae smoky-yellow.

Holotype (male) and allotype (female) in Ind. Mus. Paratypes, No. 21026 U.S. Nat. Mus., male and female.

This species is evidently similar to *Idia cervina*, O.S., of Amboyna.

Metallea, Wulp.

Genotype, *Metallea notata*, Wulp.—Java, (syn. *Rhyncomya diversicolor*, Big.).

Facial carina but little developed, flat and weak; epistoma *Phasia*-like, not very broad, not strongly protuberant; arista finely pubescent; apical cell well open; male eyes nearly contiguous, the frontalia completely pinched out; male hypopygium rather large; marginal row of macrochaetae on last three segments.

Metallea notata, Wp.

Twenty-four specimens, both sexes, from Java, Puri, Shillong, Port Blair, and other Indian localities including on board ship 10 miles off the Madras coast. East African specimens appear to be conspecific with the Indian specimens.

Trichometallea, gen. nov.

Genotype, *Trichometallea pollinosa*, sp. n.

Facial carina absent; epistoma *Phasia*-like; arista bare; apical cell widely open; male eyes nearly contiguous, the parafrontalia reduced to a line; male hypopygium small; abdominal macrochaetae bristle-like, suberect, marginal on last two segments, at sides of other segments, some discals on anal segment; front tarsi of female slightly widened, those of male not so; palpi phylliform, not very broad; mesoscutum, scutellum and abdomen pilose in male, but not in female.

Trichometallea pollinosa, sp. nov.

Length of body, 5·25 to 6·5 mm.; of wing, 5·75 to 6 mm. Two males and one female: One male Songara, Gonda District, United Provinces, March 3-5, 1907; the others Umballa, North-west India, 900 ft., May 8-13, 1905 (*E. Brunetti*).

Pale yellowish, thinly silvery pollinose. Head pale luteous; antennae, frontalia and palpi fulvous. Thorax greenish-cupreous, pleurae thickly pale yellowish pollinose. Mesoscutum and scutellum rather thickly silvery pollinose. Abdomen pale yellowish; median vitta and hind margins of segments blackish, either broadly, narrowly or irregularly, the whole more or less thickly silvery pollinose shading to pale golden. Legs blackish or brownish, hind tibiae fulvous. Wings clear. Tegulae nearly white.

Holotype (male) and allotype (female) in Ind. Mus. Paratype, No. 21027 U.S. Nat. Mus., male.

Stegosoma, H. Loew.

Genotype, *Stegosoma vinculatum*, H. Loew.—Orange Free State, Africa.

Facial carina absent; epistoma *Phasia*-like, not very broad; arista bare; apical cell widely open; male eyes contiguous, the parafrontalia nearly pinched out; male hypopygium of moderate size, the scutellum greatly swollen and over-reaching the two basal segments of abdomen; no abdominal macrochaetae, the abdomen swollen, the anal segment bare on disk; front tarsi widened; palpi phylliform.

This genus appears to be confined to Africa.

Rhynchomyiopsis, gen. nov.

Genotype, *Rhynchomyiopsis indica*, sp. n.

Facial carina not developed; epistoma *Phasia*-like; arista practically bare; apical cell practically closed in margin quite far before wing-tip; weak bristles on margins of third and anal segments; front tarsi not widened; palpi phylliform; female vertex wider than eye; no fronto-orbitals in female save small reclinate ones; no preacrostichals; all head and other macrochaetae very weak; frontals stopping at base of antennae; costal spine strong; two sternopleurals, and only one postsutural. Male not known.

Rhynchomyiopsis indica, sp. nov.

Length of body, 6 mm.; of wing, 4·5 mm. One female, Karachi, Sind, Western India, July 28, 1889 (*Cumming*).

Head, scutellum, abdomen and legs rather pale fulvous, including frontalia, antennae and palpi; the abdomen subrufous from hind half of second segment to tip. Parafrontalia, parafacialia and cheeks very thinly silvery; three polished subround black spots near eye on each side; the largest about middle of parafacialia, one on front half of parafrontalia, the smallest one on cheeks. Thorax light metallic gold-green, the humeri fulvous. Wings scarcely infuscate. Tegulae nearly white.

Holotype in Ind. Mus.

Thoracites, B.B.

Genotype, *Musca abdominalis*, Fab.—East Indies.

Facial carina absent; epistoma *Phasia*-like, very narrow, the vibrissal angles constricting the facial plate far above oral margin; arista long-plumose to tip; apical cell narrowly open; male eyes not contiguous, about or fully as far apart as length of second antennal joint; male hypopygium rather large, claws very elongate; macrochaetae strong, suberect, on margins of last two segments, discal and marginal on sides of second and third segments, marginal on sides of first segment; palpi phylliform, but rather narrow; very strong, long costal spine; female with very narrow frontalia, male with same scarcely or not at all showing; female with two strong proclinate fronto-orbitals and one reclinate, male with none of either; female anal segment with close-set row of strong marginal spines, in addition to the regular marginals which thus become practially submarginal.

Thoracites abdominalis, Fab.

Twenty-one specimens, both sexes, from Ceylon, Puri and Madras. The species may be known by the green thorax and fulvous to rufous abdomen, with the under edges of the intermediate abdominal segments more or less widely black.

Chloroidia, gen. nov.

Genotype, *Chloroidia flavifrons*, sp. n.

Facial carina not developed; epistoma *Phasia*-like, rather narrow; arista ciliate on both sides nearly to tip; apical cell very narrowly open, almost closed, the tip of cell narrowed; male eyes nearly contiguous, the frontalia pinched out; male hypopygium extremely large, that of female large and broad; macrochaetae bristle-like on margins of last two segments; front tarsi of female widened, those of male not so; intermediate abdominal segments of male extremely shortened, the two hypopygial segments greatly enlarged and almost as long as the four preceding segments; fifth sternite of male with spine-brush, the sixth sternite excessively broadened and with spine-brushes on each side.

Chloroidia flavifrons, sp. nov.

Length of body, 5 to 5·5 mm.; of wing, 4 to 4·5 mm. One male, Mergui, Lower Burma (*W. Doherty*); one female, Chalakudi, Cochin State, Sept. 14-30, 1914 (*F. H. Gravely*).

Head light golden pollinose, parafrontalia more deeply golden; frontalia and large spot on each cheek black; antennae and palpi fulvous-yellow. Facial plate and facialia not pollinose, shining, tinged black in centre of clypeus and on vibrissal angels. Thorax and scutellum a very bright burnished emerald-green, thinly yellowish pollinose. Abdomen nearly as bright green; in female shading to cupreous at tip and more or less blackish on disk of tergum, in male dusky on tergal disk. Male hypopygium wholly purplish-brown; that of female nearly black, with some purplish tinge. Legs subfulvous; front femora bright green, others more black; tarsi darker distally. Wings faintly infuscate, or at least so on costa and tip. Tegulae tawny-whitish to yellowish.

Holotype in Ind. Mus., female; allotype, male.

Strongyloneura, Big.

The main characters of this genus as interpreted by me have been already given. My reference of the following species to *Strongyloneura* is provisional. They seem almost certainly, however, to be congeneric with the genotype (*prasina*, Big.—Japan), which I cannot identify positively in material but which, according to the description, is a member of the *Rhyncomya* group with strongly rounded fourth vein. The supplementary characters given by Brauer (*Sitz. Ak. Wiss.*, math.-nat. Cl., CVIII, 519) also agree.

Strongyloneura nepalana, sp. nov.

Length of body, 8·5 mm.; of wing, nearly 7 mm. One female, Thamaspur, Nepal, Feby. 18-20, 1908.

Metallic green; slightly cupreous, especially on abdomen. Parafrontalia, parafacialia and cheeks pale golden pollinose. Frontalia brown; antennae and palpi rufofulvous; clypeus and facialia shining yellowish-fulvous. Thorax and scutellum brighter green than abdomen, all with thin coat of silvery pollen. Legs brownish; tibiae tinged with fulvous; femora black, front pair greenish. Wings clear; apical cell rather widely open, though much narrowed at tip. Tegulae nearly white. Parafacial hairs yellowish, thick.

Holotype in Ind. Mus.

A male from Bhim Tal (4,500 ft.) seems to belong here; it is certainly congeneric, and I have drawn the male characters from it as already given, but the apical cell is more narrowly open, and the hairs of parafacialia are blackish. Also fifteen other specimens, both sexes, from Calcutta, Sukna, Assam and Burma appear to be this species, though the fourth vein is not so broadly rounded in all of them. Some have the wings lightly infuscate, and the hairiness of the parafacialia is variable in degree, though quite uniformly yellowish.

Strongyloneura nebulosa, sp. nov.

Length of body, 7 to 7·5 mm.; of wing, 6 to 6·5 mm. One male and one female, Margherita, Assam; and Mergui, Lower Burma (*W. Doherty*).

Differs from *nepalana* as follows: Whole body dark cupreous-purplish, with more or less green reflections. The female shows more green. Head testaceous, antennae and palpi fulvous. Parafrontalia and parafacialia pale yellowish to golden pollinose. Wings strongly smoky-infuscate across apical half and on extreme basocostal region. Tegulae yellow, upper scale more whitish. Apical cell narrowly open. Parafacial hairs sparse, blackish.

Holotype in Ind. Mus., male; allotype, female.

Strongyloneura viridana, sp. nov.

Length of body, 7 to 10·5 mm.; of wing, 6 to 8·5 mm. Five females: one Sadiya, North-east Assam, Nov. 27, 1911 (*S. Kemp*—Abor Exped.); four Calcutta, Aug. 27, Sept. 26, Oct. 2, 1907.

Entire body except head brilliant metallic green, with cupreous reflections especially on thorax. Head yellowish; pale golden pollinose on parafrontalia, parafacialia, facialia, cheeks and orbits; occiput more ashy. Frontalia brown; antennae, facial plate and palpi fulvous. Thorax thinly silvery pollinose, the scutellum and abdomen showing rather less so except on venter. Legs brownish-rufous; femora black, the front and middle pairs decreasingly green. Wings and squamae usually infuscate with smoky-yellow, the anal region less so, the squamulae whitish. Fourth vein less evenly rounded. The abdomen shows a faint purplish median vitta; and is more or less tinged with cupreous, sometimes wholly so. Parafacial hairs partly or wholly blackish.

Holotype in Ind. Mus. Paratypes, No. 21028 U.S. Nat. Mus.

Thirty-five other specimens, both sexes, from Calcutta, Sikkim and Assam (Sylhet), appear to be this species, but show fourth vein often bent rather suddenly and not evenly rounded. The parafacial hairs are quite uniformly blackish.

It is quite impossible to decide the distinctness of these specimens and those mentioned under *nepalana* without investigation of the forms in their native habitats and dissections of fresh material. The genitalia can not be satisfactorily prepared in the material before me.

Strongyloneura coerulana, sp. nov.

Length of body, 8·5 mm.; of wing, 6·75 mm. One female, Port Blair, Andaman Is., Feb. 15 to Mch. 15, 1915 (*S. Kemp*).

Differs from *viridana* as follows: Face and antennae rather testaceous; the pollen of head grayer, less golden. Disk of abdominal tergum broadly purplish-blue; the scutellum same colour, also the humeri and the central hind portion of mesoscutum. Wings clear, fourth vein broadly rounded. Tegulae nearly pure white. Parafacial hairs rather blackish.

Holotype in Ind. Mus.

Metalliopsis, gen. nov.

Genotype, *Metalliopsis setosa*, sp. n.

Facial carina weak, flat, separating antennae; epistoma *Phasia*-like, rather narrow; arista very short-plumose or long-pubescent about two-thirds way; apical cell widely open; macrochaetae marginal on last two segments, with irregular discals on anal segment; front tarsi a little widened; palpi phylliform, moderately wide; female front rapidly widening from vertex, parafrontalia thickly bristled outside of frontal row; parafacialia hairy above. Male unknown.

Metalliopsis setosa, sp. nov.

Length of body, 7 (abdomen recurved) to 8·5 mm.; of wing, 7 to 7·5 mm. Three females: Kurseong, Eastern Himalayas, 5,000 ft., July 6, 1908 (*N. Annandale*); and Siliguri, base of Eastern Himalayas, July 18-20, 1907.

Head rufofulvous, the parafrontalia showing obscurely green beneath the yellowish pollen; a black spot on parafacialia; third antennal joint and extreme tips of palpi dusky. Thorax and scutellum bright metallic green, with thin coat of silvery pollen; some thin long yellow pile on pleurae and humeri. Abdomen fulvorufous, with black median vitta; anal segment metallic cupreous-green. Edge of third segment and spot on side of second segment metallic greenish. Legs brownish-rufous; femora black with metallic green tinge, especially front ones. Wings and tegulae yellowish-infuscate.

Holotype in Ind. Mus. Paratype, No. 21029 U.S. Nat. Mus.

Synamphoneuropsis, gen. nov.

Genotype, *Synamphoneuropsis viridis*, sp. n.

Facial carina absent; epistoma *Phasia*-like, not very wide; arista long-plumose nearly to tip; apical cell open; male eyes not contiguous, separated by distance equal to half or more of the length of second antennal joint, the frontalia reduced to a line; male hypopygium moderately large, claws moderately elongate; macrochaetae not very strong, marginal on last three segments, with irregular suberect discals on anal segment; front tarsi of female a little widened, those of male not so; palpi phylliform, moderately wide; abdomen broader than in *Synamphoneura*.

Synamphoneuropsis viridis, sp. nov.

Length of body, 6 to 8 mm.; of wing, 4·5 to 6·5 mm. Eighteen specimens, both sexes: nine from Sukhwani, Nepal Frontier, Feb. 15-16, 1908; three from Muttra, United Provinces, July 24, 1905 (*E. Brunetti*); two from Allahabad, United Provinces, August 12-13, 1909 (*B. Lord*); one from Motisal, Garhwal District, base of Western Himalayas, March 5, 1910; one from Amangarh, Bijnor District, United Provinces, Feb. 24, 1910; and two from Anwarganj, Cawnpore District, United Provinces, Oct. 1-13, 1911 (*J. W. C.*).

Metallic cupreous-green; the coppery showing on dorsal portions, and especially on tip of abdomen. Front and face silvery-yellow pollinose; a shining brown spot near middle of parafacialia, a dusky area on cheeks, and another at front end of parafrontalia. Pollen of head of female more golden. Frontalia light brown; antennae and palpi fulvous to rufous. A thin silvery bloom over the metallic green of body. Obscure dark median vitta on abdomen. Legs brownish-rufous; femora blackish, more or less metallic green especially the front ones. Wings and tegulae distinctly smoky-yellowish, often the costal border of wing more infuscate.

Holotype (female) and allotype (male) in Ind. Mus. Paratypes, No. 21030 U.S. Nat. Mus., male and female.

Nitellia, R. D.

Genotype, *Musca vespillo*, Fab.—Europe.

Facial carina absent; epistoma *Phasia*-like, very narrowed; arista long-ciliate above, with only a few cilia below in middle; apical cell closed or very short-petiolate; male eyes nearly contiguous, the frontalia reduced to a line or nearly pinched out; male hypopygium rather large; macrochaetae like *Pollenia*; mesoscutum without yellow pile, and with pronounced flat discal impression.

This genus appears not to reach India.

Apollenia, Bezzi.

Genotype, *Pollenia nudiuscula*, Big.—Port Natal, Africa.

Facial carina flattened, wide, weak, broadly separating the antennae; epistoma *Phasia*-like, broad; arista long-plumose to tip; apical cell widely open; macrochaetae marginal on last three segments, with irregular discals on anal segment; front tarsi of female widened; palpi phylliform, but not very broad; scutellum with erect short straight spines.

This genus appears to be confined to Africa.

Thelychaeta, B. B.

Genotype, *Thelychaeta chalybea*, B. B.—Borneo.

Facial carina broad, but flattened; epistoma *Phasia*-like, broad and very long; arista wholly long-plumose to tip; apical cell widely open; male eyes almost contiguous, the frontalia nearly or quite pinched out, the parafrontalia reduced to a line; male hypopygium not very large, claws not very long; macrochaetae like *Pollenia*; front tarsi of female much widened, those of male scarcely so; palpi phylliform; female with two strong proclinate fronto-orbitals and one reclinate, male with none of either. No straight erect spines on scutellum.

Thelychaeta chalybea, B. B.

One female, labelled "no history." This specimen differs from the description by the third antennal joint being scarcely twice the length of the second. It is strongly bluish, and the abdomen shows practically no pollen. The tegulae are strongly infuscate with brownish, the wings but faintly so. The form is evidently congeneric with *viridaurea*, Wd., and is doubtfully referred to *chalybea*, B. B.

Thelychaeta viridaurea, Wied.

One male and six females of this interesting species are from Mergui, Lower Burma; Ghumti, Eastern Himalayas, 1,800-3,500 ft.; Sadiya, North-east Assam; and Soondrijal, Nepal; three others being labelled "no history." Wiedemann's characterization, though very brief, seems quite unmistakable. Brauer and Bergenstamm have given additional characters (*Musc. Schiz.*, III, 179). Wiedemann's specimen was evidently an undersized female. The present specimens measure 10 to 11 mm. The colour is golden-green, more or less cupreous; the abdomen with changeable pollen like *Pollenia rudis*, F., but greenish-gold. The male generic characters above are drawn from this species.

Pollenia, R. D.

Genotype, *Musca rudis*, Fab.—Europe, Asia, North America (evidently introduced in last).

Facial carina acute, sharp, narrow; epistoma *Phasia*-like, very narrowed; arista plumose to tip; apical cell widely open; male eyes not contiguous, but rather closer together than length of second antennal joint, the frontalia practically pinched out;

male hypopygium not large, claws not long; macrochaetae bristle-like, long, suberect, marginal on last three segments, irregularly discal on anal segment; front tarsi of female widened, those of male not so; palpi club-shaped, not much flattened and not very stout; female with two proclinate and one reclinate fronto-orbitals, male with none of either.

Pollenia rudis, F.

Two males, one between Yanghissar and Sinkol (Yarkand Exped.); the other Styria.

This species has been demonstrated by Keilin to be parasitic in earthworms in France. It has recently been reared by the U.S. Bureau of Entomology from earthworms in America.

Dexopollenia, gen. nov.

Genotype, *Dexopollenia testacea*, sp. n.

Facial carina strong, wide and depressed, merged widely into epistoma; vibrissae but little above oral margin, the epistoma *Pollenia*-like, narrow; arista moderately plumose; apical cell narrowly open, the fourth vein curved much like that of *Pyrellia*; male eyes practically contiguous, the parafrontalia reduced to a line; male hypopygium rather large; macrochaetae bristle-like, erect, marginal on last three segments, lateral discals on all; front tarsi not widened in either sex; palpi subcylindrical; thorax with yellowish crinkled pile; parafacialia wide and bare.

Dexopollenia testacea, sp. nov.

Length of body, 5·5 mm.; of wing, 6 mm. One male and one female, Assam-Bhutan Frontier, Mangaldai District, N.E., Jany. 1-2, 1911 (*S. W. Kemp*).

Fulvotestaceous, shaded to brown. Head with pale brown shading over face and cheeks; the parafrontalia dark brown, thinly silvery pollinose, leaving three main darker areas on vertex, middle, and opposite base of antennae, the vertical area not showing in male. Thorax and scutellum mostly brown; the scutum blackish, but showing some silvery pollen. Abdomen with hind borders of segments brown, the third and anal brown on posterior half, or anal wholly brown. Legs testaceous, tinged with brown; tarsi blackish. Wings clear. Tegulae smoky.

Holotype in Ind. Mus., female; allotype, male.

Polleniopsis, gen. nov.

Genotype, *Polleniopsis pilosa*, sp. n.

Facial carina broad, flattened, rounded, reaching nearly to epistoma, the latter *Pollenia*-like, narrow and short; arista thickly plumose; apical cell moderately open, the fourth vein bent suddenly; male eyes nearly contiguous, the frontalia pinched out or only very narrowly showing; male hypopygium not very large, claws moderately elongate; macrochaetae bristle-like, much as in *Pollenia*; short straight pile of thorax black, longer on pleurae; no crinkled yellow pile; front tarsi normal in male; palpi subcylindrical; parafacialia moderately wide, more or less pilose above.

Polleniopsis pilosa, sp. nov.

Length of body, 5 to 8 mm.; of wing, 5 to 8 mm. Two males: Darjiling, 6,000 ft., Sept. 21, 1908 (*E. Brunetti*); and Purneah, Bihar, August 5, 1907 (*C. Paiva*).

Brown to blackish, more or less silvery or ashy pollinose. Head pale brownish, the front darker; pollen silvery to ashy. Palpi fulvous to fulvorufous; third antennal joint subfulvous; frontalia light to dark brown. Mesoscutum with five black vittae, the middle one obsolete before suture in posterior view; the two inner ones before suture narrow in posterior view, but forming one wide vitta in anterior view. Abdomen tessellate much as in *Pollenia rudis*. Legs brown. Wings nearly clear, faintly tinged with smoky-yellowish especially on costa. Tegulae yellowish-smoky.

Holotype in Ind. Mus. Paratype, No. 21031 U.S. Nat. Mus.

XIII. NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

IX. *LEANDER STYLIFERUS*, MILNE-EDWARDS, AND RELATED FORMS.

(Plates VIII—X).

By STANLEY KEMP, *B.A., Superintendent, Zoological Survey of India.*

One of the most conspicuous features of the fauna of the silt-laden waterways of the Gangetic delta and other estuarine regions of the Indian coast is the enormous abundance of prawns belonging to the genus *Leander*. In general appearance the forms that frequent these localities differ widely from the marine species on which our conception of the genus is primarily based; the rostrum is much longer, with an elevated dentate crest at its proximal end, the second legs are very slender, often with the palm of the chela inflated, and the last three legs are attenuated. *Leander styliferus*, described by Milne-Edwards eighty years ago from specimens obtained at the mouth of the Ganges, is typical of the species that exhibit these characteristics.

The group of species, though it appears to be a natural one, is by no means clearly defined, for it grades almost imperceptibly into the more normally constituted elements of the genus, through such forms as *Leander concinnus*, de Man, and *L. indicus*, Heller. It is, however, of particular interest in the study of the brackish water fauna of Eastern Asia in that it includes a number of abundant species that migrate annually from the sea into estuaries and tidal rivers, as well as others that have succeeded in establishing themselves in pure fresh water.

Some of the forms are of considerable economic importance in India and China, and probably also in other countries. Vast quantities of *Leander styliferus* and *L. tenuipes* are caught in the Gangetic delta and sold in those markets frequented by the poorer classes of the population, while in the Kiangsu province of China *L. modestus* is captured in large numbers, especially in the Tai Hu Lake. To a European palate these species of *Leander* are lacking in flavour and seem greatly inferior to the Penaeidae that frequent the same waters.

Among the Carids that have been accumulating in the Indian Museum for the past thirty years, the species of *Leander* allied to *L. styliferus* are well represented and the collection has recently been enriched by the acquisition of a number of specimens, comprising several forms of great interest, obtained by Dr. Annandale in China and in the Malay Peninsula.

Including the new forms described below, ten species showing affinity with *L. styliferus* are now known; seven of these are dealt with in detail below. I have added an account of a very remarkable allied form which occurs in great abundance in Indian estuaries in company with *Leander*. According to the methods at present in vogue this species must be referred to the genus *Palaemon*, but it bears such an exceedingly close resemblance to *L. styliferus* that it may be doubted whether there is not some error in our scheme of classification. I have called this species *Palaemon mirabilis*.

The principal characters of *Leander styliferus* and the related species may be expressed in the following way:—

I. Dactylus of last three peraeopods very long and slender, that of fourth and fifth pairs at least as long as propodus; pleopods very long, those of first pair much longer than carapace [carapace with branchiostegal spine; palm of second peraeopods much swollen].

 A. Last two pairs of peraeopods excessively long, flagelliform, with dactylus much longer than carapace; carpus of second peraeopods much more than half as long as palm.

  1. Basal crest of rostrum with at most 7 teeth; fingers of second peraeopod more than twice as long as carpus ... *tenuipes*, Henderson.

  2. Basal crest of rostrum with 8 teeth; fingers of second peraeopod twice or less than twice as long as carpus ... *hastatus*, Aurivillius.[1]

 B. Last two pairs of peraeopods not excessively long, dactylus much shorter than carapace; carpus of second peraeopods less than half the length of palm ... ... *annandalei*, sp. nov.

II. Dactylus of last three peraeopods not abnormal in length, shorter than propodus; pleopods normal in length, those of first pair shorter than carapace.

 A. Carapace with branchiostegal spine; carpus of second peraeopods less than one and a half times as long as chela.

  1. Palm of second peraeopods much swollen in large specimens, carpus much shorter than chela.

   a. One or more subapical dorsal teeth on rostrum; carpus of second peraeopods shorter than merus or than fingers; last abdominal somite in adults not more than half length of carapace.

    i. Dactylus of third peraeopod more than three quarters length of propodus, that of fifth peraeopod nearly half length of propodus: last four abdominal somites sharply carinate dorsally ... ... *carinatus*, Ortmann.

    ii. Dactylus of third peraeopod scarcely half length of propodus, that of fifth peraeopod at most one third length of propodus;

[1] I have not seen specimens of this species.

last four abdominal somites at most very bluntly carinate dorsally ... ... *styliferus*, Milne-Edwards.

b. No subapical dorsal tooth on rostrum; carpus of second peraeopods as long as merus or fingers; last abdominal somite nearly two thirds as long as carapace ... ... *japonicus*, Ortmann.[1]

2. Palm of second peraeopods little if at all swollen, carpus at most only a trifle shorter than chela [at most 5 teeth on lower border of rostrum].

a. One or two small subapical dorsal teeth on rostrum ... ... *mani*, Sollaud.[1]

b. No subapical dorsal teeth on rostrum ... ... *modestus*, Heller.

B. Carapace without branchiostegal spine; carpus of second peraeopods at least one and a half times as long as chela.

1. Rostrum shorter, with 3 to 5 inferior teeth; last three peraeopods shorter, fifth pair extending beyond antennal scale by little more than length of dactylus ... *fluminicola*, sp. nov.

2. Rostrum longer, with 6 to 10 inferior teeth; last three peraeopods longer, fifth pair extending beyond antennal scale by dactylus and at least one half of propodus ... ... *potamiscus*, sp. nov.

These species form, I believe, a natural group, though some of them possess very unusual characters. *Leander tenuipes*, together with a related but imperfectly known W. African species, described by Aurivillius as *L. hastatus*, exhibits in the excessive length and slenderness of the last three thoracic legs a feature paralleled among Macrura only in the deep-sea Nematocarcinidae.[2] A link between these species and more normal types is, however, afforded by *L. annandalei*, a most interesting form obtained by Dr. Annandale near Shanghai.

The two last species mentioned in the key differ, so far as I am aware, from all described representatives of the genus in the complete absence of the branchiostegal spine. This character might, indeed, be held to possess generic value; but the spine in question is not infrequently very small in other species of *Leander* and the affinities of the forms in which it is absent appear to be unmistakably with the more normally constituted *L. mani* and *L. modestus*.

Of the seven species that I have myself examined, *L. styliferus* and *L. tenuipes* are apparently seasonal immigrants to brackish water, ascending estuaries and tidal rivers, possibly for breeding purposes, when the monsoon floods are abating. The two species

[1] I have not seen specimens of this species.

[2] In the Nematocarcinidae, however, the extreme length of the legs is due to the lengthening of the merus, ischium and carpus, whereas in *Leander tenuipes* and its ally the merus and ischium are nearly normal in length and the carpus quite short, the propodus and daetylus being the segments that are attenuated.

are often found together. *L. potamiscus* has been found only three times, on each occasion in water that was fresh but subject at times to tidal influence: *L. annandalei* and *L. modestus* appear to be inhabitants of pure fresh water. The most remarkable species from the point of view of habitat is *L. fluminicola*, which although occasionally taken in water of slight salinity, also occurs in rivers far above tidal influence and has even been found at Mirzapur in the United Provinces at a distance of fully 700 miles by river from the coast.

All the species here referred to the genus *Leander* possess a mandibular palp of three segments. The maxillae and maxillipedes are remarkably uniform in structure, differing little if at all from those of *L. serratus* (Pennant).

Leander tenuipes, Henderson.

(Plate viii, fig. 1.)

1893. *Leander tenuipes*, Henderson, *Trans. Linn. Soc., Zool.* (2), V, p. 440, pl. xl, figs. 14, 15.
1903. *Leander tenuipes*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.

The rostrum is variable in length, extending beyond the apex of the antennal scale by a proportion varying from one fifth to nearly one half of its length. The basal crest is well elevated and bears from 5 to 7 teeth,[1] of which from 2 to 4 are situated on the carapace behind the orbit. The teeth increase in size from behind forwards, the hindmost being as a rule quite rudimentary. The foremost tooth of the series does not reach the end of the first segment of the antennular peduncle. In front of the basal crest, the rostrum trends downwards, but before reaching the end of the antennular peduncle is reflected strongly upwards and is continued almost in a straight line from this point to the apex. On the dorsal edge near the tip there is, almost without exception, a single tooth. The lower margin is provided with from 2 to 6 teeth, nearly always 4 or 5[2]; the teeth are small and widely spaced and the proximal one is well in advance of the foremost of those that constitute the basal crest (pl. viii, fig. 1).

The antennal and branchiostegal spines are about equal in length; the latter is flanked by a short carina and is placed on the extreme frontal margin of the carapace, *not* a little distance behind it as in some other species of the genus. In the eyes the breadth of the cornea is about equal to the length of the stalk; there is no visible ocellus.

The spine forming the lateral process of the basal antennular segment is very inconspicuous. The second peduncular segment, measured dorsally, is exceedingly short, much less than half the length of the third. The short ramus of the outer antennular

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[1] Of 42 specimens, eight have 5 teeth on the basal crest, twenty-one have 6 teeth and thirteen have 7 teeth.

[2] Of 42 specimens, two have 2 inferior teeth, three have 3 teeth, sixteen have 4 teeth, nineteen have 5 teeth and two have 6 teeth.

flagellum reaches barely to the apex of the antennal scale; it is fused with its fellow for some 7 or 8 segments, the fused portion being about two fifths the length of the entire shorter ramus and a little less than the length of the ultimate peduncular segment. The basal portion of the inner flagellum is swollen. The antennal scale is rather strongly narrowed anteriorly; its length is about three and a third times its greatest breadth and the distal portion of the lamella extends far beyond the spine that terminates the outer margin.

The oral appendages and maxillipedes do not differ markedly from those of *L. serratus*. The mandibular palp is composed of three segments, of which the third is scarcely longer than the second. The anterior lobe of the epipod of the first maxillipede is not pointed as in Sollaud's *L. mani*. The antepenultimate segment of the third maxillipede is considerably expanded distally, the exopod reaching only a little beyond the middle of its length. The ultimate segment is only about one eighth shorter than the penultimate.

The first peraeopods reach a little beyond the apex of the antennal scale. The carpus is a trifle shorter than the merus and is about one and a half times the length of the chela. The fingers are fully one and a half times the length of the palm.

The second peraeopods in most cases reach beyond the antennal scale by at least the length of the chela, sometimes by that of the chela, carpus and a small portion of the merus. Measurements (in mm.) of the separate segments in seven specimens are as follows:—

Serial Number.	Locality.	Sex.	Total length.[1]	Length of carapace & rostrum.	Length of carapace.[2]	Total length of 2nd leg.[3]	2nd Peraeopod: length of				
							Ischium.	Merus.	Carpus.	Palm.	Dactylus.
1	Chennia, Gangetic delta.	♀ ovig.	63	27·2	12·5	34·7	4·4	11·3	4·0	5·0	8·9
2		♀ ovig.	62	26·1	12·0	34·2	4·4	11·4	3·4	4·5	9·1
3		♀ ovig.	60	27·3	10·4	30·0	4·0	10·2	2·8	4·0	8·4
4	Port Canning, Gangetic delta.	♀	65	28·4	12·2	31·9	4·4	10·0	3·2	4·2	8·0
5		♂	63	28·8	10·9	31·0	4·2	10·2	2·5	3·5	8·4
6		♂	61	26·9	11·1	28·3	3·6	9·3	2·5	3·7	7·8
7	Green I., Amherst, Tennasserim.	♂	56	23·2	11·0	31·0	4·1	10·6	2·8	3·6	8·0

[1] Measured from the tip of the rostrum to the tip of the telson, with the animal extended as nearly as possible in a straight line.

[2] Measured from the back of the orbit to the posterior mid-dorsal point.

[3] Measured from the basis to the tip of the fingers.

It will be noticed that the merus is the longest segment and that the carpus is distinctly shorter than the palm and is less than half the length of the fingers. The palm is strongly swollen and the fingers are straight with conspicuously inturned tips that cross one another when the claw is closed.

The last three legs are of extraordinary length and slenderness and are usually found broken in preserved material. In a few individuals in which they are present they yield the following measurements (in mm.):—

Serial Number.[1]		Sex.	Length of Ischium.	Merus.	Carpus.	Propodus.	Dactylus.
4	Third peraeopod ...	♀	4·3	8·9	3·2	9·1	4·7+
7		♂	3·9	7·9	2·8	8·0	11·4+
2	Fourth peraeopod ...	♀ ovig.	5·5	9·7	3·1	17·7	36·8+
4		♀	5·5	9·3	3·4	17·9	34·5+
1	Fifth peraeopod ...	♀ ovig.	6·1	8·7	3·8	17·4	...
3		♀ ovig.	5·5	7·3	3·2	17·9	28·3+
4		♀	5·8	7·9	3·2	17·8	36·6+
7		♂	5·0	7·3	3·0	16·3	37·5+

The extreme length of these legs[2] is due in the main to the lengthening of the propodus and dactylus; the carpus in all cases is quite short. The third legs are at least two thirds the entire length of the animal; the fourth and fifth pairs are much longer, considerably exceeding the total length. The dactylus is broken in all the specimens examined; when complete it is evidently much longer than the combined lengths of the rostrum and carapace and more than twice the length of the propodus. Henderson notes that the dactylus of the last legs (in a specimen measuring 55 mm. from the orbit to the apex of the telson), though broken at the tip, was 45 mm. in length.

Except for the first pair the peraeopods are entirely devoid of hairs.

[1] The specimens measured are the same as some of those in the table previously given. The serial numbers afford individual reference.

[2] I understand that the figures illustrating Dr. Henderson's valuable "Contribution to Indian Carcinology" were not drawn under the author's supervision, but were executed after his return to India. In the figure of *L. tenuipes* the proportions of the segments of the last three legs are wholly erroneous.

The abdomen, though compressed, is not dorsally carinate. The pleura of the fifth somite are narrowed and drawn out posteriorly. The sixth somite, measured dorsally, is a trifle more than half the length of the carapace. The pleopods are exceptionally long, those of the first pair being about one and a half times the length of the carapace.

The telson reaches only a little beyond the middle of the outer uropod. It is rounded above and sometimes bears a pair of small spinules near the distal end. The apex, when perfect, is seen to bear a single pair of lateral spinules which extend considerably beyond the rounded median prominence. The outer uropod is long and narrow; its outer margin in front of the subterminal spine is distinctly concave.

Large specimens of *L. tenuipes* reach a total length of 65 or 70 mm. The eggs are small, about 0·55 mm. in length and 0·44 mm. in breadth.

In examples from 15 to 30 mm. in length the rostrum is very much shorter than in adults, not reaching beyond the middle of the last segment of the antennular peduncle and with at most only faint traces of teeth on the lower margin. The last abdominal somite is proportionately much longer, being scarcely shorter than the carapace in the smallest examples. In a specimen only 22 mm. in length the second peraeopods already closely resemble those of adults, reaching beyond the antennal scale by almost the entire length of the chela. The great length of the last three legs is a conspicuous feature even in the smallest individuals.

Leander tenuipes is evidently a very close ally of *L. hastatus* (Aurivillius)[1] from the Cameroons. Aurivillius does not refer in his description to the great length and slenderness of the last three pairs of peraeopods, but it is clear from his figure that the species possesses this character. A further examination of West African specimens is necessary before the distinctions between *L. hastatus* and *L. tenuipes* can accurately be determined. The African species appears to differ in having 8 teeth on the basal crest of the rostrum, in the shorter fingers of the second legs which are usually less than twice the length of the carpus, and in the greater length of the sixth abdominal somite which is fully two thirds as long as the carapace. According to Aurivillius' measurements the segments of the second peraeopods show far greater variation in length than in *L. tenuipes*.

Living specimens of *L. tenuipes* are for the most part translucent with a slightly milky tinge. In adults the mandibular region is bright red and the rostrum is dotted with carmine. The lower antennular flagellum is carmine at the base changing to deep mauve nearer the tip. There are a few very small red chromatophores on the segments of the large chelipede. On either side of the abdomen there are red flecks at the points where the somites

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[1] *Palaemon* (*Leander*) *hastatus*, Aurivillius, *Bihang till K. Svenska Vet.-Akad. Handl.*, XXIV, Afd. iv, no. 1, p. 27, pl. iv, figs. 3-6.

are hinged and there are also small red chromatophores on the pleura and dorsally at the distal ends of the last three segments. The lateral margins of the telson and the outer edge of the external uropod are deeply stained with red; on the internal uropod there are scattered red chromatophores. The eggs are bright gamboge yellow. Very young individuals are almost wholly transparent.

In specimens kept alive in an aquarium it was found that the ischial and meral segments of the last three legs were held forwards, downwards and a little outwards. The filiform terminal segments were trailed from the distal end of the merus in much the same manner as if the lash of a whip were drawn through the water from the end of a stiff handle. The legs were evidently not used in progression and it may be surmised that they have taken on a sensory function.

The specimens examined are from the following localities:—

$\frac{3271\text{-}2}{7}$	Madras	Purchased.	Several.
$\frac{167\text{-}90}{7}$	Tanda, about 30 miles S. of Coconada, 4-5 fms.	'Investigator.'	Several.
$\frac{1171}{7}$	4 miles off Vizagapatam Coast, Madras Pres., $7\frac{1}{2}$-$9\frac{1}{2}$ fms.	'Investigator.'	One.
$\frac{9152}{10}$ $\frac{9723}{10}$	Puri, Orissa Coast (from fishermen's nets) ...	T. Southwell, S. Kemp.	Many.
$\frac{3148\text{-}56}{7}$ $\frac{9515\text{-}21}{10}$ $\frac{9717\text{-}22}{10}$	Gangetic delta (many localities)	A. J. Milner, R. Munro, W. T. Blanford, J. Wood-Mason, J. T. Jenkins, T. Southwell, S. Kemp.	Many.
$\frac{9522}{10}$	Mouth of Rangoon R., Burma	'Investigator.'	Three.
$\frac{9523}{10}$	Moulmein R., Burma ...	,,	One.
$\frac{9524}{10}$	Bassein R. Estuary, Burma	,,	Two.
$\frac{9514}{10}$	Green I., Amherst, Tennasserim	,,	Several.

In addition there are a large number of specimens, unquestionably belonging to *L. tenuipes*, labelled "Lyttleton Harbour, New Zealand; W. Guyes Brittan." I can find no reason to distrust the label, but the record seems to require verification before such a great increase in the range of the species can be accepted.

Leander tenuipes was described by Henderson from the Gulf of Martaban and Madras and has since been recorded by Nobili from Bombay. It is frequently found in company with *L. styliferus* and has occasionally been caught in surface nets near the shore. Though often taken in the open sea, it is evidently far from uncommon in brackish water, probably migrating to estuaries and up rivers at the close of the monsoon. I am not aware that it has even been found in pure fresh water.

Leander annandalei, sp. nov.

When describing *L. tenuipes*, Henderson noted that the species was so peculiar in character that he was at one time inclined to create a new genus for its reception. The new form obtained by Dr. Annandale in China is proof that he was wise in adopting a

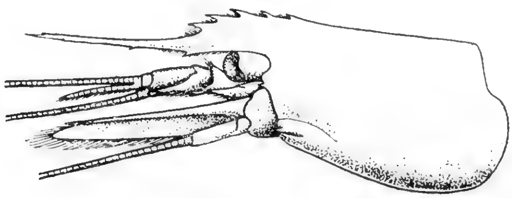

FIG. 1.—*Leander annandalei*, sp. nov.
Carapace, rostrum, etc., in lateral view.

conservative policy: it forms a link between Henderson's species and more normal members of the genus and affords most interesting evidence of the manner in which such an extreme type as *L. tenuipes* has been evolved.

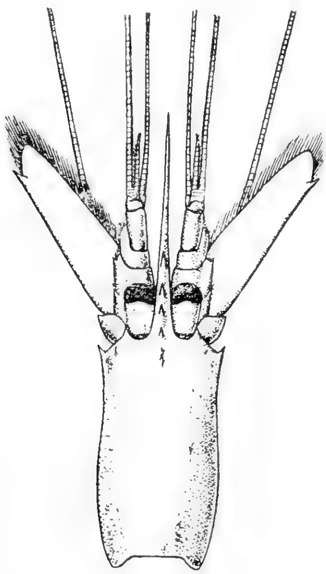

FIG. 2.—*Leander annandalei*, sp. nov.
Carapace, rostrum, etc., in dorsal view.

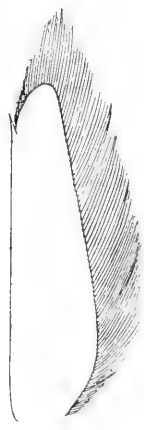

FIG. 3.—*Leander annandalei*, sp. nov.
Antennal scale.

Unfortunately only a single specimen of *L. annandalei* was obtained.

The rostrum is similar to that of *L. tenuipes*, but is shorter, reaching beyond the antennal scale by only about one tenth of its length; the distal portion trends only a little upwards. The basal crest bears 5 equally separated teeth, increasing in size from behind forwards; the hindmost alone is situated on the carapace behind the orbit and the foremost is placed over the articulation between the first and second segments of the antennular peduncle (text-fig. 1). There is a single small sub-terminal dorsal tooth and four small, widely separated teeth on the lower margin.

The branchiostegal spine is fully as large as the antennal; it is situated a little behind the frontal margin, thus differing from *L. tenuipes*. The eyes resemble those of the allied species, the stalk being proportionately a trifle larger. The antennular peduncle does not show any marked peculiarities; the second segment is very short (text-fig. 2). The shorter ramus of the outer flagellum is nearly as long as the peduncle; it is fused basally with its fellow for a distance not greater than one third the dorsal length of the ultimate peduncular segment. The antennal scale is narrowed anteriorly and is a trifle more than four times as long as broad (text-fig. 3).

The oral appendages resemble those of *L. tenuipes*; the mandibular palp is composed of three segments.

The peraeopods differ conspicuously in their proportions from those of all other known species. The measurements of the separate segments (in mm.) are as follows:—

	Ischium.	Merus.	Carpus.	Propodus.	Palm.	Dactylus.
First peraeopod	2·2	3·1	2·8	...	0·7	0·6
Second ,, ...	3·6	3·1	0·7	...	1·8	4·0
Third ,, ...	3·6	3·7	0·4	1·9	...	1·1+
Fourth ,, ...	3·8	3·9	0·6	3·0	...	3·2
Fifth ,, ...	3·1	3·2	1·0	3·4	...	3·4

It will be noticed that in all the last four pairs of peraeopods the carpus is exceedingly short. In the second legs (text-fig. 4*c*), which reach beyond the antennal scale by about half the length of the fingers, this feature is specially remarkable, the segment being conical, little longer than broad, recalling that of certain species of the Pontoniid section of the Palaemonidae. In this limb, also, the ischium is conspicuously longer than the merus, resembling in this respect *L. styliferus*, rather than *L. tenuipes*. The dactylus of the third peraeopod (text-fig. 4*d*) is incomplete; in the fourth pair (text-fig. 4*e*) it is longer than the propodus, while in the fifth pair (text-fig. 4*f*) the two terminal segments are of equal length. Very long hairs are to be found on the ischium and merus of the first, third and fourth pairs; otherwise the limbs are glabrous or with a few short and fine hairs. The dactylus of the last pair has a slight swelling at the base which is rather thickly clothed with short hairs.

The abdomen is much compressed laterally, but is not carinate. The sixth somite, measured dorsally, is fully two thirds as long as the carapace. The pleopods, as in *L. tenuipes*, are very long, those of the first pair being nearly one and a half times the length of the carapace. The telson is rounded above and bears a single pair of dorsal spinules near the distal end. The apex is minutely pointed in the middle with a long lateral spinule on either side.

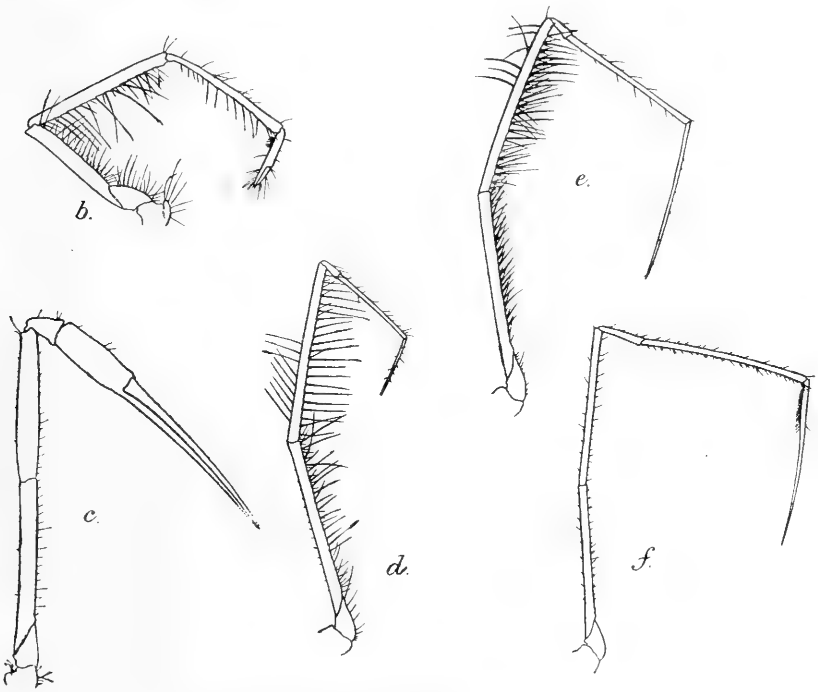

FIG. 4.—*Leander annandalei*, sp. nov.
b. First peraeopod. *d.* Third peraeopod.
c. Second peraeopod. *e.* Fourth peraeopod.
f. Fifth peraeopod.

The single specimen of this interesting species is a female, without eggs. The rostrum and carapace together measure about 14 mm., the carapace alone being about 6·5 mm. Owing to the fact that the specimen is strongly bent it is difficult to measure the total length in a satisfactory manner; it would probably be about 32 or 33 mm. when the animal was extended.

The type specimen (no. 9758/10, *Zool. Surv. Ind.*) was dredged by Dr. Annandale in China, in the Whangpoo River between Shanghai and Woosung, at a depth of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. It was obtained in water that was quite fresh.

Leander styliferus (Milne-Edwards).

(Plate viii, fig. 2.)

1837. *Palemon longirostris*, Milne-Edwards, *Hist. Nat. Crust.*, II, p. 394.
1840. *Palemon styliferus*, Milne-Edwards, *ibid.*, III (*errata*), p. 638.
1893. *Leander longirostris*, Henderson, *Trans. Linn. Soc.* (2), V, p. 439.
1902. *Palaemon styliferus*, Rathbun, *Proc. U. S. Nat. Mus.*, XXVI, p. 51.
1903. *Leander longirostris*, Nobili, *Boll. Mus. Torino*, XVIII, no. 452, p. 7.
1908. *Leander* sp., de Man, *Rec. Ind. Mus.*, II, p. 220, pl. xviii, fig. 3.
1915. *Leander styliferus*, Kemp, *Mem. Ind. Mus.*, V, p. 273.

The rostrum is long, reaching beyond the apex of the antennal scale by a distance varying from one third to three fifths of its length. The proximal portion is strongly elevated dorsally forming a well-marked basal crest which bears from 5 to 7 (usually 6)[1] procurved teeth. The teeth increase in size from behind forwards; the hindmost is frequently situated on the carapace behind the level of the orbit and the foremost reaches little if at all beyond the end of the first segment of the antennular peduncle. In front of the basal crest the rostrum is slender and upturned; for the greater part of its length it is usually unarmed, but near the tip is as a rule provided with from 1 to 3[2] small widely separated teeth. The lower margin bears from 6 to 10 teeth (usually 7, 8 or 9)[3]; the proximal teeth are generally rather closer together than the distal and the hindmost is usually situated a little behind or a little in front of the foremost tooth of the basal crest (pl. viii, fig. 2).

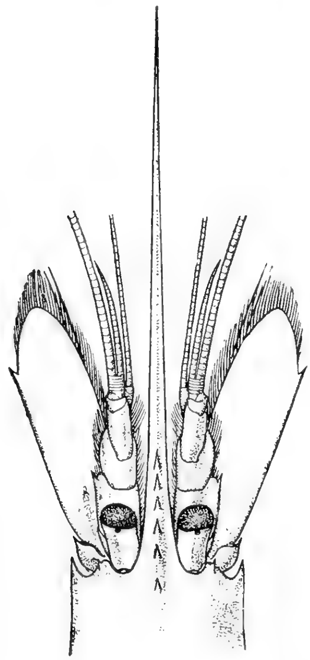

FIG. 5.—*Leander styliferus*, Milne-Edwards.
Carapace, rostrum, etc., in dorsal view.

The carapace bears a small and inconspicuous antennal spine; the branchiostegal is much larger, situated on the frontal margin and is flanked by a short and blunt carina. Above the branchio-

[1] Of forty specimens thirteen have 5 basal teeth, twenty-three have 6 and four have 7.

[2] I have seen one specimen without any teeth on the distal part of the upper margin, one with 4 teeth and one with 5.

[3] Of forty specimens two have 6 inferior teeth, fourteen have 7, twelve have 8, eight have 9 and four have 10. I have seen single examples with 5 and 11 teeth and Nobili records specimens, one from Bombay and one from Borneo, with 12 and 13 inferior teeth.

stegal spine there is a finely cut groove, resembling a suture line, which extends from the anterior margin backwards for about one third the length of the carapace.

The greatest breadth of the cornea is about equal to the length of the eyestalk. A small ocellus (not found in either of the two preceding species) is visible, partly joined to the cornea (text-fig. 5).

The basal segment of the antennular peduncle bears a small spine on the lower surface near the middle of its internal margin. The outer border, in front of the short spine representing the lateral process, is sinuous and terminates in a tooth which extends but little beyond the level of the protruding, setose antero-external margin of the segment The second segment, measured mid-dorsally, is a little more than half the length of the third. The total length of the shorter branch of the outer antennular flagellum is about equal to that of the peduncle; sometimes it is a little longer, sometimes shorter. The length of the fused portion is variable, even on the two sides of the same specimen; it consists of some 8 to 12 segments and is as a rule decidedly shorter than the last peduncular segment.

The antennal scale differs considerably from that of the two preceding species. It is broader, scarcely three times as long as wide, and the rather sharply rounded distal end of the lamella extends much further beyond the spine that terminates the outer margin.

The oral appendages do not differ in any noteworthy degree from those of *L. serratus*, Pennant. The mandibular palp is composed of three segments, the ultimate almost twice the length of the penultimate. The third maxillipedes reach about to the end of the antennal peduncle; the antepenultimate segment is less expanded distally than in *L. tenuipes* and the exopod reaches to its anterior quarter; the last segment is about two thirds the length of that which precedes it.

The first peraeopods reach almost or quite to the end of the antennal scale. The merus and carpus are about equal; the chela is barely three fifths the length of the carpus and the fingers are only a trifle longer than the palm.

The second peraeopods vary considerably in length. In large specimens of both sexes they may extend beyond the tip of the scale by the whole of the chela, carpus and a small portion of the merus; in others, also fully adult, they reach beyond the same point only by the length of the chela, in others again only by a small fraction of the finger-length. The proportions of the segments in ten large individuals are shown in the table on p. 216.

It will be noticed that the ischium, merus, carpus and palm decrease successively in length in nearly all cases, but that in very large males the carpus is sometimes equal to, or a little longer than the merus. The fingers are either a little shorter than, equal to, or longer than the ischium; the carpus in all cases is very much shorter than the entire chela, often only about half its length. In specimens in which the limb is very long the characteristic swollen condition of the palm is most obvious, the tips of the fingers being strongly incurved and crossing each other when the claw is closed. In examples in which the limb is proportionately shorter the palm is less strongly swollen and the tips of the fingers are little, if at all, inturned.

The last three pairs of legs are slender and usually bear short setae on the posterior margins of the ischium, merus, carpus and propodus. Those of the third pair reach to, or a little beyond the middle of the antennal scale; those of the fifth pair are longer, usually reaching beyond the scale by part or all the length of the

Locality.	Sex.	Total length.	Length of carapace & rostrum.	Length of carapace.	Length of 2nd leg.	2nd Peraeopod: length of				
						Ischium.	Merus.	Carpus.	Palm.	Dactylus.
Port Canning, Gangetic delta.	♂	88	39·5	18·0	67·3	14·8	12·4	12·9	9·4	14·5
	♂	79	37·0	14·4	53·3	11·7	9·6	10·2	6·9	11·5
Off Cowcolly Lighthouse, Gangetic delta.	♀ ovig.	91	44·5	17·3	49·7	12·1	10·5	9·1	7·2	11·3
	♀ ovig.	87	41·7	17·9	34·9	8·0	7·5	5·8	4·6	7·2
Hog I., Bombay. ...	♂	94	50·0	16·0	48·3	11·0	10·0	9·3	7·3	11·0
Bombay.	♂	96	47·8	17·9	53·7	11·7	10·1	10·1	8·7	11·0
Keti, Karachi dist.	♀ ovig.	84	44·6	15·0	29·9	6·3	5·9	4·5	3·7	7·1
	♀ ovig.	79	39·7	13·7	24·8	5·3	5·0	3·9	2·8	4·6
Green I., Amherst, Tennasserim.	♂	81	36·8	16·6	57·4	12·4	11·3	10·3	8·7	12·4
	♂	79	36·7	15·5	53·1	11·9	10·5	10·0	7·5	11·7

dactylus. The dactylus is slender and styliform; in the third pair it is rather less than one half the length of the propodus (text-fig. 6*a*). In the fifth pair it is from one third to one quarter the length of the propodus, being shortest in very large specimens (text-fig. 6*b*).

The abdomen is smoothly rounded above in small examples, but in those of large size sometimes bears a blunt and inconspicuous dorsal ridge extending from the middle of the third somite to the end of the sixth. The sixth somite, measured dorsally, is rather less than one half the length of the carapace.

The telson reaches to about three quarters the length of the outer uropod; it is not sulcate dorsally and usually bears two pairs of minute or semi-obsolete spinules in its distal half. The apex in large specimens is simply pointed, without trace of lateral spinules; in smaller but still adult individuals two pairs of very small spinules may be found, not reaching the tip. The outer uropod is narrow, about three times as long as broad, with the external margin in front of the subterminal tooth almost straight.

Large individuals reach a length of a little over 100 mm.; the eggs are a trifle larger than in *L. tenuipes*, from 0·65 to 0·82 mm. in length and from 0·56 to 0·61 mm. in breadth.

As regards young specimens it may be noted that the second legs are very long, extending beyond the scale by the chela and practically the whole length of the carpus in an individual less than 60 mm. in total length; this precocious development seems, however, to be unusual. A series of very small specimens from Chittagong indicates clearly that those described by de Man in 1908 as *Leander* sp., belong to this species. In individuals about 30 mm. in total length the general appearance is closely similar to that of adults; the rostrum, however, has a less elevated basal crest and is shorter, reaching beyond the antennal scale by at most one quarter its length; the second legs do not as a rule exceed the scale by more than half the length of the fingers. In still smaller examples between 15 and 20 mm. in length, the rostrum is even shorter, sometimes not reaching the end of the scale; it usually bears only a single subterminal dorsal tooth and a reduced number of teeth (from 3 to 6) on the lower border. The second legs reach little, if at all beyond the scale; the palm is as long or even a little longer than the carpus and the fingers are shorter than in adults, being indeed in very small examples only as long as the palm. The sixth abdominal somite is a little more than half the length of the carapace. The telson tip, in specimens of 30 mm. in length and under, bears two pairs of lateral spinules, the inner pair very long and far exceeding the apex.

Living specimens are translucent with a faint milky tinge. The lower antennular flagellum, which is deeply pigmented in *L. tenuipes*, is quite colourless. The dark gastric mass is frequently visible through the carapace and often the tip of the rostrum and the extremities of the telson and uropods are suffused with red.

This species was known to earlier authors as "*Leander longirostris*, Say." Miss Rathbun has pointed out that Say never described a species under such a name, the confusion having arisen from misplaced footnote references in Milne-Edwards' treatise. The latter author described two separate species as "*Palemon*" *longirostris*, but suggested the name *styliferus* for the present form in the errata at the end of vol. III.

The specimens from Amoy, recorded by de Man[1] as *L. longirostris*, Say, have since been referred by that author[2] to *L. longipes*, Ortmann.

[1] De Man, *Notes Leyden Mus.*, III, p. 141 (1881).
[2] De Man, *Trans. Linn. Soc. Zool.* (2), IX, p. 409 (1907).

Leander styliferus is closely related to *L. carinatus*, Ortmann; the distinctions between the two species are enumerated below. *L. japonicus*, Ortmann, which I have not seen, is an allied species, but according to Miss Rathbun (*loc. cit.*, 1902, p. 51) is to be distinguished by the absence of dorsal spines on the distal part of the rostrum, by the lower number of inferior teeth (4 to 6), by the greater length of the sixth abdominal somite and by the longer carpus of the second peraeopods.

The specimens of *Leander styliferus* in the Indian Museum are from the following localities:—

3241-50/7	Keti, Karachi Dist., on the Hajamro branch of R. Indus.	Karachi Mus.	Many.
4688-9/9	Bombay	Purchased.	Two.
1604/7	Hog I., Bombay ...	'Investigator.'	One.
9526/10	Chilka Lake, Orissa coast	Mus. staff.	One.
3412/5, 9532-51/10, 9727-9/10	Gangetic delta (many localities).	W. T. Blanford, J. Wood-Mason, J. T. Jenkins, R. Munro, T. Southwell, S. Kemp.	Many.
9527/10	Chittagong (edge of river)	N. Annandale, S. Kemp.	Many young.
7721/6	Mouth of Yé R., Burma	'Investigator.'	Two.
9528/10	Mouth of Rangoon R., Burma	'Investigator.'	Several young.
9529/10	Rangoon market ...	N. Annandale.	Many.
9530/10	Haingyi I., Tennasserim	'Investigator.'	One.
9531/10	Green I., Amherst, Tennasserim	'Investigator.'	Several.
9278/6	Mergui	J. Anderson.	Two.

Specimens from the west coast of India as a rule have the rostrum markedly longer than those from the Bay of Bengal.

The species was originally described by Milne-Edwards from "l'embouchure du Gange." It is recorded by Henderson from Karachi, the Gangetic delta, the Gulf of Martaban and Mergui. Miss Rathbun has also recorded it from Karachi, and Nobili has reported specimens from Bombay and a single individual from Borneo.

The species occurs in water that is both salt and brackish and has been found at Diamond Harbour in the Gangetic delta in a freshwater creek. As in the case of *L. tenuipes*, with which it is frequently found, the species is probably migratory, entering estuaries and tidal rivers at the close of the monsoon. Capt. R. Munro, to whom we are indebted for numerous specimens, notes that in 1912 at the mouth of the Hughli river "the first appearance of cold weather shrimps" was in August.

Leander carinatus, Ortmann.

1891. *Leander longirostris* var. *carinatus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 521.
1902. *Leander carinatus*, Doflein, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, XXI, p. 639, pl. iii, fig. 8.
1914. *Leander styliferus* var. *carinatus*, Balss, *ibid.*, Suppl. Bd. II, Abh. 10, p. 57 (? part only).

Twenty-seven specimens from N. China, all of which are unfortunately in very poor condition, appear to belong to this species. *L. carinatus* was originally described by Ortmann in the briefest possible manner from a much mutilated specimen obtained in China and was regarded by its author as a variety of Milne-

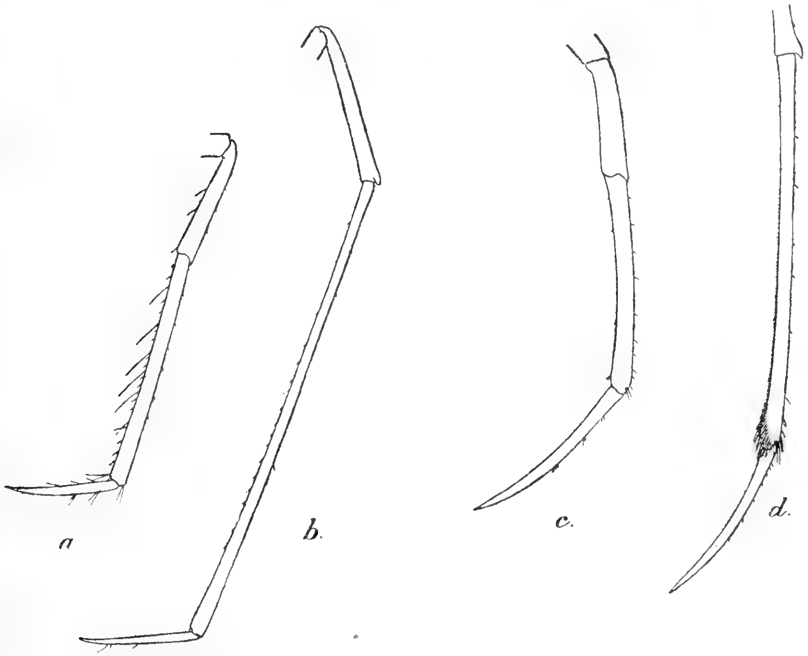

FIG. 6.—*a, b. Leander styliferus*, Milne-Edwards.
c, d. Leander carinatus, Ortmann.
a, c. Third peraeopod. *b, d.* Fifth peraeopod.

Edwards' *L. longirostris* (=*L. styliferus*). If my identification is correct there can be no doubt that the form is specifically distinct, though closely related to *L. styliferus*. *L. carinatus* may be distinguished by the following characters :—

(i) The basal crest of the rostrum bears from 6 to 9 (usually 7 or 8) teeth,[1] a number rather higher than is usual in *L. styliferus*. The foremost of these teeth is much in advance of the hindmost tooth of the ventral series.

[1] Of twenty specimens one has 6 teeth on the basal crest, ten have 7 teeth, eight have 8 teeth and one has 9 teeth.

(ii) The fingers of the first peraeopods are a little longer, fully one and a half times the length of the palm.

(iii) The carpus of the second peraeopods is proportionately shorter; except in very large males it is shorter than the palm and little more than half the length of the fingers.

(iv) The dactyli of the last three peraeopods are proportionately much longer. In the third pair (text-fig. 6*c*) the propodus is only one and a fifth times and in the fifth pair (text-fig. 6*d*) only two and a fifth times as long as the dactylus.

(v) The last four abdominal somites are sharply carinate dorsally.

The rostrum is broken in all except two of the specimens. In these there are respectively 7 and 8 ventral teeth[1] and in both there appears to have been a single small subapical dorsal tooth.

Doflein appears not to have seen any fully developed males. In large examples of this sex the second peraeopods may reach beyond the antennal scale by the whole of the carpus and chela; the degree of development of these limbs is, however, as in *L. styliferus*, subject to much variation. Five specimens yield the following measurements (in mm.):—

Sex.	Total length.	Length of carapace.	Length of 2nd peraeopod.	2nd Peraeopod: length of Ischium.	Merus.	Carpus.	Palm.	Dactylus.
♂	77+	17·0	47	10·3	9·7	7·4	7·2	10·5
♂	71+	15·0	42	9·8	8·7	5·5	6·3	10·3
♂	76+	16·2	34	8·2	6·8	4·0	4·8	8·9
♂	85+	17·2	32	7·2	6·8	4·4	4·7	7·8
♀	?	14·0	25	5·4	5·3	3·3	3·7	6·1

The second peraeopods as a whole bear a close resemblance to those of *L. styliferus*; in specimens in which the limb is relatively long the carpus is swollen at its distal end and the palm inflated. The proportionate length of the segments is variable, but the carpus appears always to be shorter than in the related species.

The best distinctive character is to be found in the great relative length of the dactylus of the last three pairs of peraeopods. In these limbs the length of the dactylus, compared with that of the propodus, is nearly twice as great as in *L. styliferus* (text-fig. 6). The third peraeopods reach almost to the end of the antennular

[1] Ortmann states that there are 5 ventral teeth and Doflein that there are 4 or 5. Balss has, however, remarked that the rostrum was incomplete in all the specimens seen by Doflein.

peduncle; the fifth are longer and sometimes extend to the tip of the antennal scale.

The dorsal carination of the last four abdominal somites—the chief character mentioned by Ortmann—is very conspicuous in all the specimens; it cannot be confounded with the low and very blunt dorsal ridge sometimes found in large examples of *L. styliferus.*

The sixth abdominal somite, as in the related species, is less than half the length of the carapace. I have not found any differences in the telson or uropods.

The specimens, none of which are ovigerous, were obtained at Ningpo in China by Dr. B. Sing; they appear to have been found in brackish water.

Ortmann described the species from "China"; Doflein's specimens were from Tsingtau. The record by Balss from Singapore appears to me doubtful.[1]

Leander modestus, Heller.

(Plate ix, fig. 1.)

1865. *Leander modestus,* Heller, *Reise 'Novara'-Exped., Crust.,* p. iii, pl. x, fig. 6.

The rostrum reaches beyond the antennal scale by at most one fifth of its length. The basal crest is strongly elevated and is furnished with from 8 to 10 evenly spaced teeth[2] of which one or two are situated on the carapace behind the orbit; the foremost of the series reaches to or beyond the articulation between the second and third segments of the antennular peduncle. In front of the basal crest the rostrum is straight or very slightly upturned, the upper margin being invariably unarmed. On the lower margin there are from 2 to 4 small teeth[3] which are restricted to the middle third of the rostral length (pl. ix, fig. 1).

The branchiostegal spine is somewhat larger than the antennal and is situated on the frontal margin of the carapace. Above it there is a rather conspicuous longitudinal depression in which a finely-cut groove, similar to that found in the preceding species, may usually be detected.

The cornea of the eye is rather strongly swollen; a small ocellus is present.

The basal segment of the antennular peduncle is rather broad and bears the usual tooth on the inferior surface; the outer margin is convex, terminating in a spine which does not reach as far forward as the protruding setose antero-external portion of the

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[1] Balss' record of *L. japonicus* from Hankow in China also seems to require confirmation.

[2] Of thirty-one specimens eight have 8 teeth on the basal crest, eighteen have 9 and five have 10.

[3] Of thirty-one specimens three have 2 inferior teeth, twenty-four have 3 and four have 4.

segment. The second segment, measured dorsally, is shorter than the third. The accessory antennular ramus is shorter than the peduncle and is fused with its fellow for a length considerably less than that of the last peduncular segment, the fused portion consisting only of some 5 or 6 segments.

The antennal scale is broadly rounded apically, the lamella extending much beyond the spine that terminates the straight external margin. It is about three times as long as wide.

The mandibular palp is composed of three segments, the third nearly twice the length of the second. The third maxillipedes reach to the end of the antennal peduncle; the terminal segment is about two thirds the length of that which precedes it.

The first peraeopods reach the end of the antennular peduncle. The carpus is about one fifth longer than the merus and is a little more than twice the length of the chela; the fingers are longer than the palm.

The second peraeopods may reach beyond the tip of the antennal scale by nearly the whole length of the chela. The ischium is equal to or a little shorter than the merus and the carpus is between $1\frac{1}{4}$ and $1\frac{1}{5}$ times as long as the ischium. The chela is about equal to (sometimes a trifle shorter than, sometimes a trifle longer than) the carpus; the palm is not swollen as in the preceding species and is from one fifth to one tenth shorter than the fingers. The latter are straight with short, inturned corneous tips and are without teeth on the inner margin.

The last three pairs of peraeopods are slender; the third pair is the shortest, not quite reaching the end of the antennal scale; the fourth and fifth pairs are longer, extending beyond the scale by a portion of the length of the dactylus. In the third pair the propodus is less than twice the length of the carpus and is about one and a third times the length of the dactylus. In the fourth pair the propodus is longer, from two to two and a quarter times the length of the carpus, the dactylus being longer than the latter segment. In the fifth pair the dactylus is longer than the carpus and the carpus is about three sevenths the length of the propodus. The propodus of all three pairs is provided with a bunch of setae at its distal end and, in the case of the fifth pair, is thickly set with short hairs on the distal half of its inferior margin. The dactylus in each pair is without teeth, slightly curved, with some long setae on its upper border.

The abdomen is compressed but not carinate above. The sixth somite, measured dorsally, is rather more than half the length of the carapace. The pleopods are short, those of the first pair being shorter than the carapace.

The telson reaches to rather more than two thirds the length of the outer uropod. It bears two pairs of dorsal spinules distally; the apex is produced to a sharp point with two plumose setae beneath and two spinules on either side, the inner pair of the latter extending considerably beyond the tip. The outer uropod is about three times as long as broad. There is a movable spinule on the inner side of the tooth that terminates the straight or slightly convex outer border.

Large specimens reach a length of about 60 mm. None of the females in the collection are ovigerous.

Young examples, from 15 to 25 mm. in total length, differ from adults in possessing a shorter rostrum, often not reaching beyond the end of the antennular peduncle and in the proportionately greater length of the sixth abdominal somite.

The colour of living specimens was translucent white, with sparsely scattered minute reddish-brown pigment cells, not arranged to form a definite pattern.

L. modestus is very closely related to *L. mani*, Sollaud,[1] from Tonkin, a freshwater species described as possessing large eggs. The most conspicuous character in which *L. modestus* differs from the southern Chinese form is the complete absence of teeth at the distal end of the upper border of the rostrum, a feature which is unquestionably of high specific value in other species of the same group of the genus. The first maxillipede differs from the figure given by Sollaud in the greater proportionate length of the basipodite, while the distal lobe of the epipod, though apically pointed, is not drawn out to the triangular process to which Sollaud has directed attention. The description of *L. mani* is preliminary; other distinctions will probably be found when the full account is published.

The specimens of *L. modestus* in the Indian Museum were all obtained by Dr. Annandale in China, in the neighbourhood of Shanghai. The species is common at the margins of the Tai Hu Lake, and is caught in large numbers in basket traps set among weeds. A few individuals were dredged from a bare muddy bottom in the middle of the lake and others were obtained in the Whangpoo River, between Shanghai and Woosung at depths of $5\frac{1}{2}$ to $7\frac{1}{2}$ metres. Young examples are common in ditches and ponds in the neighbourhood of Shanghai. All the specimens were obtained in pure fresh water.

The species was described by Heller from Shanghai in 1865, since which date it does not appear to have been recorded.

Leander fluminicola, sp. nov.

(Plate ix, fig. 2.)

This species bears a close general resemblance to the preceding, differing from it only in the following particulars:—

(i) The rostrum exceeds the antennal scale by one sixth or one quarter of its length. The basal crest is less elevated and bears from 7 to 11 teeth (usually 8 or 9)[2] of which 1 or 2 are placed behind the level of the orbit. The distal part of the rostrum is

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[1] Sollaud, *Bull. Soc. Zool. France*, XXXIX, p. 315, text-figs. (1914).

[2] Of forty specimens one has 7 teeth on the basal crest, twelve have 8, twenty-three have 9, three have 10 and one has 11.

more strongly upturned and is provided with one or two teeth on its upper edge near the tip [1] and sometimes with another between this point and the foremost tooth of the basal series. The lower margin bears from 3 to 5 teeth (usually 4),[2] which are spread out along its distal two-thirds and not restricted to the middle third as in *L. modestus* (pl. ix, fig. 2).

(ii) The branchiostegal tooth of the carapace is entirely absent.

(iii) The tooth that terminates the outer margin of the basal segment of the antennular peduncle extends much beyond the produced, setose, antero-external portion of the segment.

(iv) The accessory antennular ramus is very long, between one and a quarter and one and a half times the length of the peduncle.

(v) The antennal scale is a little more narrowed apically and is a trifle broader, less than three times as long as wide.

(vi) The first peraeopods reach a little beyond the end of the antennular peduncle; the carpus varies from two to nearly two and a half times the length of the chela.

(vii) The carpus of the second peraeopods is much longer, about one and a half times the length of either the ischium or the chela. The fingers are about as long as the palm. The chela is distinctly spooned in appearance; when viewed from its inner face the fingers are seen to be hollowed longitudinally, meeting only along their outer edges. When the chela is examined in dorsal and ventral views, the fixed finger and dactylus appear considerably broader near the apex than at their junction with the palm.

(viii) The last three pairs of peraeopods are very slender, but in their proportionate lengths similar to those of *L. modestus*. The dactylus in all three pairs is much shorter than the carpus, that of the fifth pair being scarcely half its length and only about one fifth the length of the propodus (*cf.* pl. ix, figs. 1 and 2). There are fewer hairs on the propodus of the fifth leg and the dactylus in all three pairs is without setae on its upper edge.

Large specimens reach a length of about 45 mm. The eggs are numerous and are comparatively small, from 0·74 to 0·87 mm. in length and from 0·57 to 0·65 mm. in breadth.

The species resembles *L. mani* in the presence of teeth at the distal end of the upper margin of the rostrum, but is readily distinguished by the absence of the branchiostegal spine and the greater length of the carpus of the second peraeopods.

The specimens in the Indian Museum are from the following localities:—

$\frac{9570}{10}$	R. Ganges, Mirzapur, United Provinces	R. B. S. Sewell.	Many. TYPES.
$\frac{9573}{10}$	Podhua Nala, Rajmahal, Bengal ...	B. L. Chaudhuri.	Two.

[1] I have seen a single specimen without any dorsal teeth on the distal part of the rostrum.

[2] Of forty specimens four have 3 ventral teeth, twenty-nine have 4 and seven have 5.

$\frac{9577}{10}$	Kanaigunge, Backergunge Dist., Bengal	H. E. Stapleton.	Six.
$\frac{9578}{10}$	R. Hughli, Calcutta	?	Several.
$\frac{9575}{10}$	Dhappa, near Calcutta ...	S. Kemp.	Many.
$\frac{9574}{10}$	Chingrighatta, near Calcutta ...	Mus. staff.	One.
$\frac{9579}{10}$	Karnaphuli R., Rangamati, Chittagong Hill Tracts	Mus. collr.	Eight.
$\frac{9571}{10}$	Pazudaung and Dala Creeks, Rangoon, Burma	N. Annandale.	Many.
$\frac{9576}{10}$	Moulmein R., Burma. ...	'Investigator.'	Three.
$\frac{9572}{10}$	Gying R., nr. Moulmein, Burma ...	N. Annandale.	Several.

The species occurs in water that is quite fresh as well as in that of low salinity. At Chingrighatta it was obtained in water of specific gravity 1·0015 and it is evidently not uncommon in the Gangetic delta, occurring also in the estuaries of the Sitaung and Moulmein rivers in Burma. It has, however, been taken at places far remote from tidal influence. Rajmahal is some 350 miles by river from the sea, while Mirzapur in the United Provinces is 700 miles by river from the coast and nearly 400 miles in a direct line from the sea.

Leander potamiscus, sp. nov.

This species resembles *L. fluminicola* in the absence of the branchiostegal spine and in the great length of the carpus of the second peraeopods; it may be distinguished by the following characters:—

(i) The rostrum is longer, extending beyond the tip of the antennal scale by two fifths or one half of its length. The basal crest is low and bears from 7 to 10 teeth,[1] the hindmost being situated on the carapace behind the level of the orbit. On the upper side of the apex there are from 1 to 3 small teeth, usually 2, and there is not infrequently an additional tooth between these and the foremost of those that form the basal crest. The teeth on the lower margin are more numerous, from 6 to 10[2] (text-fig. 7).

(ii) The finely-cut longitudinal groove on the carapace, just above the position usually occupied by the branchiostegal spine, is particularly well defined.

(iii) The peraeopods are all more slender. The first pair reaches about to the end of the antennal scale, the carpus being two and a quarter or two and a half times the length of the chela.

(iv) The second peraeopods reach beyond the scale by the chela and a portion (sometimes as much as one third the length) of the carpus. The chela is one fifth shorter than the ischium and about one half (sometimes a little more, sometimes a little

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[1] Of twenty-two specimens five have 7 teeth on the basal crest, twelve have 8, four have 9 and one has 10.

[2] Of twenty-two specimens one has 6 inferior teeth, five have 7, ten have 8, five have 9 and one has 10.

less) the length of the carpus. The fingers are not markedly spooned and are much shorter than in *L. fluminicola*, scarcely more than two thirds the length of the palm.

(v) The last three peraeopods are very long and slender. The third pair reach beyond the antennal scale by more than the length of the dactylus, the fifth by the dactylus and one half or two thirds the length of the propodus. The dactylus in all three pairs is very short. In the fifth pair the dactylus is considerably less than half the length of the carpus; the propodus is twice the length of the carpus and about one-sixth longer than the merus.

(vi) The spinules on the upper surface of the telson are rather differently placed. In *L. fluminicola* the first pair is placed behind the middle of the telson, and the second pair is little if at all nearer

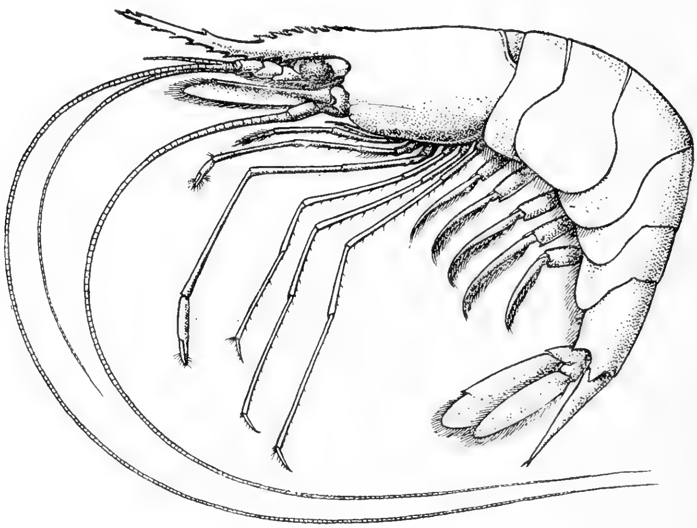


FIG. 7.—*Leander potamiscus*, sp. nov.

to the first than to the tip. In *L. potamiscus* the first pair is almost in the middle of the telson and the second is placed much in advance of a point midway between the first pair and the tip.

In all other respects *L. potamiscus* bears the closest resemblance to *L. fluminicola*. The antennules and antennal scale are almost exactly similar. The first maxillipede is nearly the same as in Sollaud's figure of *L. mani*, the distal lobe of the epipod being more sharply pointed than in other species. The spines at the tip of the telson are rather longer than in allied forms.

Large specimens reach a total length of about 48 mm. The eggs borne by ovigerous females are small, about 0·54×0·44 mm. in longer and shorter diameter.

Dr. Annandale notes that most of the specimens he collected, were practically colourless when alive, though not transparent.

A few of the largest, however, probably adult males, had several longitudinal black lines on each side of the carapace which converged forwards slightly. They had also a small black spot on the side of each abdominal somite. The fingers of the second legs were scarlet and the palms of the chelae opaque shining white; there were also opaque shining white spots on the other segments of the chelae.

The specimens collected by Dr. Annandale were caught in February 1916, in the Patani River, below the town of Patani in the Siamese Malay States and at Telok Tikus on Penang Island in a small stream near the sea. A number of other examples [1] are in the Indian Museum, obtained by Col. C. G. Rogers in a small creek at the south-eastern corner of Middle I. in the Andamans. The largest of these specimens is 38 mm. in length, the collection, which was made in April 1911, not comprising any ovigerous females. In all three localities the specimens were found in fresh water, the situation in which they were taken being, however, subject to tidal influence.

The type specimens, from the Patani River, bear the number 9552/10 in the register of the Zoological Survey.

Palaemon mirabilis, sp. nov.

(Plate x.)

A very remarkable Palaemonid, represented in the Indian Museum by a number of specimens from the Rangoon and Moulmein Rivers and from various localities in the Gangetic delta, apparently belongs to a species hitherto undescribed. In the peculiar form of the rostrum and the extreme slenderness of the legs the species differs widely from typical members of the genus *Palaemon* and bears a curious and perhaps significant resemblance to *Leander styliferus*.

The rostrum is short and does not quite reach the end of the antennular peduncle. On the upper side of the lateral carina it consists of a thin lamella—in height greatly exceeding that of any other species of *Palaemon* known to me—with a strongly convex

[1] Since the above account was written I have obtained about thirty-five additional specimens of *L. potamiscus* in Portuguese India. A number were found in the Sanguem R. at Sanvordem and one, presented by Capt. F. de Vasconcellos, was taken in the Tuari R. near Cortalim. These records, being from the west coast of India, indicate a considerable extension in the known range of the species. The specimens agree closely with the types, but possess on the whole fewer rostral teeth; on the upper margin at the base there are 7 or 8, rarely 9, and on the lower margin only 6 or 7. In the single individual from the Tuari R. the basal crest is composed of 6 teeth, while there are 8 on the lower margin. The specimens differ from *L. fluminicola* in all the points noted above. When living they were semi-transparent, with a few very small chromatophores scattered on the body; the rostrum in front of the basal crest was deeply pigmented. The colouration thus differs conspicuously from that noted by Dr. Annandale in the case of large Patani R. examples. As in the case of the other records, the specimens from Portuguese India were found in fresh water, but in places subject to tidal influence. A number of individuals harbour Bopyrid parasites.

upper border bearing many close-set teeth. The rostrum begins as a carina in the middle of the carapace and its upper border is sharply ascendant up to a point immediately over the eye; in front of this it drops steeply to the apex, which is straight, narrow and produced. The margin between the highest point and the apex is concave. The teeth on the upper border vary in number from 13 to 16,[1] of which from 4 to 6 (usually 4 or 5) are situated on the carapace behind the level of the orbit. The teeth are fixed and evenly spaced and the interstices between them are filled with hairs. The lower margin is convex, but is not greatly expanded: the depth of the inferior portion of the blade is considerably less than half the depth of the upper portion. The lower margin bears 1, very rarely 2 teeth[2] in the distal half of its length.

The carapace is smooth. The antennal tooth is well-formed and from its base a strong carina runs backwards and downwards to the base of the hepatic tooth. The latter is large and beneath and behind it there is a shallow groove. A depression defines the upper posterior limits of the branchial region and there is a faint longitudinal groove on either side of the cardiac area.

The eye is short and somewhat depressed. The "ocellus" is rather large and is broadly in contact with the cornea (pl. x, fig. *a*).

The antennular peduncle does not differ materially from that of typical *Palaemcn*. The basal segment is rather slender and the keel near the inner edge of its lower surface bears the customary tooth in its proximal half; the outer margin terminates anteriorly in a sharp tooth extending far beyond the produced lateral portions of the segment. The second segment is less than two thirds the length of the third. The accessory flagellum is conspicuously serrate externally and is about as long as the peduncle; it is fused basally with the outer branch for a distance not equal to half the length of the last peduncular segment.

The antennal scale (pl. x, fig. *b*) is about three times as long as wide. Its outer margin is straight and ends in a sharp tooth which does not reach nearly as far forwards as the apical portion of the lamella.

The oral appendages do not appear to differ in any noteworthy feature from those of *Palaemon* or *Leander*. The mandible bears a three-segmented palp, the last segment being almost as long as the two basal ones combined; the incisor-process ends in three large teeth. In the second maxilla the two lobes that form the distal lacinia are rather narrower than is usual. The first maxillipedes possess a bilobed epipod and the second an epipod with a podobranch attached. The third maxillipedes reach about to the middle of the antennal scale. The exopod

[1] Of fifty specimens five have 13 dorsal teeth, thirteen have 14, twenty-three have 15 and nine have 16.

[2] Of fifty specimens forty-eight have a single ventral tooth, while two have 2 teeth.

extends nearly to the end of the antepenultimate segment, which is conspicuously flattened and dilated distally; the terminal segment is about three quarters the length of the penultimate.

The first peraeopods reach the tip of the antennal scale. The carpus is rather less than twice the length of the chela; the fingers bear tufts of setae and are a little longer than the palm.

The second peraeopods reach beyond the end of the scale by the length of the chela and are equal and equally long in both sexes. The merus is a shade longer than the ischium and is about one and a quarter times the length of the carpus. The chela is rather more than one and a half times the length of the carpus and the palm is about two thirds the length of the fingers. The whole limb bears a singularly close resemblance to that of *Leander styliferus* and differs widely in form from that of typical *Palaemon*. The basal segments are all slender: the carpus is broadened distally where it is fully one and a half times as thick as at its proximal end; the palm is strongly inflated and much broader than the carpus, while each of the fingers is very slender, slightly curved and with an inturned claw at the apex (pl. x, fig *c*). The fingers meet throughout their length when the chela is closed and are without teeth on their inner margins. The entire limb is glabrous except for a few fine and sparsely distributed hairs on the fingers.

The last three pairs of peraeopods are very slender and increase successively in length to a notable extent. The third pair reaches beyond the tip of the antennal scale by the length of the dactylus, the fourth by the dactylus and the greater part of the propodus, the fifth by the dactylus, propodus and a small portion of the carpus. The fifth leg is more than twice the length of the carapace and rostrum combined. In the third pair the carpus and dactylus are about equal in length; the propodus is nearly two and a half times as long and is a little shorter than the merus. In the fifth pair, which is excessively slender, the carpus is a good deal more than twice the length of the dactylus. The propodus is twice the length of the carpus and is one and a fifth times as long as the merus. Two or three pairs of microscopic spinules may usually be found on the propodi of the third and fourth pairs and a series of similar but more closely-set spinules at the distal end of the same segment in the fifth pair. In all three the upper surface of the dactylus is setose (pl. x, fig. *d*).

The abdomen is smooth. In adults the sixth somite, measured dorsally, is about one and a half times the length of the fifth; in young examples it is rather longer. The telson is much shorter than the inner uropod; it is smoothly rounded above and generally bears two pairs of minute dorsal spinules. The apex is very narrow and consists of a small median point flanked by a pair of spinules. Those of the inner pair are long and between them there are two plumose setae; those of the outer pair are quite short (pl. x, fig. *e*).

Large specimens reach a length of about 55 mm. from the tip of the rostrum to the apex of the telson. The eggs borne by the females are small, about 0·56 mm. by 0·43 mm. in longer and shorter diameter.

Living specimens are transparent, the dark gastric and hepatic masses being as a rule clearly visible through the carapace. In large individuals reddish flecks and suffusions are sometimes found on the sides of the abdomen and the postero-dorsal margin of each somite is rather deeply tinged with the same colour. The eggs are pale greenish yellow. Small specimens are quite colourless.

This remarkable species shows in a new and very striking manner the close relation that exists between the genera *Leander* and *Palaemon*, and once again awakens doubts as to whether our classification is correct.

The only essential difference between the two genera rests in the hepatic spine, which is present in *Palaemon* and absent in *Leander*, and, in comparing normal forms of the latter genus with species of *Palaemon* in which the chelipedes of the male have not assumed a peculiar development, it is frequently by this point alone that the two genera can be distinguished. The value of the character has recently been much discounted by Calman's discovery that it is not, as was previously thought, absolutely constant.[1] In *Palaemon hildebrandti*, a form which is restricted to Madagascar, the hepatic tooth may be either present or absent. In all other respects this species is a typical *Palaemon*; it shows no affinity with *Leander* and cannot be regarded as establishing a link between the two genera. It indicates none the less that the hepatic tooth may occasionally prove an unreliable factor.

The existence of such a form as *Palaemon mirabilis* is both unexpected and perplexing, for, except for the presence of the hepatic tooth, its affinities seem to be unmistakably with *Leander styliferus* and its allies, a group of species which form an outstanding and apparently highly specialized section of the genus. Were it not for the tooth in question *P. mirabilis* would undoubtedly be given a place in this section of *Leander*, differring from *L. styliferus* merely in the abrupt curtailment of the rostrum and in the proportionate length of the various segments of the legs. Moreover, so far as I am aware, the species bears no resemblance to any *Palaemon* hitherto described.

We see, therefore, that if the character of the hepatic tooth be upheld as a generic determinant, a double relationship can be traced between the two genera: firstly, through the unspecialized forms of each and secondly,—if my interpretation of the facts be correct—between *Palaemon mirabilis* and the specialized *Leander* of the *styliferus*-group. If these relationships are accepted as indications of the course which evolution has taken, as I think they must be, we are forced to admit the existence of a double line of descent—which is manifestly impossible in a rational scheme of classification. It should be noted that the *styliferus*-group does not appear to be a disconnected entity, such as might have evolved

[1] Calman, *Proc. Zool. Soc. London*, 1913, p. 928.

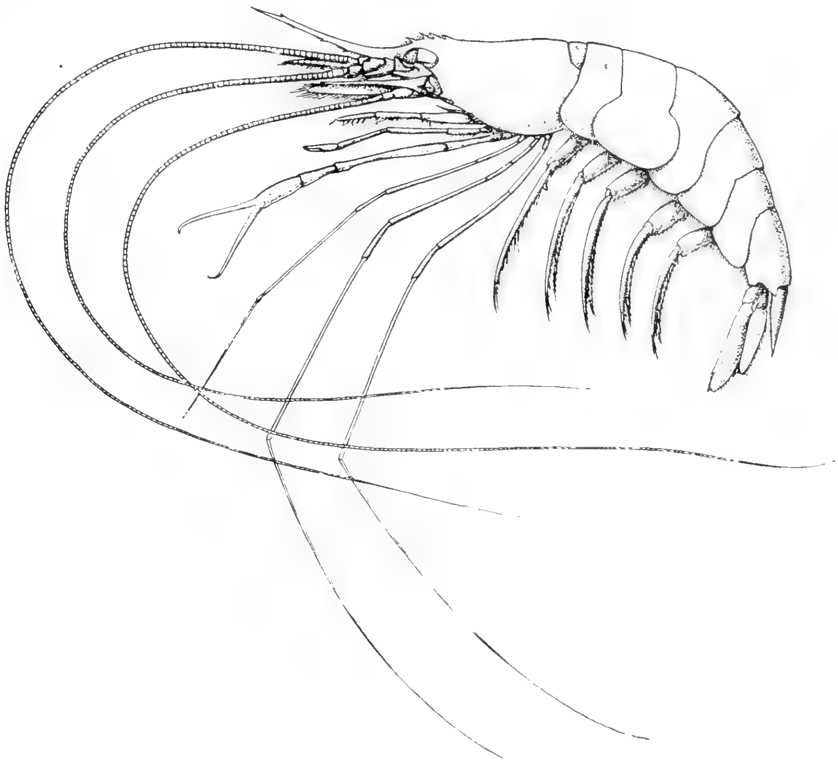
independently from some such form as *P. mirabilis*; on the contrary, it seems to grade evenly into the more normal species of *Leander* through such forms as *L. concinnus.*

Following the classification at present in vogue, I have described the species as a member of the genus *Palaemon*, though, as already pointed out, it then becomes extremely difficult to explain how the different forms have evolved. The facts of the case, in my opinion, almost compel one to regard *P. mirabilis* as a true *Leander* and lead to the conclusion that, whereas the hepatic tooth in *Palaemon hildebrandti* has sometimes become suppressed, it has actually *reappeared* in a specialized member of the related genus. My only excuse for not at once referring the species to the genus *Leander* is that I believe it unwise to alter accepted classification on theory alone, unless such theory be extremely well founded. At present, unfortunately, our knowledge of the classification and affinities of the genera of Palaemonidae is very incomplete; it may well be that further investigation will throw light on the position of the species here described.

The specimens in the Indian Museum are from the following localities:—

$\frac{9633\text{-}5}{10}$	Pazudaung and Dala Creeks, Rangoon	N. Annandale.	Sixty-five.
$\frac{9431}{10}$	Moulmein R., Burma ...	'Investigator.'	Nineteen.
$\frac{9636}{10}$	Off Cowcolly Lighthouse, Hughli R.	J. Munro.	Six.
$\frac{9638}{10}$	Trebeni, Hughli dist. ...	B. L. Chaudhuri.	Many young.
$\frac{9637}{10}$	Sandheads, Gangetic delta ...	J. Wood-Mason.	One.
$\frac{9724}{10}$	R. Hughli, Sibpur, Calcutta ...	S. Kemp.	Many.
$\frac{9725}{10}$	Matlah R., Port Canning, Gangetic delta	S. Kemp.	Several.
$\frac{9639}{10}$	Hughli Nullah, Bosondherabad, Gangetic delta	J. T. Jenkins.	One.
$\frac{9641}{10}$	Mouth of Damodar R., Gangetic delta	T. Southwell.	Three.
$\frac{9726}{10}$	Near Shela, Khulna dist., Gangetic delta	J. T. Jenkins.	Four.
$\frac{9640}{10}$	Creek nr. Barisal, Backergunge dist.	T. Southwell.	One.

In all these localities the water is brackish, either permanently or at certain states of the tide. The type specimens are from Rangoon and bear the number 9633/10 in the register of the Zoological Survey.



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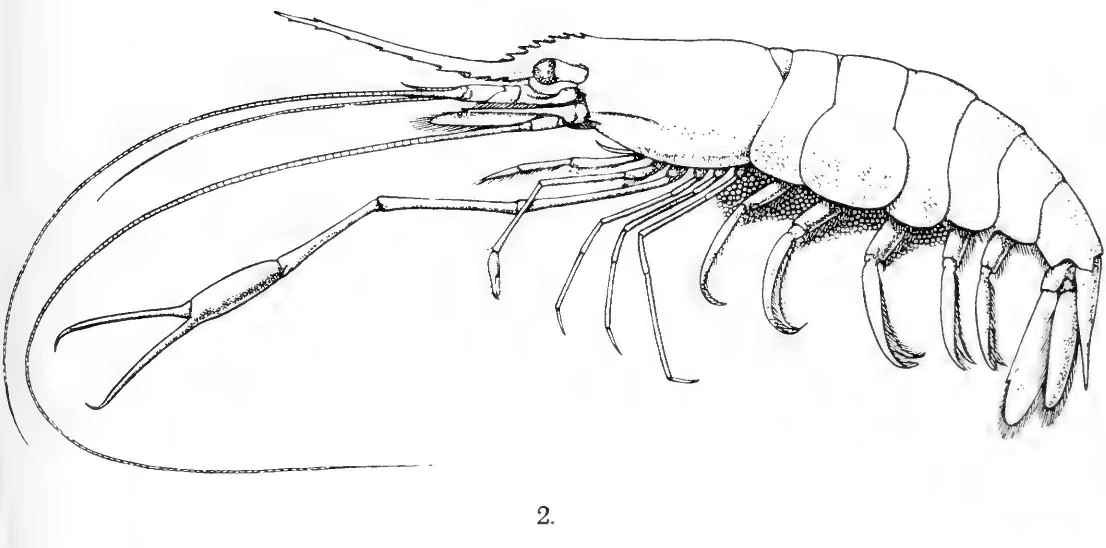
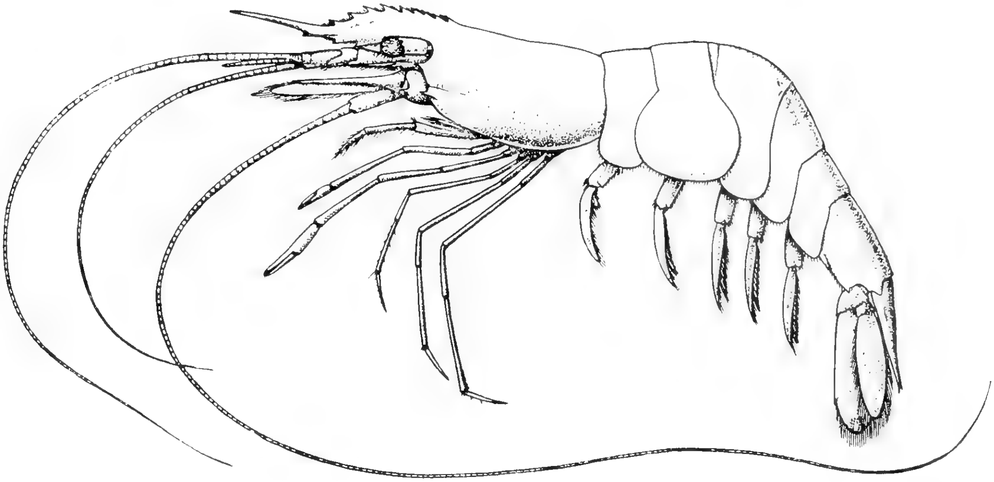


2.

1. *Leander tenuipes*, Henderson.
2. *Leander styliferus*, Milne-Edwards.



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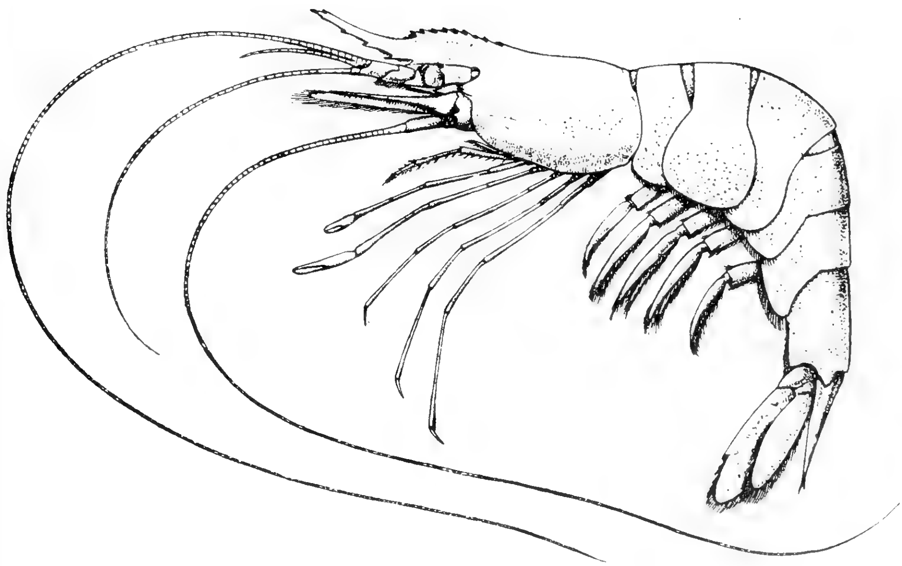
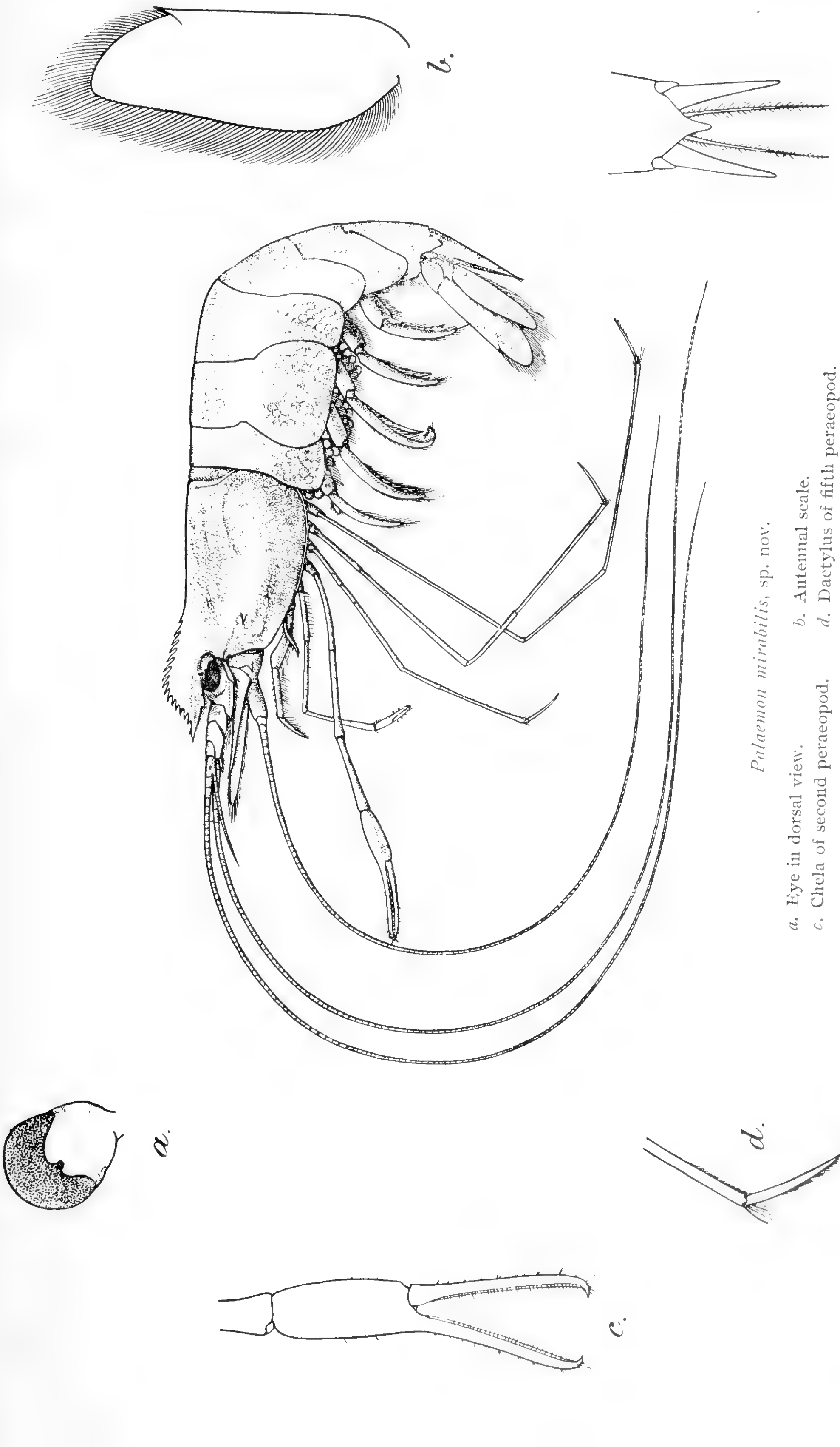


2.

1. *Leander modestus*, Heller.
2. *Leander fluminicola*, sp. nov.



Palaemon mirabilis, sp. nov.

a. Eye in dorsal view. *b.* Antennal scale.
c. Chela of second peraeopod. *d.* Dactylus of fifth peraeopod.
e. Apex of telson.

XIV. NOTES ON THE FAUNA OF THE MATLAH RIVER IN THE GANGETIC DELTA.

By STANLEY KEMP, B.A., *Superintendent, Zoological Survey of India.*

In December 1915, thanks to the kindness of Mr. T. Southwell, Deputy Director of Fisheries, Bengal and Bihar, I was able to visit certain parts of the Gangetic delta in the S.L. "Kitty," a launch recently built by Government for fishery investigation. The area examined comprises the Matlah River and the channels in its vicinity, and extends from Port Canning in the north to the junction of the Matlah and Biddah rivers in the south, a distance of about 30 miles. The following note deals only with the bottom fauna of this area.

The Matlah river is one of the largest of the numerous waterways that traverse the Gangetic delta and is navigable for ships of large tonnage as far as Port Canning. It varies in depth, but in the main channel there is nowhere less than $4\frac{1}{2}$ fathoms at low spring tides; over considerable areas the water exceeds 8 fathoms and the chart published in 1855 shows that still deeper pockets exist, soundings at a point some $7\frac{1}{2}$ miles below Port Canning reaching a maximum of 27 fathoms.

The level of the water varies greatly according to tide; there is as a general rule a difference of about 10 feet between high and low water, a figure that may rise to as much as 15 feet at spring tides. Towards the close of the monsoon the average level is raised by floods and at such times the uncultivated islands (that is to say, those that are not surrounded by an embankment) are almost wholly submerged at high tide. The water is nearly always heavily laden with silt and doubtless shows great seasonal variation in salinity. On the occasion of my visit the specific gravity (corrected to a standard temperature of 15°C.) varied from 1·00375 to 1·01075.[1] Higher readings would almost certainly be found immediately prior to the monsoon, when the land drainage is at its minimum, and during the flood season the water at certain states of the tide is probably almost fresh.

In the area examined the river bottom appears to be composed of very finely divided mud, in character considerably softer than I have seen in any other locality. On the banks at low water a person of average weight will sometimes sink to a depth of two feet and, unless active, may require assistance to extricate himself.

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[1] The specific gravity of the sea on the Orissa coast of the Bay of Bengal is much greater than the highest of these readings, varying from about 1·017 at the close of the monsoon to 1·0280 in early spring.

The mud of the river bed appears to be of a similar consistency, but in a few places near the junction of the Biddah river there is a small admixture of sand. The tidal currents run swiftly, with the result that the upper layers of mud on the river bed must always be kept in motion and partially in suspension, the actual bottom being perhaps almost impalpable.

The fauna of the river bed appears to be very limited; but, though poor in species, it is abundant in individuals. The more characteristic of the species obtained in our small trawl[1] were the following:—

CRUSTACEA.

Palaemonidae.
- **Palaemon mirabilis*, Kemp.
- **Leander styliferus*, Milne-Edwards.
- * ,, *tenuipes*, Henderson.

Penaeidae.
- *Penaeopsis monoceros* (Milne-Edwards).
- ,, *brevicornis* (Milne-Edwards).
- **Parapenaeopsis sculptilis* (Heller).

FISH.

Kurtidae.
- *Kurtus indicus*, Bloch.

Polynemidae.
- **Polydactylus paradiseus* (Linn.).

Sciaenidae.
- *Sciaena cuja* (Ham.-Buch.).

FISH.

Sciaenidae.
- *Sciaena corta* (Ham.-Buch.).
- *Umbrina sinuata*, Day.

Trichiuridae.
- *Trichiurus haumela* (Forsk.).

Gobiidae.
- *Glossogobius elegans* (Kuhl & Hass.).

Siluridae.
- **Macrones gulio* (Ham.-Buch.).
- *Pangasius pangasius* (Ham.-Buch.).

Scopelidae.
- **Harpodon nehereus*, (Ham.-Buch.).

Clupeidae.
- **Coilia dussumieri*, Cuv. & Val.
- *Stolephorus indicus* (von Hasselt).

The names of the more abundant species are marked with an asterisk. For the identifications of the fish I am indebted to my colleague Dr. B. L. Chaudhuri.

The list may, I think, be taken as a fair sample of the bottom fauna of the area examined; but the larger and more active species of fish, such as *Lates calcarifer*, were not obtained in our nets. Apart from fish and Decapod Crustacea the fauna is excessively poor; it includes a Mysid, probably belonging to the genus *Gastrosaccus*, and occasional Isopods, Amphipods and Polychaetes, not more than one or two species of each. Young specimens of Portunid crabs, *Scylla serrata* and *Charybdis rostrata*, were found on a few occasions. A peculiar Medusa, *Asenathia piscatoris*, Annandale,[2] that appears to live at or near the bottom, was also obtained, but was extremely scarce.

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[1] A beam trawl 6 feet in breadth.

[2] Annandale, *Mem. Asiat. Soc. Bengal*, VI, pp. 114-116, text-figs. 3-5 (1917).

The chief interest of this fauna, and the point with which this note is mainly concerned, is the extraordinary resemblance which the species bear to those inhabiting great depths of the sea. I am convinced that if anyone with experience of both deep-sea and shallow-water faunas were to have made a casual inspection of the contents of the nets we hauled in the Matlah River, he would have expressed the opinion that the catch came from water not less than 400 fathoms in depth. On closer inspection he would no doubt find reason to alter his opinion, for only one of the species is a member of a deep-sea genus and few belong even to families known from considerable depths. But in general facies the two faunas resemble one another so closely that he would almost certainly be deceived at first sight.

The bottom of the Matlah River, with its rapid currents and moving silt, affords an environment altogether unsuitable for sedentary or slow moving organisms, and it is to this feature that the predominance of Crustacea and fish must be ascribed. Conditions in the deep sea are evidently different, for fixed animals such as Hexactinellid sponges are often far from uncommon, while creatures of slow movement such as the leathery sea-urchins and Holothurians are often very abundant. It is in the fish and Decapods that the peculiar character of the Matlah fauna is exhibited and it is, moreover, in the most abundant species that the resemblance to deep-sea forms is most pronounced.

The modifications that give to the deep-sea fauna its peculiar facies may be discussed under two headings,—form and colour; and in view of what has already been said it will be sufficient to refer here only to the fish and Decapod Crustacea.

The colours of deep-sea fish are very limited. The great majority of the species are deep black, grey of varying intensity, silver, and semitranslucent or dead white. Two or more of these colours are frequently found in combination. Reddish and brownish tints are very rare and blues and yellows are almost non-existent. In the Matlah fish there are no black forms, the majority being grey, white or silver. The *Macrones* is very deep grey above and dull white below, with black fins; the *Pangasius*, *Sciaena* and *Umbrina* are grey and silvery and the *Trichiurus* and *Kurtus* altogether silvery. *Coilia dussmieri* is white with a lateral row of brilliant silver spots, while *Harpodon nehereus* is semitranslucent milky white with minute black dots. An exception is *Polynemus paradiseus*, which though greyish above has dull golden brown sides.

The range of colour in deep-sea Crustacea is even more limited than in the case of fish. A considerable number of the species are uniformly crimson, red or pink, while in a few cases purple tones are found. Other species are ivory or milky white, frequently semitranslucent, and these are sometimes blotched or streaked with red, orange or yellow. Forms which are uniformly orange or yellow also occur, but are less common. In the great majority of cases the eggs are yellow or yellowish green.

The Crustacea found in the Matlah River most strikingly resemble deep-sea forms in their colour. *Parapenaeopsis sculptilis* is uniformly deep red, while the Palaemonidae are of a milky semitranslucency[1] with red markings. In *Palaemon mirabilis* red flecks or suffusions are found on the abdominal somites; in *Leander styliferus* the tip of the rostrum and the extremities of the telson and uropods are red. In *L. tenuipes* the mandibular region is bright red and the rostrum dotted with carmine; the lower antennular flagellum is carmine at the base, changing to deep mauve nearer the tip; there are red flecks on the abdominal somites and the telson and uropods are deeply stained with bright red. The eggs are gamboge or greenish yellow.

The peculiar character of the Matlah fauna is at first sight most forcefully brought to notice through the medium of colour, and it is unfortunate that it is not possible to do justice to this very striking feature by mere description. Several of the constituent species, however, show in their structure also a remarkable resemblance to deep-sea forms. The most notable instance is perhaps the "Bombay Duck," *Harpodon nehereus*,[2] which, with its gelatinous consistency and large mouth with the lower jaws loosely articulated and furnished with recurved teeth, exhibits every characteristic of a deep-sea species. *Harpodon nehereus* differs from all other forms found in the Matlah River in belonging to a family (the Scopelidae) the members of which are almost exclusively of abyssal or bathypelagic habitat; other species of the same genus are known only from considerable depths. The peculiarity of *H. nehereus* lies therefore not in its structure, but in the fact that a representative of such a typically deep-sea family should occur in shallow water. The resemblance to abyssal forms misled even so great an authority as Gunther; for, in reference to the two species of *Harpodon* known to him (one being *H. nehereus*), he remarks "both are evidently inhabitants of considerable depths, and periodically come nearer to the surface."[3]

Polynemus paradiseus is remarkable for the extreme length of certain free pectoral rays and for the elongation of the upper and lower caudal rays. In general appearance it is not dissimilar to deep-sea Scopelids of the genus *Bathypterois*, in which both these modifications occur. The eyes in *Bathypterois* are small and some of the species are probably quite blind; in *P. paradiseus* the eyes are small and covered by skin.

In a number of the fish found in the Matlah River the body tends to become attenuated posteriorly. This feature, which is also found in abyssal forms, reaches an extreme development in *Coilia dussumieri*, a species which bears a strange resemblance to deep-sea fish of the genus *Macrurus*.

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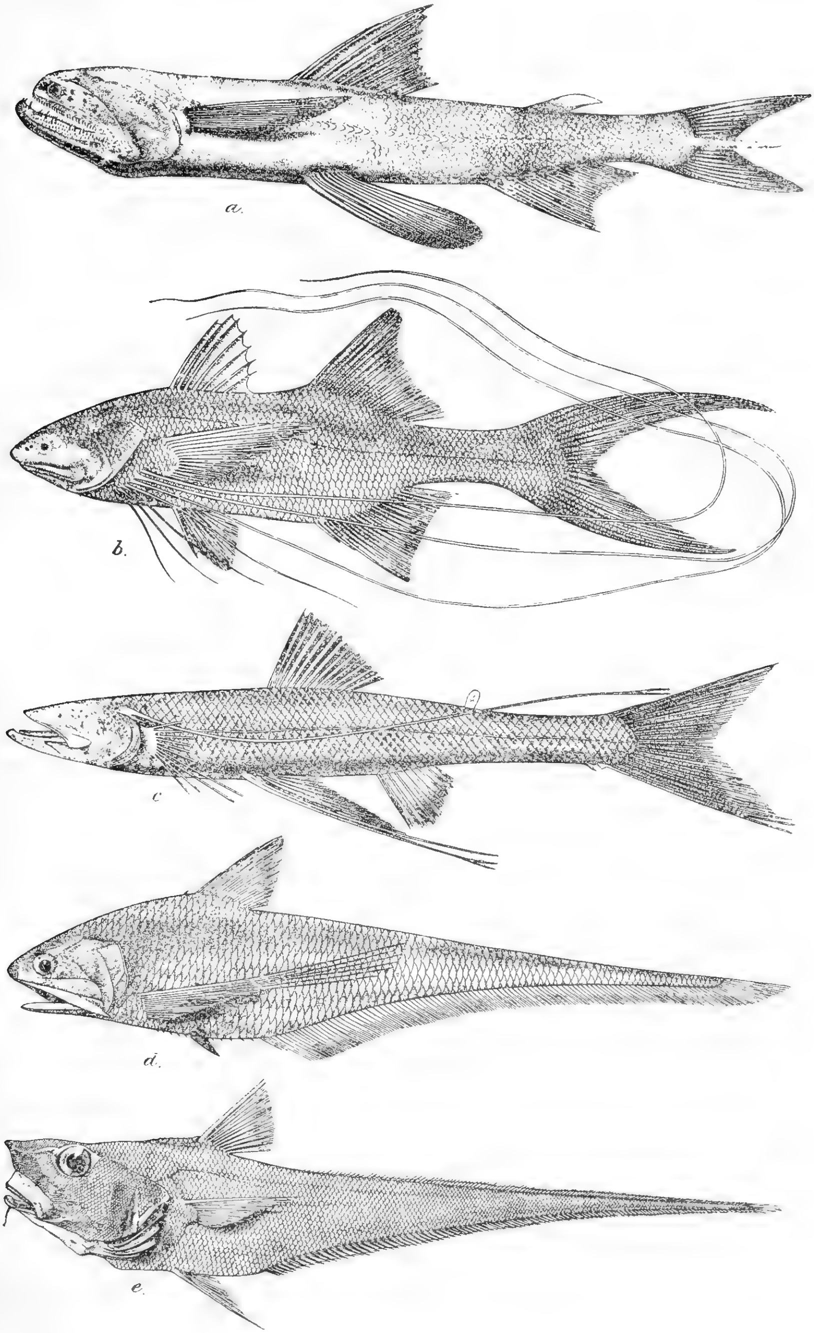
[1] This milky tint is also found in the bottom-living Medusa, *Asenathia piscatoris*.

[2] Dr. Chaudhuri informs me that Hamilton-Buchanan must have adopted the specific name of this fish from the Bengali term *nihádé*, meaning "boneless."

[3] Gunther, *Study of Fishes*, p. 584 (1880).



a. Harpodon nehereus (Ham.-Buch.) [Matlah River].
b. Polydactylus paradiseus (Linn.) [Matlah River].
c. Bathypterois dubius, Vaillant [Deep-sea].
d. Coilia dussumieri, Cuv. & Val. [Mutlah River].
e. Macrurus wood-masoni, Alcock [Deep-sea].

FIGS. *a*, *b*, *d*, after Day, fig. *c* after Vaillant, fig. *e* after Alcock.

Among the Decapoda Macrura characteristic differences between abyssal and shallow-water forms are less evident, but in a number of species belonging to several different families the walking legs tend to become extremely long and slender. This tendency reaches its maximum development in the very peculiar forms belonging to the Nematocarcinidae, a family known only from great depths of the ocean.

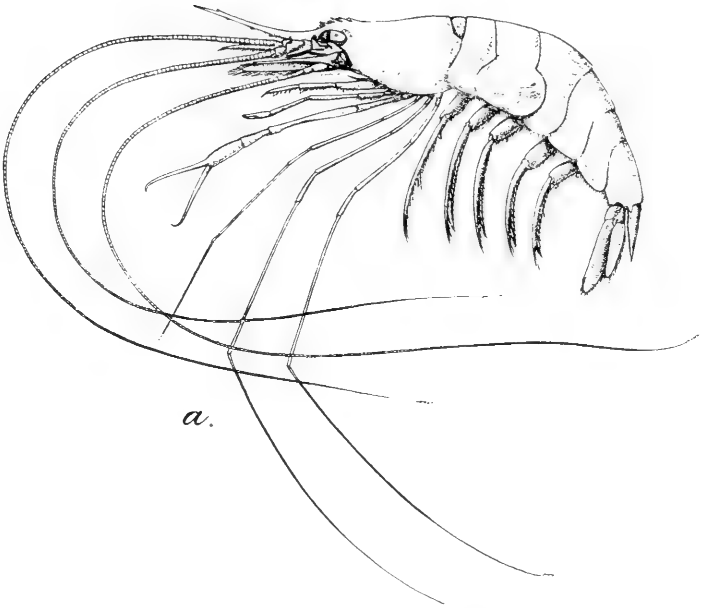
Only a few species of Macrura inhabit the bed of the Matlah River. The Penaeids do not show any special structural modifications, but in all the Carids the legs are noticeably longer and very much more slender than is customary. The most remarkable form is unquestionably *Leander tenuipes*, in which the legs are of the most extreme length and tenuity. I do not know of any shallow-water Carid[1] that is in the least degree comparable with this peculiar species; to find analogous cases we must turn to deep-sea forms and in particular to the genus *Nematocarcinus*. The modification is not effected in the same way in both cases. In *L. tenuipes* it is in the main brought about by the extreme attenuation of the propodus and dactylus; in *Nematocarcinus* these two segments are short, the great length of the leg being due to an elongation of the ischium, merus and carpus.

There are two characteristic features of a deep sea fish and Crustacean fauna that are not met with in the Matlah River,—(i) the eyes are about normal in size and no species, except perhaps *P. paradiseus*, is even partially blind, (ii) none of the species possess luminous organs. In many deep-sea forms, however, the eyes show but little modification, and it now seems probable that all abyssal animals that possess definite luminous organs or photophores (as opposed to glands excreting a luminous fluid) are meso- or bathypelagic in habit and do not live on the bottom. *Harpodon nehereus* is said to be brilliantly luminous over its whole surface, but this is a statement that I am not able to corroborate by observation.

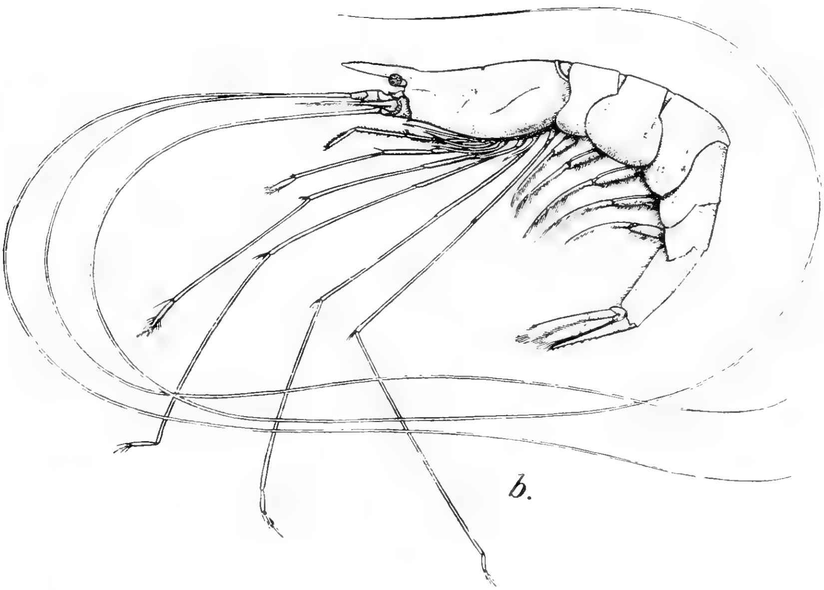
Summarising what has already been said, it may be stated that the comparatively small number of animals living on the bed of the Matlah River present modifications similar to those found in a deep-sea fauna. The resemblance is due largely to colour—the similarity in this respect being almost exact—, while it is enhanced in a number of instances by the presence of structural peculiarities rarely met with except in abyssal forms.

It should be noted that no single member of the Matlah fauna is restricted to the Gangetic delta; some of the species have a wide distribution and several are known to occur in the open sea. It is, moreover, probable that a number are migratory forms, visiting the Bay of Bengal during the flood season; there is, at any rate, evidence that this is the case with the two species of *Leander*.

[1] Except *Leander hastatus*, Aurivillius, from the W. African coast, a species having an extremely close affinity with *L. tenuipes*.



a.



b.

a. Leander tenuipes, Henderson [Matlah River].
b. Nematocarcinus exilis (Bate) [Deep-sea].

Notwithstanding these facts I am strongly of the opinion that the resemblances between the two faunas are not fortuitous; some underlying cause must be at work and there can be no reasonable doubt that this cause is to be sought in the environment. So far as I can understand, the environment appears to have exercised a selective influence on the Matlah fauna, and has in some way permitted the existence only of those species that conform to certain definite rules. That this has resulted in the existence of a fauna resembling that of the deep sea is exceedingly curious, but it affords, I think, a clue as to the factors involved.

There are few points of similarity between the environment of the species found in the Matlah River and that of those found in the ocean depths. Complete absence of light, great pressure, low temperatures, high salinities and still water characterise the latter, whereas in the former the temperatures are high, the salinities very low and the tidal currents swift. I have no precise information as to the amount of light on the bed of the Matlah River. It is no doubt greatly diminished, for the water is heavily laden with silt and, as has already been pointed out, the upper layers of mud are probably always kept in motion by the tidal currents. There can, however, be little doubt that some light penetrates to the bottom.

But there is another factor, which may or may not be dependent on the amount of light, that appears to be of considerable importance; to this factor the term visibility may be applied. Dr. Annandale and I noticed that the Palaemonidae found in the Matlah River, when placed in an aquarium with the cleanest river water we could procure, were quite invisible unless they approached within an inch or so of the glass. The lack of visibility was brought about in the main by the colour of the animals, the milky translucency of their bodies seeming to correspond precisely with the turbidity of the water. Transparency is quite ineffectual in rendering animals invisible in muddy water; I have frequently noticed that such planctonic forms as *Pleurobrachia* and the Penaeid *Acetes* are extremely conspicuous in silt-laden water, forming as it were hyaline spaces in an otherwise merely translucent medium. In aquatic forms, then, the factor of visibility seems to depend, when light is present, on a relation between the opacity of the animal compared with that of the water in which it lives. In the Matlah River visibility, in the case of a considerable part of the bottom fauna, is evidently very low and in the deep sea, unless animal or bacterial luminosity is strong, it is practically absent.

Thus in the matter of visibility there is perhaps some slight similarity between the two environments and other factors common to both are the absence of vegetation and the nature of the bottom. But weeds are in many places absent without producing the curious effects seen in the Matlah fauna, and it is probable that the character of the bottom is much the more important. The mud of the Matlah River bed is of a peculiarly soft consistency and is perhaps the nearest approach to the deep-sea oozes that is to be found in shallow water.

A diminished supply of light, low visibility and the very soft nature of the bottom appear to me to have been the principal factors that have determined the character of the Matlah fauna. The colour phenomena seem for the most part to be controlled by the first two of these factors. The presence of red pigmentation in deep-sea Crustacea is probably brought about in some way not yet fully understood in response to a diminished supply of light and, if this is so, there is every reason to think that the red colouration so commonly met with in the Matlah prawns is precisely similar in origin. In these cases there is no evidence that the colour has any protective significance. It is otherwise, however, with the peculiar translucency of the tissues that may exist either in combination with, or in absence of red pigment. This feature is clearly of protective value in the Matlah fauna; whether it is more than fortuitous in deep-sea forms we have at present no means of ascertaining.

The structural modifications, on the other hand, more particularly the elongation and attenuation of fin-rays and appendages, appear to be correlated with the nature of the bottom, and the evidence afforded by the inhabitants of the Matlah River suggests that this factor has had a greater influence than has generally been supposed in moulding the character of many deep-sea species.

XV. NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

X. *Hymenosomatidae.*

By Stanley Kemp, *B.A., Superintendent, Zoological Survey of India.*

The small crabs belonging to the family Hymenosomatidae are singularly unobtrusive in habit and unless very abundant are liable to escape notice. A few species are found in salt water of no great depth, and are not infrequently taken on coral reefs or living under stones between tide-marks; but the majority (at any rate on the Indian coast) appear to inhabit estuaries or lagoons where the water is of low or variable salinity. Two species of the family have, indeed, succeeded in establishing themselves in pure fresh water and one has been taken in lakes 3,000 ft. above sea level.[1]

Most of the species prefer a bottom composed of mud, which, when matted with the fine hairs on their bodies, doubtless assists them in escaping detection. In many instances the mud forms such a dense coating on the carapace and appendages that it is almost impossible to remove it without injury to the specimen. The legs are very brittle; some species appear to throw them off almost without provocation, and this so constantly occurs with *Elamena (Trigonoplax) unguiformis* that it is almost impossible to preserve a perfect example.

Among the crabs recently collected on the Indian coasts several species of Hymenosomatidae are represented. Alcock in his memoir on the Indian Catometopes[2] was able to give an account of five species and two more have since been recorded. Six others, all of which have not hitherto been described, are here added, bringing the total number of known Indian forms up to thirteen.

The new Indian species were all obtained in brackish water. Four were found by myself in Portuguese India, one being a very abundant species which has also been collected by Dr. F. H. Gravely in the Cochin backwaters. The other two were taken by Dr. Annandale and myself in the vicinity of Calcutta. Both these species exhibit very peculiar structure and one of them, obtained on the banks of the River Hughli, cannot be included in any of the genera hitherto described. There can be no doubt that numbers

[1] *Halicarcinus lacustris* (Chilton) [see p. 247, footnote] and *Rhynchoplax introversus*, sp. nov.

[2] Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 385 (1900).

of additional species yet remain to be discovered on the Indian coasts.

I have included descriptions of two new forms obtained by Dr. Annandale during his recent tour in the Far East. One of these is from the Tai Hu in the Kiangsu province of China, a lake which is fresh at all times of the year; the other was found in brackish water in the Tale Sap in Lower Siam.

We are at present very far from possessing a clear knowledge of the species referred to this family. The descriptions and figures of many of the older authors are a constant source of difficulty and the identity of numerous species described in the earlier half of the nineteenth century still remains obscure. The confusion is accentuated by differences of opinion regarding the genera. Many authors appear to have distributed their species almost at random and Haswell,[1] who places all the Australian forms in the genus *Hymenosoma*, has expressed the opinion that " the subdivision....

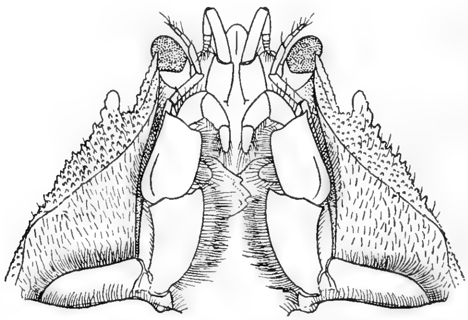


FIG. 1.—*Hymenosoma orbiculare,* Desmarest.
Anterior part of carapace, seen from below.

into the genera *Hymenosoma*, *Hymenicus* and *Halicarcinus* appears to be unnecessary and based on extremely slight points of distinction." This view finds no support from subsequent writers, and it is evident that its author was unaware of the characters of the true *Hymenosoma*; nevertheless, as explained below, I believe him to have been right in uniting *Hymenicus* and *Halicarcinus*.

The following notes on the genera are based on the material in the Indian Museum, which contains in addition to twelve Indian species, a number of specimens from China, Australia, New Zealand, S. Africa and the Falkland Is., all the known genera with one exception being represented.

Hymenosoma was described by Desmarest in 1825,[2] the type species being *H. orbiculare* from the Cape of Good Hope. It is one of the most clearly defined of the genera comprised in the family, differing widely from all others in the complete absence of the epistome (text-fig. 1). The external maxillipedes almost encroach

[1] Haswell, *Cat. Australian Crust.*, p. 114 (1882).
[2] Desmarest, *Consid. gén. Crust., Paris*, p. 163 (1825).

on the bases of the antennules and the buccal cavern is not limited anteriorly by a ridge. The ischium of the external maxillipedes is a little longer than the merus; both segments are slender and, when normally folded, gape in the middle line, the underlying appendages being partially visible. In the abdomen of the male the sutures of all the segments are distinct. The regions of the carapace, as in most genera of the family, are defined by fine-cut grooves.

Numerous species have from time to time been placed in *Hymenosoma*, but in the majority of instances the reference is erroneous and it is now practically certain that the genus is monotypic. Stimpson's *H. geometricum*[1] is synonymous with *H. orbiculare* and Guérin Méneville's *H. gaudichaudii*,[2] though included in the genus by Milne-Edwards,[3] is evidently a species of *Halicarcinus*.

Halicarcinus was established by White in 1846,[4] the type

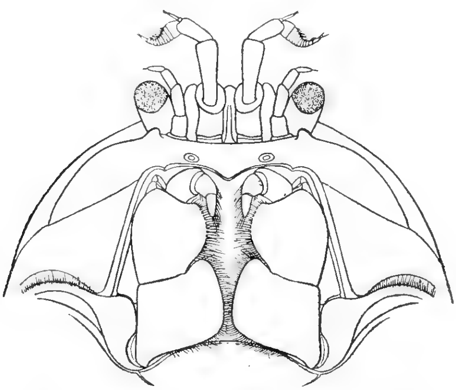


FIG. 2.—*Halicarcinus planatus* (Fabr.). Anterior part of carapace, seen from below.

species being Fabricius' *Leucosia planata*[5] from Tierra del Fuego. In this genus the epistome is a conspicuous plate, and the buccal cavern is bounded anteriorly by a transverse ridge (text-fig. 2). The ischium and merus of the external maxillipedes are of similar size and are broad segments, completely or almost completely closing the buccal cavern. As in *Hymenosoma* the grooves on the upper surface of the carapace are clean cut and, in the abdomen

[1] Stimpson, *Proc. Acad. Sci. Philadelphia*, X, p. 108 [54] (1858) and *Smiths. Misc. Coll.*, XLIX, p. 144 (1907). Stebbing, in *Marine Invest. S. Africa*, IV, p. 50 (1905) and *Ann. S. African Mus.*, VI, p. 332 (1910), retains *H. geometricum* as a distinct species, but has since agreed that it is synonymous with *H. orbiculare* [see *Trans. Roy. Soc. Edinburgh*, L, ii, p. 270 (1914)].

[2] Guérin Méneville, *Voy. de la 'Coquille'*, II, ii, 1re div., p. 21 and *Atlas, Crust.*, pl. ii, figs. 12-18.

[3] Milne-Edwards, *Ann. Sci. nat., Zool., Paris* (3), XX, p. 222 (1853).

[4] White, *Ann. Mag. Nat. Hist.* (1), XVIII, p. 178 (1846).

[5] For references see Stebbing, *Proc. Zool. Soc. London*, 1900, p. 524; Doflein and Balss, *Mitth. naturhist. Mus. Hamburg*, XXIX, p. 35 (1912) and Chilton, *Subantarctic Is. of New Zealand*, p. 609 (1910).

of the male, the sutures of all the segments are distinct. In my interpretation of its limits, *Halicarcinus* comprises species with simple rostra as well as those in which it is trilobate or tridentate.

Lucas's *Hombronia*,[1] suggested as a generic name for Jacquinot's *Hymenosoma depressa*[2] from the Auckland Is. and Nicolet's *Liriopea*,[3] based on two species from Chili, are generally regarded as synonyms of *Halicarcinus*, and Dana's *Hymenicus*[4] is separated by such slight distinctions that it cannot in my opinion be retained as a separate genus. In describing *Hymenicus* Dana says: "In this genus the front has not the three teeth of *Halicarcinus* (between which the flexed first antennae are seen), but a simple rounded or trilobate prominence forms the front, and the first antennae are covered. The feet are much longer and more slender than in any of the species of *Halicarcinus*, seen by the author." On comparing *H. varius*, the type species of *Hymenicus*, with *Halicarcinus planatus*, the points to which Dana has drawn attention are readily appreciated. The difference, however, is in reality of very slight morphological importance and is entirely due to the greater development of the front in *H. varius*, the disposition and structure of the related parts being as nearly as possible identical. Examination of allied forms shows that a wide variation exists in the form of the front and affords conclusive evidence that the character is of specific rather than generic value. The comparatively great length of the legs in *H. varius*—the only other point mentioned by Dana—is clearly insufficient as a generic criterion; the external maxillipedes are almost identical in structure with those of *H. planatus* and, as in that species, the sutures of all the segments of the male abdomen are distinct.

But though Dana's *Hymenicus* must, through the characters of its type species, be placed in the synonymy of *Halicarcinus*, it does not follow that all the species hitherto referred to *Hymenicus* must be transferred to White's genus. The two Indian species described by Alcock,[5] together with four others dealt with below, appear to offer distinctive characters. In most particulars they agree with *Halicarcinus*, but the external maxillipedes are much more slender, with the ischium conspicuously smaller than the merus; when normally folded they gape widely in the middle line, leaving parts of the underlying appendages exposed (see text-fig. 7, p. 259). In the abdomen of the male, moreover, the 3rd, 4th and 5th segments are fused, with complete obliteration of the sutures (see text-fig. 9, p. 259). The rostrum is variable in form, but is normally tridentate or trilobate.

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1 Lucas, in Hombron and Jacquinot's *Voy. au Pôle Sud, Zool.*, III, Crust. p. 62 (1853).

2 Jacquinot, Atlas to above, *Crust.*, pl. v, figs. 34-39 (1842-53); Chilton, *Ann. Mag. Nat. Hist.* (7), XIX, p. 146, pl. v (1907). It is perhaps doubtful whether this species really belongs to *Halicarcinus* as here defined, for the grooves on the upper surface of the carapace are not shown in either of the figures.

3 Nicolet, in Gay's *Hist. fisica y politica de Chile, Zool.*, III, p. 158 (1849).

4 Dana, *U. S. Explor. Exped.*, *Crust.*, I, p. 387 (1852).

5 Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 388 (1900).

As a generic name for this group of species I have employed Stimpson's *Rhynchoplax*,[1] though unfortunately I cannot be altogether certain that its application is correct. Stimpson does not state that any parts of the male abdomen are fused and his reference to the external maxillipedes is decidedly confusing, his only remark being "ischium-joint....scarcely longer than meros," a description that applies if anything better to *Halicarcinus* than to the group of Indian species. On the other hand *Rhynchoplax messor*, the type species of the genus from Simoda in Japan, appears specifically to be an exceedingly close relative of Alcock's "*Hymenicus*" *wood-masoni*, both species, apart from other resemblances, possessing a series of teeth on the upper border of the merus of the chelipede. The question cannot finally be settled until further specimens of *Rhynchoplax messor* are examined. The types were, I understand, destroyed by fire in 1871 and the species has not been recorded since Stimpson's time.

To distribute the numerous described species correctly beween the genera *Halicarcinus* and *Rhynchoplax*, as here defined, is a matter of very great difficulty, but from the figures and descriptions which have been published I conclude that the following species may safely be referred to the genus *Halicarcinus*,[2]—*Hymenosoma gaudichaudii*, Guérin Méneville,[3] *Halicarcinus pubescens*, Dana,[4] *Hymenicus pubescens*, Dana,[5] *Hymenicus varius*, Dana,[6] *Halicarcinus ovatus*, Stimpson,[7] *Hymenosoma tridentata*, Jacquinot,[8] *Hymenosoma rostratum*, Haswell,[9] *Elamene pilosa*, A. Milne-Edwards,[10] *Hymenosoma laeve*, Targioni-Tozzetti,[11] *Hymenicus marmoratus*, Chilton,[12] and *Hymenosoma lacustris*, Chilton.[13]

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1 Stimpson, *Proc. Acad. Sci. Philadelphia*, X, p. 109 [55] (1858) and *Smiths. Misc. Coll.*, XLIX, p. 147 (1907).

2 In addition to the type species of the genus I have seen specimens of *H. ovatus*, *H. varius*, *H. rostratus* and a species from the Australian coast which is perhaps undescribed.

3 Guérin Méneville, *loc. cit. supra* p. 245.

4 Dana, *U. S. Explor. Exped., Crust.*, I, p. 386, pl. xxiv, fig. 8.

5 Dana, *ibid.*, p. 388, pl. xxiv, figs. 11 *a-c*.

6 Dana, *ibid.*, p. 387, pl. xxiv, fig. 9.

7 Stimpson, *Proc. Acad. Nat. Sci. Philadelphia*, X, p. 109 [55] (1858) and *Smiths. Misc. Coll.*, XLIX, p. 146 (1907); Stebbing, *Proc. Zool. Soc. London*, 1900, p. 525, pl. xxxviA. Chilton, in *Subantarctic Is. New Zealand*, p. 609 (1910) suggests that *H. ovatus* is synonymous with Jacquinot's *H. tridentata*.

8 Jacquinot, in Hombron and Jacquinot's *Voy. au Pôle Sud, Zool., Atlas, Crust.*, pl. v, figs. 27-33. Usually regarded as a synonym of *H. planatus*. Chilton, *loc. cit.*, 1910, p. 609, suggests its retention at least in a subspecific significance.

9 Haswell, *Proc. Linn. Soc. N. S. Wales*, VI, p. 550 (1882) and *Cat. Australian Crust.*, p. 116 (1882); Baker, *Trans. Roy. Soc. S. Australia*, XXX, p. 114, pl. iii, figs. 2, 2*a,b* (1906).

10 A. Milne-Edwards, *Nouv. Arch. Mus. Paris*, IX, p. 322, pl. xviii, figs. 6, 6*a-e* (1873).

11 Targioni Tozzetti, *Crost. Viaggio 'Magenta,'* p. 179, pl. xi, figs. 3*a-e* (1877).

12 Chilton, *Trans. N. Zealand Inst.*, XIV, p. 172, pl. viii, figs. 1*a-c* (1881).

13 Chilton, *Trans. N. Zealand Inst.*, XIV, p. 172 (1881) [as *Elamena? lacustris*]; *ibid.*, XLIV, p. 128 (1912); *ibid.*, XLVII, p. 316, fig. 1 (1915); Fulton and Grant, *Proc. Roy. Soc. Victoria*, XV, p. 59, pl. viii (1902); Grant and McCulloch, *Proc. Linn. Soc. N. S. Wales*, XXXII, p. 153 (1907).

The generic position of a number of other species is doubtful, but I think it will eventually be found that all those from southern latitudes hitherto referred to the genera *Hymenicus* and *Hymenosoma*[1] belong in reality to *Halicarcinus*. *H. planatus*, if the records are to be trusted, is circumpolar in distribution and the species listed above are without exception from southern latitudes. The forms that can be referred to *Rhynchoplax* are, on the other hand, all found on the Asiatic coasts, from which no representative of *Halicarcinus* has yet been obtained.

The genus *Rhynchoplax*, in my estimation, comprises Stimpson's two species, *R. messor* from Japan and *R. setirostris* from Hong Kong, de Man's *Elamene filholi*[2] from near Batavia, Alcock's *Hymenicus wood-masoni* and *H. inachoides* from India and six other species described below. It probably includes also Miss Rathbun's *R. coralicola*[3] from Singapore.

A species of Hymenosomatidae found on the banks of the R. Hughli, near Calcutta, does not appear to be admissible into any of the genera hitherto recognized; it is described below under the name *Hymenicoides carteri*. In its structure this species shows a high degree of specialization and generically is related to *Halicarcinus* and *Rhynchoplax*. It agrees with the former of these genera in having the sutures of all the segments of the male abdomen distinct and with the latter in the slender form of the basal segments of the third maxillipedes: it differs from both in the remarkably elongate dactylus of the latter appendages and in the entire absence of a rostrum (see text-fig. 16, p. 267).

In *Hymenicoides* the antennule is completely exposed in dorsal view. This character has frequently been used as a generic criterion, but in my opinion is of specific importance only, being due almost entirely to the extent to which the rostrum is reduced. In *Rhynchoplax* the rostrum is normally trilobate and well developed, but in *R. nasalis*, sp. nov., the lateral portions are suppressed, with the result that the antennules, just as in *Hymenicoides carteri*, are visible from above.

The genus *Elamena* was established by Milne-Edwards in 1837,[4] the type species being Desmarest's *Hymenosoma mathaei*[5] from the Ile de France. Haswell's suggestion that this species is merely the young of *Halicarcinus planatus*[6] has been contested by Stebbing and is certainly incorrect. That Rüppell's identification[7] of Desmarest's species is correct may be assumed from the

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[1] Except, of course, *Hymenosoma orbiculare* and the synonymous *H. geometricum*.

[2] De Man, *Arch. f. Naturgesch.*, LIII, i, p. 386, pl. xvii, fig. 3 (1887).

[3] Rathbun, *K. Danske Vid. Selsk. Skrift.* (7), *naturvid. og math.*, V, p. 316, text-fig. 5 (1910).

[4] Milne-Edwards, *Hist. nat. Crust.*, II, p. 33 (1837).

[5] Desmarest, *Consid. gén. Crust.*, *Paris*, p. 163 (1825). I have not seen this species.

[6] Haswell, *Cat. Australian Crust.*, p. 114 (1882).

[7] Rüppell, *Beschreib. Abbild. 24 Arten Krabben*, *Frankfurt*, p. 21, pl. v, fig. 1 (1830).

fact that his description and figure is quoted by Milne-Edwards, who, as Stebbing has remarked, probably had Desmarest's specimen before him when he wrote. Paulson's figure[1] differs considerably from that given by Rüppell; the carapace is of much greater proportionate length and bears grooves on its upper surface much as in *Halicarcinus* and *Rhynchoplax*. Stebbing has pointed out (*loc. cit.*) that Milne-Edwards' subsequent reference to the species in 1853[2] is almost certainly erroneous; the genus is here credited with a tridentate rostrum, a character not found in Desmarest's species

In *Elamena*, as represented by the species in the Indian Museum, the carapace is very greatly depressed, sometimes of wafer-like thinness, and the regions of its upper surface are not defined by the fine-cut grooves found in the other genera. The epistome is conspicuous and sometimes of great length. The external maxillipedes completely close the buccal cavern and the ischium, though somewhat variable in size, is always longer than the merus (see text-fig. 25, p. 276). As in *Rhynchoplax* the 3rd, 4th and 5th segments of the male abdomen are fused, and the sutures between them obliterated. The front, or rostrum, is simple, never trilobate.

I agree with Alcock[3] that *Trigonoplax* is, at most, only a subgenus of *Elamena*. It was described by Milne-Edwards in 1853,[4] the type species being de Haan's *E. unguiformis*.[5] As has been pointed out above, Milne-Edwards when writing in 1853 appears to have misunderstood the characters of his own genus *Elamena*, and the foundation of *Trigonoplax* seems to have been a direct result of this mistake The only constant differences that I am able to find between *Elamena* and *Trigonoplax* do not appear to be important and it is probable that when the characters of the species are better understood, the latter will come to be regarded as a synonym of the former.

Six species of *Elamena* have been found on the Indian coasts and are referred to below; of these three (perhaps four) belong to the subgenus *Trigonoplax*. Other representatives of the genus are *E. mathaei* (Desmarest),[6] the type species, found at Réunion and in the Red Sea, *E. producta*, Kirk[7] (with which *E. kirki*, Filhol,[8] is

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[1] Paulson, *Crust. Red Sea, Kiew*, p. 71, pl. ix, figs. 3, 3*a,b* (1871).

[2] Milne-Edwards, *Ann. Sci. nat., Zool., Paris* (3), XX, p. 223, pl. xi, figs. 4, 4*a* (1853).

[3] Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 386 (1900).

[4] Milne-Edwards, *Ann. Sci. nat., Zool., Paris* (3), XX, p. 224 (1853).

[5] De Haan, in Siebold's *Fauna Japonica, Crust.*, p. 75, pl. xxix, fig. 1, pl. H (1839).

[6] For references see p. 248, footnotes 4, 5. *Elamene truncata*, Lenz (not A. M.-Edw.), *Abhandl. Senckenberg. Naturforsch. Ges. Frankfurt*, XXVII, i, p. 367, pl. xlviii, figs. 15*a,b* (1902) is apparently synonymous.

[7] Kirk, *Trans. N. Zealand Inst.*, XI, p. 395 (1878); Filhol, *Recueil de Mém. Inst. France, Miss. à l'île Campbell, Zool.*, p. 404, pl. l, figs. 1, 2 (1885); Chilton, *Rec. Canterbury Mus.*, I, p. 294 (1911).

[8] Filhol, *loc. cit. supra*, p. 405, pl. xlvii, figs. 6, 8 (1885).

apparently synonymous) and *E. longirostris*, Filhol,[1] both from New Zealand. The position of *E. quoyi*, Milne-Edwards,[2] *E. mexicana*, Milne-Edwards[3] and *E. whitei*, Miers,[4] is doubtful. *E. pilosa*, A. Milne-Edwards, as already pointed out, is probably a species of *Halicarcinus*, while *E. filholi*, de Man, appears to belong to *Rhynchoplax*. *E. minuta*, A. Milne-Edwards,[5] whatever it may be, is certainly not an *Elamena*.

Elamenopsis was established by A. Milne-Edwards in 1873 for *E. lineatus*,[6] a species found in New Caledonia I have seen no specimens of the genus and have not been able to satisfy myself regarding its position in the family. It is said to form a link between the Hymenosomatidae and Pinnotheridae. From the description it appears to be related to *Rhynchoplax*, but the walking legs are much shorter and stouter than in any species of that genus that I have seen.

The principal characters of the other five genera may be summarised in the following way:—

I. There is no epistome. [The external maxillipedes are slender and do not nearly close the buccal cavern. In the abdomen of the male the sutures of all the segments are distinct] ... ... *Hymenosoma*, Desmarest.

II. The epistome is well defined and frequently very long.

  A. The regions of the carapace are defined by sharp-cut grooves. The ischium of the external maxillipedes is not longer, frequently much shorter than the merus.

    1. A rostrum is present and is frequently trilobate or tridentate. The dactylus of the external maxillipedes is short (normal).

      a. The external maxillipedes are broad and completely, or almost completely, close the buccal cavern. In the abdomen of the male the sutures of all the segments are distinct ... ... *Halicarcinus*, White (=*Hymenicus*, Dana).

      b. The external maxillipedes are slender and do not nearly close the buccal cavern. The 3rd, 4th and 5th segments of the male abdomen are fused and the sutures obliterated ... . *Rhynchoplax*, Stimpson.

    2. The rostrum is altogether absent. The dactylus of the external maxillipedes is abnormally long, reaching the hinder limit of the buccal cavern. [The external maxillipedes are very slender and do not nearly close the buccal cavern. In the abdomen of the male the sutures of all the segments are distinct]... *Hymenicoides*, gen. nov.

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[1] Filhol, *loc. cit. supra*, p. 403, pl. xlvi, fig. 7 (1885).

[2] Milne-Edwards, *Ann. Sci. nat., Zool., Paris* (3), XX, p. 223, pl. xi, fig. 3 (1853).

[3] Milne-Edwards, *ibid.*, p. 224.

[4] Miers, *Cat. Crust. N. Zealand*, p. 52, pl. i, fig. 4 (1876).

[5] A. Milne-Edwards, *Nouv. Arch. Mus. Paris*, IX, p. 324, pl. xviii, fig. 5 (1873).

[6] A. Milne-Edwards, *ibid.*, p. 324, pl. xviii, fig. 4.

B. The surface of the carapace is smooth, rarely uneven; its regions are never delimited by sharp-cut grooves. The ischium of the external maxillipedes is longer than the merus. [The rostrum, when present, is simple. The external maxillipedes are broad and completely close the buccal cavern. The 3rd, 4th and 5th segments of the abdomen of the male are fused and the sutures obliterated] ... ... *Elamena*, Milne-Edwards.

Of these genera only the last three are found on the Indian coasts.

Genus **Rhynchoplax**, Stimpson.

1858. *Rhynchoplax*, Stimpson, *Proc. Acad. Sci. Philadelphia*, X, p. 109 [55].
1900. *Hymenicus*, Alcock (not of Dana), *Journ. Asiat. Soc. Bengal*, LXIX, p. 387.
1907. *Rhynchoplax*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 147.

The carapace is circular, ovate or polygonal in outline and is depressed; the upper surface is sunken with the usual grooves sharply defined and the margin upturned. The rostrum is tridentate or trilobate, the lateral processes very rarely absent. The epistome is of good length and the buccal cavern is bounded anteriorly by a sharp ridge. The external maxillipedes are comparatively slender and, when normally folded, gape widely in the middle line; the merus is longer than the ischium and the dactylus is, as usual, short. The chelipedes in both sexes are stouter than the walking legs. In the abdomen of the male the 3rd, 4th and 5th segments are fused and the sutures between them completely obliterated.

This genus is very closely related to *Halicarcinus*, but is distinguished by the more slender merus and ischium of the external maxillipedes and by the fact that certain segments of the male abdomen are fused.

The six Indian species of *Rhynchoplax* together with the two obtained by Dr. Annandale in Siam and China may be distinguished in the following manner:—

I. A large forwardly directed tooth or process on either side of carapace above base of 1st walking legs [rostrum tridentate; a sharp post-ocular tooth visible in dorsal view].
  A. Carapace subcircular, its antero-lateral border armed with one or two blunt teeth; merus of chelipede armed with several strong teeth on its upper border; dactyli of last three legs armed with a series of small teeth.
    1. Two teeth on antero-lateral border of carapace; chela of adult male more than twice as long as high, palm rounded below, fingers not gaping and armed with regular teeth ... ... *R. wood-masoni* (Alcock).
    2. Only one tooth on antero-lateral border of carapace; chela of adult male much less than twice as long as high, palm keeled below, fingers widely gaping and with irregularly disposed teeth ... ... *R. alcocki*, sp. nov.

B. Carapace octagonal; its antero-lateral border without teeth; merus of chelipede without teeth on its upper border; dactyli of last three legs with a single large tooth near apex ... ... *R. octagonalis*, sp. nov.

II. No tooth on side of carapace above base of 1st walking legs [no teeth on antero-lateral border of carapace].

A. Rostrum trilobate or tridentate; basal segment of antennular peduncle not visible in dorsal view; penultimate piece of abdomen of male longer than broad, without tubercle.

1. Rostrum composed of three very broad lobes; post-ocular tooth not visible from above; legs stout, dactyli without teeth ... ... *R. demeloi*, sp. nov.

2. Rostrum composed of three narrow lobes or teeth; post-ocular tooth visible from above; legs slender, dactyli with teeth.

a. Carapace not longer than broad; rostrum composed of three lobes; 2nd walking legs not more than $2\frac{1}{2}$ times length of carapace.

i. Postero-lateral border of carapace normal; dactyli of walking legs very strongly curved and with very large teeth; terminal segment of male abdomen broader than long ... ... *R. exiguus*, sp. nov.

ii. Side-walls of branchial region of carapace reflected upwards, forming a crest outside the true postero-lateral border; dactyli of walking legs moderately curved, with small teeth; terminal segment of male abdomen much longer than broad ... ... *R. introversus*, sp. nov.

b. Carapace much longer than broad, rostrum composed of three long teeth; 2nd walking legs more than 3 times length of carapace [dactyli of walking legs moderately curved, with small teeth; terminal segment of male abdomen as long as broad] ... ... *R. inachoides*, Alcock.

B. Rostrum composed of a single tooth-like process; basal segment of antennular peduncle completely visible in dorsal view; penultimate piece of abdomen of male broader than long, with a large tubercle at distal end [no post-ocular tooth; dactyli of last three legs with a single tooth] ... ... *R. nasalis*, sp. nov.

Rhynchoplax wood-masoni (Alcock).

1900. *Hymenicus wood-masoni*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 388, and (1902) *Illust. Zool. 'Investigator,'* pl. lxiv, fig. 4.

A few particulars regarding the structure of this species, some of which are additions to Alcock's description, are given below in the course of a comparison with the closely allied *R. alcocki*.

Stimpson's *Rhynchoplax messor* from Simoda appears also to be a related form, agreeing in the presence of a series of teeth on the upper aspect of the carpus of the chelipede. In the Japanese species, however, the carapace is stated to be triangular, with only two teeth on the lateral border, and the median tooth of the rostrum points obliquely upwards, instead of being depressed as in *R. wood-masoni*. The carpus of the chelipedes bears on its upper surface three or four small teeth; in adult males of *R. wood-masoni* one such tooth is sometimes found near the meral articulation, but it is frequently absent. Stimpson states that each joint of the ambulatory feet, except the dactyli, is "dentigerous in the middle," a character not found in *R. wood-masoni* or in any other species of the genus that I have seen.

The only specimens of this species in the Indian Museum are those described by Alcock from the Andamans and from Port Canning near Calcutta.

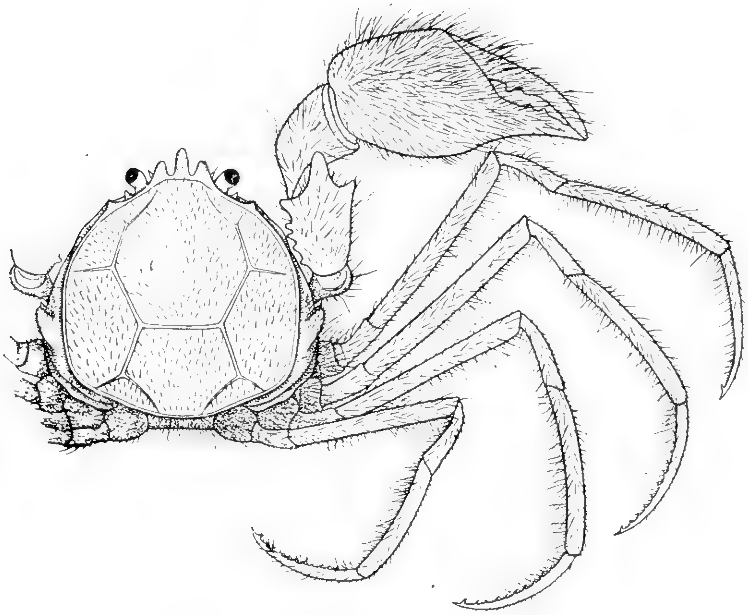

FIG. 3.—*Rhynchoplax alcocki*, sp. nov.

Rhynchoplax alcocki, sp. nov.

The carapace is subcircular, a little produced anteriorly and with its sides slightly flattened and nearly parallel. Its breadth is almost equal to its length, excluding the rostrum. The surface is hairy and sunken and the usual grooves are well defined. The entire margin is upturned and is continuous from side to side across the base of the rostrum. A sharp post-ocular tooth is visible in dorsal view and behind it, on the margin itself, there is a blunt tooth corresponding to the foremost of those found in *R. wood-masoni* (text-fig. 4*d*). Below the margin near the base of the first pair of walking legs there is a huge tooth-like process directed forwards, upwards and outwards.

The rostrum is composed of three narrow lobes with rounded extremities; the median lobe is longer than the two others, and its apex is situated on a lower level.

The antennules, when folded, are concealed beneath the rostrum; at their base they are separated by a prominent septum. The epistome is of moderate length. As in *R. wood-masoni* the external maxillipedes are slender and do not nearly close the

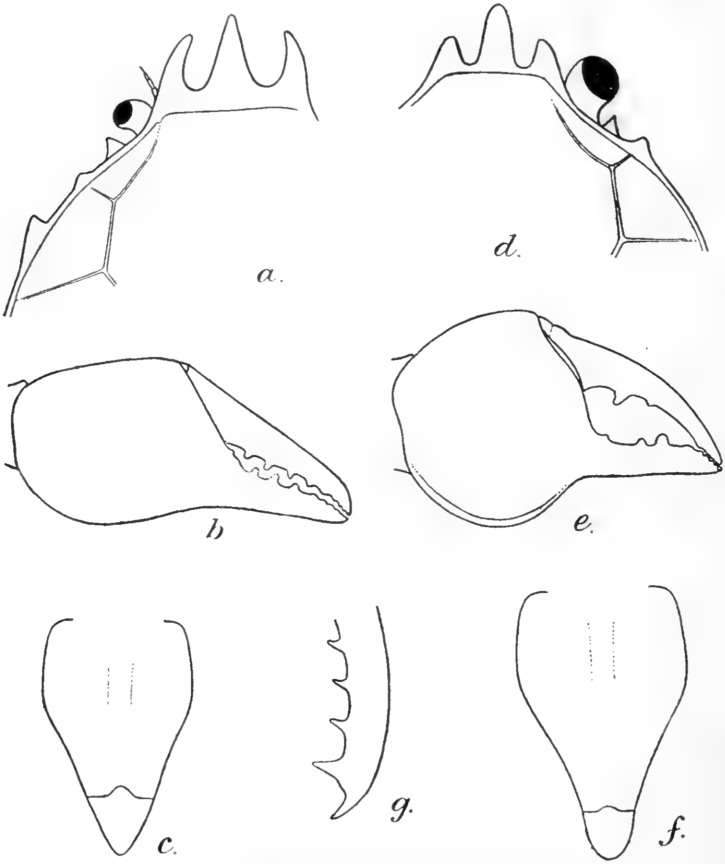

FIG. 4.—*a-c*, *Rhynchoplax wood-masoni* (Alcock).
d-g, *Rhynchoplax alcocki*, sp. nov.
a, *d*.—Rostrum, eye and antero-lateral margin of carapace.
b, *e*.—Chela of male (denuded).
c, *f*.—Abdomen of male.
g.—Terminal part of dactylus of penultimate leg.

buccal cavern. The ischium is produced at its inner distal angle and the merus is expanded antero-externally, partially concealing the exognath.

The chelipedes in both sexes are stouter than the walking legs, the chelae of the adult male being particularly large. In the male the merus bears a conical tooth near the end of its lower margin and a series of some five large blunt teeth superiorly.

The carpus is smooth. The chela is very greatly compressed and in adult males is little more than one and a half times as long as high. The palm in lateral view is nearly circular in outline (text-fig. 4*e*) and is slightly hollowed both internally and externally near the strongly compressed upper border. The lower border is convex and is keeled. The fingers gape very widely and meet only at their tips. The dactylus is almost twice the length of the upper border of the palm and bears in its basal third a single large tooth, in front of which a second smaller tooth is occasionally found. The fixed finger bears two large teeth in advance of those on the dactylus and one or two others, which are smaller, near the base. Near the apex, where they meet, the fingers are provided with four or five small interlocking teeth. In the female the teeth on the merus are obscure or altogether wanting and the chela is much narrower, fully twice as long as high; the fingers meet throughout their length and are armed with regularly spaced teeth.

The walking legs are very slender ; those of the second pair are slightly the longest and are about two and a quarter times the length of the carapace and rostrum. The anterior border of the merus ends in a very obscure tooth. The dactyli are very slender and are curved ; close to the apex each is armed with a large recurved tooth (text-fig. 4*g*) and in front of this, in the last three pairs, there is a series of 8 to 11 smaller teeth, also recurved and extending over practically the whole length of the posterior margin. The chelipedes and legs are clothed with hair, which is particularly long and thick on the chela of the male.

The sternum and abdomen are densely clothed with hair. The abdomen of the male resembles that of *R. wood-masoni*, but is slightly narrower. The terminal segment is scarcely longer than broad and is rounded at the apex (text-fig. 4*f*) ; the preceding portion is longer than broad, parallel-sided at the base and from the middle point onwards strongly narrowed.

A large male is only 4·8 mm. in length from the tip of the rostrum to the posterior margin of the carapace. Ovigerous females are smaller, sometimes not more than 4 mm. long. The carapace of living specimens, when brushed clean, was of a dull purplish brown colour with groups of small whitish spots.

R. alcocki is very closely allied to *R. wood-masoni*, Alcock, there being an almost exact resemblance between the two in the teeth on the merus of the male chelipede. Apart from size, *R. wood-masoni* being much the larger form, the species may be distinguished by the following characters (*cf.* text-figs. 4*a-c* and 4*d-f*) :—

R. wood-masoni, Alcock.	*R. alcocki*, sp. nov.
Carapace longer, its length excluding rostrum about one-tenth greater than its breadth.	Carapace shorter, its length excluding rostrum scarcely greater than its breadth.
Two teeth on antero-lateral margin of carapace.	Only one tooth on antero-lateral margin of carapace.

Rostral teeth slender.	Rostral teeth less slender.
Cornea of eye proportionately smaller.	Cornea of eye proportionately larger.
Chela of adult male not greatly compressed, more than twice as long as high, lower edge of palm rounded.	Chela of adult male very greatly compressed, much less than twice as long as high, lower edge of palm keeled.
Fingers of chela of adult male not gaping at base, armed with a regular series of teeth.	Fingers of chela of adult male widely gaping at base, armed with a very irregular series of teeth.
Terminal segment of abdomen of male apically pointed.	Terminal segment of abdomen of male apically rounded.

There are altogether about 100 specimens of this species in the Indian Museum. The greater number were found in Portuguese India in September 1916 and were obtained in the Rachol river at the head of Mormugao Bay above Cortalim Point and in the Mandavi river at Nova Goa. Some of the specimens were dredged on a muddy bottom in water from $1\frac{1}{2}$ to $4\frac{1}{2}$ fathoms in depth, while others were found at Betim Point opposite Nova Goa, living on the posts of a jetty densely covered with Hydroid. All the specimens were found in brackish water, the specific gravity (corrected) varying from about 1·0010 to 1·0060. There are also in the Museum a few specimens found by Dr. F. H. Gravely in September 1914 in the Cochin backwaters near Ernakulam.

The types are from Portuguese India and bear the number 9735/10 *Zool. Surv. Ind.*

Rhynchoplax octagonalis, sp. nov.

The carapace, rostrum excluded, is a trifle broader than long and is distinctly octagonal in outline. The surface, in an ovigerous female, is very little sunken; it is rather closely covered with short hairs and the usual grooves are well defined. The margin is continuous from side to side across the base of the rostrum and is entire, the blunt teeth found on the antero-lateral borders in the two preceding species being absent. On the side wall above the base of the first pair of walking legs there is a large and sharp procurved tooth (text-fig. 5).

The rostrum in dorsal view is seen to consist of three sharp isolated spines, the lateral ones a little shorter than the median and directed obliquely outwards and upwards. The greater part of the eye can be seen from above, together with a small but sharp post-ocular tooth.

The antennules when folded are not visible in dorsal view; they are separated by a well-marked septum. The external maxillipedes resemble those of the preceding species.

The chelipedes of the female are stouter than the legs. The merus does not bear any distinct teeth. The chela is not compressed and the fingers, which are longer than the palm, meet throughout their length when the claw is closed and bear a regular series of 5 or 6 teeth on their inner margins.

The walking legs are not very slender; those of the second pair are about twice the length of the carapace and rostrum. The anterior border of the merus in each pair ends in a prominent tooth. The dactylus of the first walking legs is unarmed; that of the three following pairs is provided with a stout recurved tooth close to the apex. The chelipedes bear scattered hairs; these also occur on the walking legs, which are, moreover, densely fringed on their posterior margins.

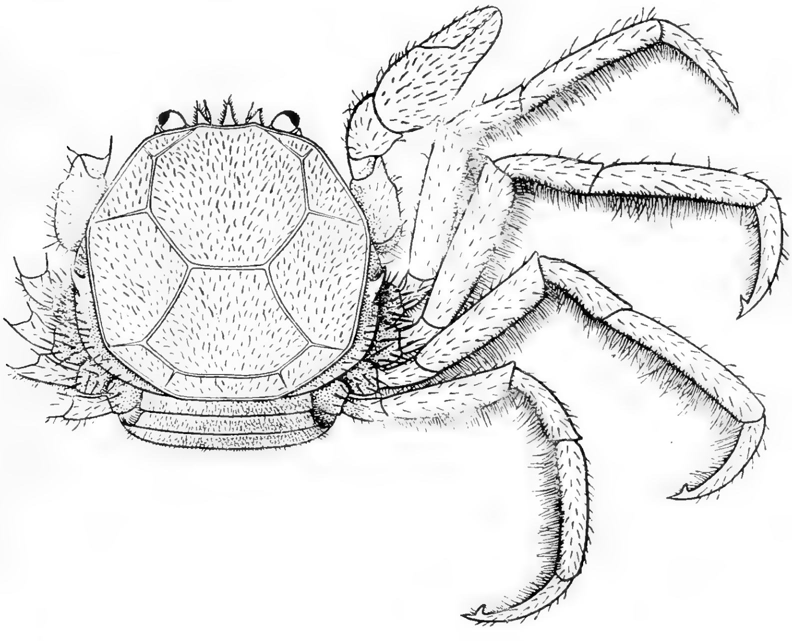

FIG. 5.—*Rhynchoplax octagonalis*, sp. nov.

The species is described from a single ovigerous female, with carapace about 3·9 mm. in length.

De Man's *Elamene filholi*[1], from Noordwachter I. near Batavia, is without doubt a species of *Rhynchoplax* and resembles *R. octagonalis* in the structure of the dactyli of the walking legs and in the position of the single tooth found on the lateral margin of the carapace. In the Javanese species, however, the eye is altogether concealed from above, the carapace and rostrum are quite different in form and the legs are much more slender. Miss Rathbun's *R. coralicola*[2] from Singapore also possesses a single tooth at the

[1] De Man, *Archiv. f. Naturgesch.*, LIII, i, p. 386, pl. xvii, fig. 3 (1887).
[2] Rathbun, *K. Danske Vid. Selsk. Skrift.* (7), *naturvid. og math.*, V, p. 316, text-fig. 5 (1910).

side of the carapace, but it is said to be antero-lateral in position In this species the dactyli are spinulous, thus differing conspicuously from those of *R. filholi* and *R. octagonalis*.

The specimen was obtained at low water under stones among mangroves on Vareeg Islet in Mormugao Bay, Portuguese India. It bears the number 9740/10 *Zool. Surv. Ind.*

Rhynchoplax demeloi, sp. nov.

The carapace is nearly circular; the breadth of its upper surface is about equal to its length, including the median rostral lobe.

FIG. 6.—*Rhynchoplax demeloi*, sp. nov.

The surface is greatly sunken and is covered with fine hairs that retain a quantity of mud; the usual grooves are deeply cut. The lateral border is entire, upturned, and continuous anteriorly across the base of the three rostral prominences; it is obscurely angulate a short distance behind the eye. The tooth found in the three preceding species on the side wall of the carapace is absent.

The three rostral prominences are exceedingly short. The median one is almost square, a little longer than broad, and is abruptly deflexed; the other two are rounded, very much broader than long, and project straight forwards. The greater part of the cornea of the eye is visible in dorsal view.

When viewed from below the median rostral lobe is seen to be longitudinally carinate and behind the eye there is a small post-ocular tooth which is altogether invisible from above (text-fig. 7). The antennules when folded are completely concealed beneath the front; they are separated at their base by a strong septum. The epistome is rather short. The external maxillipedes are similar to those of *R. alcocki.*

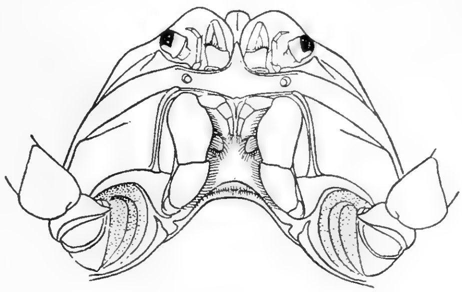

FIG. 7.—*Rhynchoplax demeloi*, sp. nov. Anterior part of carapace, seen from below.

The chelipedes in both sexes are stouter than the walking legs and the chelae are much larger in the male than in the female. The merus and carpus are without teeth. The chela of the adult male (text-fig. 8) is about twice as long as high and is not carinate on its upper or lower margins. Except for a gap close to the base the fingers meet throughout their length; they are armed on their inner margins with 5 or 6 broad interlocking teeth that diminish in size from behind forwards. The dactylus is nearly twice the length of the upper border of the palm. The chela of the female is similar, but more slender. In both sexes the chelipedes are covered with fine hairs; on the outer surface of the palm of the male they are very long and dense, each retaining a quantity of mud.

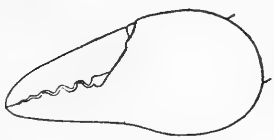

FIG. 8.—*Rhynchoplax demeloi*, sp. nov. Chela of male (denuded).

The second walking legs are slightly the longest and are a little more than two and a half times the length of the carapace. All the segments are exceptionally broad and the anterior border of the merus in each pair ends in a blunt tooth. The dactyli are quite flat, very broad, and only slightly curved; that of the last pair is only about four times as long as wide. The posterior margin is without any of the usual recurved teeth, in this respect differing from all other Indian species of the genus. The walking legs like all other parts of the body are covered with fine hairs which form a short but dense fringe on the posterior borders of the last four segments.

FIG. 9.—*Rhynchoplax demeloi*, sp. nov. Abdomen of male.

The abdomen of the male is similar to that of *R. alcocki* and *R. wood-masoni*, but is narrower. The ultimate segment is bluntly pointed and is much longer than broad; the preceding portion, which, as in the other species, appears to comprise three fused segments, is obscurely grooved in the middle line; its lateral margin is angulate near the middle and in front of this point is distinctly concave.

The carapace of the largest specimen, an adult male, is about 4·4 mm. in length.

The species is described from fourteen specimens, including a number of ovigerous females, obtained on the shores of the Mandavi river at Nova Goa in Portuguese India. They were found at low water under stones on a muddy bank. At the time they were taken the water in the river was brackish, the specific gravity being about 1·0010.

With this species I have associated the name of Capt. Froilano de Melo, Director of the Bacteriological Laboratory of the Instituto de Análises e Vacina at Nova Goa. I am greatly indebted to Capt. de Melo for the assistance he gave me during my visit to Portuguese India, especially for facilities for the investigation of the very interesting fauna of the Mandavi river.

The types bear the number 9741/10 *Zool. Surv. Ind.*

Rhynchoplax exiguus, sp. nov.

The carapace is ovate and is widest a little behind the middle point; its upper surface, rostrum included, is a little longer than broad. In an adult female (text-fig. 10) the portions of the carapace above the bases of the first two pairs of walking legs are swollen, covered with stiff hairs and project beyond the upturned lateral margin of the carapace; in males these parts are not visible in dorsal view. There is no tooth or process above the base of the first walking legs or on the antero-lateral margin. The upper surface is a little sunken, covered with fine hairs, and with the usual grooves sharply defined. The rostrum is composed of three lobes set with stiff setae. The median lobe is depressed and longer than the other two; in the adult female it is narrow and parallel-sided, in males broader at the base and triangular.

The eye is unusually large; the entire cornea and a portion of the stalk is visible from above, together with a large and very conspicuous post-ocular tooth. The antennules when folded are completely concealed beneath the front; at their base they are separated by a well-marked septum.

The epistome is comparatively long. The buccal cavern is of the usual form and is not nearly closed by the external maxillipedes. The merus in the latter appendage is a little longer than the ischium and expanded antero-externally, partially concealing the exopod The stalk of the exopod, as in *R. naso*, is long and projects a little beyond the endopod when the segments are normally flexed.

The chelipedes of male specimens (which are perhaps not full grown) resemble those of the female, the chela being only a little stouter than the walking legs. The merus is without teeth and the chela, though the palm is somewhat swollen, is comparatively long and slender. The fingers when closed meet throughout their length and are armed from base to apex with a regular series of 5 or 6 teeth.

The walking legs are slender; those of the second pair are about twice the length of the carapace and rostrum. The merus in each pair ends bluntly. The dactylus is long, slender and very strongly curved; the apex is finely pointed and on the posterior margin there are a number of exceptionally large recurved teeth. In the adult female there are 8 or 9 such teeth, distributed

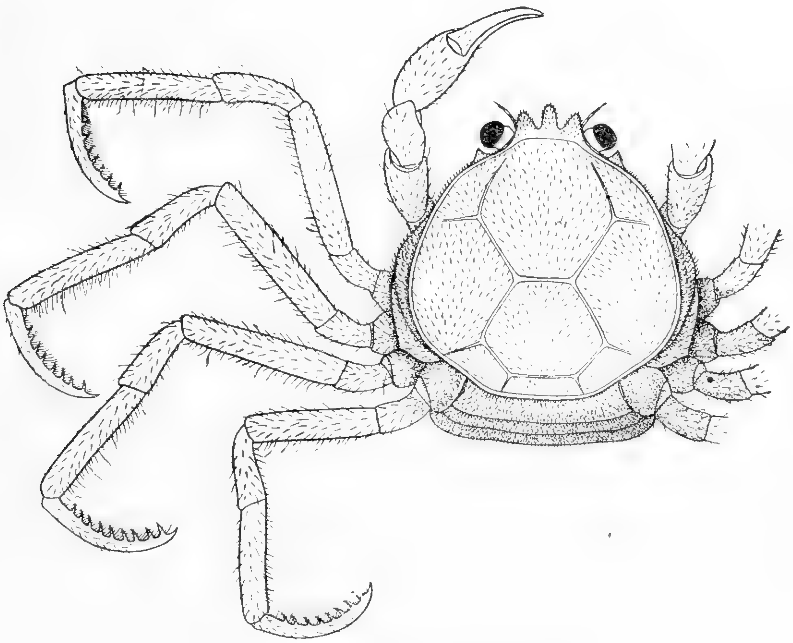

FIG. 10.—*Rhynchoplax exiguus*, sp. nov.

along the whole length of the dactylus; in smaller specimens they are less numerous—sometimes only 3—and occur only in the distal half.

The abdomen of the male is similar to that of *R. demeloi*. The 3rd, 4th and 5th segments form a single piece; the ultimate segment is triangular and a little broader than long.

The species is described from ten specimens, most of which are exceedingly small. The adult female, which appears to have been captured soon after the eggs were discharged, is only 3·4 mm. in length from the tip of the rostrum to the hinder part of the carapace. The largest male, similarly measured, is only 2·8 mm. in length.

Rhynchoplax exiguus appears to be related to *R. inachoides* (Alcock), but is distinguished by the broader carapace, shorter rostral lobes, much shorter walking legs and larger dactylar teeth.

The specimens were obtained by Dr. Annandale in the Tale Sap in Peninsular Siam. They were found on the mainland opposite the western end of Koh Yaw, living in lumps of turf that had fallen into the lake owing to the undermining of the bank. The water in the vicinity was brackish, the specific gravity being about 1·00625 (corrected).

The types bear the number 9743/10 *Zool. Surv. Ind.*

Rhynchoplax introversus, sp. nov.

The carapace is ovate and is widest behind its middle point; its greatest breadth slightly exceeds its length, rostrum included. The upper surface is much sunken; in addition to the usual grooves, which are sharply demarcated, the branchial regions are traversed by a fine oblique line. There is an obscure angulation on the antero-lateral margin midway between the eye and the chelipedes, but there are no teeth in this position and no tooth or process above the base of the first walking legs. At first sight the antero-lateral and postero-lateral borders on each side appear to be discontinuous (tex-fig. 11*a*). This, however, is due to the fact that the lateral walls of the branchial chamber project on either side and are reflected upwards, so as to form a crest which is actually higher than the true postero-lateral border. This border is continued as a low ridge within and parallel to the branchial crest. The posterior margin is short, with a slight emargination on either side opposite the last leg. The rostrum is composed of three blunt processes, the median horizontal, parallel-sided and about twice as long as broad, the two others shorter, and projecting obliquely upwards.

Almost the whole of the eye is visible from above, together with a small post-ocular tooth. The antennules fold beneath the front and are separated at the base by a blunt longitudinal ridge. The epistome is long. The external maxillipedes are of the usual form; they gape widely in the middle line and the merus is a little longer than the ischium. The exognath is almost entirely exposed (text-fig. 11*b*).

The chelipedes are stout and clothed with fine hairs. The merus is without teeth. The chela is stout in the male, about two and a half times as long as broad, with the palm slightly swollen. The fingers are fully one and a half times as long as the upper border of the palm; they meet throughout their length when the claw is closed and their inner margins bear five or six interlocking teeth.

The walking legs are slender; the second pair is about two and a third times as long as the carapace and rostrum. The merus in all four pairs bears a small tooth at the distal end of the upper border. The dactylus is moderately curved and is armed

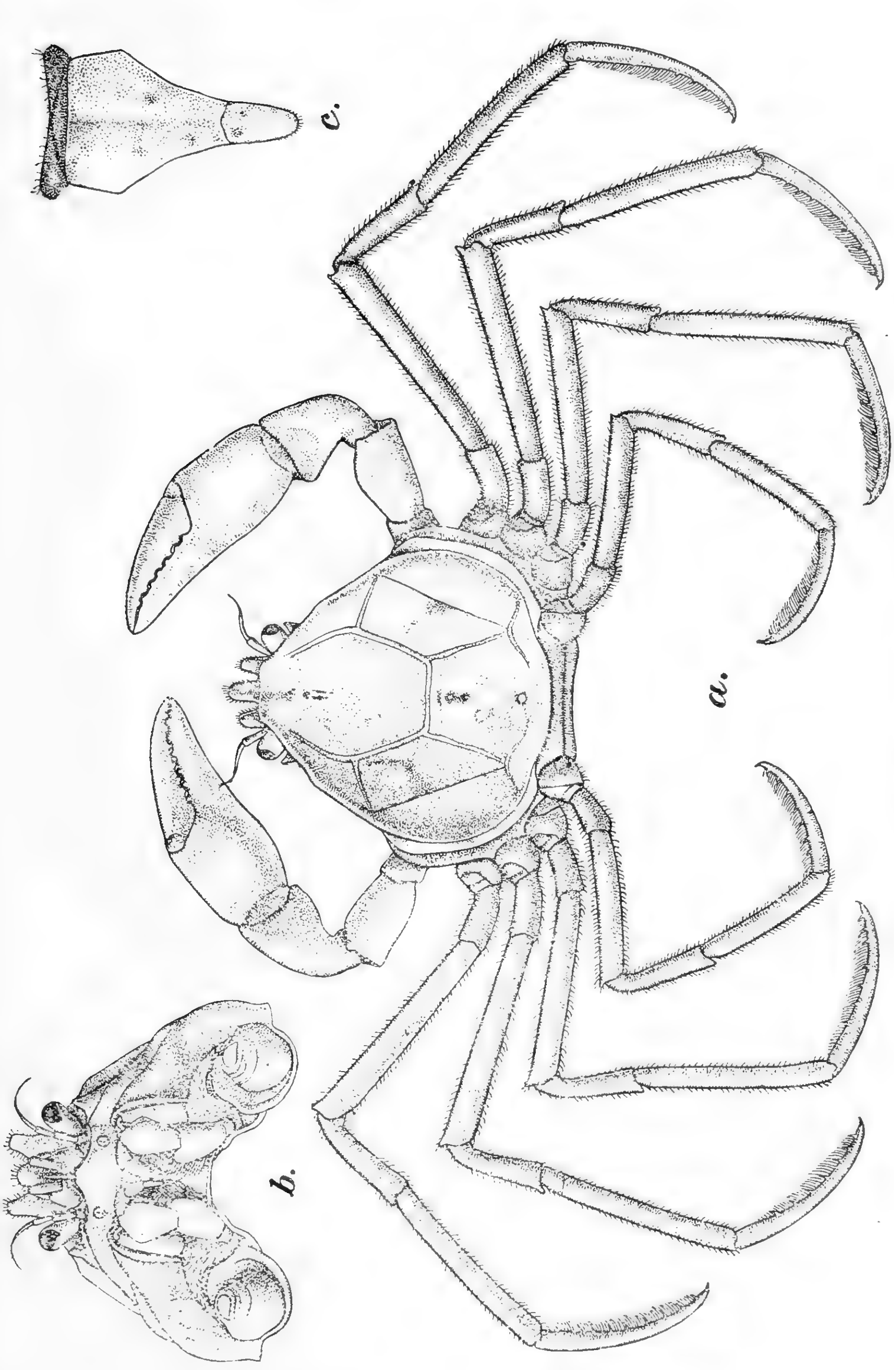

FIG. 11.—*Rhynchoplax introversus*, sp. nov.
a. Large male in dorsal view. *b*. Anterior part of carapace of same specimen from below. *c*. Abdomen of same specimen.

with 6 to 8 small rather widely separated teeth that occupy the greater part of the length of the posterior border.

In the abdomen of the male (text-fig. 11*c*) the penultimate piece is of the usual form, but is very strongly narrowed distally. The terminal segment is exceptionally long, its length being nearly twice its basal breadth.

The species is described from two males, in one of which—much the larger of the two—the carapace is 5·4 mm. in length.

In most respects *R. introversus* is intermediate between *R. exiguus* and *R. inachoides*, but differs from both in the form of the postero-lateral border of the carapace. It resembles *R. inachoides* in the character of the dactyli of the walking legs, but the legs themselves are shorter, the rostral lobes shorter and blunter and the carapace broader.

The specimens were found by Dr. Annandale in the Tai Hu Lake in the Kiangsu Province of China. The larger individual was found off the mouth of the Tong Dong Ding Creek and the smaller at the mouth of the Moo Too Creek. Both were dredged in water about 2 metres in depth. Dr. Annandale noted that the specimens were pale buff in colour with brown markings on the carapace somewhat like a *fleur-de-lys*.

The species is remarkable in that it was obtained in pure fresh water far beyond the reach of tidal influence. A considerable number of Hymenosomatidae have been found in localities where the salinity is low and some appear to be able to exist in water that is quite fresh during a portion of the year. But the only species hitherto recorded from permanently fresh water is *Halicarcinus lacustris* (Chilton),[1] which has even been found 3,000 ft. above sea-level.

The type specimen, the larger of the two individuals, bears the number 9730/10 *Zool. Surv. Ind.*

Rhynchoplax inachoides (Alcock).

1900. *Hymenicus inachoides*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 388, and (1902) *Illust. Zool. 'Investigator,'* pl. lxix, fig. 1.

I have little to add to Alcock's description of this species. The post-ocular denticle is clearly visible in dorsal view; the fingers of the chela of the male meet throughout their length and are armed with a regular series of teeth; the abdomen in the same sex is narrow and similar to that of *R. demeloi*.

The only known specimen is the male described by Alcock and found by Wood-Mason, along with *R. wood-masoni*, at Port Canning near Calcutta On a recent tour in this locality I tried to obtain further specimens but was unable to find either species.

[1] For references see p. 247.

Rhynchoplax nasalis, sp. nov.

The carapace is almost exactly circular and is nearly or quite as broad as long, excluding the rostrum. The surface is sunken, covered with hair, and with the grooves sharply defined. The border is entire, upturned, and is continuous from side to side across the base of the rostrum.

The rostrum differs from that of all other species in the genus in the suppression of the lateral processes; it consists merely of a single horizontal plate, more than twice as long as wide, pointed at the apex and bordered with hairs (text-fig. 12).

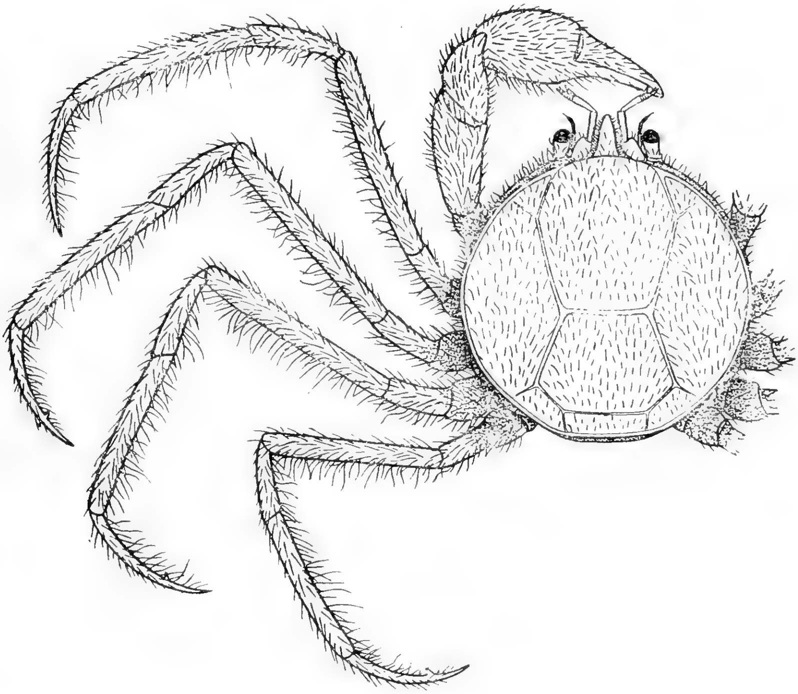

FIG. 12.—*Rhynchoplax nasalis*, sp. nov.

The basal segment of the antennular peduncle and the whole of the eye are visible in dorsal view. There is no post-ocular tooth and no trace of an inter-antennular septum. The epistome is of moderate length. The external maxillipedes are similar to those of the preceding species, but the merus is larger in proportion to the ischium and, when normally folded, the stalk of the exognath extends much beyond the distal end of the merus.

The chelae are swollen in both sexes and are much stouter than the walking legs; they are only a trifle larger in the male than in the female. The distal end of the lower border of the merus ends in a stout tooth, but the segment is not otherwise armed. The carpus is smooth. The chela is not greatly compressed and is not carinate either above or below. In the male it is little more than twice as long as deep, the dactylus being about one and a half times the length of the upper border of the palm. When the claw is closed the fingers meet throughout their length; they are armed with a regular series of six blunt teeth which diminish in size from behind forwards (text-fig. 13).

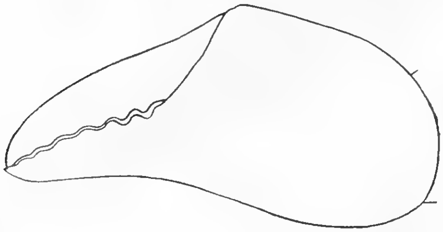

FIG. 13.—*Rhynchoplax nasalis*, sp. nov.
Chela of male (denuded).

The second pair of walking legs is about two and a half times the length of the carapace and rostrum, the last pair about twice the length. All the segments are very slender and there is no tooth at the end of the upper border of the merus. The dactyli are curved; that of the first pair is simple, while in the remaining three pairs there is a single small recurved tooth situated some distance behind the apex (text-fig. 14).

FIG. 14.—*Rhynchoplax nasalis*, sp. nov.
Tip of dactylus of penultimate walking leg.

The abdomen of the male (text-fig. 15) is abnormally broad, the length of the two ultimate pieces being equal to the breadth of the penultimate. The lateral margin of the latter is abruptly narrowed anteriorly and bears a large and curiously formed tubercle near its distal end. The ultimate segment is broader than long, broadly rounded apically and with elevated lateral margins. In the female the abdomen is broad, but the ultimate segment is rather more triangular than in other species.

FIG. 15.—*Rhynchoplax nasalis*, sp. nov.
Abdomen of male.

The entire animal is covered with hairs, which are comparatively long on the chelipedes and legs. The specimens when caught were covered with a dense coating of mud which was only removed with great difficulty. When denuded the crabs were ivory white in colour, the eggs of the female being reddish orange.

The length of the carapace and rostrum in an adult male is 4·4 mm., an ovigerous female is exactly the same size.

The species is described from fifteen specimens, most of which are exceedingly small. They were dredged in the Bidyadhari river near Chingrighatta on the outskirts of Calcutta in October and December 1914. They were found in very foul water which gave specific gravities of 1·0045 and 1·0060 on the two occasions on which the locality was visited.

The types bear the number 9744/10 *Zool. Surv. Ind.*

Genus **Hymenicoides**, nov.

The carapace is nearly circular in outline, sunken, with the usual grooves sharply defined and the lateral margins upturned. The rostrum is altogether absent. The epistome is of moderate length and the buccal cavern is bounded anteriorly by a sharp ridge. The external maxillipedes are slender, gaping widely in the middle line and leaving visible parts of the underlying appendages.

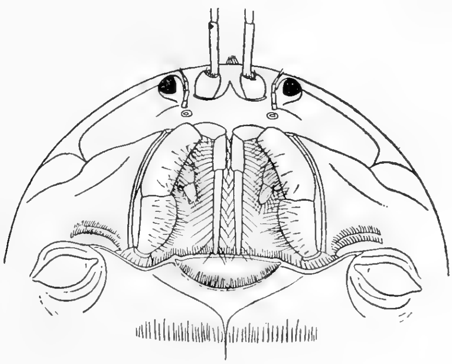

FIG. 16.—*Hymenicoides carteri*, gen. et sp. nov. Anterior part of carapace, seen from below.

The merus is much longer than the ischium and is more than two and a half times as long as wide; the dactylus is styliform and of abnormal length, reaching the posterior limit of the buccal cavern when normally flexed (text-fig. 16). The chelipedes in both sexes are stouter than the legs. In the abdomen of the male the terminal segment is trilobate and the sutures of all the segments are distinct.

This genus is related to *Rhynchoplax* and *Halicarcinus*, but differs from both in the absence of the rostrum and in the great length of the dactylus of the external maxillipedes. It resembles *Rhynchoplax* in the slenderness of the basal segments of the external maxillipedes and *Halicarcinus* in having all the segments of the male abdomen distinct.

Type and only known species,—*Hymenicoides carteri*, sp. nov.

Hymenicoides carteri, sp. nov.

The carapace is almost circular, emarginate at the base of the last legs and with the posterior border short; it is broader than long in the proportion of 21 to 20. The upper surface is greatly depressed, with the grooves well defined, and is closely covered with minute hairs. The margin is entire and upturned; anteriorly and antero-laterally it forms an even curve and bears in the middle of the front a small tuft of hairs. The rostrum is entirely absent. The basal segment of the antennule and the greater part of the eye are visible in dorsal view.

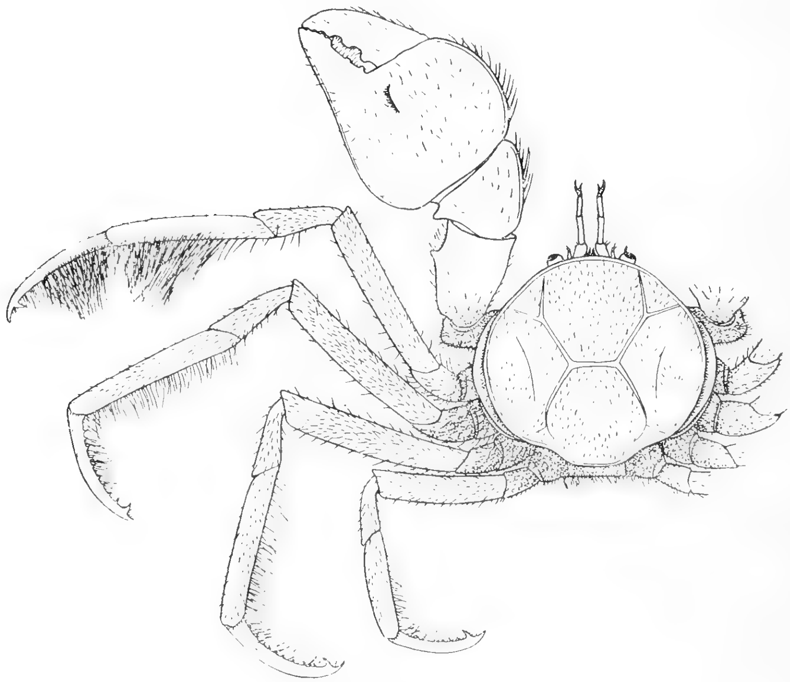

FIG. 17.—*Hymenicoides carteri*, sp. nov.

At their bases the antennules are separated by a sharp forwardly directed tooth: there is no post-ocular tooth. The epistome is of moderate length. The buccal cavern is somewhat narrowed anteriorly; its lateral borders are rather strongly curved and, as in the genus *Rhynchoplax*, its anterior and posterior edges are curved inwards (text-fig. 16). On the sternum behind the bases of the external maxillipedes there is a semicircular ridge, concave anteriorly, which bears a fringe of long hairs. The curious structure of the external maxillipedes has been referred to in the generic description. There are long hairs on the inner borders and outer surface of the ischium and merus and on both inner and outer borders of the dactylus. The exognath bears a long flagellum and, except for a small portion at the base of the stalk, is entirely concealed from view.

The chelipedes are greatly swollen in both sexes; the chelae of the male are much larger than those of the female. The outer border of the merus bears a conspicuous tooth in front of its middle point. On the inner side of the carpus there is a longitudinal ridge which is furnished with a fringe of long hairs. The chela of the male (text-fig. 18) is less than one and a half times as long as high. There are sharp keels on both upper and lower borders of the palm, the latter being continued to the tip of the immobile finger. These keels like that on the carpus are fringed with long hairs. The inner surface of the palm is convex and the outer face bears a huge protuberance (text-fig. 19), only well developed in very large males, which culminates in a short crest not far form the finger cleft. The fingers are stout and in large individuals meet only at the tips. The dactylus bears two large blunt teeth in its basal half and the fixed finger two smaller ones placed just behind them; nearer the tip each finger bears four or five teeth. The dactylus is fully one and a half times the length of the upper border of the palm and is obscurely ridged dorsally. The chela of the female is similar to that of the male, but is more slender and shows practically no trace of the large protuberance on the palm. Except for the fringes of hair already mentioned the chelipede bears only a few fine and scattered setae.

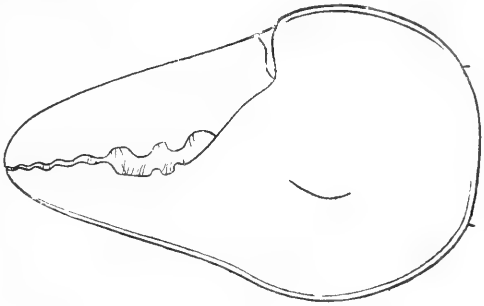

FIG. 18.—*Hymenicoides carteri*, sp. nov. Chela of large male, external view.

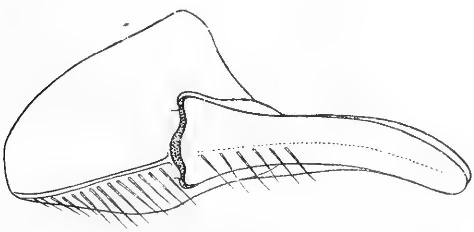

FIG. 19.—*Hymenicoides carteri*, sp. nov. Chela of large male, dorsal view.

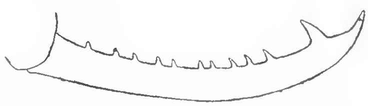

FIG. 20.—*Hymenicoides carteri*, sp. nov. Dactylus of penultimate walking leg.

The second walking legs are a little longer than the first and third and are about three times the length of the carapace; the last pair is only two-thirds the length of the second. The anterior border of the merus in all four pairs terminates in a blunt tooth. The dactyli are slender and curved. Close to the apex each bears a large recurved tooth, behind which a number of smaller teeth are usually found. On the first pair of legs there are generally not more than one or two such teeth; on the other legs they are more numerous (text-fig. 20) and often extend from the base to the large subterminal tooth; the maximum number observed is eleven. There are fine hairs on all the segments and a fringe on the posterior margins of the propodus and dactylus. In large males the hairs on the propodus and dactylus of the first legs are very long and numerous, forming dense tufts that retain a great quantity of mud.

The sternum and abdomen are thickly beset with hairs. In the abdomen of the male (text-fig. 21) all the sutures are distinct. The lateral margins are markedly sinuous, the widest point being at the junction of the fourth and fifth segments; the ultimate segment is trilobed terminally and is much broader than the distal width of the sixth.

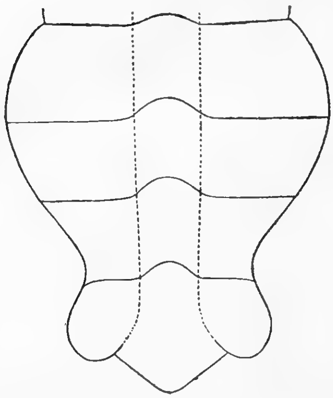

FIG. 21.—*Hymenicoides carteri*, sp. nov. Abdomen of male.

The carapace of the largest specimen, a male, is 5·7 mm. in length.

The species is described from twenty-two specimens found on the banks of the R. Hughli at Sibpur, near Calcutta, in January 1917, by Dr. Annandale and myself. They were obtained in timber bored by Teredo (*Xylotria dunlopi*) lying between tide-marks. The water at the time they were found was almost or quite fresh at all states of the tide, but is doubtless brackish later in the year. There are also in the collection two specimens, both small, collected by Mr. T. Southwell near Khulna in the Gangetic delta in August 1915.

With this species I have associated the name of Dr. H. G. Carter, Officiating Director of the Botanical Survey of India, to whom I am indebted for facilities for collecting at Sibpur. The types, which are from this locality, bear the number 9746/10 *Zool. Surv. Ind.*

Genus **Elamena**, Milne-Edwards.

1837. *Elamena*, Milne-Edwards, *Hist. nat. Crust.*, II, p. 33. [Not *Elamene*, Milne-Edwards, *Ann. Sci. nat., Zool.* (3), XX, p. 223 (1853); nor *Elamene*, A. Milne-Edwards, *Nouv. Arch. Mus. Paris*, IX, p. 321 (1873).]

1900. *Elamena*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 385 (not the synonymy).

The carapace is oval, triangular or polygonal, greatly depressed, and sometimes lamellar. The upper surface is flat or concave, without the usual sharp-cut grooves, and the lateral margins may or may not be upturned. The rostrum is broadly truncate or triangular, never tridentate or trilobate. The epistome is long, sometimes very long and is separated by a ridge from the floor of the buccal cavern. The external maxillipedes are broad and completely close the buccal cavern; the ischium is longer, sometimes much longer than the merus, and the dactylus is, as usual, short. The chelipedes of the male may or may not be stouter than the walking legs. In the abdomen of the male the 3rd, 4th and 5th segments are fused and the sutures between them obliterated.

Judging from the Indian species, this genus, here described *sensu lato*, differs from all other Hymenosomatidae in the absence of the customary grooves on the upper surface of the carapace. In the character of the male abdomen it resembles *Rhynchoplax*, but differs from that genus in the form of the rostrum and external maxillipedes. Milne-Edwards' *Trigonoplax* is, at most, a subgenus of *Elamena* (*v. infra*, p. 274).

Six species of *Elamena, s.l.* are now known from the Indian coasts, all being represented in the Indian Museum with the exception of *E. gracilis*, Borradaile. I have not been able to satisfy myself regarding the position of this species and have, in consequence, omitted it from the following key. It is perhaps intermediate between *Elamena, s.s.* and *Trigonoplax*.

I. Margin of carapace upturned; rostrum with a vertical keel on its lower surface and in frontal view T-shaped; chelipedes of male greatly swollen, much stouter than legs [dactylus of walking legs apically triunguiculate] = *Elamena s.s.*
  - *A.* Carapace as broad or broader than long[1]; rostrum broad and squarely truncate; a small post-ocular tooth present, but not visible from above ... ... *E. truncata* (Stimpson).
  - *B.* Carapace longer than broad[1]; rostrum prominent, triangular; no post-ocular tooth ... *E. sindensis*, Alcock.

II. Margin of carapace not upturned; rostrum at most with a small tooth at base of lower surface, not T-shaped in frontal view; chelipedes of male slender, not stouter than walking legs. = subgen. *Trigonoplax*.
  - *A.* Rostrum parallel-sided at base; a strong post-ocular tooth visible in dorsal view; dactyli of walking legs armed in their distal third with a series of small teeth [carapace about as long as broad] ... ... *E.* (*T.*) *cimex*, Kemp.
  - *B.* Rostrum strictly triangular, its sides convergent from base to apex; no post-ocular tooth visible in dorsal view; dactyli of walking legs triunguiculate at apex.
    - 1. Carapace longer than broad,[1] its antero-lateral margins curved and not longer than postero-lateral; rostrum flat above; a post-ocular tooth visible only from

[1] Rostrum included.

below; 2nd walking legs less than $2\frac{1}{2}$ times length of carapace[1] ... ... *E.* (*T.*) *xavieri*, sp. nov.

2. Carapace broader than long,[1] its antero-lateral margins straight and very much longer than postero-lateral; rostrum hollowed above; no post-ocular tooth; 2nd walking legs more than 3 times length of carapace[1] ... ... *E.* (*T.*) *unguiformis*, de Haan.

Elamena truncata (Stimpson).

1858. *Trigonoplax truncata*, Stimpson, *Proc. Acad. Nat. Sci. Philadelphia*, X, p. 109 [55].
1873. *Elamene truncata*, A. Milne-Edwards, *Nouv. Arch. Mus. Paris*, IX, p. 323.
1893. *Elamene truncata*, Henderson, *Trans. Linn. Soc., Zool.* (2), V, p. 395.
1900. *Elamena truncata*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 386.
1906. *Elamena truncata*, Baker, *Trans. Roy. Soc. S. Australia*, XXX, p. 112, pl. ii, figs. 2, 2*a*-*d*.
1907. *Trigonoplax truncata*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 146.

There does not appear to be any reason to doubt that the descriptions given by Stimpson and A. Milne-Edwards refer to the

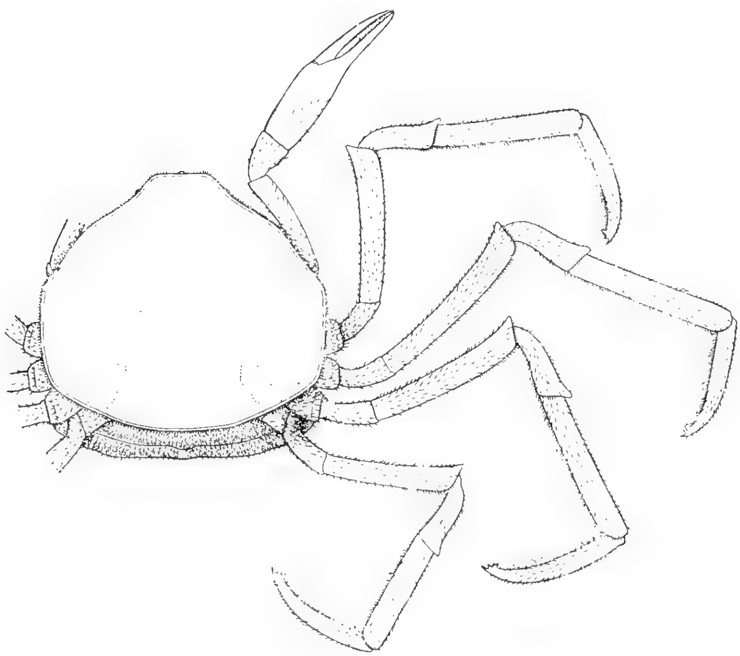

FIG. 22.—*Elamena truncata* (Stimpson) ♀.

same species, though the specimens examined are from widely distant localities. A. Milne-Edwards, however, seems to have

[1] Rostrum included.

been unaware of the existence of Stimpson's account, for he makes no reference to it and his description is headed "*Elamene truncata* (nov. sp.)." That both authors have used the same specific name is presumably due to a remarkable coincidence.

Alcock was able to examine only a single example of this species, but two others have since been obtained; unfortunately all three specimens are females. Both Stimpson and A. Milne-Edwards note that the chelae of the male are inflated and there is consequently little doubt that the species belongs to *Elamena*, *sensu stricto*. As in *E. sindensis*, the margins of the carapace are upturned and the front, or rostrum, bears on its underside a deep vertical keel, giving it a T-shaped appearance in facial view

The abdomen of the male, according to Baker's description and figure, consists of five pieces, whereas only four are to be found in all the males of other species of *Elamena* and *Trigonoplax* that I have seen. From the figure it looks as if only the 3rd and 4th segments were fused in *E. truncata*, in place of the 3rd, 4th and 5th. A fresh examination of males is desirable.

In the Indian specimens the carapace is proportionately broader than in those described by Baker, the breadth being decidedly greater than the length. The front, or rostrum is squarely truncate, not rounded as described by Henderson. Behind the base of the swollen eyestalk there is a small post-ocular tooth (not shown in Baker's figure) which is altogether invisible in dorsal view. The chela of the female is little stouter than the walking legs; the fingers gape slightly when closed and are armed on their inner margins with minute teeth and short hairs. The dactylus in all four pairs of walking legs is triunguiculate at the apex. The anterior border of the ultimate segment of the abdomen of the female is strongly sinuous (text-fig. 23).

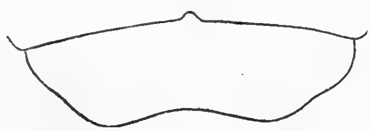

FIG. 23.—*Elamena truncata* (Stimpson).
Terminal segment of abdomen of female.

Alcock examined a single individual of this species, obtained at the Nicobars. The two additional specimens were found at Port Blair in the Andamans under a block of coral exposed at low water; the carapace of the larger is 4·8 mm. in length. When alive the carapace was brown in colour with four cream-coloured marks[1] as described by Stimpson.

There is also in the Indian Museum a female specimen of *E. truncata*, unfortunately with all the legs missing, received many years ago from the Godeffroy Museum under the name *Elamena quoyi*. It bears the label "Samoa and Viti Is."

The species appears to be one of wide Indo-pacific distribution. In addition to the above records it is known from the Ceylon coast (Henderson), the Loo Choo Is. (Stimpson), New Caledonia (A. Milne-

[1] Shown by dotted lines in text-fig. 22.

Edwards) and S. Australia (Baker). Lenz's record from Zanzibar [1] is erroneous, the specimens described belonging in all probability to Desmarest's *E. mathaei*.

Elamena sindensis, Alcock.

1900. *Elamena sindensis*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 386 and (1902) *Illust. Zool.* '*Investigator*,' pl. lxiv, fig. 3.

This species is still represented in the Indian Museum only by the specimens described by Alcock from Karachi. In addition to particulars noted by Alcock, it may be mentioned that the dactylus of the male chela bears a low blunt tooth near the base, the margin of both fingers being otherwise finely serrate. The dactylus of the walking legs is apically triunguiculate. The abdomen of the male is rather broadly triangular, its sides being lightly sinuous, with the 3rd, 4th and 5th somites fused. The terminal segment of the abdomen of the female resembles that of *E. truncata*.

Subgenus Trigonoplax, Milne-Edwards.

1853. *Trigonoplax*, Milne-Edwards, *Ann. Sci. nat., Zool.* (3), XX, p. 224.
1900. *Trigonoplax* (subgenus of *Elamena*), Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 386.

I agree with Alcock that *Trigonoplax* can only be regarded as a subgenus of *Elamena*. *E.* (*Trigonoplax*) *xavieri*, which is described below, still further emphasizes the close relation between the two groups, the inter-antennular septum being a prominent plate, exactly as in *Elamena*, *s.s.*

In the subgenus the carapace is flatter than in *Elamena*, with its margins scarcely at all upturned, and the chelipedes are similar in the two sexes and not appreciably stouter than the walking legs. In the two species of *Elamena* that I have seen, the rostrum is T-shaped when viewed from in front, owing to the presence of a large vertical plate on its lower side; this structure, which is quite distinct from the septum between the bases of the antennules, is either absent in *Trigonoplax* or is represented by a tooth situated far behind the anterior margin.

These distinctions are slight and *Trigonoplax* in course of time will probably find a place in the synonymy of *Elamena*. Borradaile's *E. gracilis* appears from the description and figure to be intermediate between the two groups here recognised.

Elamena (Trigonoplax) cimex, Kemp.

1915. *Elamena* (*Trigonoplax*) *cimex*, Kemp, *Mem. Ind. Mus.*, V, p. 216, text-figs. 4, 5, pl. xii, fig. 3.

The species differs from all related forms in the areolation of the carapace; the gastric, cardiac and hepatic regions are each

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[1] Lenz, *Abhandl. Senck. naturf. Ges. Frankfurt*, XXVII, p. 367, pl. xlviii, figs. 15 *a,b* (1902).

slightly tumid and are separated by broad and shallow furrows. In this respect there is perhaps some approach to the condition found in *Halicarcinus* and *Rhynchoplax*, but there is no trace of the finely cut grooves that are conspicuous in those genera. The tooth on the lower surface of the rostrum, which is well marked in *E.* (*T.*) *xavieri* and slightly indicated in *E.* (*T.*) *unguiformis*, is in this species altogether absent. The dactyli of the walking legs bear a series of small teeth and are not apically triunguiculate as in all other Indian species of *Elamena*.

Elamena (*Trigonoplax*) *cimex* has hitherto been found only in the Chilka Lake, on the Orissa coast of the Bay of Bengal. The specimens were dredged in fresh water, but in a situation subject to great seasonal variation in salinity.

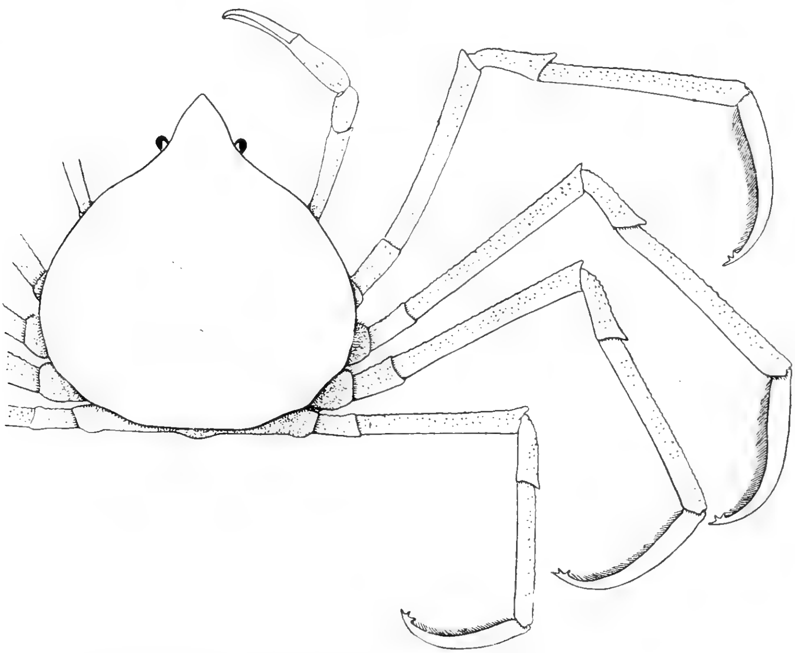

FIG. 24.—*Elamena* (*Trigonoplax*) *xavieri*, sp. nov.

Elamena (Trigonoplax) xavieri, sp. nov.

The carapace closely resembles that of *E.* (*T.*) *cimex* in outline, but the antero-lateral borders are more strongly arched; its length is to its breadth as 13 to 12. There are shallow emarginations opposite the bases of the last two legs. The surface is quite flat, the regions not being defined in any way, and is altogether devoid of hairs; the margins are not upturned. The rostrum is a large triangular plate and is flat above; its margins are slightly convex and converge regularly from the base to the apex; they are not parallel at the proximal end as in *E.* (*T.*) *cimex*. On the under side, near the base, the rostrum bears a sharp forwardly directed tooth (text-fig. 25).

The eyes and a small portion of the eyestalks extend beyond the carapace. A small post-ocular tooth may be seen when the carapace is viewed from beneath, but in dorsal view is altogether invisible. The antennules are separated at the base by a well-defined septum, much more distinct than in *E.* (*T.*) *unguiformis*. The epistome is long. The anterior border of the buccal cavern is convex on either side of the middle line. In the outer maxillipedes the ischium is much longer than the merus and is separated from it by a very oblique suture. The exognath bears a long flagellum and its basal part, though largely overlapped by the endopod, is visible throughout its length.

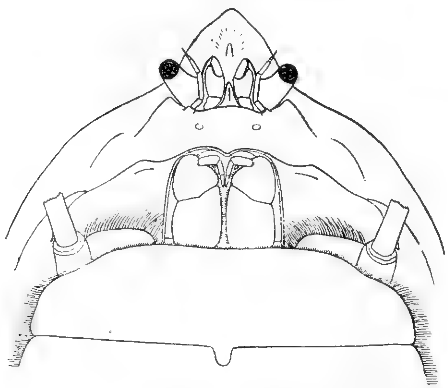

FIG. 25.—*Elamena* (*T.*) *xavieri*, sp. nov. Anterior part of carapace seen from below.

The chelipedes are alike in the two sexes and are not appreciably stouter than the walking legs; they are about as long as the carapace and rostrum. The merus is without teeth and the merus, carpus and palm are slightly roughened and bear very fine and exceedingly short hairs. The chela is about four and a half times as long as high and the fingers are equal in length with the palm. Towards their apices the fingers are slightly inturned and on the inner face of the chela are somewhat hollowed longitudinally. When the claw is closed the fingers meet throughout their length; each being provided with a series of small recurved teeth extending from the base to the apex (text-fig. 26).

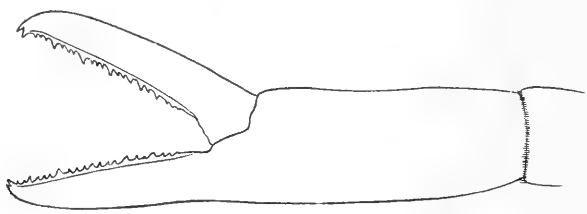

FIG. 26.—*Elamena* (*Trigonoplax*) *xavieri*, sp. nov. Chela of male.

The second pair of walking legs is slightly longer than the first or third, about two and a third times the length of the carapace; the fourth is much the shortest, about one and three quarter times the length of the carapace. All the segments except the dactylus are roughened like the chelipedes and are thinly clothed with very fine hairs. In all four pairs the merus and carpus end in a strong tooth. The dactyli are slender and curved; the inner margin is densely fringed with hair and bears near the apex two stout recurved teeth, as in *E.* (*T.*) *unguiformis* (text-fig. 27).

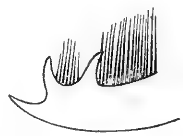

FIG. 27.—*Elamena* (*T.*) *xavieri*, sp. nov. Tip of dactylus of last walking leg.

The ultimate segment of the abdomen of the male is triangular, a little broader than long and with a pair of rather conspicuous pits near its base; proximally it is a little wider than the contracted distal end of the preceding portion. The distal margin of the abdomen of the female is slightly sinuous, as in *E.* (*T.*) *unguiformis*; in *E.* (*T.*) *cimex* it is more convex.

The carapace of a large female is 9·2 mm. in length; males are smaller, not exceeding 7·5 mm.

In living specimens the carapace is dark brown or slate-coloured, with pale antero-lateral margins and, as in *E. truncata*, a pair of elongated pale blotches project inwards and forwards from the bases of the last two pairs of legs.

In general appearance this species bears much resemblance to *E.* (*T.*) *cimex*; but it is in reality more closely allied to *E.* (*T.*) *unguiformis.* This is clearly shown by the presence of the inter-antennular septum and the tooth on the lower surface of the rostrum (both of which are in fact better defined than in *E.* (*T.*) *unguiformis*), and it is also evident in the structure of the dactylus of the walking legs.

The species is described from three males and three females obtained in the Mandavi river, opposite the town of Nova Goa in Portuguese India. They were dredged at a depth of about 10 feet on a muddy bottom in places where the current ran swiftly. The specific gravity of the water in which they were taken was very low, about 1·0010 (corrected).

In the specific name allusion is made to St. Francis Xavier, whose remains lie interred at Goa, not far from the place where the specimens were obtained.

The types bear the number 9750/10 *Zool. Surv. Ind.*

Elamena (Trigonoplax) unguiformis, de Haan.

1839. *Ocypode* (*Elamene*) *unguiformis*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 75, pl. xxix, fig. 1; pl. H.
1900. *Elamena* (*Trigonoplax*) *unguiformis*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 387.
1907. *Trigonoplax unguiformis*, de Man, *Trans. Linn. Soc., Zool.* (2), IX, p. 396.
1915. *Trigonoplax unguiformis*, Parisi, *Atti Soc. Ital. Sci. nat.*, LIV, p. 281.

Other references are given by Alcock.

This well-known species differs conspicuously from the two preceding forms in the shape of the carapace, the antero-lateral borders being proportionately very much longer and quite straight (text-fig. 28). The rostrum is hollowed above and bears near the proximal end of its lower surface a low ridge in place of the tooth found in *E.* (*T.*) *xavieri*. The epistome is extremely large, almost as long as the external maxillipedes. The fingers of the chelae are

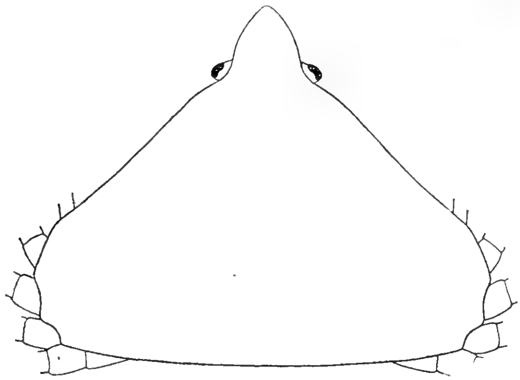

FIG. 28.—*Elamena (Trigonoplax) unguiformis*, de Haan. Outline of carapace.

furnished with minute teeth and the dactylus of the walking legs is triunguiculate. The abdomen of the male is broad at the base and narrow at the apex, the lateral margins being concave; the 3rd, 4th and 5th segments are fused.

McCulloch[1] appears to be right in regarding his South Australian specimens as a distinct variety of this species. In Indian specimens the rostrum is not nearly so long, nor the dactyli of the walking legs so broad as shown in his illustration. I give here, for comparison, outline figures of the carapace and dactylus of the first leg.

FIG. 29.—*Elamena (T.) unguiformis*, de Haan. Dactylus of first walking leg.

The species is not uncommon at Port Blair in the Andamans, living among weeds in pure sea water at depths of 2 to 8 fathoms. In life, specimens are of a dull semitransparent brownish or greenish tint, without any conspicuous markings.

The species is known from the Gulf of Martaban (Henderson) and from numerous localities in Japan (de Haan, Ortmann, de Man, Parisi).

[1] *Trigonoplax unguiformis* var. *longirostris*, McCulloch, *Rec. Australian Mus.*, VII, p. 59, pl. xii, fig. 3 (1908).

Elamena gracilis, Borradaile.

1906. *Elamena gracilis*, Borradaile, in Gardiner's *Faun. Geog. Maldive and Laccadive Archipel.*, II, p. 684, text-fig. 122 *a, b.*
1911. *Elamena gracilis*, Rathbun, *Trans. Linn. Soc., Zool.* (2), XIV, p. 242.

I have seen no specimens of this species and do not know whether it should be referred to *Elamena*, *s.s.*, or to *Trigonoplax.* Judging from the figure the lateral margins of the carapace are upturned; but the chelae are described as slender and apparently do not show any sexual differences. There is no mention of a vertical keel on the lower face of the rostrum.

In the form of the carapace *E. gracilis* differs conspicuously from any Indian species of the genus that I have seen. It was described by Borradaile from Minikoi and Male Atoll and has since been recorded by Miss Rathbun from Coetivy.

XVI. ON THE OCCURRENCE OF IRIDOCYTES IN THE LARVA OF *MICROHYLA ORNATA*, BOUL.

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(Plate XI).

Introduction.

There are some good observations recorded as regards the colour of batrachian larvae in life, but in most cases the descriptions refer to preserved specimens. Such descriptions must necessarily differ, for the material sent to leading authorities for examination generally arrives in a state in which the colour is somewhat different from what occurs in living forms, the usual methods of preservation, either in alcohol or formalin, greatly affecting the pigments. Moreover, the colouration of specimens of the same species of batrachian is not uniform as a rule, inasmuch as it depends in a great measure on the character of the surroundings from which they are taken and the conditions under which they live. For example, if the olive green tadpoles of the genus *Rana* or *Rhacophorus* should be transferred, from the green weeds amidst which they live, to a more exposed area of another pond, they turn grey; and if the same larvae should be retransferred to a third pond with a black clayey bottom, they become brown. Similarly dearth or abundance of food will greatly influence the colour. Starvation nearly causes the absorption of the yellow pigments with the consequence that the melanin chromatophores show through to some extent, the tadpole looking more or less darker. On the other hand, generous feeding favours the deposit of more than one kind of lipochrome pigment, and accordingly the larvae appear beautiful with a variety of colours.

The tadpole of *M. ornata* has been described by Capt. S. Flower (*Proc. Zool. Soc. London*, 1899, p. 902), and there is a short note on the same subject by Mr. H. S. Ferguson (*Journ. Bombay Nat. Hist. Soc.*, XV, p. 506). No allusion is made by either of these writers to the occurrence of the bright metallic dorsal band or the silver brilliancy on the sides of this beautiful tadpole. It is perhaps worthy of mention that this tadpole and its congener that of *M. rubra* are probably most singular in the possession at once of golden and silvery brilliance, of all the Anuran larvae that have been studied up till now.

The scope of this paper is to record the results of the investigations commenced with a view to discover the nature of the substance which produces this interesting phenomenon, which has also been observed in fishes, and further to trace the relation of it to the other histological elements. Incidentally, reference will be made to the colouring matter of other tadpoles, chiefly Indian forms known to me,—in all those particulars in which they approach the general scheme of pigmentation occurring in the two species of *Microhyla* which form the subject of this paper. The literature referring to this section of the paper is given below in a foot-note.[1]

The head of the tadpole of *M. ornata*, which is nearly two-thirds of the size of the body, is perfectly transparent, but this is not so in *M. rubra*. Behind the eyes, in the former species, there is a characteristic diamond-shaped black mark just above the cranium. Usually a yellow line runs fore and aft of this mark behind which is a glandular area. Over the vertebral column is the characteristic golden streak which may also extend in front over the diamond-shaped mark already referred to. Sometimes the lungs show through the transparent skin on either side of the vertebral band; more often, however, the skin may be yellowish green. The sides and ventral surface of the abdomen glitter with silvery brightness, while the throat is colourless. The ventral lobe of the tail is more or less pale copper coloured. When the dorsal metallic streak is absent, due to absorption, the underlying black band can then be seen.

The other Engystomatid larvae known to me are uninteresting in regard to their colouration. The tadpole of one species of *Kaloula* (*K. triangularis*) is absolutely transparent without any colour markings except on the head; and another (*K. variegata*) has a transparent head, but the body and tail are blotched, besides two blue spots in the region of the groin The tadpoles of *K. pulchra*, *K. obscura*, and *Cacopus systoma* are densely pigmented.

The points of interest that call for remark, in regard to the colouration of the larvae of the Ranid family, are the occurrence of bright orange red in the posterior third of the tail in *R. breviceps* and *Rhacophorus maculatus*,[2] which as metamorphosis

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[1] For an account of the colouration of Indian tadpoles the following literature, though not complete, may be consulted :—

Annandale, *Rec. Ind. Mus.*, VIII, p. 21 (1912).
Boulenger, *Ann. Mus. Genova*, (2) V, p. 420 (1887-88); *Proc. Zool. Soc. London*, 1893, pp. 526-527.
Flower, *Proc. Zool. Soc. London*, 1896, p. 911 and 1899, pp. 892, 902.
Anderson, *Proc. Zool. Soc. London*, 1895, p. 66c.
Butler, *Journ Bombay Nat. Hist. Soc.*, XV, pp. 193, 387 (1903-04).
Ferguson, *Journ. Bombay Nat. Hist. Soc.*, XV, p. 499 (1903-04).
Narayan Rao, *Rec. Ind. Mus.*, X, p. 265 (1914); XI, pp. 31, 349 (1915).
Boulenger, *Proc. Zool. Soc. London*, 1891, pp. 606-607, mentions the occurrence of metallic dots in the larvae of *Rana arvalis* and *R. temporaria*.

[2] Flower, in his account of the tadpole of the Malay race of this species, describes the colour as pinkish (*Proc. Zool. Soc. London*, 1896, p. 906).

progresses is changed into intense black. The ventral surface of all these larvae is dead chalky white, more or less speckled on the throat and the sides. On the dorsal surface one meets with every shade of colouration, ranging from bright yellow to dark brown, with or without spots. A few exceptions may be cited to this prevailing scheme of colouration For instance, the perfectly grey larvae of *Rh. plurostictus*, which bear numerous round black spots, and are perhaps the biggest tadpoles yet discovered in India.[1] The yellow dorsal streak of the larvae of *R. breviceps* and *R. tigrina* is only a premature appearance of an adult character, and the round red spots on the back and thighs of the same tadpoles are mainly larval features. In a few cases like *R. alticola* and *R. liebigii* the tail may be diversified by ocelli or vertical bars.

The tadpoles of *Bufo* are all uniformally brown. Occasionally there are metallic dots on the dorsal surface, the ventral side being dirty white as in *B. microtympanum.*

After this brief survey, it need only be mentioned that the outstanding character of the larvae of *M. ornata* and *M. rubra* is the possession of metallic bands and surfaces which make the colouration as a whole markedly striking.

BIOLOGICAL SIGNIFICANCE.

The larvae of *M. ornata* and *M. rubra* float on the surface in comparatively large shoals chiefly in the middle of the pond. In the aquarium the same habits are exhibited by these tadpoles.

Other tadpoles of the Ranid group, which I have reared and kept under observation, are unable to remain at the surface for any length of time being without the provision of a special structure like a float, as in *Megalophrys montana.* The ability to remain at the surface throughout metamorphosis is a feature that has some structural bearing. When the animal remains stationary at the top it is really occupying a plane of least effort, which it can do only when the body is for the time being lighter than the water, bulk for bulk. The gill chambers of the larvae of the two species of *Microhyla* possess large cavities filled with air, which can be easily seen through the transparent skin. These air spaces account for the enormous size of the cephalic region. On pressing the bulging portion of the throat, large bubbles of air may be driven out through the spiracle. An examination of the transverse and longitudinal sections of the larvae reveal these air cavities, situated between the first and the second and the second and the third gill arches on each side of the pharynx. This structural peculiarity, absent in the Ranid group (as revealed by sections), which bears some resemblance to the secondary air sacs of *Clarias*, accounts

[1] In my experience the dimensions quoted by Anderson for *R. cyanophlyctis* (*Proc. Zool. Soc. London*, 1895, p. 660) are not of the normal tadpole. If metamorphosis, however, is hindered through any cause the larvae attain such a size.

for the floating habit of the tadpole and like the fish it blows out a few bubbles of air through the mouth or the spiracle before sinking to the bottom.

While floating, the tadpole must be peculiarly exposed to attacks from enemies who may have some difficulty in hunting for other forms which lead a concealed mode of life. It is obvious that unless there is some special provision which to a greater or less extent secures immunity, the larvae of *Microhyla* will utterly perish.

Observation shows that in the aquarium these larvae are avoided by both fish and snakes, like *Clarias*, *Saccobranchus*, *Ophiocephalous* and *Tropidonotus*, and in ponds ducks and geese also do not touch them. They, however, greedily seize and devour other amphibian larvae. Reference has already been made to the occurrence of a cephalic gland and it is clear that the offensive matter, by which the larvae are protected, is situated in this gland. When a scraping from this gland was introduced into the conjunctiva of a dog, the eye was kept closed and at the same time it became blood-shot with a watery discharge. If an entire larva be placed in the mouth, nothing will induce the dog to swallow it ; those of *Rana* are, however, swallowed. The fish *Opiocephalus* was tried. Forcible feeding of the fish was found to be futile, for as often as the larvae were introduced into the mouth, they were thrown out with considerable force. The secretion is acid in reaction, as may be tested with blue litmus paper. The colouration may have a warning effect.

THE COLOUR ELEMENTS.

For convenience of treatment, the colour elements of the larvae of *M. ornata* may be considered under the following heads :—

1. Black chromatophores of the melanin group.
2. Coloured pigments of the lipochrome group.
3. Iridocytes which are guanin crystals, occurring chiefly in the form of plates.
4. Argenteum or reflecting tissue, on the sides and the ventral regions of the abdomen.

The first two elements combine in various proportions or individually produce the several colours referred to already in the foregoing paragraphs, while the latter elements account for the metallic brilliance. The dead chalky white on the ventral surface of Ranid larvae is due to the argenteum being impregnated more or less with calcium, the compound thus produced being known as guaninkalk.

1. BLACK CHROMATOPHORES.

These elements occur in chiefly two forms, as mere dots and as dendritic structures. The former are confined to regions that are more or less transparent, such as the head and the caudal membranes, while the latter are aggregated on the dorsal surface. A third variety—the stellate type—accounts for the dark pigmentation of the peritoneum.

2. COLOURED PIGMENT.

The true chromatophores which give colour to the skin are either yellow or orange and the degree of colouration depends on two factors. Firstly the number of coloured chromatophores present and the manner of their distribution, and secondly the extent to which they are diluted by the black chromatophores. The lipochrome pigment occurs in the form of scales or minute granules, the latter when present give the effect of colour suffusion. Only very fine granules of chromatophores produce the blue and orange, such as occur in *K. variegata* and *R. breviceps,* and in the yellow and scarlet red spots found in *Rh. maculatus* and *R. tigrina* respectively only large scaly chromatophores are met with. Green is simply the effect of the fusion of yellow and black, while purple or brown is caused by mixing red and black in various proportions. As will be shown in subsequent paragraphs, orange red is simply intensified yellow and is not a separate pigment at all.

3. IRIDOCYTES.

As has been stated already, the bright metallic band in the mid-dorsal line is formed by an opaque plate of iridocytes. Each is scaly and is irregular in outline, and when numbers of them form a thick band, they acquire strongly reflecting powers. The band is sunk in a groove in the spinal region covered over by the dermal tissue and bounded laterally by the nine pairs of dorsal muscles. Where this band occurs, the melanin chromatophores are absent. Iridocytes occur in the iris, the peritoneum, the lungs and subcutaneous tissue of the tail membranes. They are absent from the skin.

In two important respects the iridocytes of the batrachian larvae differ from those of fishes. In the first place they are irregular in outline, and are formed of minute spherical granules. The chief characters of these bodies in fishes are that they are regular, laminated structures with a clear nuclear spot, with divisions showing common origin. In the second place the crystals are most unstable in the tadpoles, falling almost to powder on removal from the subcutaneous setting; whereas in fishes they occur in the majority of cases in the skin and the crystals can be easily examined.

The iridescent phenomenon caused by this dorsal band in the *Microhyla* larva is simply the effect of light being reflected from the numerous surfaces and sides of these crystalline structures. But the golden colour is, however, due to a thin layer of yellow lipochrome spread over this band, and the occurrence of similar pigment produces the coppery hue of the tail lobes.

THE ARGENTEUM.

The argenteum is a thick, opaque, continuous layer of reflecting subcutaneous tissue in which the iridocytes no longer retain their individual character but are broken up so minutely that it is by no means possible to make out any definite structure with the microscope. This layer is covered over by the transparent epidermis which here is singularly free from all chromatophores. The silver brilliance of the argenteum is simply due to the powdering of the iridocytes which are thickly impregnated into the subcutaneous tissue: the same cause accounts for all absence of iridescence in this region. Thus the abdominal wall has a bright silver lustre on the outer surface and a spangle-like appearance on the peritoneal wall. As has been said already, the pericardium—the parietal layer—is also an argenteum and the visceral layer bears only chromatophores.

The only organs that contain iridocytes and black chromatophores are the lungs; all the other organs are perfectly devoid of them. The occurrence of argenteum in the air-bladder of fishes has been noticed, and the homology of the lungs of air-breathing Craniates with the air-bladder of fishes here receives fresh corroboration from the chemical side.

RELATION OF COLOUR AND HISTOLOGICAL ELEMENTS.

It is not possible to demonstrate the presence of connective tissue corpuscles in the dermis or epidermis of grown tadpoles, though gold chloride staining of the skin of very young tadpoles sometimes reveals the presence of a few corpuscles. The chromatophores occur in between the epidermal cells, and their cellular origin can be explained on the hypothesis that after formation in the deeper tissues they migrate bodily to the surface region. In sections of the skin two kinds of dots are noticeable, the smaller ones belong to the granular chromatophores and the larger ones represent the cut ends of the dendritic forms.

The coloured elements are absent from these sections and stained preparations, for they are most susceptible to the action of even mild solvents like rectified spirit. In the fresh specimens, the scale-like coloured chromatophores lie partly in the dermis and partly below, only a few occurring in the epidermis. Even in regard to them, their connective tissue origin can only be inferentially gathered.

The iridocytes are $\frac{1}{10}$ mm. *in situ*, while the coloured chromatophores are $\frac{3}{10}$ mm. and the granules of the former are less than $10\,\mu$. The spinal groove in which the metallic band lies is quite open in young specimens; the epidermal tissue growing over as metamorphosis advances. If the iridocytes from these young specimens are examined, under a high power of the microscope, their cellular origin can be made out. It is probable that when they leave their place of origin, they become lightly held together by some organic matrix, too feeble, however, to bind them together when mounted

The argenteum is so opaque and dense that the nature of the relation of the reflecting particles and histological elements of the subcutaneous tissue cannot be made out.

Time of Appearance of Colour Elements.

Such of the batrachian anuran larvae as are known to me are either dark or brown at the time of hatching, and the formation of coloured chromatophores is not complete till after the larvae come under the influence of sunlight. The time of appearance of colour varies in different families, mainly depending upon the environmental circumstances under which development progresses.

In *Microhyla ornata* the large cephalic region remains transparent throughout the metamorphosis, and the diamond-shaped mark appears as soon as the larvae adopt habits of floating on the surface of the water, when they measure about 10 to 12 mm. The other characters, such as the metallic band and the reflecting surfaces, gradually emerge into view as the tadpole increases in size (16 to 18 mm.). It may be mentioned that at this stage the peritoneum bears more numerous iridocytes than at later stages, so much so that they form a continuous metallic surface over a dark background formed by the melanin chromatophores. Perhaps the most important feature in the development of the argenteum at this stage is the fact that when a piece of fresh subcutaneous tissue is examined under the microscope, before it has become too opaque for such treatment, two kinds of metal elements can be noticed. The larger crystals are fairly regular in their outline, unlike those of the mid-dorsal band, and the smaller ones are irregular. As no broken pieces of these larger plates have yet been examined, the view that they contribute towards the formation of the argenteum is only tentatively put forward. When the tadpoles develop the front limbs, the dorsal golden streak and the argenteum are absorbed and the normal colouration of the adult begins to appear.

The Chemistry of Iridocytes and Argenteum.

In the sixties, Barreswil[1] and Voit[2] demonstrated the presence of guanin in the reflecting tissues and the air-bladder of fishes, and about 1845 this substance was isolated by Bodo Unger from guano. Some time later, Ewald and Krükenberg[3] found the occurrence of this substance in reptiles and amphibians as well, and their investigations go to show that the dead chalky white found on the ventral surface of the adult members of the Ranid family is really caused by a lime compound of guanin, which

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[1] *Comptes Rendus*, LIII, p. 246; 1861 (*Phil. Trans. Roy. Soc. London*, CLXXXIV B, p. 781; 1893).

[2] *Zeitsch. f. wiss. Zool.*, XV (*Phil. Trans.*, p. 782).

[3] *Zeitschr. f. Biologie*, XIX, p. 1; 1883 (*Phil. Trans.*, p. 785).

they called "Guaninkalk." About 1893 Cunningham and MacMunn,[1] as a result of extensive observations on fishes, established the fact that the iridescent effect produced in the skin of all fishes is due to the presence of iridocytes, and the silver brilliancy is caused by the reflecting tissue,—the argenteum. Guanin is the chemical substance present in both these structures.

It may be mentioned that guanin in the tissues of the body is the end product of the metabolic activity of the organism, and the utilisation of this waste matter for certain physiological ends is a feature of wide-spread occurrence in animals. As has been said in the foregoing paragraphs, the presence of guaninkalk and its chemical nature have already been worked out in the skin of adult batrachians, but so far the occurrence of the iridocytes and argenteum has not been determined either in the adult or the larvae. On chemical analysis of these substances it is established that they are guanin compounds identical with those worked out in the fishes, and the course of the chemical enquiry adopted for such a determination may now be proceeded with. I must mention here that in all stages of the work I have received considerable help from my colleague Mr. A. Subba Rao.

The tissues were thoroughly washed in distilled water till all albuminous matter was removed and then solutions of iridocytes and argenteum were obtained in nitric and hydrochloric acids.

I. A quantity of nitric acid solution was evaporated in a watch glass over a hot air bath. The residue formed is a yellow substance (guanin nitrate) which turned red on the addition of caustic potash. This is Barreswil's reaction.

II. A quantity of hydrochloric acid solution was evaporated similarly and the residue was treated with strong nitric acid. A yellow compound is obtained by reheating the solution to dryness which on the addition of caustic soda turned red, and purple on heating. This is Cunningham and MacMunn's test.

III. If to the yellow compound (nitrate of guanin), obtained in the first two cases, ammonia is added and heated the same colour changes are noticed. This test is given in Watt's chemical dictionary (p. 656).

It may be mentioned here that there is essentially no difference between Barreswil, Cunningham and MacMunn and Watt's reactions. In all the three cases the neutralising agent, a base, is added to the nitrate of guanin which on heating becomes purple.

IV. If silver nitrate is added to the nitrate of guanin a reddish-brown precipitate results, which on heating turns purple.

V. Potassium chromate gives an orange red precipitate on the addition of the nitrate of guanin (Watt).

VI. Potassium ferricyanide yields a brown precipitate with the same substance (Watt).

VII. Concentrated picric acid gives a bright red solution when treated with nitrate of guanin (Watt).

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[1] *Phil. Trans. Roy. Soc. London*, CLXXXIV B, p. 765 (1893).

VIII. Hydrochloric acid solution of guanin on heating turns red and the guanin hydrochloride—the ash obtained after boiling —is slightly reddish, which treated as in experiments V, VI and VII gives similar reactions.

IX. Potassium permanganate solution treated with nitrate of guanin, with a touch of caustic soda. The green solution (green being due to the formation of K_2Mno_4) on heating gives an albuminous flocculent red precipitate (oxyguanin) which is insoluble in water, rectified spirit and weak acids (Watt).

X. The same reactions are obtained with the hydrochloric acid solution of guanin.

If any of these precipitates obtained with silver nitrate in the above experiments should be treated with oxyguanin obtained in experiment X, the silver chloride is precipitated in the form of a white stuff.

The iridocytes are insoluble in water, ether, chloroform, glycerine[1] and acetic acid, but soluble both in acids (Nitric, Hydrochloric and Sulphuric) and bases like caustic potash, soda and ammonia. Formalin and alcohol are also solvents.

With the alkaline (NaOH) solution of iridocytes and argenteum the following additional reactions and properties were obtained.

XI. The solution was treated with strong picric acid and boiled for a few minutes. The whole turned into orange red on being allowed to stand for 18 hours.

XII. With potassium permanganate solution the usual green reaction results. On boiling, the red flocculent precipitate is obtained even without the addition of any acid.

XIII. To the alkaline solution of iridocytes, potassium ferricyanide ($K_3fe(CN)_6$) was added and boiled for about 15 minutes. Silver nitrate being added gives a white precipitate. Reboiled the precipitate is transformed into bright red.

XIV. NaOH solution of iridocytes ($C_5H_5N_5O$) on boiling slowly turns reddish and the addition of another base like NH_3 and reboiling turns the red into purple.

XV. A white ash is deposited on the sides of the test tube when the above solution (KOH or NaOH $C_5H_5N_5O$) is boiled to dryness. The calcified substance is refractory to concentrated acids and aqua regia; it dissolves, however, on heating, setting up a vigorous chemical action.

The next point which is worthy of notice is the fact that calcium in any form is absent from the argenteum of the larvae of *M. ornata* and *M. rubra* which has therefore nothing to do with the guaninkalk of Ewald and Krükenberg. Solutions of the subcutaneous tissue from the abdominal surface of the Ranid larvae react to the calcium tests and the dead white of the skin is due to guaninkalk in these cases. Guanin is silvery white, and the golden

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[1] Iridocytes mounted in glycerine broke up and crystals were found at the end of a fortnight.

brightness of the mid-dorsal streak is caused by a layer of yellow lipochrome superimposed over the crystals. On the removal of the colouring matter by alcohol or glycerine, the band is transformed into a silver brilliancy. The following crystals were obtained and examined:

1. Strong solution of iridocytes and argenteum of the tadpole in hydrochloric acid, on being boiled, is precipitated in the form of delicate pointed needles, which on standing unite to form irregular plates. These are not hygroscopic (fig. 3).

2. Nitric acid solution gives broad plate-like crystals, somewhat prismatic, truncated at both ends. They arrange themselves in pectinate groups while hot, and break into spherical granules on cooling (fig. 4).

3. Sulphuric acid solution, which chars on boiling, produce blunt delicate needles that are bent in parallel rows. They straighten on cooling (fig. 2).

4. In caustic soda iridocytes crystallise in the form of pyramidal needles, often aggregated in wisps. The crystals are hygroscopic (fig. 1).

5. Hydrochloric solution of argenteum treated with $MGCL_2$ and precipitated gives three forms of crystals:—(1) Long silky fibres; long spindle-shaped pointed or blunt needles (aggregations of the first); (2) small delicate needles arranged in the form of brushes, and (3) smaller needles either isolated or forming rounded plates. The crystals are not hygroscopic (fig. 5).

6. If $ZNCL_2$ should be substituted for $MGCL_2$ in the above, the crystalline forms are rounded with jagged edges. They decompose into very delicate yellow needles (fig. 6).

7. Hydrochloric acid solution of iridocytes treated with strong picric acid will yield tall cylindrical coloured crystals truncated at both ends. They are hygroscopic (fig. 7).

8. If nitric acid solution is used instead of hydrochloric acid in the above, radiating coloured plates more or less oblong are obtained. They are also hygroscopic (fig. 8).

9. The silver derivative of oxyguanin also crystallises in the form of short delicate needles. They arrange themselves like wheels with a number of spoke-like structures radiating from the centre and very minute concentric circles. Between any two of such aggregations the silver oxide, which is also formed, is deposited. The crystals are hygroscopic and unstable (fig. 9).

There is only one primary form of crystals of iridocytes and argenteum obtained from all these sources which, under the influence of different substances, assumes widely divergent shapes.

The lipochromes are easily soluble in alcohol and solutions of yellow and red pigments were employed for wave length measurements of the absorption band with negative results. It is possible that the red in the tail of the forms mentioned above and other larvae is only a concentrated form of the yellow pigment. As a solution of any degree of concentration could not be obtained of the blue of *K. variegata* nothing can be said about the absorption band of this pigment.

SYNTHESIS OF IRIDOCYTES AND ARGENTEUM.

The iridocytes are most unstable and are easily affected and a few observations made in the aquarium may be here set forth.

1. If light should be absolutely cut off from the specimens, the iridocytes are absorbed in about 4 or 5 days but not the argenteum.

2. Starvation produces the same effect, and the time (4 or 5 days) depends on the condition of the larva previous to the commencement of the experiment.

3. Exposure to sunlight and liberal feeding produce two effects. The larvae become absolutely transparent, head and body included, and the metallic dorsal band extends over the cranium, at the same time becoming most brilliant.

4. If specimens used in experiments (1) and (2) are restored to normal conditions, the water (preferably tank water being used) in the aquarium being renewed every day, nearly 70 per cent of them acquire the dorsal band, appearing first in the anterior region of the vertebral column.

SUMMARY.

The leading facts discussed in this paper may be now summarised.

The first set of facts relate to the floating habits of the larvae of *M. ornata* and *M. rubra* co-related with the presence of air-chambers between the branchial plates, which function more or less as hydrostatic organs. The danger of exposure to the attacks of enemies incidental to such habits is warded off by the presence of an acid offensive matter in the cephalic gland. This circumstance is probably advertised by the bright colouration.

The second set of facts deal with the unique occurrence of iridocytes and argenteum in the same larvae. Both from the morphological and evolutionary points of view the presence of iridocytes and black chromatophores on the lungs and peritoneum is full of significance, for their occurrence in the air-bladder of fishes and the peritoneum of embryonic fishes has been reported. It is established that the iridocytes of the mid-dorsal band, and the ventral argenteum of the subcutaneous tissue on the sides and the ventral surface of the abdomen of these tadpoles, are entirely free from calcium in any form, and, while both are in some respects identical with those of fishes, are entirely different from the *Guaninkalk* of Ewald and Krükenberg. The substance composing the iridocytes occurs in the form of irregular plates consisting of spherical granules, identical with those obtained by the breaking down of the guanin nitrate crystals, while the argenteum is a dense opaque reflecting subcutaneous tissue in which no structure can be made out. The dead chalky white on the ventral surface of the larvae of the genus *Rana* is due to guaninkalk.

The yellow and red lipochromes occurring in the tadpoles are not essentially different, though alcoholic solutions of them may appear quite separate.

Like the black chromatophores, the coloured ones are modifications of special connective tissue cells in which the pigments are deposited. Cells which have undergone such a change appear scaly and if the scale should break, as sometimes happens in the course of preparing tissues for mounting, the pigment occurs in the form of granules. Such a process must naturally take place in the subcutaneous tissues. Similarly the cells which develop guanin granules in the protoplasmic contents become transformed into iridocytes. They are easily marked off from the other tissue cells by their shape,—more or less flask-like, and the fact that they are not stained. As metamorphosis progresses, large amoebacytes make their appearance wherever iridocytes and argenteum occur (fig. 13).

EXPLANATION OF PLATE XI.

FIG. 1.—Hygroscopic crystals of iridocytes obtained from NaOH solution.

FIGS. 2, 3, 4.—Crystals obtained from Sulphuric, Hydrochloric and Nitric acids respectively.

(FIG. 4 Hygroscopic).

FIG. 5.—Crystals obtained after treatment of HCl. sol. of iridocytes with $HgCl_2$.

,, 6.—Crystals obtained after treating HCl. sol. of iridocytes with $ZnCl_2$.

FIGS. 7, 8.—HCl and HNO_3 sol. of iridocytes treated with Picric acid.

FIG. 9.—Silver derivation of oxyguanin.

(FIGS. 6-9 Hygroscopic).

FIG. 10.—Lateral view of the tadpole (*Microhyla ornata*).

,, 11.—Dorsal view.

,, 12.—Metallic band *in situ*.

,, 13.—Colour and histological elements from dermis.

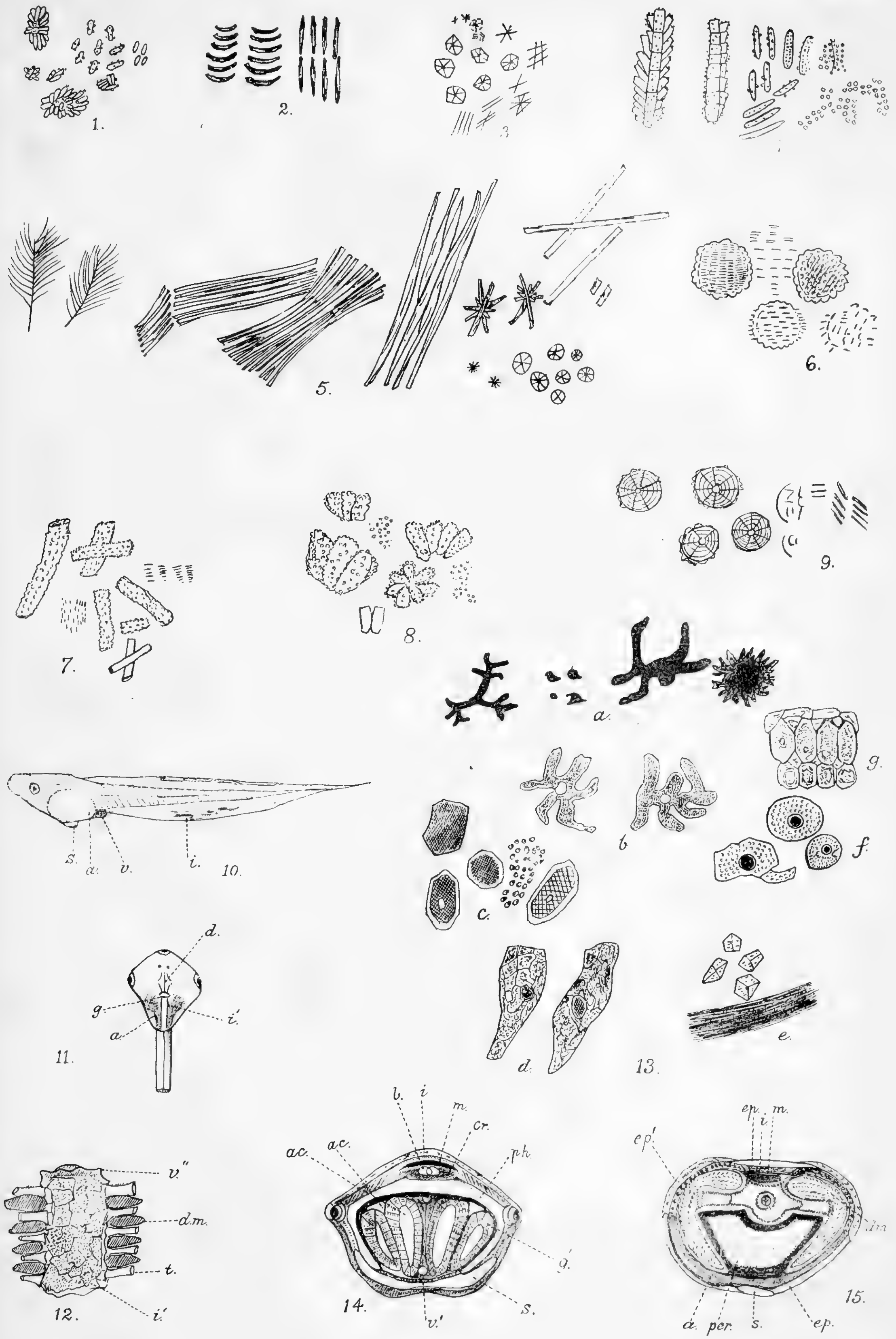
a, b. black chromatophores and connective tissue corpuscles; c. coloured chromatophores, scales, granules and connective tissue corpuscles; d. argenteoblarts; e. argenteum and plate-like iridocytes; f. phagocytes; g. elements of the dermis.

FIG. 14.—Transverse section across the eye.

,, 15.—Transverse section at about the fourth vertebra.

LETTERING IN FIGS. 10—12 & 14, 15.

a. argenteum; *ac.* air cavities; *b.* brain; *cr.* cranium; *d.* diamond-shaped mark; *d.m.* dorsal muscle; *ep.* epidermis free from chromatophores; *ep'.* with chromatophores; *g.* glandular area; *g'.* gills; *i.* iridocytes; *m.* black chromatophores. *per.* peritoneum; *ph.* pharynx; *s.* spuach; *t.* transverse process; *v.* vent; *v'.* ventral vessel; *v''.* vertebra.



C. R. Narayan Rao, del.

A. Chowdhary, lith.

XVII. NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

XI. Atyidae of the genus *Paratya* (=*Xiphocaridina*).

By Stanley Kemp, *B.A.*, *Superintendent, Zoological Survey of India.*

Bouvier has shown that the West Indian *Xiphocaris elongata* (Guérin) differs in several important structural characters from the species, previously referred to the same genus, found in Eastern Asia, Australia and New Zealand and has proposed for the latter the generic name *Xiphocaridina*. But Miers in 1882, when recording certain Japanese Atyids as *Atyephyra? compressa*, noted that the species was probably to be distinguished generically from Brito-Capello's *Atyaëphyra* by the presence of exopods on all five thoracic legs [1]; and he suggested for the Japanese form the generic name *Paratya*. There can be no doubt that Miers' specimens are generically identical with those on which Bouvier based his *Xiphocaridina* with the result that the latter name, by far the more appropriate of the two, must lapse.

Genus **Paratya**, Miers.

1868. *Atyephyra*, von Martens, *Arch. f. Naturgesch.*, XXXIV, p. 51 (in part: not *Atyaëphyra*, Brito-Capello).
1880. *Miersia*, Kingsley, *Proc. Acad. Sci. Philadelphia*, 1879, p. 416 (in part).[2]
1882. *Paratya*, Miers, *Ann. Mag. Nat. Hist.* (5) IX, p. 194.
1895. *Xiphocaris*, Ortmann, *Proc. Acad. Sci. Philadelphia*, 1894, p. 400 (in part).
1905. *Xiphocaris*, Bouvier, *Ann. Sci. France Belgique*, XXXIX, p. 60 (in part).
1909. *Xiphocaridina*, Bouvier, *Comptes Rendus Acad. Sci., Paris*, p. 1729.
1912. *Xiphocaridina*, Kemp, *Rec. Ind. Mus.*, VII, p. 113.

Only two species which can be referred to the genus *Paratya* have hitherto been recognised, *viz. Paratya compressa* (de Haan), described from Japan and since recorded from Korea, Flores, Australia and Norfolk I. and *P. curvirostris* (Heller) from New Zealand, Chatham I. and Upper Assam.

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[1] Miers was evidently unaware that von Martens in 1872 (*Arch. f. Naturgesch.*, XXXVIII, i, p. 139) had founded the genus *Xiphocaris* on this very character. *Xiphocaris*, however, was based on specimens from the West Indies and, as Bouvier has shown, is distinguished from the Pacific genus by the greater number of branchiae and other important characters.

[2] The type of this genus is Risso's *Ephyra pelagica*, probably a Hoplophorid.

In the collection recently made by Dr. Annandale in the Far East there are series of *P. compressa* from several localities in Japan. On examination, the specimens were found to fall into two well-marked races, one inhabiting the north-eastern portions of the main island, while the other is apparently restricted to the south-western parts, the upper limit of its distribution being Lake Biwa and its vicinity. This rather unexpected discovery led me to make an examination of all the *Paratya* preserved in the Indian Museum, and I find as a result that there has been a great deal of misapprehension regarding the taxonomy and distribution of the species. The Indian Museum is fortunately well supplied with material: including Dr. Annandale's collection, specimens are available from seven localities in Japan, from Sydney in New South Wales, from Lake Torrens in S. Australia (as well as a sample from "S. Australian waters"), from both east and west sides of Norfolk I., from two localities in New Zealand and from two in Upper Assam.

Examination of this extensive material leads me to conclude (i) that the true *Paratya compressa* is restricted to Japan, possibly extending into Korea; in the main island of the former country it is represented by two well-marked races; (ii) that the Australian form is to be distingusihed specifically from the Japanese and is represented in Norfolk I. by a race which differs from it in characters of at least subspecific value; and (iii) that the form recorded from New Zealand and Upper Assam is distinct from any of the others.

The five forms examined may be distinguished by the following characteristics:—

Key to the species and subspecies of *Paratya*.

I. Propodus of 3rd and 5th peraeopods, in both sexes, less than three times as long as dactylus,[1] dactylus of 3rd pair with 19 to 30 spines,[2] the number very rarely falling to 18 [propodus of 3rd and 4th pairs expanded distally in male, the dilated portion bearing numerous spines].

A. Rostrum with 16 to 25 dorsal teeth; hindmost tooth situated on carapace or immediately above orbital notch ... ... *P. compressa* (de Haan).

B. Rostrum with 7 to 18 dorsal teeth; proximal part of rostrum unarmed, no tooth on carapace or above orbital notch ... ... *P. compressa*, subsp. *improvisa*, nov.

II. Propodus of 3rd and 5th peraeopods, in females,[3] more than three times as long as dactylus; dactylus of 3rd pair usually with 6 to 13 spines, the number occasionally rising, in males only, to 18.

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[1] The extreme length of the dactylus, terminal spine included.

[2] Including the terminal spine.

[3] The character is also valid for males of *P. australiensis* and its subspecies; in males of *P. curvirostris* the proportion occasionally falls as low as 2·5.

A. Upper border of rostrum with 10 to 17 irregularly disposed teeth, forming at least three distinct groups; propodus of 3rd and 4th legs expanded distally in males, the dilated portion bearing numerous spines ... ... *P. curvirostris* (Heller).

B. Upper border of rostrum with 19 to 32 teeth, forming an uninterrupted series; 3rd and 4th legs of male not modified.

1. Carpus of 1st peraeopods twice or more than twice as long as broad; propodus of 5th peraeopods less than four times as long as dactylus; dactyli of 3rd and 5th peraeopods at least three times as long as broad,[1] dactylus of 3rd peraeopod with 9 to 13 spines ... *P. australiensis*, sp. nov.

2. Carpus of 1st peraeopods less than twice as long as broad; propodus of 5th peraeopods, at least in females, more than four times as long as dactylus; dactyli of 3rd and 5th peraeopods less than three times as long as broad; dactylus of 3rd peraeopod with 6 to 8, rarely 9 spines ... ... *P. australiensis*, subsp. *norfolkensis*, nov.

It is probable that the size of the eggs will afford a valuable criterion in specific and subspecific differentiation; but unfortunately the collection contains ovigerous females only of *P. curvirostris* and of *P. compressa* subsp. *improvisa.*

It will be noticed that in three of the five recognised forms the third and fourth peraeopods of the male are modified, the propodus being conspicuously dilated towards its distal end and armed on the posterior margin of the expanded part with a great number of short spines. Very similar sexual differences are met with in *Atyaëphyra*, a genus that has a circum-Mediterranean distribution and is also one of the more primitive genera of the family. In males of *Atyaëphyra desmaresti*, as Barrois has shown,[2] the third and fourth legs are modified on precisely the same lines as in *Paratya*; but, strangely enough, the segment concerned is not the propodus, but the merus.

That sexual modifications of the third and fourth legs should be entirely absent in the forms of *Paratya* from Australia and Norfolk I. is very curious. Males are unfortunately scarce in my material from these localities and examination of further specimens is therefore desirable. In no case, however, have I found the slightest trace of modification, though the character is well marked in much smaller specimens from Japan.

Calman[3] has noticed sexual differences in the length of the spines on the third and fourth legs in *Limnocaridina similis* and *L. socius* from Lake Tanganyika, while in other species of the same

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[1] Excluding all spines, both terminal and lateral.

[2] Barrois, *Rev. Biol. Nord. France*, V, p. 124, fig. 2 (1892).

[3] Calman, *Proc. Zool. Soc. London*, 1906, p. 195.

genus no such distinction was to be found. It seems probable, therefore, that in this genus, as in *Paratya*, the existence of sexual modifications in the thoracic legs is a specific character. In *Xiphocaris*, the most primitive of all the Atyidae, these sexual differences do not exist.[1]

Bouvier,[2] in his account of the races of *Atyaephyra desmaresti*, found that distinctive characters were afforded by the structure of the endopodite of the first pleopod of the male. In the genus *Paratya* the appendage is similar in outline in all the forms and the differences that exist in the spinulation appear to be of less importance than those derived from other parts.

All the species and subspecies examined agree in the possession of a supraorbital spine. The carpus of the first peraeopod is deeply excavate in front, that of the second pair less markedly so. Exopods are found on all the thoracic legs, but there are no arthrobranchs above the bases of any of these limbs. The outer uropod agrees with that of *Xiphocaris* in bearing only a single movable spinule in place of the series found in most genera of the family. The telson bears two, less commonly three pairs of dorsal spines and is provided at the apex with eight or ten spinules

A synopsis of the numbers of rostral teeth in the different forms is given on p. 297.

In the descriptions which follow I have referred only to the characters that show racial or specific differences.

Paratya compressa (de Haan) *sensu stricto*.

1849. ? *Ephyra compressa*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 186, pl. xlvi, fig. 7.
1880. *Miersia compressa*, Kingsley, *Proc. Acad. Sci. Philadelphia*, 1879, p. 416.
1902. *Xiphocaris compressa*, Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 49 (? part only).
1905. *Xiphocaris compressa*, Bouvier, *Bull. Sci. France Belgique*, XXXIX, p. 62 (part only; not fig. 1, p. 61).
1914. *Xiphocaridina compressa*, Balss., *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abt. 10, p. 23 (part only).

In this form the rostrum always reaches beyond the antennular peduncle, extending almost to, or a little beyond the apex of the antennal scale. On its upper border it is armed with 16 to 25 (usually 17 to 24) teeth, forming an uninterrupted series from the base to the apex. The hindmost dorsal tooth is either situated on the carapace or is placed immediately above the posterior limit of the orbit; in a few cases two posterior teeth are on the carapace. The lower border bears in the middle of its length from 1 to 6 teeth, most commonly 1 to 3.

The lateral process of the antennular peduncle extends a little beyond the end of the basal segment.

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[1] This statement is based on an examination of a few specimens from Havana in Cuba, preserved in the Indian Museum

[2] Bouvier, *Bull. Mus. d'Hist. nat. Paris*, 1913, p. 65.

DORSAL TEETH.

Number of teeth.	Number of specimens.				
	P. compressa.		*P. curvirostris.*	*P. australiensis.*	
	typical form.	subsp. *improvisa.*		typical form.	subsp. *norfolkensis.*
7	...	1			
8	...	5			
9	...	4			
10	...	5	2		
11	...	11	5		
12	..	1	8		
13	...	10	9		
14	...	3	2		
15	...	3	1		
16	2	2	3		
17	5	...	1		
18	6	1			
19	14	...	...	1	
20	7	...	..	..	
21	19	...	...	...	1
22	8	...	...	3	1
23	2	...	...	1	...
24	2	...	...	2	1
25	1	...	...	. 2	2
26	...	..	.	1	1
27	...	...	...	2	1
28	...	...	...	1	1
29	...	...	...	4	.
30	...	...	...	3	. .
31	..	...	...	2	...
32	...	...	...	1	2

VENTRAL TEETH.

Number of teeth.	Number of specimens.				
	P. compressa.		*P. curvirostris.*	*P. australiensis.*	
	typical form.	subsp. *improvisa.*		typical form.	subsp. *norfolkensis.*
1	13	3	...	1	
2	21	25	...	2	
3	22	14	5	1	1
4	4	4	17	3	2
5	3	...	7	3	3
6	3	...	1	3	2
7	...	...	...	1	1
8	...	...	1	3	1
9	...	...	...	1	
10	...	...	...	1	
11	...	...	...	1	
12	...	..	...	1	
13	...	...	...	...	
14	...	...	...	1	

In the first peraeopods (text fig. 1*a*) the carpus is comparatively slender, from 2·2 to 2·5 times as long as its greatest breadth; rarely in young specimens the proportion falls as low as 1·8. The chela is about a third longer than the carpus and its length is usually about one-third the width of the palm. The carpus of the second pair (text fig. 1*b*) is from 6·0 to 7·1 times as long as broad. The dactylus of the third peraeopods (text-figs. 1*c*, *d*) is long and slender; the propodus is only from 2·1 to 2·5 times its length. Excluding the spines its length is from 3·7 to 4·5 times its breadth. The dactylar spines vary in number from 19 to 22, very rarely 18. In the fifth peraeopods (text figs. 1*e*, *f*) the propodus is also from 2·1 to 2·5 times as long as the dactylus; the latter segment bears from 43 to 69 spinules, excluding which it is from 4·2 to 4·8 times as long as broad.

In the male the propodus of the third and fourth peraeopods is a little dilated towards the distal end and the terminal third of

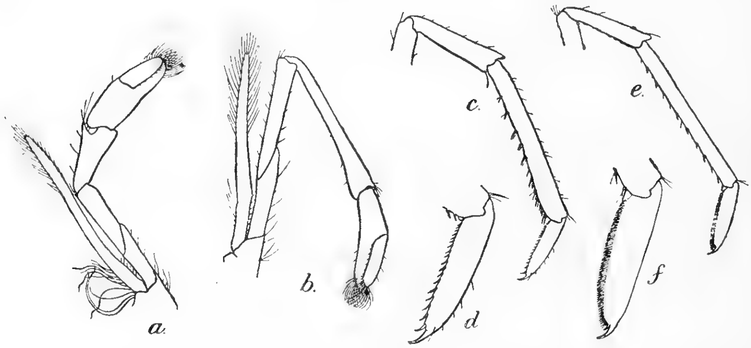

FIG. 1.—*Paratya compressa* (de Haan).

a. First peraeopod.
b. Second peraeopod.
c. Third peraeopod of male.
d. Dactylus of third peraeopod.
e. Fifth peraeopod.
f. Dactylus of fifth peraeopod.

the posterior margin is armed with numerous close-set spines (text-fig. 1*c*). In the specimens I have seen these sexual modifications are much less conspicuous than in the larger individuals belonging to the subsp. *improvisa*.

None of the specimens examined bear eggs; the largest is 23 mm. in total length.

De Haan's figure of this species is unusually poor, but except for the fact that the carpus of the second legs is stated to be indistinctly annulate, the description agrees very well with the specimens I have examined. According to de Haan there are 20 to 24 teeth on the upper border of the rostrum.

The typical form of *P. compressa* is represented in the Indian Museum by a great number of specimens collected by Dr. Annandale in Komatsu Lake near the eastern shore of Lake Biwa and from the Ogura and Yodo ponds near Kyoto: there are also a few examples from L. Biwa itself. All specimens from localities situated further to the north-east belong to the subspecies *improvisa* and it appears, therefore, that the northern distributional limit of the typical form is somewhere in the vicinity of Lake Biwa. The specimens recorded by Miss Rathbun from the latter locality undoubtedly belong to the typical form and this is perhaps also the case with the solitary individuals which she examined from Tsushima I. and from Fusan in Korea. If my views on the distribution are correct, Balss' examples from Koitogawa in Kadzuza prov. are to be referred to the subsp. *improvisa*, while those recorded from Okayama belong to the typical race. Balss notes that in the latter individuals the eggs are 0·63 mm. in length and 0·40 mm. in breadth.

Dr. Annandale noted that the species was abundant among weeds or dense vegetation at Komatsu and in pools and backwaters round Lake Biwa; in the lake itself it was much scarcer. Living specimens showed no definite markings, but were dotted more or less profusely with small pigment cells. The fingers of the chelae were tinged with orange brown. The Temnocephaloid worm *Caridinicola* was present in the gill-chambers of a large proportion of the individuals examined at Komatsu.

subsp. **improvisa**, nov.

1868. *Atyephyra compressa*, von Martens, *Arch. f. Naturgesch.*, XXXIV, i, p. 51, pl. i, figs. 4 *a-c*.
1882. *Atyephyra ? compressa*, Miers, *Ann. Mag. Nat. Hist.* (5), IX, p. 193.
? 1890. *Miersia compressa*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 464.
? 1902. *Xiphocaris compressa*, Doflein, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, XXI, p. 632.

This subspecies is distinguished from the typical form almost entirely by the dentition of the rostrum. The rostrum reaches to,

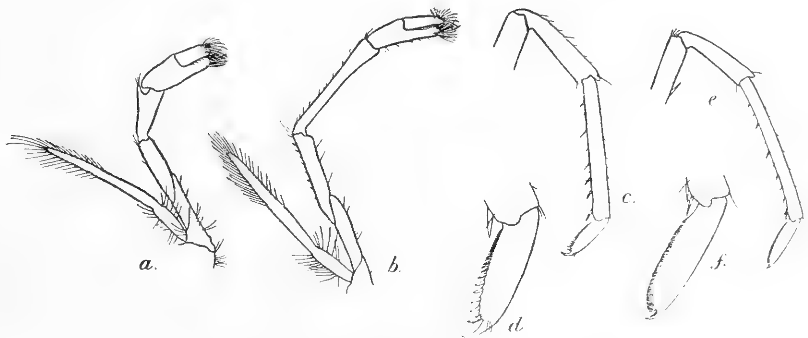

FIG. 2.—*Paratya compressa* subsp. *improvisa* nov.

a. First peraeopod.
b. Second peraeopod.
c. Third peraeopod of female.
d. Dactylus of third peraeopod of female.
e. Fifth peraeopod.
f. Dactylus of fifth peraeopod.

or a little beyond the antennal scale and bears on its upper margin an uninterrupted series of 7 to 18 (usually 8 to 15) teeth. The proximal part of the rostrum is altogether unarmed; the hindmost tooth of the series is placed above the cornea, when the eye is directed straight forwards, or is in advance of this point. On the lower border there are from 1 to 4 teeth, usually 2 or 3.

The proportionate measurements of the legs are much the same as in the typical form. In the first pair (text-fig. 2*a*) the carpus is from 2·1 to 2·7 times as long as broad and in the second (text-fig. 2*b*) from 5·6 to 6·3 times. The propodus of the third pair (text-figs. 2*c*, *d*) is from 2·4 to 2·7 times the length of the dactylus, the length of the latter segment, spines excluded, being from 3·3 to 4·0 times its breadth. In the fifth pair (text-figs. 2*e*, *f*) the propodus is from 2·4 to (in one instance only) 2·9 times as long as the dactylus, the latter segment, spines excluded, being from 4·0 to 4·7 times as long as broad. The dactylar spines seem to be rather more numerous than in the typical form; in the third pair there are from 24 to 30 and in the fifth from 71 to 92.

In large males the third and fourth peraeopods show an extreme degree of sexual modification (text-fig. 3). The propodus is very strongly expanded distally, so much so that the segment is less than 5 times as long as broad, whereas it is nearly 9 times as long as broad in females. The anterior margin is concave, while the posterior is convex and is furnished with numerous spinules in the distal two thirds of its length. The dactylus is also modified; it is more than 5 times as long as wide and is widest near the distal end; the spines are distinctly recurved and the terminal one is not larger than the others.

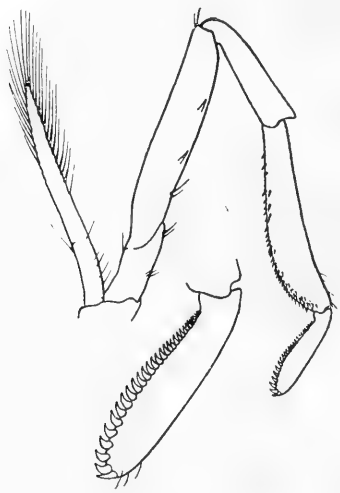

FIG. 3.—*Paratya compressa* subsp. *improvisa*, nov.
Third peraeopod of adult male with dactylus further enlarged.

The subspecies appears to be rather larger than the typical form, reaching a maximum length of 36 mm. The eggs vary from 0·63 to 0·70 mm. in length and from 0·43 to 0·46 mm. in breadth.

In this case I believe that the character of the rostrum affords a valid basis for racial distinction; among fifty specimens of the subspecies I have not been able to find a single individual that resembles the typical form. The specimens examined are from the lagoon Kasumi-ga-ura in Hikachi province, collected by Dr. N. Annandale; from Tokio, collected by Hilgendorf (Berlin Mus.); from Lake Haruna, near Ikao, at an altitude of about 3000 ft., collected by Dr. K. Nakazawa and from Lake Suwa, in the Shinano province, at an altitude of 2660 ft., collected by Dr. T. Kawamura.

The specimens from Yokohama described by von Martens belong, as is clearly shown by the figure, to the subspecies *improvisa* and this is also true of those from Tokio examined by Miers, the rostrum bearing only from 7 to 14 dorsal teeth.

From these facts it may be concluded that the subspecies is found only in the north-eastern parts of the main island of Japan and, if this is true, the specimens recorded by Ortmann from Tokio, by Doflein from Yokohama and by Balss from Koitogawa in Kadzuza province are probably to be referred to the subspecies. This is no doubt also the case with the material used by Ishikawa in his account of the development of the species.[1]

The types are from Lake Haruna and bear the number 9679/10 in the register of the Zoological Survey of India.

Paratya curvirostris (Heller).

1862. *Caridina curvirostris*, Heller, *Verhandl. zool.-bot. Ges. Wien*, XII, p. 525.
1865. *Caridina curvirostris*, Heller, *Voy. 'Novara,' Crust.*, p. 105.
1876. *Caridina curvirostris*, Miers, *Cat. N. Zealand Crust.*, p. 78.
1879. *Leander fluviatilis*, Thomson, *Trans. N.Z. Inst.* XI, 1878, p. 231, pl. x, fig. A 2.
1903. *Xiphocaris curvirostris*, Thomson, *Trans. Linn. Soc., Zool.* (2), VIII, p. 447, pl. xxix, figs. 2-13.
1906. *Xiphocaris curvirostris*, Chilton, *Proc. Zool. Soc. London*, p. 703.
1909. *Xiphocaridina fluviatilis*, Bouvier, *Comptes rendus Acad. Sci. Paris*, p. 1728.
1912. *Xiphocaridina curvirostris*, Kemp, *Rec. Ind. Mus.*, VII, p. 113.

In this species[2] the rostrum reaches to or a little beyond the apex of the antennal scale and is armed above with from 10 to 17 teeth. These teeth do not form an uninterrupted series, as in all other species of *Paratya*, but are separated, usually quite distinctly, into three groups. The hindmost group consists of 2 or 3 teeth, all of which are on the carapace behind the orbital notch; the second group is composed of 4 to 8 teeth, situated in the basal half of the rostral length; the third group is placed just behind the apex and comprises 3 to 7 teeth. In most cases 1 or 2 solitary teeth are to be found between the second and third groups. On the lower margin there are from 3 to 8 teeth, usually 4 to 6. The teeth are larger than is customary and are rather widely separated, extending on to the distal third of the rostral length.

The lateral process of the antennular peduncle reaches to the middle of the second segment.

The carpus of the first peraeopods (text-fig. 4*a*) is from 1·7 to 2·4 times as long as broad; it is decidedly more slender in males than in females. That of the second peraeopods (text-fig. 4*b*) is from 5·0 to 6·7 times as long as broad. The propodus of the third peraeopods (text-figs. 4*c*, *f*) is from 2·5 to 3·9 times the length of

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[1] Ishikawa, *Quart. Journ. Microsc. Sci.*, XXV, p. 391 (1885).

[2] The information here given is mostly abstracted from my paper of 1912, supplemented by a number of fresh observations.

the dactylus, the former segment being proportionately shorter in males. Excluding the spines the dactylus is 3·4 or 3·5 times as long as broad in females, rather narrower in males. In females the spines (the terminal one included) are from 9 to 11 in number, very rarely 8; in males they are more numerous, from 13 to 17, rarely 18. In the fifth peraeopods (text-figs. 4*g*, *h*) the propodus is from 3·1 to 3·7 times the length of the dactylus. The latter segment bears from 46 to 71 spinules, excluding which it is from 3·2 to 3·7 times as long as broad.

In males the propodus of the third and fourth peraeopods is modified much as in *P. compressa* (text-figs. 4*e*, *f*). The dactylus is slightly abnormal in form, but is without recurved spines and the propodus does not seem to attain as extreme a development as in large males of *P. compressa* subsp. *improvisa*. In very old females additional spinules are sometimes found on the propodi of

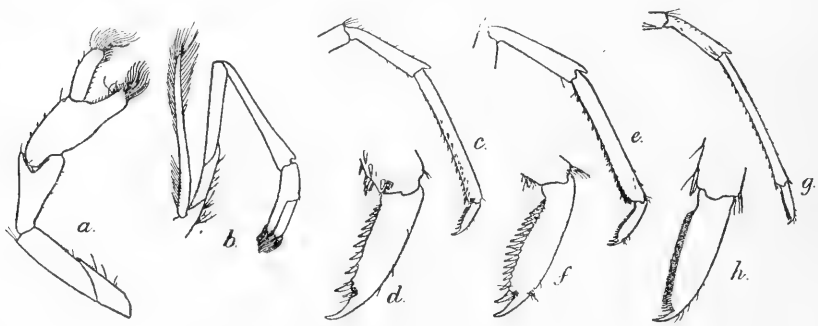

Fig. 4.—*Paratya curvirostris* (Heller).

a. First peraeopod.
b. Second peraeopod.
c. Third peraeopod of old female.
d. Dactylus further enlarged.
e. Third peraeopod of adult male.
f. Dactylus further enlarged.
g. Fifth peraeopod.
h. Dactylus further enlarged.

the third and fourth peraeopods (text-fig. 4*c*), thus resembling adult males.

The eggs are from 0·40 to 0·45 mm. in length and from 0·25 to 0·26 mm. in breadth. Large specimens reach a total length of 42 mm.

P. curvirostris is known from both north and south islands of New Zealand and from Upper Assam. It has been recorded by Chilton from the Chatham Is. In the Indian Museum it is represented by a number of specimens from the River Avon at Christchurch (Chas. Chilton coll.) and by one from the Shag River (Paris Mus.), both localities being in the southern island. There are also twenty-four specimens from Tezpur, in the Darrang district of Assam, and three from the Manipur Hills, all collected by Col. H. H. Godwin-Austen.

The views here advanced on the taxonomy of the species of *Paratya*, make it more than ever difficult to offer any explanation of the curious distribution of this species; the new observations indicate that the methods I adopted in 1912, in comparing the specimens from Assam with those from New Zealand were reliable and that had specific differences existed they would infallibly have been detected. If the record from Assam were based on specimens from one locality I would have rejected it as untrustworthy, but the fact that samples exist from two distinct places renders it improbable that any mistake can have arisen.

Paratya australiensis, sp. nov.

1894. *Miersia compressa*, Ortmann, *Jenaische Denkschrift*, VIII (=Semon's *Zool. Forschungsreis. in Australien* etc., V), p. 10.
1903. *Xiphocaris compressa*, Thomson, *Trans. Linn. Soc. Zool.* (2) VIII, p. 449 (part).
1905. *Xiphocaris compressa*, Bouvier, *Ann. Sci. France Belgique*, XXXIX, fig. 1, p. 61.

Hitherto the Australian representative of the genus *Paratya* has been considered to be specifically identical with that from

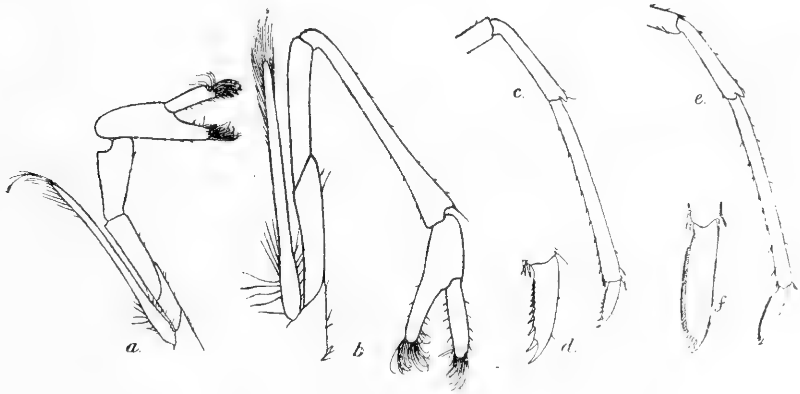

FIG. 5.—*Paratya australiensis*, sp. nov.

a. First peraeopod.
b. Second peraeopod.
c. Third peraeopod.
d. Dactylus of third peraeopod.
e. Fifth peraeopod.
f. Dactylus of fifth peraeopod.

Japan, but judging from the specimens in the Indian Museum it is undoubtedly distinct. Three samples of Australian specimens have been examined, all of which differ in certain well-marked features from the Japanese examples. They also differ rather considerably *inter se* and it appears not unlikely that recognisable races exist in different parts of the Australian continent. As types of *P. australiensis* I have selected a number of specimens from Clyde, near Sydney in New South Wales.

The rostrum in *P. australiensis* varies considerably in length, extending to the end of the antennular peduncle or far beyond the apex of the antennal scale, sometimes (in specimens from Sydney) reaching beyond the latter point by as much as one quarter its length. On its upper border it bears an uninterrupted series of

19 to 32 teeth[1] (usually 22 to 31) of which 1 or 2, rarely 3, are placed on the carapace behind the orbital notch. On the lower border there are from 1 to 14 teeth (usually 2 to 9); the distal third of the lower margin is in most cases unarmed.

The lateral process of the antennular peduncle sometimes reaches only to the end of the basal segment, in other cases to about one-third the length of the second segment.

The carpus of the first peraeopods is comparatively slender, from 2·0 (Lake Torrens) to 2·9 times as long as broad and is sometimes, as shown in text-fig. 5*a*, much less deeply excavate than in other species. The carpus of the second pair (text-fig. 5*b*) is from 5·8 to 7·5 times as long as broad. The propodus of the third pair (text-fig. 5*c*) is from 3·5 to 4·0[2] times as long as the dactylus (terminal spine included). The dactylus (text-fig. 5*d*) bears from 9 to 13 spines, usually 9 to 11; excluding these its length is from 3·0 to 3·6 times its breadth. In the fifth peraeopods (text-figs. 5*e*, *f*) the propodus is from 3·0 to (rarely) 3·8 times the length of the dactylus. The latter segment, spinules excluded, is very variable in form, from 3·3 to nearly 5[3] times as long as wide. The spinules vary in number from 28 to 82.[4]

The third and fourth legs of the male show no signs of sexual modification.

No ovigerous females are present in the material examined. The largest of the Sydney specimens is 27 mm. in length; an individual from "S. Australian waters" is rather larger, about 31 mm.

The specimens examined are from Clyde, near Sydney, from Lake Torrens in S. Australia and from "S. Australian waters." The first of these samples includes the type specimens[5] which bear the number 7590-2/10 in the Zoological Survey register. The specimens recorded by Ortmann from Burnett in Queensland, by Bouvier from Melbourne and by Thomson from Victoria and New South Wales are presumably to be referred to this species. The identity of von Martens' examples from Adenare near Flores is quite uncertain.

The material I have examined shows an unusually great range of variation and it is possible, as noted above, that more than one definable race of the species exists in Australia; the specimens in my hands are, however, not sufficiently numerous to afford evidence that this is really the case.

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[1] The rostral formulae in the three samples are as follows:—In 12 specs. from Sydney $\frac{25\text{-}32}{5\text{-}14}$: in 6 specs. from Lake Torrens $\frac{22\text{-}29}{3\text{-}8}$: in 5 specs. from "S. Australian waters" $\frac{19\text{-}30}{1\text{-}5}$.

[2] In a female from Lake Torrens.

[3] 3·3 to 4·0 in most cases. The specimen with a proportion of nearly 5 is perhaps an abnormality.

[4] From 28 to 65 in the Sydney specimens.

[5] Owing to a very unfortunate accident the types have been destroyed since the description was drawn up. The only portions of them that remain are certain appendages mounted on slides for microscopic examination.

subsp. **norfolkensis**, nov.

1903. *Xiphocaris compressa*, Thomson, *Trans. Linn. Soc. Zool.* (2) VIII, p. 449 (part).

1907. *Xiphocaris compressa*, Grant and McCulloch, *Proc. Linn. Soc. N.S.W.*, XXXII, p. 156.

Specimens from both sides of Norfolk I., collected by Messrs. Laing, are in the Indian Museum. Examples from the east side of the island are smaller than those from the west, but do not appear to be distinguished by any other constant character. The material examined does not bear out Grant and McCulloch's statement that the rostrum is proportionately shorter in specimens from the east side.

The rostrum varies greatly in length and is frequently very

FIG. 6.—*Paratya australiensis* subsp. *norfolkensis*, nov.

a. First peraeopod.
b. Second peraeopod.
c. Third peraeopod.
d. Dactylus of third peraeopod.
e. Fifth peraeopod.
f. Dactylus of fifth peraeopod.

much shorter than in any other race of *Paratya*. In specimens from the west side it reaches, in one instance, only to the end of the second antennular segment, in others almost or quite to the end of the peduncle and in one individual a little beyond the apex of the scale. Among those from the east side the rostrum in one case reaches barely beyond the end of the first antennular segment, in others to the end of the second segment, to the end of the peduncle or a trifle beyond the apex of the scale. The upper border bears from 21 to 32 teeth,[1] forming an uninterrupted series from the base to the apex. The hindmost 2 to 5 teeth[2] are placed on the carapace. On the lower border there are from 3 to 8 teeth[1] which almost always extend on to the distal third of the rostral length and not infrequently reach almost to the apex.

[1] According to Thomson's observations the teeth vary from 17 to 34 above and from 2 to 9 below.

[2] 2 or 3, rarely 4, in specimens from the east side; 4, rarely 5, in those from the west.

The lateral process of the antennular peduncle reaches to the end of the basal segment, or as far as the middle of the second segment.

The carpus of the first peraeopods (text-fig. 6*a*) is much broader than in any other race or species of *Paratya* that I have seen; in females it is only from 1·3 to 1·6 times as long as broad and in males from 1·7 to 1·9 times. It is very deeply excavate anteriorly. The carpus of the second peraeopods (text-fig. 6*b*) is from 4·2 to 4·9 times as long as broad. In the third peraeopods (text-figs. 6*c*, *d*) the propodus, in females, is from 4·3 to 5·2 times as long as the dactylus, from 3·7 to 3·9 times in males. Excluding the spines the dactylus is only from 2·1 to 2·7 times as long as broad, being rather more slender in males than in females. The spines are less numerous than in the typical form; they vary from 6 to 8, the number occasionally rising to 9 in males. In the fifth peraeopods (text-figs. 6*e*, *f*) the propodus is from 4·2 to 4·4 times as long as the dactylus, the proportion in males rarely falling to 3·9. The dactylus, excluding the spinules, is from 2·4 to 2·8 times as long as broad. The spinules are from 35 to 43 in number and differ conspicuously from those of the typical form in one particular. In the Australian race, as in all other members of the genus save the present one, the spinules towards the apex increase successively in size by even gradations. In the Norfolk I. form the spinules are fine and regular throughout the greater part of the dactylar length, but close behind the tip there is a sudden break in continuity, the three, less commonly two terminal teeth being vastly larger than the adjacent members of the series (text-fig. 6*f*).

As in the typical form the third and fourth legs of the male show no signs of sexual modification.

There are no ovigerous females among the specimens examined. Examples from the west side of the island reach a length of 32 mm.; those from the east side do not exceed 18 mm.

It appears to me not improbable that the Norfolk I. form deserves rank as a full species, but further work on the Australian races is necessary before its precise position can be determined.

The types are from the west side of the island and bear the number 8500/10 in the register of the Zoological Survey of India.

XVIII. ON SOME LITHOBIOIDEA (CHILOPODA) FROM INDIA.

By F. Silvestri (*Portici, Italy*).

Among the Chilopoda kindly sent me for examination by the Director of the Zoological Survey of India, there are a few species of Lithobioidea which I describe in this note, together with a species of Henicopidae that was collected at Trichinopoli and is considered the type of a new genus.

Only three species of Lithobiidae from India (including Burma) and the Malay Peninsula have been described up to date, *viz. Lithobius* (*s. s.*) *hardwickei*, Newp., from Singapore, *Lithobius* (*s. s.*) *feae*, Poc., and *Lithobius* (*Archilithobius*) *birmanicus*, Poc., both from Burma.

The specimens examined by me are referred to *L. feae*, Poc., to three new species and to a new variety.

The fauna of India appears very poor in Lithobiidae as in all tropical countries, but it is possible that careful collecting in temperate zones in the north will discover many other species.

In the few known species the small number of the ocelli of each eye is noticeable, and also the relatively small number of the joints of the antennae.

Fam. LITHOBIIDAE.

Lithobius (*s. s.*) feae, Poc.

Ann. Mus. Genova, X, p. 408 (1891).

Corpus supra fulvo-latericium, subtus fulvo-testaceum, pedibus maxillaribus fulvo-ferrugineis, pedibus testaceis articulis 2-4 macula nonnulla atro-violacea variegatis.

Caput subaeque longum atque latum; oculi ocellis magnitudine et dispositione vide fig. I, 12; antennae breves, 20-articulatae, articulis elongatis, omnibus breviter et sat dense setosis, articulo decimo fere duplo longiore quam latiore, articulo ultimo *c.* 2/3 longiore quam latiore (in exemplo alio antenna altera rigenerata breviore, 12-articulata, articulis a quarto brevioribus, articulo ultimo parum longiore quam latiore).

Pedes maxillares (fig. I, 11) subcoxarum margine antico lato, subrecte truncato dentibus 8 - 9+8 - 9 (vel 8+10).

Lamina dorsualis 6ª angulis posticis parum productis et rotundatis, laminae dorsuales 9, 11, et 13 angulis posticis gradatim magis productis et acutis, lamina dorsualis 15 longa, aliquantum longior quam latior, postice sinuata.

Pedes primi paris spinis $\frac{0,\ 0,\ 3,\ 0,\ 1}{0,\ 0,\ 1,\ 3,\ 2}$, octavi paris $\frac{0,\ 0,\ 3,\ 2,\ 1}{0,\ 0,\ 1,\ 3,\ 2}$, paris decimi quarti $\frac{1,\ 0,\ 3,\ 1,\ 1}{0,\ 1,\ 3,\ 3,\ 2}$, paris ultimi $\frac{1,\ 0,\ 3,\ 1,\ 0}{0,\ 1,\ 3,\ 3,\ 2}$, subcoxis pedum 13-15 calcare laterali auctis, pedes 13-15 ab articulo tertio facie interna poris numerosis glandularibus instructis, ungue terminali (fig. I, 13) unguicula laterali interna (vel postica) sat longa et seta spiniformi laterali infera externa (vel antica) brevi, in pedibus 14-15 minima aucta.

Pori subcoxales 6, 7, 7, 6-7, 8, 7, 7 (6).

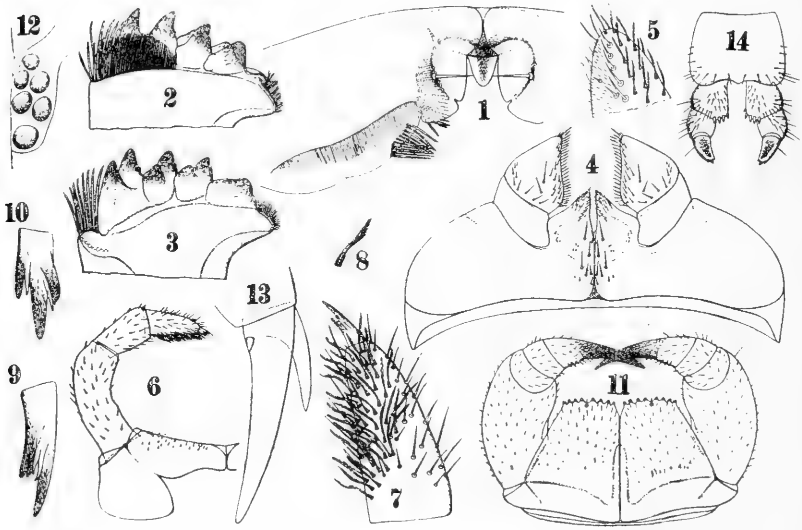


FIG. I.—*Lithobius* (*s. s.*) *feae*: 1. Labrum (parum magis quam dimidia pars); 2. mandibulae dexterae apex subtus inspectus; 3. idem supra inspectus; 4. maxillae primi paris; 5. earumdem lobi interni apex; 6. maxillae secundi paris; 7. earumdem articulus tertius cum ungue terminali; 8. seta ejusdem articuli: 9. maxillarum secundi paris unguis terminalis lateraliter inspectus; 10. idem pronus; 11. pedes maxillares; 12. oculus laevus; *O.* ocelli; *T.* Tömösvaryi organum; 13. pedum paris ultimi pars apicalis; 14. *Lithobius feae* v. *percalcarata*; feminae appendices genitales.

Appendices genitales ungue integro, calcarium utrimque quatuor, quorum internum perparvum est.

Long. corp. mm. 17, lat. 2·5; long. antennarum 6·6, pedum paris primi 3, decimi 4, ultimo 10.

Immaturus. Pori subcoxales subrotundi 5, 6, 6, 5. Long. mm. 15.

Habitat.—Rotung, alt. 1,300 ft. (Abor Exp.), under stones; Kobo, alt. 400 ft. (Abor Exp.), under bark.

Observatio.—Exempla a me ad *Lith. feae*, Poc., relata ab exemplo typico differunt pedum maxillarium dentium numero majore, antennis semper 20-articulatis, statura parum minore.

Lithobius (*s. s.*) **feae,** Poc. var. **percalcarata,** nov.

Pedes primi paris spinis $\frac{0,\,0,\,3,\,1}{0,\,0,\,1,\,2}$, decimi paris $\frac{0,\,0,\,3,\,2,\,2}{0,\,0,\,2,\,3,\,2}$, decimi quarti paris $\frac{1,\,0,\,3,\,1,\,1}{0,\,1,\,3,\,3,\,2}$, vel $\frac{1,\,0,\,3,\,2,\,0}{0,\,1,\,3,\,3,\,1}$.

Pori subcoxales 6, 7, 8, 7-6, 8, 8, 7, subcoxis pedum paris 14 et 15 supra et lateraliter spina armatis.

Genitalium femineorum (fig. I, 14) unguis trilobus, calcaria utrimque 4-5, quorum internum parvum spiniforme est.

Long. corp mm. 17, lat. 2·5, long. antennarum 6, pedum paris primi 3, decimi 4, pedum paris decimi quarti 8·6.

Habitat.—Renging, 2,150 ft. (Abor Exp.), in rotten wood; Janakmukh, alt. 600 ft. (Abor Exp.), under bark; Soom to Birch Hill (Darjiling dist.), 5,000–6,000 ft.

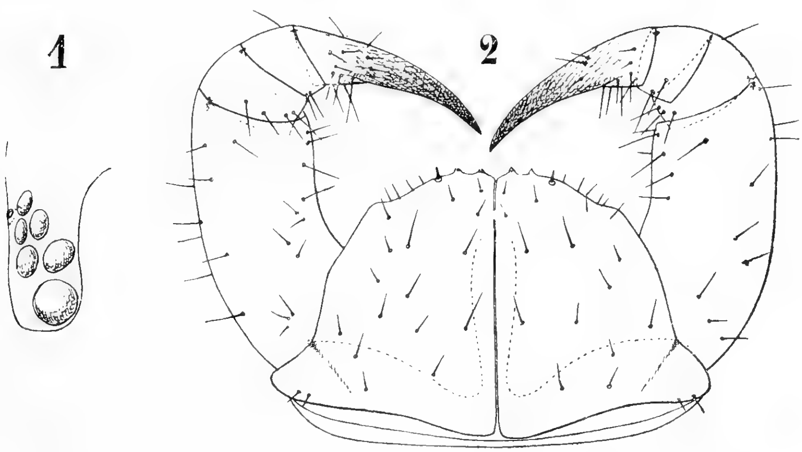


FIG. II.—*Lithobius* (*s. s.*) *kempi*: 1. Oculus laevus: 2. pedes maxillares.

Juvenes. Kobo, 400 ft. (Abor Exp.), in rotten wood, exempla duo, long. corp. 13.

Antennae 20-articulatae. Pedes maxillares dentibus 6+6; pori subcoxales 3, 5, 5, 4-4, 5, 6, 5; genitalium femineorum unguis trilobus, calcaria utrimque 4.

Observatio.—Variatio haec ab exemplis formae typicae genitalium femineorum ungue trilobo et calcaribus magis numerosis vel robustioribus distincta est.

Lithobius (*s. s.*) **kempi,** sp. nov.

Corpus testaceum ventre et pedibus parum pallidioribus.

Caput paullum longius quam latius, lateribus anticis aliquantum convergentibus; oculi ocellis 6, magnitudine et dispositione vide fig. II, 1; antennae 19-articulatae (altera certe haud integra 17-articulata), articulis elongatis, parce et breviter setosis, articulo decimo parum magis quam duplo longiore quam latiore, articulo ultimo tenui, circa quadruplo longiore quam latiore.

Pedes maxillares (fig. II, 2) antice lati, margine aliquantum convexo medio parum sinuato, dentibus 2+2.

Laminae dorsuales 6, 7, 8 angulis posticis haud productis, laminae dorsuales 9, 11, 13 angulis posticis triangularibus, acutis, retrorsum bene productis; lamina dorsualis 15 paullum latior quam longior, postice vix sinuata.

Pedes primi paris calcaribus $\frac{0, 0, 1, 1, 1}{0, 0, 0, 1, 1}$, paris decimi $\frac{0, 0, 1, 2, 2}{0, 0, 2, 2, 2}$, paris decimi quarti $\frac{0, 0, 3, 1, 0}{0, 1, 2, 1, 0}$, paris decimi quinti $\frac{0, 0, 3, 0, 0}{0, 1, 2, 1, 0}$, ungue terminali unguicula interna sat longa et unguicula externa infera minima aucto, poris glandularibus parce numerosis ab articulo quarto incipientibus.

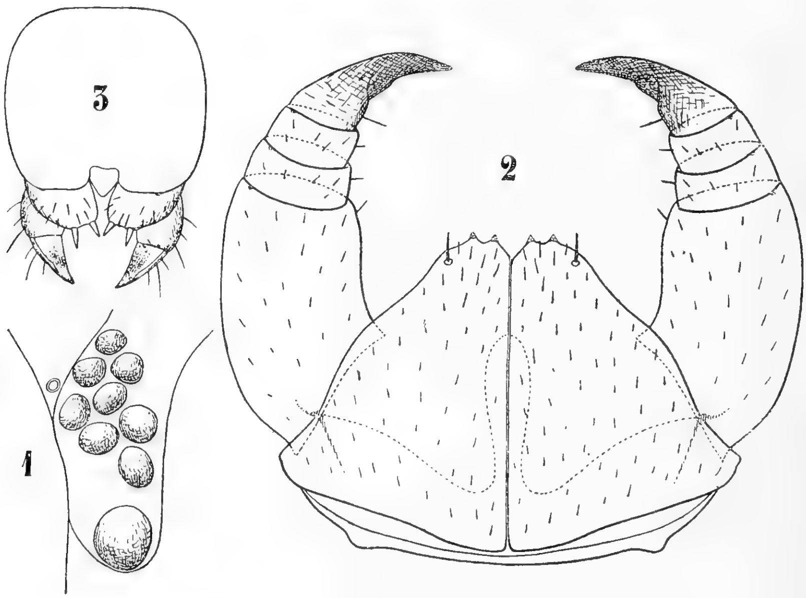


FIG. III.—*Lithobius* (*Archilithobius*) *tactus*: 1. Oculus laevus; 2. pedes maxillares; 3. feminae appendices genitales.

Pori coxales 4, 4, 4, 4.

Appendices genitales ungue distincte bilobato, lobo minore dentiformi externo, calcaribus utrique duobus robustis.

Long. corp. mm. 16, lat. 2, long. antennarum 6, pedum paris primi 3, paris decimi 4·3, paris ultimi 6·7.

Mas ignotus.

Habitat.—Rotung 1,400 ft. (Abor Exp.).

Observatio.—Species haec, quae honoris causa Clarissimo Mr. S. W. Kemp dicata est, a *Lithobius feae*, Poc. pedum maxillarium dentium, subcoxarum 12–15 pororum et calcarium appendicium genitalium numero praesertim facile distinguenda est.

Lithobius (Archilithobius) tactus, sp. nov.

Corpus subtestaceum totum.

Caput paullum latius quam longius lateribus anticis aliquantum convergentibus; oculi ocellis 9 compositi magnitudine et dispositione vide fig. III, 1; antennae 20-articulatae, articulis parum elongatis, setis numerosis brevibus instructis, articulo decimo *c.* 1/3 longiore quam latiore, articulo ultimo *c.* duplo longiore quam latiore.

Pedes maxillares (fig. III, 2) subcoxis antice augustatis, margine antico medio angulatim sinuato dentibus 2+2 et seta brevi praemarginali externa instructo.

Laminae dorsuales angulis posticis subrectis vel rotundatis, lamina dorsualis 15 aliquantum longiore quam latiore, lateribus postice aliquantum convergentibus, margine postico subrecto.

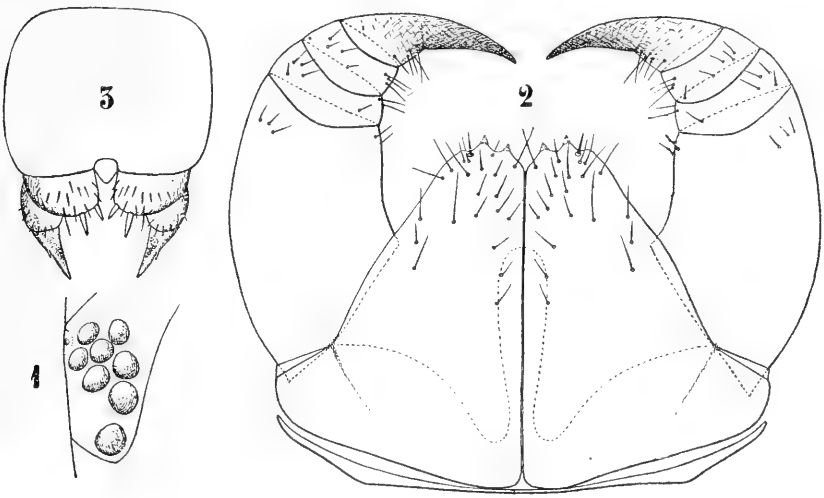


FIG. IV.—*Lithobius* (*Archilithobius*) *erraticulus*: 1. Oculus laevus; 2. pedes maxillares; 3. feminae appendices genitales.

Pedes primi paris $\frac{0, 0, 1, 2, 2}{0, 0, 2, 3, 2}$, decimi paris $\frac{0, 0, 3, 2, 2}{0, 0, 3, 3, 2}$, decimi quarti $\frac{1, 0, 3, 1, 1}{0, 1, 3, 3, 2}$, paris ultimi $\frac{1, 0, 3, 1, 0}{0, 1, 3, 2, 1}$, subcoxis pedum 12 et 13 etiam spina dorsuali instructis; pedes paris 14 et 15 ab articulo quarto interne poris glandularibus numerosis instructi, pedes paris ultimi ungue terminali unguicula interna brevi et unguicula externa minima instructi.

Pori subcoxales 3, 5, 5, 5, parvi et rotundi.

Appendices genitales feminae (fig. III, 3) breves ungue integro ad basim externe incisione spiniformi instructo, calcaribus utrimque duobus.

Long. corp. mm. 13, lat. 1·8, long. antennarum 4, pedum paris primi 2, decimi 2·6, ultimi 4·10.

Habitat.—Specimina duo vidi ex loco haud certo probabiliter ex N. Bengal cum *Mecistocephalo spisso*, Wood et *Iulidis* collecta. Var. Exemplum alium ad eamdem speciem refero ex Katihar [Purneah distr., N. Bengal (Bihar)], quod ab exemplis typicis oculi ocellis 10 et poris subcoxalibus 4, 5, 5 tantum differt.

Observatio.—Species haec a procedente magnitudine, ocellorum et pororum subcoxalium numero, genitalium femineorum appendicibus brevioribus facile distinguenda est.

Lithobius (Archilithobius) erraticulus, sp. nov.

Corpus testaceum totum.

Caput aeque longum atque latum; oculi ocellis 8, magnitudine et dispositione vide fig. IV, 1; antennae breves, 20-articu-

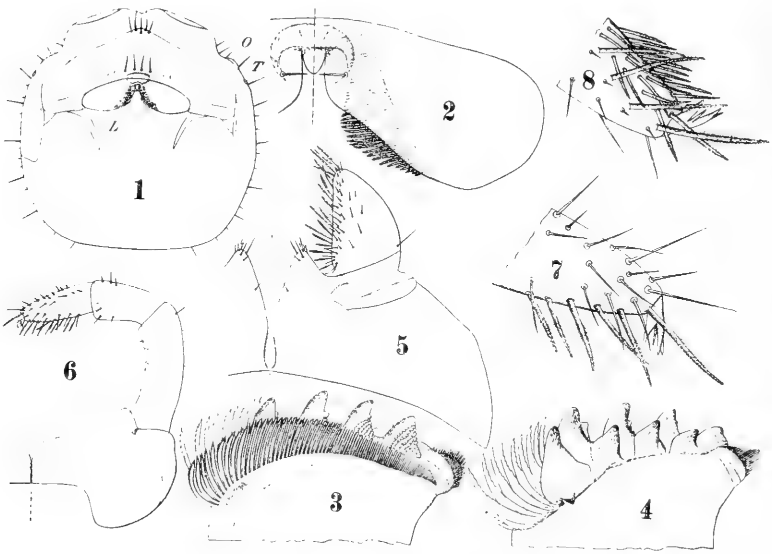


FIG. V.—*Triporobius newtoni*: 1. Caput supinum appendicibus ablatis; 2. labrum (parum magis quam dimidia pars); *O*. oculus; *L*. labrum; *T*. organum Tömösvaryi; 3. mandibulae dextarae apex subtus inspectus; 4. idem supra inspectus; 5. maxillae primi paris; 6. maxillae secundi paris; 7. ejusdem pars apicalis subtus inspecta; 8. eadem supra inspecta.

latae, articulis parum elongatis, setis sat numerosis brevibus instructis, articulo decimo fere 1/3 longiore quam latiore, articulo ultimo tenui, *c*. 2/3 longiore quam latiore.

Pedes maxillares (fig. IV, 2) subcoxis antice angustatis, margine antico medio angulatim sinuato, dentibus 2+2 et seta sublaterali externa longa aucto.

Laminae dorsuales omnes angulis posticis plus minusve rotundatis; lamina dorsualis 15 subaeque longa atque lata, margine postico paullum sinuato.

Pedes omnes tarso biarticulato, primi paris calcaribus $\frac{0,\ 0,\ 0,\ 1,\ 1}{0,\ 0,\ 1,\ 2,\ 1}$, decimi paris $\frac{0,\ 0,\ 2,\ 1,\ 1}{0,\ 0,\ 2,\ 2.\ 2}$, decimi quarti $\frac{1,\ 0,\ 3\ \ 1,\ 0}{0,\ 1,\ 3,\ 2,\ 1}$, paris ultimi $\frac{1,\ 0,\ 3,\ 2,\ 0}{0,\ 1,\ 3,\ 2,\ 1}$, subcoxis pedum 12-13 etiam calcare supero instructis, pedes paris 14 et 15 ab articulo quarto interne poris glandularibus numerosis instructi, ungue terminali unguicula interna brevi et unguicula externa infera minima.

Pori subcoxales 2, 3, 3, 3 parvi et rotundi.

Genitalium femineorum (fig. IV, 3) unguis longus attenuatus, externe ad basim parva incisione dentiformi affectus, calcaria utrimque duo.

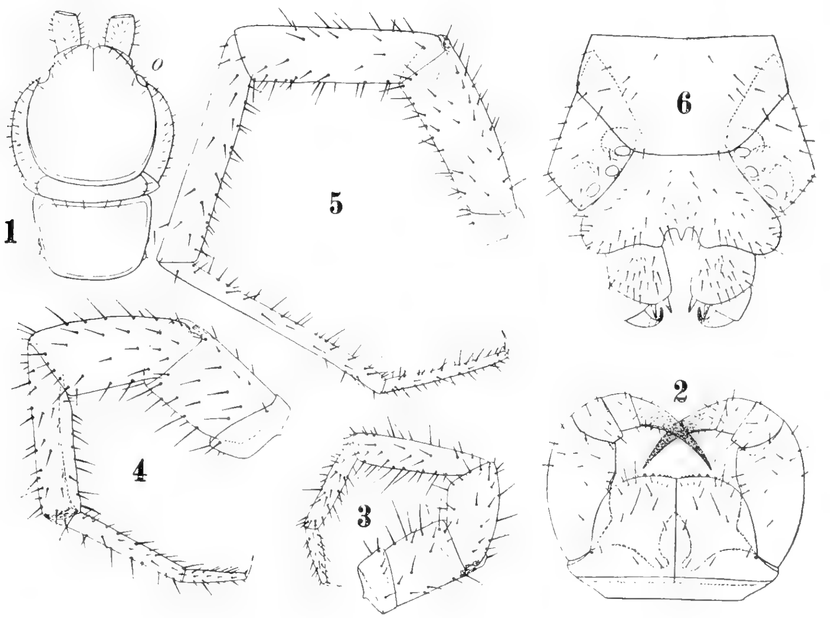


FIG. VI.—*Triporobius newtoni :* 1. Caput et trunci segmenta 1um et 2um prona ; 2. pedes maxillares : 3. pes paris primi ; 4. pes paris decimi ; 5. pes paris ultimi ; 6. feminae segmentum ultimum pediferum et segmentum genitale supina.

Long. corp. mm. 11, lat. 1·5, long. antennarum 3·5, pedum paris primi 1·30, decimi 2, ultimi 3·7.

Mas immaturus poris subcoxalibus 2, 2, 3, 2.

Habitat.—Chitral (N.W. Frontier Province, 5,000 ft., G. M. Giles legit).

Observatio.—Species haec a *L.* (*A.*) *birmanicus*, Poc. ocellorum numero et genitalium femineorum ungue integro saltem distincta est.

Fam. HENICOPIDAE.

Gen. **Triporobius**, nov.

Caput (fig. V, 1 et VI, 1) contractum laminam basalem fere omnino obtegens, lamina cephalica aliquantum longiore quam latiore antice media longitudinaliter sulcata. Oculi ocello singulo magno compositi; Tomosvaryi organum marginale parum pone oculos situm. Antennae breves, articulis elongatis, in specie typica 17-articulatae. Labrum (fig. V, 2) profunde unidentatum; mandibulae, maxillae primi et secundi paris vide fig. V, 3-8.

Pedes maxillares (fig. VI, 2) subcoxis longis et latis, antice tantum lateraliter paullum excisis, mediis paullum sinuatis, dentibus 5+5 sat parvis armatis, ungue terminali longo acuto.

Tergita 9, 11 et 13 angulis posticis gradatim parum magis acutis, tergitum 15 subaeque longum atque latum, margine postico vix sinuato.

Stigmata in segmentis pediferis 1, 3, 5, 8,10, 12 et 14 sita.

Pedes (fig. VI, 3-5) omnes, ungue incluso, 8-articulati, setosi, spinis destituti, parium 1-13 articuli quinti apice antice in processum sat longum triangularem acutum producto, ungue terminali utrimque ad basim unguicula brevi aucto.

Pori subcoxales in segmentis pediferis 13, 14 et 15 sistentes et in pede singulo 3 adsunt rotundi, sat magni.

Appendices genitales (fig. VI, 6), ungue incluso, 4-articulatae, ungue simplici, articulo primo calcaribus duobus.

Pori anales quo magni.

Mas ignotus.

Observatio.—Genus hoc a genere *Paralamyctes*, Poc. pedibus paris 12[i] poris subcoxalibus destitutis facile distinguendum est.

Triporobius newtoni, sp. nov.

Corpus subtestaceum pedibus maxillaribus fulvo ferrugineis, pedibus ambulatoriis testaceis, tarso fulvo-ferrugineo.

Characteres ceteri in generis descriptione et in figuris manifesti.

Long. corp. mm. 17, lat. 2, long. antennarum 7, pedum paris primi 3·4, decimi 4·6, ultimi 8·9.

Habitat.—Exempla duo vidi ad Trichinopoli a Cl. Newton, cui species grato animo dico, collecto et mihi donata.

XIX. DESCRIPTION OF SOME SPECIMENS OF *PLEUROTOMA CONGENER*, E. A. SMITH, FROM THE ANDAMAN SEA, WITH SPECIAL REFERENCE TO CERTAIN PECULIARITIES OF THE APERTURE.

By E. W. VREDENBURG, *B.L., B.Sc., F.G.S., etc., Superintendent, Geological Survey of India (communicated with the kind permission of the Director, Geological Survey of India).*

(Plate XII).

Pleurotoma congener, one of the most beautiful amongst the Pleurotomidae of the Indian Ocean, was first described in 1894 by Mr. E. A. Smith from specimens in the collections obtained during the cruises of H.M. Indian Marine Survey Steamer "Investigator" from the depth of 128 fathoms in the Bay of Bengal, and between 142 and 400 fathoms west of Colombo off the coast of Ceylon.

As is so frequently the case in consequence of the fragility of the aperture in the Pleurotomidae, the edge of the outer lip is missing in the original types described by Mr. E. A. Smith. Since the publication of the original description, further specimens have been obtained by the Marine Survey from the Andaman Sea (in Lat. 13° 17′ 15″N., Long. 93° 10′ 25″E.), in depths of 185 fathoms. Many of the shells are partly overgrown by organisms and were apparently dead at the time when they were dredged up, but in two of them the aperture is practically perfect and exhibits, along the outer lip, features of such a singular nature that they have been thought worthy of special notice. As the specimens differ in several details from the original type, it will be useful to give a complete description.

Pleurotoma (Gemmula) congener, E. A. Smith.

1879. *Pleurotoma coronifera*, Martin, *Tertiaerschichten auf Java*, p. 61, pl. xi, fig. 2.
1884. *Pleurotoma coronifera*, Martin, *Samml. des geol. R. Mus. in Leiden*, 1st ser., III, p. 58, pl. iv, fig. 58.
1894. *Pleurotoma congener*, E. A. Smith, *Ann. Mag. Nat. Hist.* (6), xiv, p. 160, pl. iii, figs. 4, 5.
1895. *Pleurotoma* (*s. str.*) *coronifera*, Martin, *Samml. des geol. R. Mus. in Leiden* (new series), I, p. 38.

non Pleurotoma coronifera, Bellardi, *Moll. terr. terz. Piem. e Lig.*, 2d part, p. 34, fig. 20 (1877).

Fairly large, of a variable but moderate degree of elongation, with rather broad slightly conoidal spire measuring about five-ninths of the total height, with broad body-whorl somewhat abruptly contracted anteriorly into a rather short stem corresponding to the terminal canal.

The protoconch, when fully preserved, constitutes a remarkably beautiful object. It is slightly oblique to the axis of the remainder of the shell. It is shaped like a *Turbo*, broadly conoidal in outline. It consists of a minute, highly glazed, slightly excentric nucleus followed by four spire-whorls of which the two first are very low and very broadly conical, the two last much taller and rather strongly convex. The first whorl is smooth. The three others are covered with very delicate sharply angular ribs stretching from suture to suture, slightly curved, with forward directed concavity, and most of them very oblique and anteriorly antecurrent except on the last half of the last whorl when they become practically vertical. In some specimens the transition to the spire proper is quite abrupt, while in other cases a gradual shortening of the protoconch ribs establishes a transition into the crenulations of the sinus band. The protoconch is followed by seven and a half spire-whorls, the height of which is generally equal to two-fifths of their width or slightly more in the case of specimens with a relatively narrow spire; the maximum thickness being situated nearer to the anterior than to the posterior margin of the whorls, and coinciding with the zone of accretions to the apertural sinus.

The sutures are rather deeply incised and are surrounded by a prominent broad ridge or swelling, while another ridge of the same character, corresponding with the zone of accretions to the apertural notch, occupies a more anterior position upon the whorls. The anterior margin of the whorls forms a deeply sunken zone between the sinus ridge of one whorl and the circumsutural ridge of the next whorl, proportionately scarcely broader than that between the two ridges of one whorl; and, in many specimens, as both ridges are equally prominent, the spire usually assumes the appearance of a cone very evenly encircled at close intervals, the grooves being of about the same average width as the ridges. In a few specimens, the circumsutural ridge is decidedly less prominent than the sinus band, and the spire thereby acquires somewhat more of a stepped appearance. Both ridges are bifid, the two component spiral threads being both equal in the case of the sinus ridge, while, in the case of the circumsutural swelling, the more anterior thread, to a degree varying in different specimens, is more prominent than the posterior thread which either immediately adjoins the suture, or is separated from it by one or two fine raised spiral lines. Three raised spiral lines or minor threads, of which the more posterior one is usually much thinner than the two others, are observed along the floor of the groove separating the two main ridges of each whorl Two more spiral threads may occur along the depressed zone anteriorly to the sinus ridge, or else, there may be but one, as the more anterior of the two may be entirely concealed by the posterior margin of the following whorl. The interval between these two anterior threads may carry an additional fine revolving line. Two more or less distinct revolving lines may bound the sinus ridge externally to its two main threads, one on either side. The sinus ridge is crenulated at close and even intervals by short straight ribs, practically vertical or very slightly oblique and anteriorly retrocurrent, swelling into blunt granules across the two main spiral ridges. The circum-sutural ridge is also denticulated, but at less regular intervals, by thickened lines of growth. The course of the lines of growth is steeply antecurrent or practically normal to the posterior suture, antecurrent at about 45° to the anterior suture, strongly retro-current from either side to the sinus ridge.

The broad body-whorl measures from nearly five-eighths to nearly two-thirds of the total height. Anteriorly to the sinus-ridge it contracts with a hemispherical or somewhat flattened convexity, connected by a rather broad and rather shallow concavity with the rather short terminal stem, which is rather bluntly truncated and very distinctly dorsally deflected at its extremity. The ornaments of the last spire-whorl are continued upon the corresponding portion of the body-whorl, with a tendency towards an increase in the number of minute spiral raised lines of the lowest order. In those specimens in which the spire-whorls exhibit two main spiral threads anteriorly to the sinus ridge, the convexity of the base, anteriorly to the level of the suture, carries two more main spiral threads. In those specimens in which there is only one main thread clearly visible on the anterior part of the spire-whorls, the next one, concealed by the suture, becomes clearly disclosed at its termination, and is followed on the anterior convexity by only one more main thread. Consequently, anteriorly to the sinus ridge, the convex portion of the body-whorl carries three or four main spiral threads or keels conspicuously granulated at their intersections with the raised lines of growth. From one to three fine spiral raised lines are observed in each of the intervals between these granulated keels. Another similar granulated keel occurs at the junction of the anterior concavity and of the terminal stem. A number of thin raised spiral lines, either all of one size or else more or less regularly alternating, decorate the concavity. The terminal stem carries numerous spiral threads at first alternating in three sizes and afterwards, more or less regularly in two, as far as the zone of accretions of the terminal truncation; the threads of the first order being at first distinctly granulated and but slightly inferior in thickness to the above-described main granulated keels of the anterior part of the body-whorl, and afterwards gradually decreasing anteriorly while the granulations become fainter. The terminal zone of accretions which causes the terminal dorsal deflection of the stem carries very fine, rather blunt spiral lines crossed at irregular intervals by the somewhat rugose accretions. The lines of growth become vertical at the junction of the convex and concave portions of the base, and maintain that direction up to the margin of the terminal zone of accretions when they finally become retrocurrent.

The somewhat small aperture is lanceolar, posteriorly terminated by a narrow channel, while anteriorly it contracts gradually into the rather short oblique canal. The junction of the columella with the base of the last spire-whorl is curved though rather abrupt. Anteriorly to the base of the last spire-whorl the course of the columella is, on an average, straight as far as the commencement of the canal, and slightly oblique, the direction being anteriorly towards the left of the shell. Not far from the base of the last spire-whorl it exhibits a blunt, broad revolving swelling, clearly visible when the outer lip is incomplete. At the commencement of the canal the columella becomes more strongly oblique, but it extends anteriorly only for a very short distance as a distinctly differentiated structure, the anterior portion of the canal being formed merely by the thin shell-wall without any differentiated columellar margin or columella. The columellar margin is almost everywhere very thin: it has a very slightly raised edge at the commencement of the canal, posteriorly to which it is quite flush with the adjoining outer surface, except at its posterior termination where it exhibits a small button-like callous thickening resembling that of a *Drillia*, which contributes to contract the posterior channelled termination of the aperture. The outer lip which is very thin terminates normally to the suture. The sinus is moderately broad, very deep without any raised edge. The convexity of the outer lip, anteriorly to the sinus, does not project much further forward than its posterior termination. The internal walls of the shell are lirate, but the internal lirae cease at a considerable distance from the aperture.

In the two specimens in which the outer lip is complete, or almost complete, it exhibits a most peculiar structure which does not appear to have been noticed or described in any other Pleurotomid shell. The two anterior main threads of the convexity of the base, on approaching the aperture, grow into extremely prominent trumpet-like hollow expansions which, nevertheless, do not breach the margin of the outer lip whose outline is continuous, the hollow expansions being, in the present condition of the shells, quite shut off from the interior of the shell. It is evident, however, that this was not so at the time of their formation, and that they must have originated from a more or less siphon-like fold of the mantle with the formation of a deep sinus which was afterwards obliterated. This peculiar growth was evidently several times repeated, for there are several of these trumpet-shaped foliaceous expansions fitting inside one another, the last ones becoming gradually smaller on approaching the present aperture. It is moreover to be noticed that the growths are not simultaneous on the two main threads which are affected by them. On one of the specimens, it is upon the most anterior of the main threads of the convexity of the base that this structure is first observed; then, without any closing of the temporary sinus thus produced, the mantle-fold which originated the structure shifted its position to the next principal thread posteriorly to the one upon which the structure was first developed. Consequently the expansion shifts its position forward (towards the aperture) and at the same time posteriorly from the one main thread to the other, enclosing the next similar structure produced presumably after a temporary arrest of growth. In the other specimen it is observed that the growth commenced on the more posterior of the threads concerned, shifted to the anterior one, and once more meandered back to its original position. As has already been mentioned, the successive expansions fitting inside one another become finally smaller on approaching the aperture till the sinus is obliterated and the outline of the outer lip becomes regularised in this part of the shell; but, when this happens, it would appear as though the supposed mantle-fold had once more shifted its position still further forward, for now a distinct stromboid sinus appears as an expansion of the spiral thread at the limit of the concave neck and terminal canal, representing what might be the initial stage of a structure similar to the curious expansions above described. These structures evidently result from some hitherto unrecorded anatomical peculiarity.

Dimensions.

Height ..	31 mm.	36 mm.	37 mm.	41 mm.
Thickness ..	11 ,,	13 ,,	14 ,,	17 ,,
Height of spire .	17 ,,	20 ,,	21 ,,	24 ,,
Height of body-whorl	20 ,,	22 ,,	23 ,,	25 ,,

Of the specimens, the measurements of which are above tabulated, the first is the smallest of those available, the last the largest. The two others are those exhibiting the peculiar apertural features above described.

Remarks.—Compared with the original types, the Andaman specimens above described are generally somewhat smaller, with a more evenly conical, less conoidal spire, the apex, in particular, being much more pointed instead of blunted as it is in the originally figured specimen. The circumsutural rim at all stages of growth and the revolving main keels of the body-whorl anteriorly to the sinus-band are also much more distinctly granulated in the case of the Andaman specimens.

A fossil variety of this shell occurs in the lower and upper Miocene and Pliocene formations of western India, the same variety also occurring fossil in the upper Miocene formations of Java and Sumatra from which it was described by Martin (*loc. cit.*) as *Pleurotoma coronifera*, a name pre-employed in the zoological nomenclature by Bellardi for a fossil species from the Miocene of Piedmont. The blunt posterior swelling of the columella, clearly visible in the fossil specimens from India and from Java, has not been observed in any other species of *Pleurotoma* fossil or recent.

In all the fossil specimens from India and Java the outer lip is incomplete. Judging from an illustration published by Sacco

(*Moll. terz. Piem. e Lig.*, part XXX, pl. xi, fig. 35), there are indications of a similar structure in the case of a fossil from the Pliocene of Zinola near Savona, described as *Pleurotoma monile*, Brocchi, var. *granocostata*, Sacco, which seems related to *Pleurotoma congener*, from which it is distinguished principally by its less distinctly bifid circumsutural rim and by the differently disposed crenulations of its sinus band, which are much wider-spaced and are elongated in the direction of the spiral ornaments instead of being constituted by axial ribs.

In conclusion, I wish to express my best thanks to Dr. N. Annandale for the favour of enabling me to study these interesting specimens, and to M. R. Ry. Sethu Ram Rao of the Geological Survey of India and Babu S. C. Mondul of the Zoological Survey of India, for preparing the beautiful photographs illustrating their structures.

EXPLANATION OF PLATE XII.

FIGS. 1, 2.—*Pleurotoma* (*Gemmula*) *congener*, E. A. Smith.

a, *b*, *c*, ventral, dorsal, and profile aspects, natural size; *d*, *e* details of aperture, × 3·5.

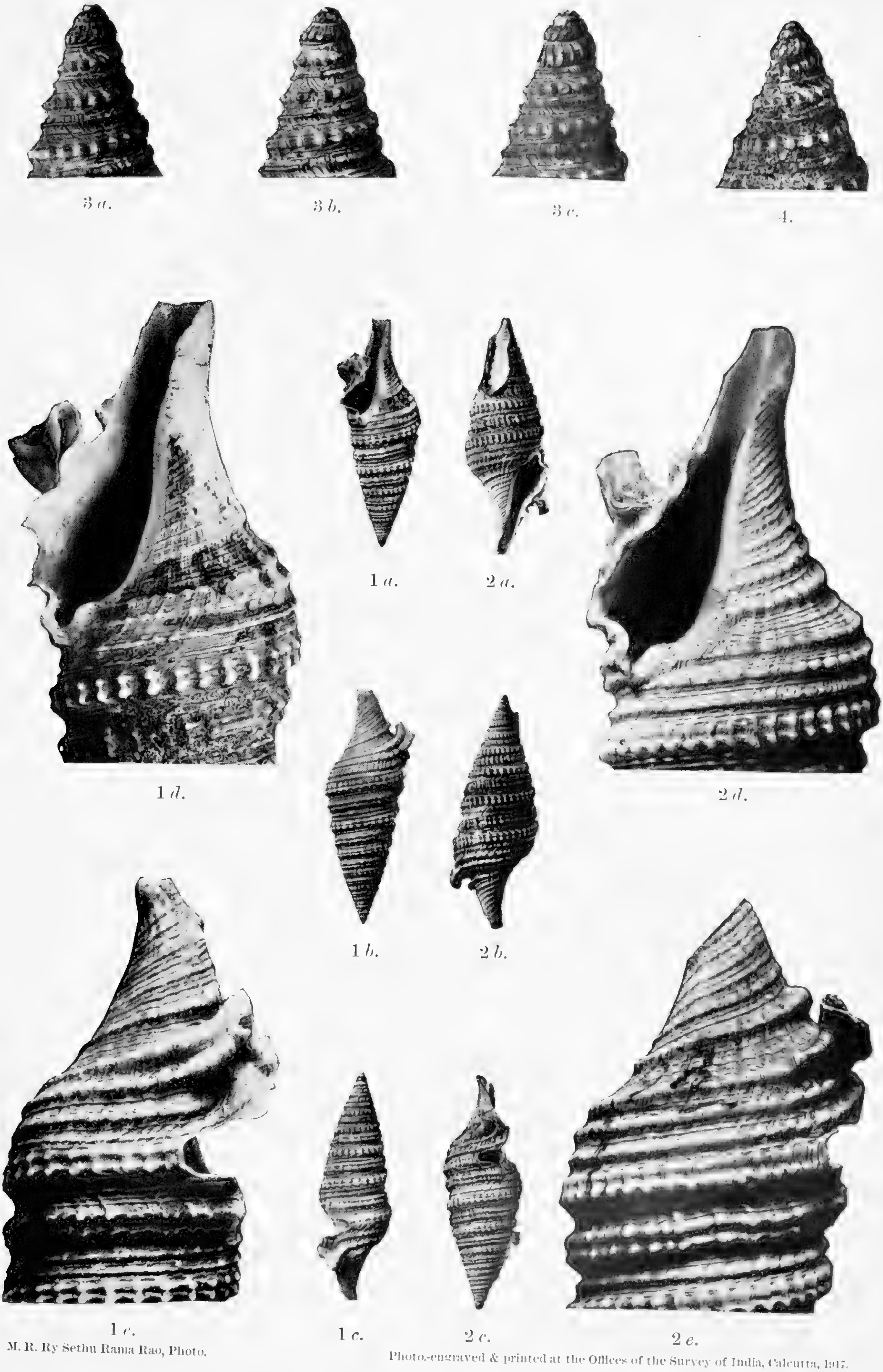
FIG. 3.—*Pleurotoma* (*Gemmula*) *congener*, E. A. Smith.

a, *b*, *c*, ventral, profile, and dorsal aspects of protoconch, × 6.

FIG. 4.—*Pleurotoma* (*Gemmula*) *congener*, E. A. Smith.

Protoconch of another specimen to illustrate its obliquity, × 6.

All the specimens were obtained from 185 fathoms, in Lat. 13° 17′ 15″ N., Long. 93° 10′ 25″ E. in the Andaman Sea.



M. R. Ry Sethu Rama Rao, Photo.

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

PLEUROTOMA CONGENER, E. A. SMITH.

XX. A LIST OF THE DRAGONFLIES RECORDED FROM THE INDIAN EMPIRE WITH SPECIAL REFERENCE TO THE COLLECTION OF THE INDIAN MUSEUM.

PART II. THE FAMILY AGRIONINAE.

A. THE SECTIONS PODOLESTES, PLATYCNEMIS, PLATYSTICTA AND PROTONEURA.

By F. F. LAIDLAW, *M.A.*

(Plates XIII—XV.)

INTRODUCTION.

The following account deals with four sections (or legions to use Selys' term) of the Agrionidae (=Coenagrioninae of Kirby's Catalogue.)

The family is the largest of the sub-order Zygoptera; it consists of insects which are for the most part small and delicate, and its species are numerous and often exceedingly abundant in individuals. It is in fact a dominant family of existing Odonata.

In the Eastern tropics, so far as my observations go, and probably in most parts of the world this holds good, the members of the family falling into one or other of two great biological groups :—

I. Those which appear not to be affected adversely by human activities, have a wide distribution as species, and are abundant in cultivated country; and probably pass their larval stages in still or stagnant water. Such for example are the species of the genus *Ischnura* and of *Agriocnemis*, which thrive in the environs even of a great city like Calcutta.

II. Forms whose habitat is uncleared forest and uncultivated land, which tend to disappear with the advent of cultivation; whose larvae probably live for the most part in running water. It is noteworthy that such forms as a rule retain certain characters that may be regarded as primitive, though, beyond question, many of them exhibit extreme specialization in certain directions.

The sections of the family dealt with in the present paper may be grouped mainly in the latter of these biological divisions.

Many of them are rare, or dwell in regions difficult of access, so that it is not surprising to find amongst them a considerable number of new species.

In discussing these and other members of the group, most of which are but little known, I have found it advisable to suggest certain modifications in the accepted classification. Hence this part is more lengthy than that dealing with the Calopterygidae.

I have again to acknowledge my thanks to Messrs H. and F. W. Campion for admirable wing-photographs. I am also indebted to the former for much helpful advice and criticism.

References to Selys' systematic writings on the Agrioninae are given where necessary, for the sake of brevity, as follows :—

Synopsis=*Bull. Acad. Belg.* (2) x, p. 12 *seq.* (1860).
Revision=*Mém. Couv.* xxxviii, p. 8 *seq.* (1886).
Odonates de Birmanie=*Ann. Mus. Civ. Genova* (2) x, p. 433 *seq.* (1891).

I hope to complete this account of the Agrionidae in a subsequent paper dealing with the section or legion "Agrion," with as little delay as possible.

Family AGRIONIDAE.

Genus.	*Species.*	*Range.*
I. Legion PODOLESTES.		Tropical continental lands, New Caledonia.
1. *Argiolestes.*		Himalaya to Burma, Australia, New Caledonia.
	1. *melanothorax*, Selys.	Himalaya to Burma.
II. Legion PLATYCNEMIS.		Old-world Temperate and Tropical lands to New Guinea.
2. *Coeliccia.*		Himalaya, Indo-China to Formosa, Malaya.
	2. *renifera*, Selys.	Himalaya to Assam.
	3. *didyma*, Selys.*	Himalaya.
	4. *bimaculata*, Laidlaw.	Assam.
3. *Calicnemis.*		Himalaya to Burma and Tonkin.
	5. *eximia*, Selys.	Kumaon to Tonkin.
	6. *miles*, n. nov.*	Burma.
	7. *erythromelas*, Selys.*	Burma, Tonkin.
	8. *miniata*, Selys.	Himalaya.
	9. *pulverulans*, Selys.	Himalaya to Assam.
	10. *chromothorax*, Selys.*	Burma.
	11. *mortoni*, n. sp.	Himalaya.
4. *Indocnemis.*		Himalaya, W. China, Malay Peninsula.
	12. *kempi*, n. sp.	Himalaya.
5. *Copera.*		Oriental region to Damascus and Madagascar.
	13. *annulata*, Selys.	India, Burma to Formosa.
	14. *vittata* (races), Selys.	India, Assam, Tonkin, Malaya to Borneo.
	15. *marginipes*, Ramb.	India, Indo-China, Malaya.

Genus.	*Species.*	*Range.*
III. Legion PLATYSTICTA.		Tropical America, Tropical Asia to New Guinea.
6. *Platysticta.*		Ceylon, S. India.
	16. *maculata*, Selys.*	Ceylon.
	17. *apicalis*, Kirby.*	Ceylon.
	18. *deccanensis*, Laidlaw.	Deccan.
7. *Drepanosticta.*		India, Indo-China, Malaya, Papua.
	19. *carmichaeli* (Laidlaw).	Himalaya.
	20. *tropica* (Selys).*	Ceylon.
	21. ? *montana* (Selys).*	Ceylon.
	22. *digna* (Selys).*	Ceylon.
	23. *hilaris* (Selys).	Ceylon.
	24. *quadrata* (Selys).*	Burma, Malay Peninsula.
8. *Protosticta.*		India, Malaya, Celebes.
	25. *gravelyi*, Laidlaw.	Deccan.
	26. *himalaiaca*, n. sp.	Darjiling to Assam.
IV. Legion PROTONEURA.		Tropical America, Africa, Oriental Region, Papua, Australia.
9. *Chloroneura.*		Central India.
	27. *quadrimaculata* (Ramb.).	Central India.
10. *Disparoneura.*		
	28. *tenax.**	Ceylon.
	29. *caesia* *	Ceylon.
	30. *pruinosa.**	Ceylon.
	31. *occlusa.**	Ceylon.
	32. *tetrica*, n. sp.	Deccan.
	33. *nigerrima*, n. sp.	Central India.
	34. *atkinsoni*, Selys.*	Burma.
11. *Disparoneura.*	35. ? *westermanni* *	Nilgiri Hills.
12. *Indoneura.*		W. Penisular India.
	36. *gomphoides* (Ramb.)	
13. *Caconeura.*		Ceylon, Burma, Malaya.
	37. *sita* (Kirby).*	Ceylon.
	38. *verticalis* (Selys).*	Burma to Borneo.
	39. *interrupta* (Selys).*	Burma to Singapore.

Species marked with an asterisk are not in the Indian Museum collection. I have, however, been able to examine examples of most of these either in the collection of the British Museum or elsewhere.

Legion I. PODAGRION, Selys.

Genus **Argiolestes,** Selys.

Argiolestes melanothorax, Selys.

(Pl. xv, fig. 1).

Argiolestes melanothorax, Selys, *Ann. Mus. Civ. Genova* (2) x, p. 500 (1891).
,, ,, Ris, in *Nova Caledonia*, (*Zoologie*), Vol. II, L. 1, No. 4 (1915).
See also Calvert, *Proc. Acad. Nat. Sci. Philadelphia*, 1913, p. 260.

3 ♂ 1 ♀ Darjiling district.
2 ♂ 1 ♀ Gopaldhara, Darjiling district (*H. Stevens*).

Kashmir and Baluchistan.

II { Platycnemis 1

Himalaya.

I { Argiolestes 1

II { Coeliccia 2, *Calicnemis* 4, Indocnemis 1

III { Protosticta 1, Drepanosticta 1

IV { —

Assam.

I { Argiolestes 1

II { Coeliccia 2, *Calicnemis* 3, Copera 2, Indocnemis ?

III { Protosticta 1, Drepanosticta 1

IV { —

Indo-China.

I *Rhipidolestes.*

Central India.

I {

II { Copera

III {

IV { *Chloroneura* 1, Disparoneura 1

Burma.

I { Argiolestes 1

II { Coeliccia ?, Indocnemis ?, *Calicnemis* 4, Copera 2

III { ?

IV { Disparoneura 1, Caconeura

Tonkin.

II { *Calicnemis* 3.

Deccan.

I { —

II { Copera

III { *Platysticta* 1, Protosticta 1

IV { *Indoneura* 1, Disparoneura 1, (D. ? westermanni 1)

Malaya.

I { *Amphilestes*, *Podolestes*

Ceylon.

I { —

II { Copera

III { *Platysticta* 2., Drepanosticta 4.

IV { Disparoneura 4., Caconeura 1.

I=Legion Podolestes.
II= ,, Platycnemis.
III= ,, Platysticta.
IV= ,, Protoneura.

Genera in italics are endemic.

Under Calvert's rubric (*loc. cit.*) this species should fall into the genus *Wahnesia* of Forster. This genus cannot stand : its type species has not been described. As, moreover, Dr. Ris is not disposed to subdivide the genus *Argiolestes* on our present imperfect knowledge, the present species is best left as before, though it is probably generically apart from the Australian species.

No other representative of the 'Legion' has been recorded within the limits of the Indian Empire ; and S. India and Ceylon are at present, I believe, the only large tropical continental areas without such representation.

Legion II. PLATYCNEMIS.

Diagnostic table for the Indian genera.

A. Upper side of quadrilateral shorter than lower side by at least one-fifth of the length of the latter in the fore-wing, usually by more than this.

i. Wing petiolated to the level of Ac.

Wing relatively long and narrow ; usually 2 or 3 cells between the quadrilateral and the sub-nodus.

COELICCIA, Kirby.

Type : *Coeliccia membranipes* (Ramb.).
Distribution : Himalaya, Formosa, Malaya.

ii. Wing ceasing to be petiolated before the level of Ac.

Wing[1] relatively long and narrow, 4 cells between the quadrilateral and sub-nodus. Reticulation very dense (over 300 cells on the hinder-wing).

INDOCNEMIS, n. gen.

Type : *Indocnemis kempi*, n. sp.
Distribution : Assam, ? W. China.

Wing[2] relatively broad and rounded, 3 cells between the quadrilateral and sub-nodus. Reticulation on the fore-wing not so dense (not more than 250 cells on the hinder-wing).

CALICNEMIS, Selys.

Type : *Calicnemis eximia*, Selys.
Distribution : Himalaya, Burma, Tonkin.

B. Upper and lower sides of quadrilateral nearly equal.

Third joint of antennae equal in length to second joint.

COPERA, Kirby.

Type : *Copera marginipes* (Ramb.).
Distribution : Oriental Region, Madagascar.

It may be added that the larvae of A (probably) inhabit quick running streams, of B, so far as is known, slow moving or still water.

Genus **Indocnemis**, nov.

The genus is to some extent intermediate between *Coeliccia* and *Calicnemis*, and probably more primitive than either.

---

[1] *Indocnemis*, hind-wing length to breadth, 68 : 12.
[2] *Calicnemis*, hind-wing length to breadth, 57 : 12 (in *C. pulverulans*).

Indocnemis kempi, sp. nov.

(Pl. xv, fig. 2).

1 ♂ Cheerapunji, Assam, 4000 ft , 2-9-x-14 (*S. W. Kemp*).

Wings hyaline, slightly smoky, pterostigma black, one and a half times as long as broad, covering one and a half cells. Postnodals on fore-wing 22. Length of abdomen 51 mm.; of hinder-wing 38 mm.

Head entirely black save for a pair of small, oval, post-ocular marks on the occiput, which are blue.

Prothorax and *thorax* black, the latter with a pair of antehumeral bands of blue, extending for about two-thirds of the length of the dorsum of the thorax, pointed at both ends and broader below.

Abdomen, legs and anal appendages entirely black, save that the basal two-thirds of the lower pair of appendages are brown. The upper pair are about three-quarters the length of the lower pair, triangular when viewed from above, carrying each two teeth at the ends of a crescentic projection on their under surface. Lower pair slender, rather cylindrical but broad at the base; incurved at their free extremities, and hooked downwards (text-fig. 1).

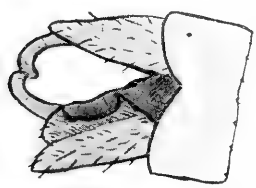


FIG. 1.—*Indocnemis kempi*, sp. nov.
Anal appendages ♂, from above.

RIS (*Supplementa Entomologica*, Berlin, No. I, 1912, p. 67) notes a female probably of this species from Tsa-Yui-San, in Kwangtun, under the name *Coeliccia? orang* (Forster).

Forster's species *Trichocnemis orang* [Forster, in Laidlaw, *Fasc. Malay.* (*Zool.*), Pt. 4, p. 2 (1907)—Perak, coll. Forster] is distinctly smaller.

Its dimensions according to Forster are :—

Length of abdomen 46 mm., of hinder-wing 33 mm.
,, ,, ,, 43 mm. ,, ,, 32 mm.

I do not know the species, which is probably congeneric with *I. kempi*.

Type (male) in the Indian Museum, No. 8200/20.

With this species I have associated the name of Mr. S. W. Kemp of the Zoological Survery of India.

Genus **Calicnemis**, Selys.

Calicnemis mortoni, sp. nov.

1 ♂ Pashok, Darjiling district, 5500 ft., June, 1916 (*F. H. Gravely*).

Wings hyaline, pterostigma black, covering one and a half cells.

Post-nodals on fore-wing 21. Length of abdomen 36 mm., of hinder-wing 29 mm.

Body slender when compared with that of the three common species discussed below. Colouring almost entirely black, with the following exceptions:—

Head.—A small oblique yellow mark on either side of the posterior ocelli, and a narrow transverse line of the same colour on either side of the occiput.

Prothorax.—A minute yellow spot on either side of the middle lobe of the dorsum.

Thorax.—The interalar space is cherry red.

Abdomen.—Segment 1 is dull brown. Dorsum of segment 2 and the base of segment 3 cherry red.

Legs and anal appendages black.

Anal appendages.—Upper pair two-thirds the length of the lower pair, twice as long as the tenth segment; nearly straight, digitiform, each with a small tooth downwardly directed near its base on the under side. Lower pair slender, cylindrical, slightly uncurved, and with a slight downward hook at their apices.

Type (male) in the Indian Museum, No. 3463/H.I.

I have named this species after Mr. K. J. Morton of Edinburgh.

Calicnemis chromothorax, Selys.

Calicnemis chromothorax, Selys, *Ann. Mus. Civ. Genova* (2) x, pp. 70-71 (1891).

This handsome Burmese species is, I imagine, more closely related to *C. mortoni* than to other species of the genus.

The anal appendages of the male appear very similar to those of *C. mortoni*, and in both the abdomen can be described as slender.

Selys' statement as to the length of the hind-wing of the female seems to be a misprint. For the male it is given as from 22-26, for the female 38-40 mm.

Calicnemis eximia, Selys.

Calicnemis eximia, Kirby, *Cat. Ordonata*, p. 131 (1890).
,, ,, Selys, *Ann. Mus. Civ. Genova* (2) x, p. 72 (1891).
,, ,, Martin, *Mission Pavie* [Nevroptères] (sep.), p. 18 (1904).
Calicnemis atkinsoni, Selys, *Ann. Mus. Civ. Genova*, (2) x, p. 72 (1891) ♀.

Kumaon is probably near the western limit of the genus.

The female described by Selys as that of *C. atkinsoni* is a female of the present species. Hence a new name is required for the male referred to that species: it appears distinct from any of the other members of the genus. The female referred to *C. eximia* by Selys in his synopsis belongs really to the next species, *C. miniata*, Selys.

I give below an account of a female of *C. eximia* taken *in copula* with a male.

Head.—Lower and anterior surfaces yellow, as far as the level of the anterior ocellus, with a black line running from eye to eye at the level of the base of the antennae; the two basal joints of the antennae yellow, the remainder black. The yellow colour of the frons has a distinct greenish tinge. The occiput is black with a narrow linear yellow mark lying transversely on either side.

FIG. 2.—*Calicnemis eximia*, Selys. Abdomen ♀, seen from above.

The eyes are yellow for their lower two-thirds, the upper third is brown; the brown colour is separated from the yellow by a darker margin which runs latitudinally, and joins the black transverse band on the frons at the level of the base of the ocelli.

Prothorax.—Dorsally black, yellow at the sides and below.

Throax.—Dorsum black with rather broad yellow antehumeral bands; sides and under-surface yellow with a black band at the level of the second lateral suture.

Abdomen yellow; the first segment with a fine black basal triangle; the remaining segments all with a broad bronze-brown longitudinal band dorsally occupying their whole length. On segments 2–6 this band is narrowed at the base of the segment, so that each of these segments has a small pair of basal yellow lunules when looked at from above; segment 7 has a similar narrowing apically, whilst segments 8–9 show both basal and apical lunules. The sternal plates of segments 2–7 are also brown, except at their extremities (text-fig. 2).

The legs are yellow; the two anterior pairs have a slight orange tinge, and the posterior surfaces of the femurs have each a brown line. The pterostigma is brown. Superior anal appendages yellow.

Calicnemis miniata, Selys.

Calicnemis miniata, Kirby, *Cat. Odonata*, p. 131 (1890).
Calicnemis eximia, Selys, *Synopsis*, p. 160 (♀)?

♂ ♂ ♀ ♀ Gopaldhara, Darjiling district (*H. Stevens*).
♂ ♂ ♀ ♀ Darjiling district.

The female of this species does not appear to have been described fully.

Head.—Lower and upper lip, ante- and post-clypeus yellow; the ante-clypeus with a pair of black spots, the post-clypeus with a rectangular black mark, genae and frons as far as the level of the base of the antennae greenish-yellow, the rest of the head black, with a transverse yellow band from eye to eye at the level of the anterior ocellus, and a fine yellow line on either side of the occiput, the lower two-thirds of the eyes greenish-yellow, the upper third black.

Prothorax.—Dorsum black, the sides and under surface yellow.

Thorax.—Black above, with greenish-yellow antehumeral bands, rather narrower than those of *C. eximia*; sides and under surface yellow with a black line on the second lateral suture.

Abdomen reddish-brown, segments 1–6 with a terminal black band, becoming broader on segment 6. Segment 1 with a black triangle dorsally occupying its whole length (in mature females). A fine black line runs along the mid-dorsal carina of the first six segments, it is however scarcely evident on segments 5 and 6 of fully mature females. The remaining abdominal segments are entirely black, save for some traces of reddish-brown at the base of 7. Superior appendages black.

Legs yellow, the posterior surfaces of the femurs with broad black line, and the posterior parts of the tibias brown, tarsi black.

Pterostigma very dark brown, almost black.

Calicnemis pulverulans, Selys.

(Pl. xv, fig. 3).

Calicnemis pulverulans, Kirby, *Cat. Ordonata*, p. 131 (1890).

♂ ♂ ♀ ♀ Darjiling district.

♂ ♂ ♀ ♀ Gopaldhara, Darjiling district (*H. Stevens*).

♂ Young. *Head.*—Lower lip yellow, upper lip black with yellow margin, genae and lower two-thirds of eyes pale greenish-yellow, the rest of the head black save for a narrow yellow band running across the frons immediately in front of the anterior ocellus, and a pair of narrow linear yellow marks on the occiput behind the eyes.

Prothorax black dorsally, sides and under surface pale yellow.

Thorax black above with broad pale yellow antehumeral bands; pale yellow at the sides and below with a black line on the second lateral suture.

Abdomen yellowish-brown, paler below, the posterior segments becoming progressively darker, the last three being entirely black. Sutures marked with a black ring, the apices of segments 2–6 with a very fine pale yellow ring, incomplete in the mid-dorsal line. Anal appendages yellowish-brown, legs black, base of femurs yellow, especially anteriorly.

As the male becomes mature its colouring becomes rapidly darker.

A fully adult male has the margin of the upper lip and genae still yellow; the yellow markings on the frons and occiput are replaced by blue primrose marks. The yellow of the prothorax, and the yellow antehumeral thoracic marks are similarly altered ; the sides of the thorax are more extensively marked with black. The abdomen is almost entirely black, segments 4–5 showing some dark brown colour. The anterior segments especially have a blue pruinescence; the legs are entirely black, pulverulent like the abdomen.

Lastly, an old male is almost entirely black, the only colouring being on the extreme of the upper lip, which still remains yellow, and the lower two-thirds of the eyes, which are of a bluish-green colour. The sides of the thorax have become entirely black, the pruinescence is retained on the top of the head, and on the antehumeral bands of the thorax. The black of the abdomen is intense and metallic.

♀ *Young*.—Colouring almost identical with that of the young male, the chief difference seems to be that the yellow margin of the upper lip is more extensive than in the male sex.

The first indication of approaching melanism is the appearance of a narrow, very dark brown band, running longitudinally on the dorsum of abdominal segments 2–4, whilst the remaining distal segments pass progressively from very dark brown to black.

It may be remarked that at this stage the female bears some resemblance in colour pattern to that of *C. eximia*.

A female coloured thus was taken *in copula* with a male in the 'all black' stage.

More adult females pass through the same colour change as the males, reaching ultimately the condition of blackness relieved only by the pale yellowish green of the lower part of the eyes; in this state also they are taken mating.

The three species noted above are evidently at least locally abundant, and presumably occur together, as I have before me bottles containing spirit specimens of two or in some cases three species apparently collected indiscriminately and in considerable numbers.

The remaining species of the genus must be very rare on the Himalayan range, or more probably do not occur there at all, as they are unrepresented in the Museum collection and in Mr. Stevens' series.

Calicnemis miles, nom. nov.

The synonymy involved here is as follows:—

(1) *Calicnemis eximia*, Selys, *Synopsis*, 1863.
,, ,, race *atkinsoni* ♀, *Revision*, 1886.
,, ,, *atkinsoni* ♀, *Odonates de Birmanie*, 1891.
(2) *Calicnemis miniata*, Selys, *Revision*, 1886.
,, *eximia* ♀, *Synopsis*, 1863.
(3) Sp. *innominata* = *miles*.
Calicnemis atkinsoni ♂, *Odonates de Birmanie*, 1891.

TABLE OF THE SPECIES OF *CALICNEMIS*.

♂ A. Legs yellow or orange.
i. Abdomen entirely scarlet ... ... *C. eximia*, Selys.
ii. Abdomen with black articular rings, segments 9, 10 dark. *C. miles*, n. n.

B. Legs largely black.
  i. Abdomen slender, 35 mm. or more in length.
    a. Thorax black (in *adult* male) ... *C. mortoni*, sp. n.
    b. Thorax largely brilliant chrome yellow.
      C. chromothorax, Selys.
  ii. Abdomen stout, about 30 mm. long or less.
    a. Abdomen of young males yellow marked with black, of adult males brownish-black or entirely black.
      C. pulverulans, Selys.
    b. Abdomen dark carmine-red marked with black.
      1. Upper lip red-brown, lower anal appendages longer than upper pair ... ... *C. miniata*, Selys.
      2. Upper lip black, lower anal appendages not longer than upper pair ... ... *C. erythromelas*, Selys.

♀ A. Legs yellow.
  Dorsum of abdomen bronze-green (in adult). *C. eximia*, Selys.
B. Legs largely black.
  i. Abdomen yellow with black marks.
    a. Terminal segments black (or whole abdomen black in fully adult specimens ... *C. pulverulans*, Selys.
    b. Terminal segments marked with yellow.
      C. chromothorax, Selys.
  ii. Abdomen crimson with black marks.
    a. Upper lip black ... ... *C. erythromelas*, Selys.
    b. Upper lip red-brown ... .. *C. miniata*, Selys.

Genus **Coeliccia**, Kirby.

I regret to find that I have caused considerable confusion in the synonymy of this genus. It is one where adequate material is very necessary, as the species are decidedly difficult. I take the opportunity here of correcting my previous mistakes.

Species of the genus will probably prove numerous; from Borneo I have seen several undescribed forms. The structure of the anal appendages of the male and of the prothorax of the female are of especial importance in discriminating the species.

The genus has been divided by Selys with two sections dependent on the position of the sectors M3, RS, with regard to the subnodal cross vein.

It is possible that some use may be made of the thoracic colour pattern in grouping the species according as to whether :—

(*a*) Males and females both have an 'antehumeral' band (as in *C. membranipes*).

(*b*) Males have round or oval spots on either side of the thoracic carina, females with antehumeral band (*e.g. C. renifera*, Selys).

(*c*) Both sexes have round or oval spots on either side of the thoracic carina (*e g. C. flavicauda*, Ris).

Presumably those species falling under (*c*) are the most specialized, at any rate as regards colour.

The thoracic colour pattern is certainly very interesting; species of the genus have apparently evolved, within the limits of the genus, an arrangement widely different from their allies. But the whole 'Legion' is characterized by a tendency to originality in colouring.

The grouping of the species adopted by Selys, which depends on the position of M3, RS, relative to the subnodal cross-vein, seems to be a natural one as it is supported by the geographical distribution of the species.

Thus the species agreeing with *C. renifera* in this respect are all found in the Himalaic mountain complex and its outlying spurs; those akin to *C. membranipes* are more definitely Malayan with their headquarters in Borneo. In the accompanying table I have attempted to give the chief characteristics of the *C. renifera* group so far as they are known to me. The table is, of course, largely compiled from Dr. Ris' article on species of the genus (*Supplementa Entomologica*, No. 1, 1912, pp. 61–67; Berlin).

Martin has recorded *C. octogesima* (Selys), *C. renifera* (Selys), and *C. membranipes* (Ramb.) from Tonkin (Martin, *Mission Pavie* (Nevroptères), 1904). I think it possible that the Tonkinese form of *C. renifera*, at any rate, may prove to be distinct from species of the type locality.

TABLE.

M_3 proximal to nodus, MS distal.

Costal side of quadrilateral of fore-wing about one-third shorter than anal side.

Space between quadrilateral and subnodus normally with two cross-veins (*i.e.* 3-celled).

a. Costal side of pterostigma about one-third shorter than anal side.

♂ segments 9, 10 blue; thorax of ♂ and ♀ similar.

C. brachysticta, Ris.—Philippine Is.

b. Costal and anal sides of pterostigma sub-equal.

i. ♂ segments 9, 10 orange; anal appendages orange; thorax of ♂ and ♀ similar.

C. flavicauda, Ris.—Formosa.

ii. ♂ segments 9, 10 black (marked with blue), anal appendages black; thorax of ♀ with complete antehumeral band.

C. erici, n. sp.—Malay Peninsula.

iii. ♂ segments 9, 10 largely blue, anal appendages brown; thorax of ♀ with complete antehumeral band.

C. simillima, n. sp.—Malay Peninsula.

Costal side of quadrilateral of fore-wing about one-fifth shorter than anal side.

I. Space between quadrilateral and subnodus normally with one cross-vein.

C. bimaculata, Laidlaw.—Assam.
(? = *C. didyma*, Selys).

II. Space between quadrilateral and subnodus normally with two cross-veins.

i. ♂ segments 9, 10 and anal appendages blue; thorax of ♀ with narrow antehumeral band.

C. cyanomelas, Ris.—Formosa.

ii. ♂ segments 9, 10 (adult) and anal appendages black; thorax of ♀ with complete antehumeral band.

C. renifera (Selys).—Himalaya.

A specimen in the British Museum from the Chin Hills labelled *Coeliccia didyma* is certainly quite distinct from *C. bimaculata*. I have not been able to satisfy myself that this specimen is certainly the true *didyma*, but as I had no sufficient time to examine it fully I can give no reason for supposing that it is not correctly referred to that species.

Coeliccia renifera, Selys.

(Pl. xiii, figs. 1–3; pl. xiv, fig. 3).

Coeliccia renifera, Kirby, *Cat. Odonata*, p. 128 (1890).

9 ♂ ad., 4 ♂ juv., 4 ♀ ad. Pashok, 2000-4000 ft., Darjiling dist., 7—14-vi-16 (*F. H. Gravely*).

♂ Abdomen 44 mm., hind-wing 27·5 mm.

♀ ,, 40 mm., ,, ,, 27·5 mm.

♂ *Adult.*—Lower lip and lower two-thirds of eyes yellowish-green. Rest of head and upper surface of eyes black, except the anteclypeus and genae which are silvery blue, and a small yellow transverse post-ocular mark.

Prothorax entirely black.

Thorax black with a pair of oval-oblong, silvery blue spots on either side of the mid-dorsal carina, extending from below for about half its length; and a large mark of the same colour laterally divided into two by a black line along the second lateral suture.

Abdomen brownish-black, paler below; at the apex of each segment from the third to the eighth is a paired ventro-lateral spot of a bluish-white colour.

Legs white. Posterior surfaces of femurs, anterior surface of tibias black, likewise tarsi and spines.

Anal appendages white, the tips of lower pair black.

♂ Juv.—Black marks on head not nearly so developed as in adult. The upper lip is yellowish-white, and there is a broad yellowish band running from one eye to the other across the head at the level of the anterior ocellus. Upper third of eyes abruptly darker than lower parts.

Prothorax entirely yellow, with the exception of the anterior and posterior margins which are marked with black.

Thorax brownish-black dorsally, with well-marked antehumeral stripes, exactly matching those of the female, and internally to these are the oval markings of the adult male; these along their border coalesce with the antehumeral band. Sides and under surface of thorax pale yellow, with vestige of black stripe along the second lateral suture.

Abdomen pale brown, darker at articulations. Segments 9 and 10 whitish-yellow.

♀ *Adult.*—Coloured much as the young male, but with the anteclypeus black, and the dorsum of the thorax entirely without the oval markings characteristic of the male. The dorsal parts of segments 4, 5 are more darkly coloured than in the young male, and the posterior half of 9 and the whole of 10 is of a whitish-yellow.

Coeliccia erici, sp. nov.

Trichocnemis renifer, Laidlaw (nec, Selys), *Fasc. Malay.* (Zool.) IV, p. 2 (1907).

1 ♂ 2 ♀ ♀ Bukit Besar, Jalor, Malay Peninsula, 2500 ft.

♂ Abdomen 45 mm., hind-wing 26 mm.
♀ ,, 40 mm., hind-wing 27 mm.

♂ *Head* (damaged).—Upper lip metallic black, genae ? blue. Rest of dorsal surface black, with a pair of small wedge-shaped post-ocular blue spots.

Prothorax (damaged).—Largely black, probably a yellow spot on either side.

Thorax.—Dorsum black as far as first lateral suture, marked in front on either side of the mid-dorsal carina along its lower two-fifths with a very large almost circular spot of bright blue. This spot appears to be homologous not only with the oval spot of *C. renifera*, but also to include the persistent lower end of the antehumeral band. Sides and lower surface pale yellow with an incomplete black band at the second lateral suture.

Abdomen.—Segments 1, 2 black above; 3–8 brown, darker at the articular rings; 9, 10 black (probably) marked with blue dorsally; anal appendages blackish-brown. Upper pair longer than lower pair, and when viewed from above flattened and truncate. In profile they appear shaped rather like the blade of a table knife, and each carries two small downwardly directed teeth separated from one another by a concave edge. Lower pair stout, of the shape characteristic of the genus, curved inwards to meet each other at their extremities, and at the same time hooked downwards (text-fig. 3).

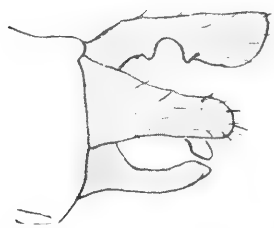


FIG. 3.—*Coeliccia erici*, sp. nov. Anal appendages ♂, obliquely from above.

♀ (much damaged). Head as in male?

Prothorax with a very large yellow mark on either side of middle line separated by fine back line, anterior and posterior lobes black. Posterior margin gently concave, with minute projection backwards in the middle line.

Thorax with broad yellow antehumeral bands.

Abdomen dark brown, passing to black-brown apically. Segments 8, 9 with apical dorsal, crescentic yellow mark.

I have named this species after a soldier who fell in 1915 and also after my little son his cousin.

Coeliccia simillima, sp. nov.

Trichocnemis octogesima, Laidlaw (nec Selys), *Fasc. Malay.* (Zool.) IV, p. 4 (1907).

4 ♂ ♂ 1 ♀ Bukit Besar, April, May, September, 2000 ft.

♂ Abdomen 40 mm., hind-wing 26 mm.
♀ (much shrivelled) ,, 25·5 mm.
"Thorax sky-blue and black; abdomen black with blue tip."

♂ *Adult.*—Head black, anteclypeus and genae blue. Post-ocular marks of the same colour, almost circular.

Prothorax black, with a pair of small lateral spots which are blue.

Thorax black above, a pair of oblong-oval blue spots on either side of the mid-dorsal carina, extending to about the lower two-fifths of its length, and above these a much smaller pair of linear blue marks. Sides and under surface yellow with black line along second lateral suture.

Abdomen.—Segments 1–2 black, with some yellow at the sides, and a small median dorsal blue line on 2; 3–8 brownish-black, each with a very small pair of yellow spots laterally at its apex; 9–10 blue above, basal third of 9 black. Anal appendages: upper pair black, tipped with yellowish-white at the extremity; with a fine black basal tooth, and a larger hook-like projection at the end of the middle third, both directed downwards; apex subacute. Lower pair brown, pincer-like, a little longer than the upper pair.

♀ In poor condition, immature and shrivelled. The thorax shows a pair of yellow antehumeral bands.

It is evident that this species strongly resembles *C. octogesima* (Selys). I have not access to any authentic example of the latter species and the published descriptions are not very full. It would appear to be smaller than *C. simillima*, and to differ in details of colouration. Granting the venational characters to be constant there should be no difficulty in separating the two species.

Coeliccia didyma, Selys.

Coeliccia didyma, Kirby, *Cat. Odonata*, p. 123 (1890).

I have not seen an authentic example.

Coeliccia bimaculata, Laidlaw.

Coeliccia bimaculata, Laidlaw, *Rec. Ind. Mus.* VIII, iv, p. 341, pl. xvi, fig. 1 (1914).

1 ♂ Abor Expedition.

The specimen is rather immature. The statement that the space between the quadrilateral and nodus is occupied by a single cell is true only for one wing, the right hind-wing, the other wings in each case have two cells in the space, *i.e.* one cross nerve, the latter condition is probably normal.

Unfortunately the account of *C. didyma* is not very full, and it is not possible at the present time to see the type specimen. I note the following differences between the description of *C. didyma* and the type of *C. bimaculata*.

	C. didyma.	*C. bimaculata.*
Prothorax ...	Black with large light round spot on each side.	Yellow with anterior and posterior margins black.
Thorax ...	An upper pair of small blue spots near the wings on the dorsum.	Upper pair of spots absent.
Abdomen ...	Segment 1 black above, yellow at the sides.	Segment 1 yellow with semicircular brown mark anteriorly.
Size ...	Hind-wing 24 mm. ...	Hind-wing 22 mm.

It must be noted that the anal appendages of the described specimens are very similar.

Coeliccia albicauda (Forster).

Trichocnemis octogesima albicauda, Forster (as race).
Trichocnemis borneensis, Laidlaw (nec. Selys), *loc. cit.*

Some time ago I re-examined the male specimen which I had regarded as probably belonging to Selys' species. I found it to agree with the form described by Forster as a race of *octogesima*, and now believe it to have been identical with that form, which is certainly distinct from the true *octogesima* and worthy of specific rank. Unfortunately the two specimens, male and female, taken *in copula* at Kwala Aring have been destroyed in the meantime.

I have examined specimens of several species from Borneo, male and female, and find so much resemblance amongst the females that in my opinion it will be a matter of no little difficulty to determine in the future what is the male of the real *borneensis*.

The present species differs then obviously from *C. octogesima* in that the female has no antehumeral band; and is also almost certainly distinct from *C. borneensis*.

It is to be hoped that material from the type locality may be forthcoming, which will settle the question.

I have been able to identify a larval form from Kalimpong as belonging to *Calicnemis* (No. 85/H.I., April-May, 1910, F. H. Gravely). It is very different in appearance from the larva of *Copera annulata*, its legs are relatively short, the body stouter and instead of the very long gill lamellae of *Copera* there are very short strongly ridged lamellae, shaped like a spear-head, triradiate in transverse section, not so long as the mask. The differences between the two larvas are so striking as to suggest that the two genera are not really closely related, but show a convergent similarity in their venation. A point of interest and one that will perhaps help to throw light on the question is that in the *Calicnemis* larva I have been able to determine that the tracheae which supply *RS* and M_3 rise from a common stalk from the main trunk of *M*. This feature may be the explanation of the remarkable venation found in *Prionocnemis*.

Genus **Copera**, Kirby.

(= *Psilocnemis*, Selys).

Copera annulata (Selys).

Copera annulata, Kirby, *Cat. Odonata*, p. 129 (1890).
Copera annulata stevensi, Laidlaw, *Rec. Ind. Mus.* VIII, iv, p. 341, pl. xvi, fig. 2 (1914).

1 ♂ North Lakhimpur, foot of hills, Upper Assam (*H. Stevens*) (type of *stevensi*).

1 ♂ with larval skin, from Museum tank, Calcutta, emerged April 4th, 1915, No. 3015/21.

Selys (*Revision*) expresses the opinion that there is but a single species ranging from Japan to Sumatra and Assam which includes perhaps varieties and not local races. He observes that the females cannot be distinguished. The 'races' named are :—

C. subannulata (Selys).—Tenasserim, Calcutta.
,, *ciliata* (Selys).—Malacca.
,, *serapica* (Selys).—Nicobars.
,, *stevensi* (Laidlaw) —Assam.

It is evident that the species is one of which long series are necessary for determining the value of the differences which exist between individuals.

The larval skin is incomplete and lacks the mask. I hope later to publish an account of the larval forms of Indian dragonflies, so will not attempt an account here beyond that the legs are long and slender, and the caudal lamellae are linear-lanceolate, occupying about two-fifths of the total length of the larva.

Copera marginipes (Ramb.).

(Pl. xiv, fig. 2).

Copera marginipes, Kirby, *Cat. Odonata*, p. 129 (1890).
,, ,, Martin, *Mission Pavie* [Nevropteres] (sep.), p. 18.
Psilocnemis marginipes, Kruger, *Stettin Ent. Zeit.* 1898, p. 102.

1 ♂ Parambikulam, 700–3200 ft., Cochin State, September, 1914 (*F. H. Gravely*). No. 8265/H.I.

2 ♂ ♂ 2 ♀ ♀ Nagpur, C.P., 1000 ft., August, 1915 (*E. D'Abreu*).

1 ♂ Mormugao, Portuguese India, August 1916. No. 4369/H.I.

This species is characterized by the moderate dilatation of the two hinder pairs of tibias in the male, and by the very short superior anal appendages of the same sex These are about one-quarter as long as the stout lower pair This well-known species shows striking age variations.

Young males and females are white, the abdominal segments ringed with black, giving a very striking, almost ghostly, appearance to the living insect. Adult specimens appear almost black, the legs bright orange.

The eyes as seen in spirit specimens have a remarkable appearance. The upper and lower poles are of pale gray ; there is a fine equatorial belt of the same colour and on either side of this a narrow zone of brownish-black. The upper of these zones is continuous with the dark transverse line on the frons.

Locally this species, which is widely spread, seems to vary but little. Specimens from the Malay Peninsula, with which I have been able to compare Indian examples, have perhaps a more pronounced white mark at the apex of abdominal segment 8. Otherwise there seems to be no differences of importance.

Copera vittata (Selys).

Copera vittata, Kirby, *Cat. Odonata*, p. 129 (1890).
,, ,, see Förster in Laidlaw, *Fasc. Malay.* (Zool.) iv, 2, p. 7.
,, ,, Laidlaw, *Rec. Ind. Mus.* VIII, iv, p. 342.

The males of this species are characterized by the absence or slight indication of dilatation of the four posterior tibias, and by the length of the upper pair of anal appendages, which equals one-half (roughly speaking) that of the lower pair.

In the case of this species it is possible to recognize a certain number of races which appear to be quite clearly defined.

I have been able to compare specimens from three localities only, from Borneo, Assam, and Cochin State, S. India; the adult of the typical race from the Malay Peninsula is unknown to me. Also I regret I have not more than a few specimens available in each case, and no females from Assam.

The Bornean race *C. vittata atomaria*, Selys, is very distinct, the upper surface almost entirely black; in the adult the antehumeral bands of the thorax are obsolescent, segment 10 of the abdomen remains yellowish-white, and the upper surfaces of the anal appendages are of the same colour. The legs are of a rich orange-brown and the tibias show no indication of lateral dilatation.

Length of hind-wing 19 mm., of abdomen 32 mm.

The Assam race *C. vittata assamensis*, Laidlaw, is largely russet-brown in colour, notably the vertex which in the other two races noted here is intense black. Likewise the upper surface of the abdomen is dark brown, and the white apical mark begins on segment 9. The legs are brown, quite different from the reddish legs of *C. atomaria*, or the bright yellow legs of the next race.

Copera vittata deccanensis, subsp. nov.

2 ♂ 1 ♀ Parambikulam.

♂ Adult. *Head.*—Upper lip, genae and anteclypeus greenish-white, frons and occiput black, with a broad creamy-white transverse band covering the ocelli. A pair of linear post-ocular lines.

Prothorax black above, with lateral yellow marks, bright lemon-yellow below.

Thorax black dorsally, creamy white antehumeral bands present, sides yellow, mottled with black.

Abdomen black, segment 2 with fine longitudinal yellow line dorsally; 4–7 with small apical bluish-white lunules, 9 white above, 10 entirely white.

Anal appendages.—Upper pair white, lower pair white tipped with black.

Legs lemon-yellow, the posterior pairs of tibias distinctly though slightly dilated.

Length of hind-wing 16·5 mm., of abdomen 29 mm.

The female is coloured as the male, though duller, the legs and under surface of the thorax being of a dull white. On segment 9 of the abdomen is a square apical white mark. Segment 10 is brown below, and the general colour of the abdomen is rich brown, not black.

The adult of the Bornean race is very distinct in appearance. In fact it bears at first sight a close likeness to certain species of *Caconeura* (especially to *Caconeura verticalis*, Selys) with which I have more than once received it. The rich brown-red colour of the legs and the almost entirely black body give it an appearance strikingly unlike that of other species of the genus.

Specimens from Kwala Aring in the Malay Peninsula identified by me as *C. atomaria*, Selys (*Proc. Zool. Soc. Lond.*, 1902, p. 356) are all immature and their proper designation must remain doubtful.

Legion III. PLATYSTICTA, nov.

Rather large or moderate-sized Agrionid dragonflies, with a long and rectangular quadrilateral, without supplementary sectors. Ab absent, or (probably) represented by a nerve descending *from the lower side of the quadrilateral* to join Ac or the hinder margin of the wing. Cu_2 represented only by Cu_{2b}. Cu_1 normal or reduced. Pterostigma trapezoidal. Wings falcate, a supplementary basal post-costal nerve always present. Body generally very slender, legs with long cilia.

Distribution :—Tropical America, Tropical Asia to New Guinea.

The distinctness of the forms included in this new 'Legion' from the *Protoneura—Disparoneura* series, can scarcely be questioned, especially when the more primitive members of each series are compared together.

The following are the genera of the 'Legion' with their differentiating characters :—

A. Cu_1 extending beyond half the wing length.

PALAEMNEMA, Selys.
Type: *P. paulina* (Drury).
Distribution : Tropical America.

B. Cu_1 not reaching half the length of the wing.

I. RS markedly fractured.

Ab present, joining Ac. Sectors of arculus not stalked.

PLATYSTICTA, Selys.
Type: *P. maculata*, Selys.
Distributions : Ceylon, S. India.

II. RS straight.

a. Ab present, joining Ac, or hinder margin of wing 'sectors of arculus' stalked.

DREPANOSTICTA, nov.
Type: *D. carmichaeli* (Laidlaw).
Distribution : Ceylon, India, Burma, Tonkin, Malaya to New Guinea.

b. Ab absent.

PROTOSTICTA, Selys.
Type: *P. simplicinervis*, Selys.
Distribution : S. India, Himalaya, Malay Peninsula, Borneo, Celebes.

The distinction between *Drepanosticta* and *Protosticta* is not of great importance, and is liable in individual cases to break down.

The two genera may, however, be retained at least as a matter of convenience.

I have not found it possible to hit on a good character to further sub-divide the genus *Drepanosticta* though it is likely that the genus can be further broken up. I have been able to examine some seven species of the genus, for the purpose of defining the genus, and I find that the point of attachment of '*Ab*,' and likewise the point of origin of M_3 and *Ms*, shows a certain amount of individual variation.

On the whole the Ceylon species have the least reduced venation. I have selected *D. carmichaeli* as type of the new genus because it is a well-characterized species, and with a fair number of specimens at hand I have been able to deposit a paratype in the British Museum and in my own collection.

Genus **Platysticta**, Selys.

Platysticta deccanensis, Laidlaw.

Platysticta maculata deccanensis, Laidlaw, *Rec. Ind. Mus.* XI, p. 388, text-fig. 1 (1915).

Length of hind-wing 34 mm., of abdomen 46 mm. Post-nodals on fore-wing 22–23. Pterostigma one and a half times as long as it is broad, covering more than one cell, brown with a fine white margin.

Head.—Upper surface black, basal half of upper lip, ante- and post-clypeus bluish-white.

Prothorax brown, its anterior lobe yellowish-white.

Thorax rich cinnamon-brown, paler below, the mid-dorsal carina and alar sinuses black.

Abdomen.—Segments 1–2 dark brown with lighter brown marks on the sides, 3–7 very dark brown, black at the articular rings, 8–9 pale blue above, black below, 10 black.

Anal appendages black. Upper pair more than twice as long as segment 10, sharply bent down at the middle. Lower pair nearly straight, hooked inwards at their extremity.

Legs brown, articulation of the femurs yellow, cilia brown.

The Museum collection also includes a female belonging to this genus and probably to the present species from Cochin State (Forest Tramway: mile 10–14, alt. 0–300 ft., 28-ix-14, No. 8272/20, taken by Mr. Gravely). The colouring of the head and prothorax agrees with that of the males described above. The thorax is black above, with bluish-white antehumeral bands; brown at the sides and paler below. The abdomen is brown with lilac coloured lateral spots on segment 10.

Length of hind-wing 28 mm., of abdomen 36 mm.

Platysticta maculata, Selys.

Platysticta maculata, Kirby, *Cat. Odonata*, p. 132 (1890).

A species apparently confined to Ceylon. A specimen in the British Museum labelled *Platysticta tropica*, from Ceylon, is also a true *Platysticta*. I have not had opportunity to satisfy myself as to the correctness of the specific determination, but it appears distinct from *P. maculata*, Selys, and *apicalis*, Kirby.

Platysticta apicalis, Kirby.

Platysticta apicalis, Kirby, *Journ. Linn. Soc. Lond.* (Zool.) XXIV, p. 561, pl. xlii, fig. 1, ♀ (1893).

Like the last confined to Ceylon. The only old-world species of the Legion with coloured wings.

Genus Drepanosticta, nov.

Drepanosticta carmichaeli (Laidlaw).

(Pl. xiv, figs. 1, 4; pl. xv, fig. 5)

Protosticta carmichaeli, Laidlaw, *Rec. Ind. Mus.* XI, p. 390, fig. 3 (1915).

Kalimpong, 500–4,500 ft., No. 74/H.I., April 1915 (*F. H. Gravely*).

Pashok, 2,500 ft., Nos. 3410/H.I., 3441/H.I., 3801/H.I., 3411/H.I., May-June, 1916 (*F. H. Gravely*).

The type specimen and others secured with it were in a bad state of preservation and give no idea of the beautiful colouring of the living insect. Fortunately fresh material enables me to remedy the defective description given in my first notice of the species.

Venation.—Vestige of *Ab* entirely separated from *Ac*. Sectors of arculus with long stalk. M_3 descending from subnodal vein. *RS* distal 13–16 postnodals on front wing.

Head.—Upper lip, genae and anteclypeus pale blue. Postclypeus and frons to level between the anterior ocellus and posterior pairs black, second joint of antennae pale blue. Irregular pale blue band across vertex from in front of posterior ocelli to occiput, the latter black. Eyes pale blue, with an equatorial band of grey, wider in front.

Prothorax olive-green dorsally, becoming laterally pale blue, sides and under surface rich brown-black.

Thorax olive-green dorsally, fading to pale blue humeral stripes, succeeded by golden-brown colour at the sides. This in passing ventrally becomes intensified to brown-black. A pale, silvery blue line on the second lateral suture.

Abdomen brown, segment 2 with a longitudinal, blue band dorsally. Segments 3–6 have a narrow, pale blue mark at the base and a dark ring apically; 7 except for a bright blue spot at the base dorsally is black, 8–9 brilliant light blue, 10 black with dorsal blue mark.

Anal appendages black. *Legs* yellowish-white.

Length of hind-wing 24 mm., of abdomen 36 mm.

The female specimens are teneral and in bad preservation. The colouring appears to be similar to that of the male, except that segment 8 of the abdomen is dark coloured.

A male (No. 3410/H.I.) has a remarkable abnormality of the vestigial *Ab* on the right hind-wing. On this wing the vestige consists of two transverse nerves united by a minute cross-vein so as to be **H**-shaped.

A second male (No. 3801/H.I.), in poor condition, has lost this vestige altogether on the right hind-wing, so that evidently the distinction between *Drepanosticta* and *Protosticta* occasionally breaks down in this species at least.

Genus **Protosticta**, Selys.

Protosticta gravelyi, Laidlaw.

Protosticta gravelyi, Laidlaw, *Rec. Ind. Mus.* XI, p. 390, text-fig. 2 (1915).

1 Talewadi, near Castle Rock, N Kanara District, 3-x-16 (*S. Kemp*). No. 4389/H.I.

♀ Adult. *Head* as in the male; it should be added that the dorsal surface of the eyes is black, the rest a grayish-white.

Prothorax and *thorax* as in the male.

Abdomen black, segments 3–8 each with a white basal ring relatively small on segments 1–7, but occupying about one-half of the length of segment 8; increasing gradually from segments 1–7 on the last of which it is actually larger than on segment 8. These rings are more extensive on the sides and ventral surface of the segments than they are dorsally. Segment 9 is entirely black. Length of hind-wing 20·5 mm., of abdomen 40 mm.

The nerve referred to as Cu_2 in the original description of the male is the nerve I now regard as *Ac*.

Protosticta himalaiaca, sp. nov.

(Pl. xv, fig. 6).

Kalimpong, Darjiling district, 500–4,500 ft.

Pashok, 5,500 ft., May-June, 1916. No. 3465/H.I.

Kalimpong, teneral and in bad condition.

The representatives of this fine large species are unfortunately all somewhat immature, so that it is possible that the colouring of the male when quite adult may differ from the description given below. As the species should be very readily refound, I think it worth while to give it a name.

♂ Juv. *Head.*—Upper lip whitish edged with black, anteclypeus and genae creamy-white, the rest of the upper surface metallic black, with green reflex.

Prothorax black above, with indications of pale lateral lines, creamy-white below.

Thorax metallic black as far as first lateral suture, sides and under surface creamy-white with broad black lateral band along second lateral suture.

Abdomen brown, each of segments 2–9 with black apical ring, and 3–7 with whitish apical ring (probably blue in the adult), widening on the sides. Apical half of 8–9 whitish (or blue in the adult); 10 entirely brown.

Anal appendages.—Upper pair about equal in length to segment 10, light brown, curved downwards, the distal half blade-like. Lower pair white, slender, cylindrical, a little longer than the upper pair, incurved at the extremity. Each carries a small inwardly directed spur at its middle.

♀ Colouring as in male, but segments 8–10 of the abdomen entirely brown.

Length of hind-wing 30 mm. Post-nodals 15–17 on forewing.

I have examined an imperfect, immature male of this species sent to me by Mr. H. Stevens.

The species of the genera *Drepanosticta* and *Protosticta* will in all probability turn out to be numerous and I am inclined to think that the habitats will also prove quite restricted. *Drepanosticta quadrata* (Selys) is recorded from the Malay Peninsula and Burma; I cannot feel sure that the Burma specimen is co-specific with the Peninsular insect.

Legion IV. PROTONEURA, Selys (restricted).

Agrionid dragonflies, with a long and rectangular quadrilateral without supplementary sectors.

Ab normal, vestigial or absent; never attached to the quadrilateral.

Cu_2 represented only by Cu_{2b}, or absent. Cu_1 normal, reduced or absent. Pterostigma rhomboidal. No supplementary basal post-costal nerve. Wings not falcate. Size moderate, body slender, or very slender. Legs with long cilia.

Distribution:—Africa (excl. Madagascar ?), Tropical Asia, and Australasia, Tropical America.

I have but little acquaintance with American forms of the Legion. I take their relationship to Old World forms as a matter of course.

The following table shows the grouping of regional genera which I suggest, and indicates the characters on which I rely to establish them:—

A. *Ac* lies at a level about midway between the two costal antenodal nerves.

I. *Ab* normal (*i.e.* meeting the nerve descending from the distal end of the quadrilateral (Cu_{2b}).

Hinder margin of prothorax of female crenate or dentate.

a. Wings broad (length to breadth 4 : 1). Cu_1 reaching hinder margin of wing beyond half the wing length. Body rather stout. Wings of males coloured.

CHLORONEURA, gen. nov.

Type: *C. quadrimaculata*, Ramb.
Distribution: Central India.

b. Wings narrow (length to breadth 9 : 2). Cu_1 reaching hinder margin of wing before half the wing length. Body slender. Wings of male uncoloured.

DISPARONEURA, Selys.

Type: *D. frenulata*, Selys.
Distribution: Africa, Tropical Asia to Borneo.

II. *Ab* reduced or absent (*i.e.* when present not meeting Cu_{2b}).

a. *Ab* present, Cu_1 reaching to half the wing length on the hinderwing. Posterior prothoracic margin of female simple.

INDONEURA, gen. nov.

Type: *I. gomphoides* (Ramb.).
Distribution: W. Peninsular India.

b. *Ab* present as a vestige or absent. Cu_1 not reaching half the wing length of hinder wing. Posterior prothoracic margin of female not simple.

CACONEURA, Kirby.

Type: *C. dorsalis*, Selys.
Distribution: Ceylon, Burma, Malaya.

B *Ac* lies at about level of first antenodal or proximal to it.

Nososticta and other Papuan and Australasian genera; not regional.

Disparoneura westermanni, Selys, is not represented in the Museum collection, and is not known to me.

Genus **Chloroneura**, nov.

This monotypic genus, which is peculiar to Central India, ranges apparently from the neighbourhood of Bombay, through the West Ghauts as far at any rate as Nagpur in the Central Provinces, but the limits of its distribution are not at all known.

It is perhaps more primitive than the true *Disparoneura*, to which it is very closely allied. The form of the anal appendages of the male and of the posterior prothoracic margin of the female of the two genera are extremely similar.

Chloroneura quadrimaculata, Ramb.

Disparoneura quadrimaculata, Kirby, *Cat. Odonata*, p. 133.
,, ,, Laidlaw, *Rec. Ind. Mus.* XI, p. 391 (1915).

Medha, Yenna Valley, Satara District.
Nagpur, C. P. (*E. D'Abreu*).

Genus **Disparoneura**, Selys.

The type of the genus was a species identified by Selys in his *Synopsis* as the *Agrion glaucum* of Rambur. Unfortunately Rambur's species turns out to be an *Enallagma* (see Calvert, *Trans. Amer. Ent. Soc.*, XXV, p. 40; 1898).

Hence at the present time some doubt exists as to the type species of the genus. Selys, however, gives *Agrion frenulatum*, of

Drégé, as a synonym for his type, and remarks of his second species of the genus, *Disparoneura frenulata*, that it is difficult to separate it from *Disparoneura glauca*. Hence we cannot be very wide of the mark in taking *Disparoneura frenulata*, Selys, as the provisional type of the genus.

The definition given above encloses a group of species ranging from Africa through peninsular India, Burma, the Malay Peninsula, to Sumatra and Borneo, which is, I think, a very natural one.

Besides the type species, of which we have fortunately admirable figures, given by Dr. Ris (*Sitzungsberich. d. Kais. Akad. d. Wissensch. in Wien*, mathem.-naturw. Klasse, Bd. CXXI, Abt. 1, Apr. 1912, pp. 12–14, text-figs. 7–9), there are probably other African species. In Asia there are in addition to the two new species described below, *D. analis*, Selys, ranging from the Malay Peninsula to Sumatra and Borneo, the closely allied *D. atkinsoni*, Selys, from Burma and lastly *D. aurantiaca*, Selys, from Borneo. All these species, in addition to the generic characters given above, have rather dull colouring, mostly black and yellow, with the anal appendages of the males very similar in structure, the upper pair being provided in each case with a large ventral spur or tooth.

There are, besides, three or four species from Ceylon, which may form a small group within the genus.

Disparoneura tetrica,[1] sp. nov.

3 ♂ 2 ♀ Talewadi, N. Kanara Distr., Oct. 1916, No. 4389/H.I. (*S. W. Kemp*).

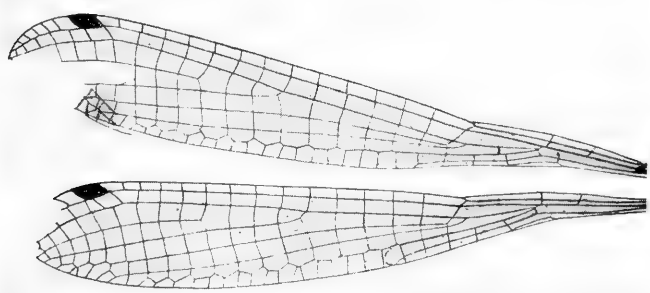


FIG. 4.—*Disparoneura tetrica*, sp. nov.
Wing photograph of ♂.

Length of hind-wing 18·5 mm., of abdomen 27–28 mm.

Post-nodals on fore-wing 12–13. Cu_1 reaching the hinder margin of the wing 3 cells beyond the sub-nodus on the hind-wing.

[1] Tetricus = sombre.

Pterostigma brownish-black, rather large, covering one and a half cells.

♂ Adult. *Head.*—Genae and anteclypeus bluish-white, the rest of the dorsal surface velvety black. Eyes with a black equatorial belt, below this pale bluish-white, immediately above it a zone of the same colour, upper pole grey-black.

Prothorax.—Dorsum and sides entirely black, under surface yellowish-white, posterior margin simple.

Thorax.—Dorsum black as far as the level of the first lateral suture; sides and under surface yellowish-white, with an irregular black band along the second lateral suture, not enclosing the stigma.

Abdomen dark brown, with a yellow mark on the sides of segments 1–2, and a black terminal ring on 3–7, preceded by a small, ill-defined postero-lateral lunule of whitish-blue colour on either side of these segments, 8–10 black. Posterior margin of 10 projecting a little in the middle line.

Anal appendages brown, upper surface and extremity of upper pair white. Viewed from above the upper pair have each a prominent white projection at their outer extremities, their inner margins are crescentic; in profile they are obliquely truncate, with a strong downwardly directed ventral tooth. Lower pair rapidly tapering and incurved at their extremities (text-fig. 5).

Fig. 5.—*Disparoneura tetrica*, sp. nov. Anal appendages ♂.

Legs yellowish-white. Posterior surface of femurs, lateral margins of tibias, spines and tarsi black.

♀ Adult. Resembles adult male, but the abdominal colours are more vivid, and there is a yellowish-white lateral spot on abdominal segments 8–9.

♀ Juv. Upper lip brown, also brown markings on the postclypeus and a narrow brown band running traversely from eye to eye across the base of the antennae. There is also a brown spot on either side of the middle lobe of the prothorax and distinct traces of brown antehumeral bands occur on the thorax. Otherwise as in the adult female. The hinder margin of the prothorax carries two small projections directed upwards and a little forwards.

Types in the Indian Museum. Paratype in my own collection.

Disparoneura nigerrima, sp. nov.

1 ♂ Nagpur, Central Provinces 1,000 ft., September, 1916 (*E. D'Abreu*).

Length of hind-wing 16·5 mm., of abdomen 25 mm.

Post-costals on fore-wing. Cu_1 reaches hinder margin of hind-wing 2 or 3 cells beyond the sub-nodus. Pterostigma brown, small, covering about one-half of a cell.

♂ Adult. Colouring black, with the following exceptions :—

Head.—Upper lip with a narrow white margin, genae bluish-white, eyes of the same colour, darkening towards the upper pole.

Prothorax and *thorax.*—Ventral surfaces yellowish-white.

Abdomen.—Segments 1–2 brownish-white; 3–5 with small postero-lateral whitish lunules on either side of the segment.

Anal appendages.—Apex of the upper pair white, lower pair dark brown. Viewed from above the upper appendages are triangular, the outer margins parallel to each other, and the apices are prolonged to form a fine projection. In profile they appear bifid (text-fig. 6).

The lower pair are relatively more massive than in the last species.

This is the smallest member of its genus; it is also the first recorded from Central India.

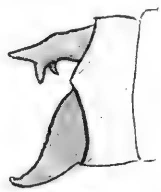


FIG. 6.—*Disparoneura nigerrima*, sp. nov. Anal appendages ♂.

Disparoneura atkinsoni, Selys.

Disparoneura atkinsoni, Kirby, *Cat. Odonata*, p. 133 (1890).

The Burmese representative of the genus. Closely allied to *D. analis*, Selys, from Malacca, Sumatra and Borneo, but larger.

Genus Indoneura, Kirby.

Unless, as is not unlikely, *D. westermanni*, Selys, is congeneric with *Indoneura gomphoides* (Ramb.), the genus is monotypic.

The simple structure of the hinder margin of the prothorax of the female is I think an important character, though a sexual one. The type species is very considerably larger than any of the species of the genus which stands next to it (*Caconeura*), and the dense reticulation of the wings points, I think, to the genus being a primitive one.

Indoneura gomphoides (Ramb.)

(Pl. xv, fig. 7).

Disparoneura gomphoides, Kirby, *Cat. Odonata*, p. 134 (1890).

1 ♂ 1 ♀ Talewadi, S. Kanara Distr., No. 4376/H.I.

Length of hind-wing 26 mm., of abdomen 38 mm.

,, ,, ,, ,, 29 mm., ,, ,, 39 mm.

Both specimens are fully adult. The female has not been described.

♀ Adult. *Head.*—Upper lip metallic black, edged with brown. Ante- and post-clypeus metallic black; genae blue. The rest of the dorsal surface dull black. Eyes, lower two-thirds blue, upper third dull black.

Prothorax black, its anterior lobe blue, blue marks on the sides of the middle lobe.

Thorax.—Dorsum bronze-black as far as the level of the first lateral suture, with narrow blue antehumeral bands. Sides blue with a black band along the second lateral suture. Under surface yellowish-white.

Abdomen bronze-black. Segment 1 light blue above, with a large square black mark, segments 8–10 each with a blue mark on the dorsum.

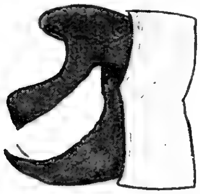


FIG. 7.—*Indoneura gomphoides* (Ramb.). Anal appendages ♂.

Legs black.

The specific name is given, I imagine, on account of the gomphonic-like appearance of the anal appendages of the male (text-fig. 7).

The female type will be returned to the Indian Museum, with the male specimen.

Genus **Caconeura**, Kirby.

Caconeura sita, Kirby.

Disparoneura sita, Kirby, *Journ. Linn. Soc.* (Zool.), XXIV, p. 563 (1893).

I have examined the specimens in the British Museum. The species appears to be a true *Caconeura.*

[In Mr. Laidlaw's previous papers in this Journal (vol. xii, p. 135 and vol. xiii, pp. 31 and 39) the localities "Gopal, Assam" and "Gopaldhara in Assam" should read "Gopaldhara in the Darjiling district."—*Ed.*]

EXPLANATION OF PLATE XIII.

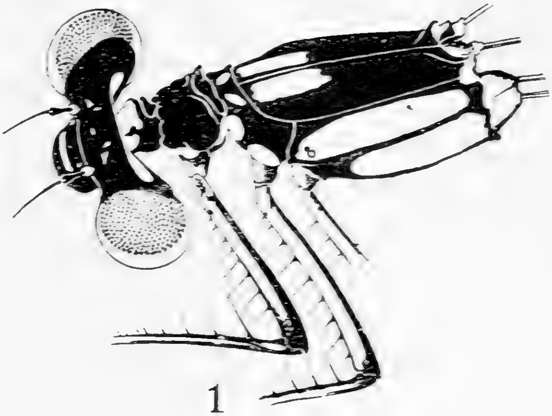
Coeliccia renifera (Selys).

FIG. 1.—Head, prothorax and thorax of adult male.

,, 2.—Head, prothorax and thorax of young male.

,, 3.—Head, prothorax and thorax of female.

(Drawn from specimens in spirit collection of Indian Museum).



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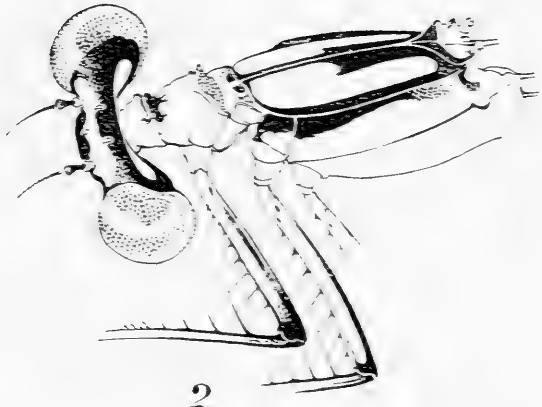

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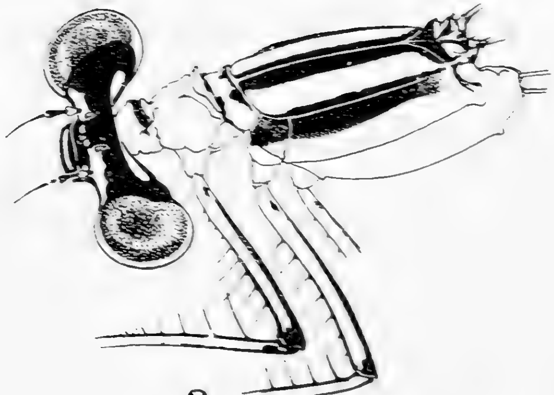

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INDIAN AGRIONINAE

EXPLANATION OF PLATE XIV.

FIG. 1.—Head, prothorax and thorax of *Drepanosticta carmichaeli* (Laidlaw), ♂. Unshaded parts of thorax and prothorax bright blue, dotted parts olive-brown.

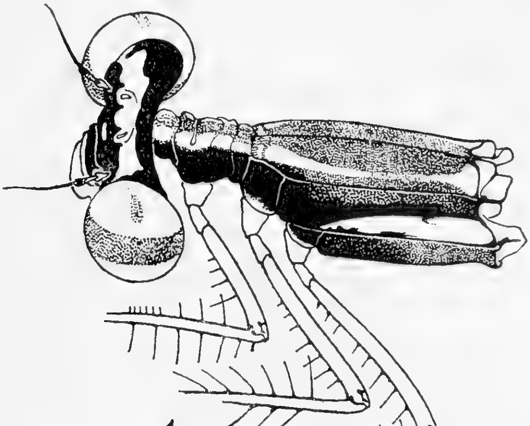
(Drawn from spirit specimen in collection of Indian Museum.)

FIG. 2.—Head, prothorax and thorax of *Copera marginipes* (Ramb.), ♂.

(Drawn from spirit specimen in collection of Indian Museum).

FIG. 3.—Anal appendages of *Coeliccia renifera* (Selys), seen from the side.

,, 4.—Terminal segments of abdomen of *Drepanosticta carmichaeli* (Laidlaw), from above and from the side.



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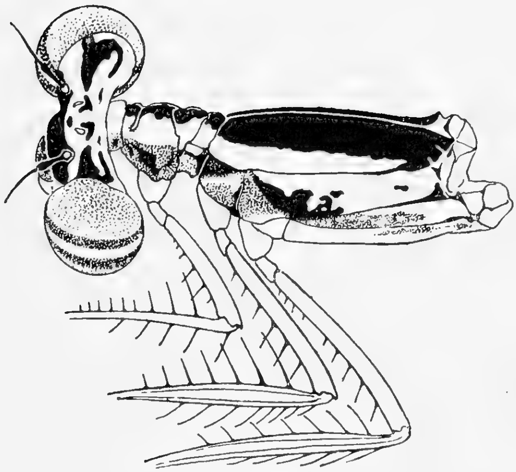

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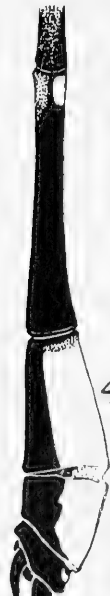

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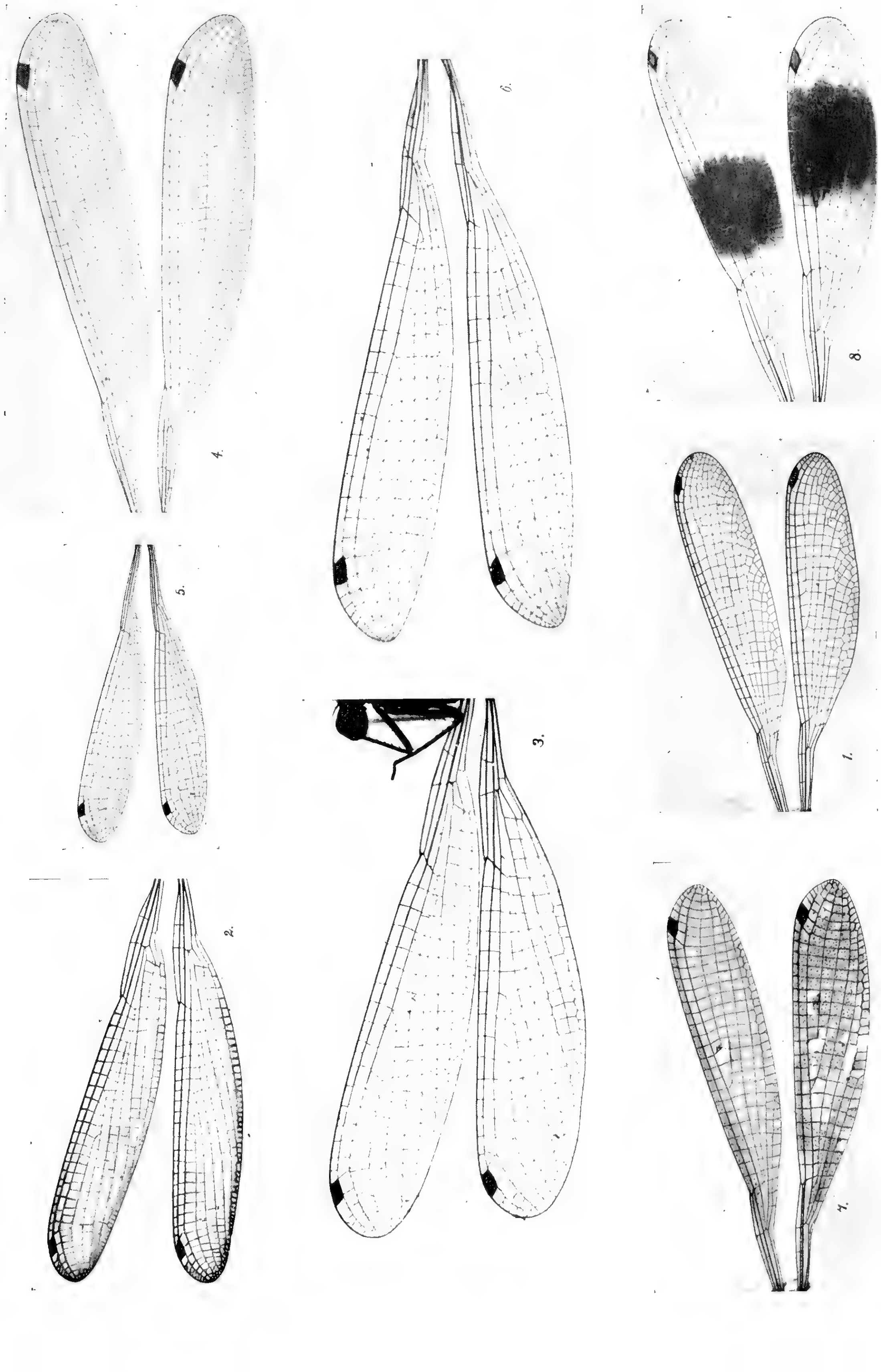
INDIAN AGRIONINAE.

EXPLANATION OF PLATE XV.

Wing photographs, by Messrs H. and F. E. Campion.

FIG. 1.—*Argiolestes melanothorax*, Selys, ♂.
,, 2.—*Indocnemis kempi*, n. sp., ♂.
,, 3.—*Calicnemis pulverulans*, Selys, ♂
,, 4.—*Platysticta deccanensis*, Laidlaw, ♂.
,, 5.—*Drepanosticta carmichaeli* (Laidlaw), ♂.
,, 6.—*Protosticta himalaiaca*, n. sp., ♀.
,, 7.—*Indoneura gomphoides* (Ramb.), ♀.
,, 8.—*Chloroneura quadrimaculata* (Ramb.), ♂.



INDIAN AGRIONINAE.

Photo-engraved & printed at the Offices of the Survey of India, Calcutta, 1917.

XXI. THE LAND MOLLUSCA COLLECTED ON THE ISLAND OF BARKUDA IN THE CHILKA LAKE, GANJAM.

By LT.-COLONEL H. H. GODWIN-AUSTEN, *F.R S., etc.*

Dr. Annandale, Director of the Zoological Survey of India, and Mr. F. H. Gravely, Asst. Superintendent, have very recently (July, 1916) been investigating the fauna of this island, and obtained there three species of land shells, which Dr. Annandale has kindly sent to me for examination. The specimens are well preserved in spirit. One turns out to be a most interesting species both from its history, habitat and morphological characters. It proves to be a species described by W. Blanford in 1866 (*Journ. As. Soc. Bengal,* XXXV (2), p. 36) as *Nanina* (*Macrochlamys*) *infausta*, and occurred among Captain Beddome's Anamullay collections, but in the *Fauna of British India*, *Mollusca* vol. I, p. 134, Blanford says: "The locality originally assigned to this species, the Anaimalai Hills, appears to have been given in error, as in the case of *M. lixa.*" He compared it in 1866 with *Helix vitrinoides*, Desh., which at that date included several distinct species such as *hardwickei*, G.-A.; *indica*, G.-A.; *petrosa*, Hutton; *perplana*, G.-A. and *pedina*, Bs.; all differing widely in their anatomy. At that period the animals of Indian molluscs had received little attention. Wm. Blanford led the way to a better state of things by the copious notes he made in the field of the outward form of the animal, and the examination of the radula, while it was Stoliczka who gave us the first insight into the internal anatomy of many Indian genera. In the *Fauna of British India*, *Mollusca* vol. I (1908), p. 133, nothing being known of its anatomy, it was on shell character placed in *Macrochlamys*. The species now described shows conclusively that it belongs to the genus *Ariophanta*, of my section *Nilgiria*, a group of the land mollusca, together with *Euplecta* and *Eurychlamys*, not hitherto found outside Peninsular India, with one exception. *Ariophanta interrupta*, Bs. is common in Calcutta and in 1865 I found it in Jessore. This extension into the delta from the side of Orissa is however probably due to the agency of man.

Ariophanta infausta, W. Blf.

Forbes and Hanley, *Conch. Ind.*, pl. clix, figs. 2, 3 (*Helix*).
W. T. Blanford, *Journ. As. Soc. Bengal*, XXXV (2), 1866, p. 36 [*Nanina* (*Macrochlamys*)].
W. T. Blanford and H. H. Godwin-Austen, *Faun. Brit. Ind., Moll.* I 1908, p. 133 (*Macrochlamys*).

Locality.—Banks of Chilka Lake.

Sculpture very finely decussate.

Animal (fig. 1, A, B, C). The spirit specimen is colourless, with the exception of a darkish narrow patch on the right dorsal lobe near the rectum, and a conspicuous long narrow black line on the visceral sac bordering the renal organ (fig. 1, B).

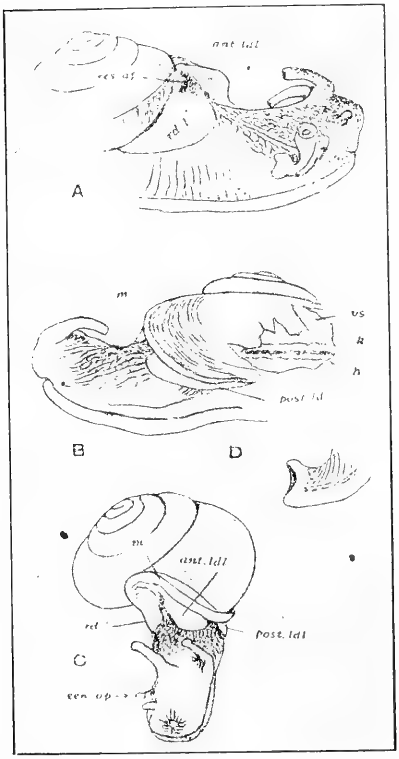


FIG. 1.—*Ariophanta infausta*, W. Blf.
A, B, C. Animal.
D. Extremity of foot.

The sole of the foot is divided and wide V-shaped segments cross it. The peripodial margin is broad with the usual two grooves above it; they are indistinctly seen in these specimens. The mucous gland at the extremity of the foot is large and vertical (fig. 1, D).

The edge of the peristome is overlapped slightly by the mantle edge (*m*), and there is a thin, narrow separate expansion of this for a short distance backwards over the shell on the upper margin, a character I have never yet met with in any other species. It is due no doubt to the very perfect state of preservation and freshness of these specimens. The right dorsal lobe (*rd. l*) is large triangulate, the left in two parts, quite separate; the anterior part is small in comparison with the right dorsal, and a posterior (*post. ldl.*) which is narrow and elongate and extends narrowing to the hinder part of the shell. From this it is clear that the position of this mollusc is in the Ariophantinae and certainly not in the Macrochlamyinae, which section of it only the generative organs will show.

Generative organs (fig. 2, A). The species has a long caecum or diverticulum (*crp.*) at the end of which the retractor muscle is given off. The kalc-sac or flagellum (*fl.*) is short, the spermatheca (*sp.*) is globose and sessile; the amatorial organ (*am. or.*) very long. In every respect the genitalia are similar to those of the subgenus *Nilgiria*, as represented by *N. bistrialis*, Beck., vide *Moll. India*, vol. II, p. 80, pl. lxxxi, fig. 4-4*a*.

The radula differs very considerably from that of *Nilgiria bistrialis* both in the form of the marginals and in the formula, which is 38. 2. 12. 1. 12. 2. 38 or 52-1-52, the marginals being unevenly bicuspid, the inner cusp the longest. It thus falls into the group B δ, vide *Moll. Ind.* p. 82, with *solata*, *tranquebarica*, *maderaspatana* and *ligulata*, species with very different shells, *tranquebarica* being the nearest to *infausta*. The jaw (fig. 2, B) is rather straight in front with a central projection, similar to that of *bistrialis*.

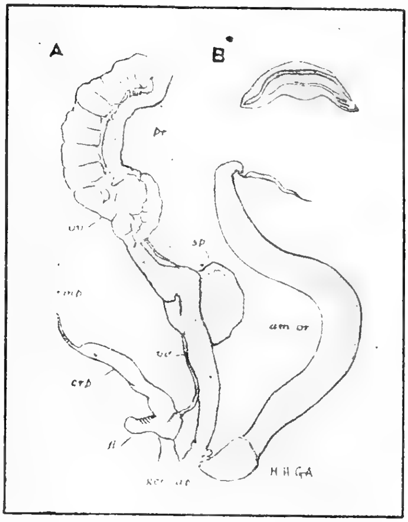


FIG. 2.—*Ariophanta infausta*, W. Blf.
A. Generative organs × 9.
B. Jaw × 9.

The other two land shells from this small island are *Rachisellus praetermissus*, W. T. & H. F. Blf. and *Opeas gracilis*, Hutton. I have compared this last, a single specimen, with some from the typical locality Mirzapur, described by Captain Hutton. There are points of difference, but a series from the Chilka Lake is wanted. The genitalia of both genera appears to be unknown and the specimens will be most useful when the time comes to examine them.

[The *Ariophanta* and the *Rachisellus* are both abundant on the leaves of shrubs in the rainy season. In periods of temporary drought they secrete a false operculum of mucus, but remain in exposed positions. The *Opeas*, on the other hand, was found in the earth under a log of wood.—*N. A.*].

As the original blocks for the two text-figures have been lost in transit, they have had to be reproduced from the proofs.

XXII. ON A COLLECTION OF OLIGOCHAETA FROM VARIOUS PARTS OF INDIA AND FURTHER INDIA.

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(Plates XVI—XVIII.)

CONTENTS.

INTRODUCTION.

The greater part of the present communication deals with a number of specimens of Oligochaeta, many of them of considerable interest, which have lately been added to the collection of the Indian Museum; my thanks are due to Dr. Annandale, Director of the Zoological Survey of India, for the opportunity of examining them. I have also added records, and sometimes notes or descriptions, of the worms which have come into my hands from elsewhere during the past year or so.

The chief localities which have yielded material of interest have been the following:—

(1). Murree, in the Himalayas of the N. Punjab. The list of the earthworms of the Punjab is still a short one, and the addition of even two species is an event of some local interest. One of these two species is *Drawida japonica*, a peregrine species which has been found in China, Japan, and the Bahamas, but which has not, curiously, hitherto been certainly identified from India. Also from Murree I have received a *Helodrilus* which to the best of my knowledge is new; though as the records of this genus are scattered, and in part inaccessible to me, I ought to express myself with caution; this perhaps represents one of the outposts of the Lumbricidae in their southward extension from Palaearctic regions, another being possibly *Helodrilus* (*Bimastus*) *indicus*, Mchlsn. (*cf.* Michaelsen, 13), from Calcutta.

(2). Rangamati, in the Chittagong Hill Tracts, Bengal,—near the head of the Bay of Bengal,—is quite a nest of species of *Drawida*. I need only point out that the occurrence of a number of endemic species in this region emphasizes what I wrote formerly, on the geographical aspect of the facts of distribution of the genus *Drawida*, after describing a number of new species of the genus from the Abor country (17).

(3). New species of *Perionyx* from the Eastern Himalayas are in accordance with what we should expect from the known geographical distribution of the genus.

(4). From Portuguese India and the neighbourhood Mr. Kemp has collected a number of interesting species; these include *Erythraeodrilus kinneari*, recently described by me (19), and no fewer than five species of a genus which I believe to be that of which Bourne's *Perichaeta stuarti* is the type, and which is now known as *Hoplochaetella*; we might indeed speak of a "nest" of these species in this region. As the discussion of this material is complicated, I propose to devote an introductory chapter to it, instead of interrupting the systematic portion of the paper by an excursus of such an extent,—one which, in addition, touches on points of somewhat wider interest.

THE GENUS *HOPLOCHAETELLA*.

In 1886 Bourne published, in a "Preliminary notice of Earthworms from the Nilgiris and Shevaroys" (7), a short description of a species which he called *Perichaeta stuarti*. Beddard in 1890 (1) established for this worm the genus *Hoplochaeta*; but, in 1895 (3) he thought that it might be referable to Benham's genus *Plagiochaeta*, and that the name *Hoplochaeta* had perhaps better be withdrawn, pending further investigations by the discoverer of the species; the worm does not find a place at all in his systematic account of species and genera. Michaelsen, however, in 1900 (10) retained the genus under the name *Hoplochaetella* (*Hoplochaeta* having been found to be preoccupied), and it has since figured in his lists of Indian Earthworms (13, 14). The worm has played a part in zoogeographical discussions, since Michaelsen (13) has referred to this genus several species described by Benham from the South Island of New Zealand as *Plagiochaeta* (4), and has thus illustrated the connection between the Oligochaete fauna of New Zealand and India.

All that we know of the anatomy of the Indian *Hoplochaetella*, however, is derived from Bourne's original account. Though Bourne subsequently expanded the descriptions of the Moniligastridae enumerated in his preliminary account, he did not do so for *Perichaeta stuarti* nor for most of the other Megascolecidae. I venture therefore,—since the ascription of five species obtained by Mr. Kemp to the genus of which *Perichaeta stuarti* is the type requires some justification,—to transcribe Bourne's words.

"*Perichaeta stuarti*, sp. n.

The clitellum extends over somites xiv, xv, and xvi; it is very well marked.

There are two pairs of male pores in somites xvii and xix respectively; these are all four placed upon a whitish, slightly depressed patch, which thus extends over the greater portion of somite xvii, the whole of somite xviii, and the greater portion of somite xix. Connected with each of these pores is a large coiled prostatic gland, which extends backwards in each case through some 8 or 9 somites.

There is a single median oviducal pore in the anterior portion of somite xiv.

There are two pairs of spermathecae, situated in somites vii and viii respectively. They do not possess any appendages, but present a sort of frilled appearance around the base.

The gizzard is situated in somite x.

In somites xxiii-xxvi (?) there are four pairs of special diverticula on the dorso-lateral portions of the intestine.

I have not observed any nephridia.

There are about 52 setae in each somite, arranged with small dorsal and ventral gaps; setae are present on the clitellum.

There are no special setae in somite xviii; but in the anterior portion of somite viii (i.e., between the anterior and posterior pair of spermathecae) there are two groups of large modified setae. Where these project on the surface, there is a papilla which in some specimens becomes very well marked.

Length 148 mm., circumference 15 mm.; number of somites 111.

Hab. Yercaud, at an elevation of about 5,000 ft.[1], and also down the ghaut as low as Salem (1,000 ft.). I have specimens from Salem.

This is an exceedingly common worm in this region. It occurs in dry ground, and often under large stones."

The only other remark Bourne makes about the worm is a reference to the two pairs of male pores as establishing a difference between it and other species of *Perichaeta.*

It will be seen at once that there are striking similarities between *Perichaeta stuarti* and the group of species described in the body of the present paper under the genus *Hoplochaetella.* Besides such general features as size, setal numbers and distribution, situation of prostatic and female apertures, the two pairs of long coiled prostates, etc., there are the special setae in segment viii, displaced out of the line and seated on papillae; and the frill of diverticula at the base of the spermathecae, which is exactly paralleled in several species here described.

The differences are however not negligible. Thus the gizzard is said to be in segment x; this is anomalous,—I do not recall any single Megascolecid in which it occurs in this position, *i.e.* in a

[1] With regard to the locality, Bourne in a subsequent publication says, "I have stated that *Perichaeta stuarti* is to be found at an elevation of 5000 ft., and also at one of 1000 ft., but this has proved to be a mistake which arose from my collector having mixed specimens from the two localities. I cannot find *P. stuarti* at any great distance down the ghaut." (On certain Earthworms from the Western Himalayas and Dehra Dun, *P. As. Soc. Bengal*, vol. lvii, 1889). Michaelsen has overlooked this correction.

testis segment, and certainly not in any of the subfam. Octochaetinae. Michaelsen does not seem quite clear what to make of it; in the generic characters which he attributes to *Hoplochaetella* (10) he has "1 Muskelmagen vor den Hoden-Segm."; while in the specific diagnosis of *H. stuarti* he says "Muskelmagen im 10 Segm." I think we may fairly suspect an error in Bourne's statement.

The four pairs of dorso-lateral intestinal caeca may or may not be more than the usual segmental bulgings of the intestinal walls, commonly best marked in the dorso-lateral region, carried to an unusual degree.

These are the only differences between *Perichaeta stuarti* and the group of species described below that could possibly be of generic importance;—I mean, the only differences that unequivocally follow from the description. Michaelsen in his generic and specific diagnoses in the "*Tierreich*" gives other points, which rest on inference.

The first of these is the (doubtful, for he queries it) position of the male pore (*i.e* the ending of the vas deferens, as distinct from the prostatic pores) on segment xviii. Bourne does not mention this; in so far as we can infer anything, I think we must infer the absence of pores on xviii.; since in his introduction he brings forward the presence of two male pores, on segments xvii and xix, as a distinction between *P. stuarti* and ordinary species of *Perichaeta*, which have "a pair of laterally-placed male pores in somite xviii."

The second is the position of the spermathecal apertures in furrows 7/8 and 8/9. Bourne makes no reference of any kind to the apertures, saying only that the spermathecae are in segments vii and viii. The apertures often are in the furrows just mentioned in the Octochaetinae, but not always; in *Erythraeodrilus*, and in some species of *Octochaetus*, they are on the segments, not between them.

The third and most important is the condition of the nephridial system. All that Bourne says is, "I have not observed any nephridia." Michaelsen naturally takes this to mean that the system is micronephric throughout. I hope I shall not be going too far if I suggest that *Perichaeta stuarti* may have possessed both mega- and micronephridia, and that the meganephridia as well as the micronephridia may have been overlooked by Bourne. It is to be remembered that (1) in the group of species which I describe in the body of the paper the meganephridia only begin in segment xx; if a similar condition existed in *P. stuarti* it *might* not have attracted attention in a dissection of the anterior part of the worm (though I admit that Bourne must have dissected one or more specimens back to at least the level of the hinder ends of the long prostates). (2) Bourne's observations on the nephridia of other species described in the same paper are extraordinarily various; thus "I have found no nephridia," (*Perichaeta lawsoni*); "there are two pairs of groups of small nephridia opening on the posterior edges of somites vii. and viii," (*P. gracilis*,—nothing about nephridia elsewhere) ; "I am at present unable to say anything about the nephridia" (*P. burliarensis*); "no nephridia were observed" (*P. hulikalensis*) ; "nephridia seem to be present in certain anterior segments only" (*P. mirabilis*); "the nephridia occur in, at any rate, most of the somites; they are very large and present rosettes of tubules in certain anterior somites" (*P. salettensis*). We can only conclude that Bourne's observations on the nephridia of his various species are inadequate in respect of present-day requirements, and are not of much help in identifying his forms ; one can hardly accept his statements, for example, with regard to the nephridial distribution in *P. gracilis* and *P. mirabilis*. (3) The ease or difficulty of determining the nephridial condition depends largely on the condition of the specimen ; it is easiest in a well-preserved spirit specimen, as the nephridia are then opaque, but in badly preserved material it may be impossible. Even much later than Bourne's day the most experienced investigators have at times been under the necessity of revising their accounts of the nephridial conditions ; so Benham (4, 6,—*Plagiochaeta ricardi* and *montana* at first supposed micronephridial, later recognized as meganephric) ; Michaelsen (11, 14,—*Eudichogaster ashworthi* at first supposed micronephridial, later recognized as having both mega- and micronephridia).

Thus I do not think it is unfair to leave aside the nephridia of *Perichaeta stuarti* altogether. When Bourne says "I have not observed any nephridia," it may simply have been for want of sufficiently close observation, or the specimen may have been badly preserved ; in any case we are dealing with the early days of Oligochaete research, with a preliminary communication which was only meant to be a first survey of the field, and written at a time it was not known even what characters were of generic value. We must admit that we know nothing about the nephridia, even by inference.

I have, I think, shown that there is pretty certainly a mistake in Bourne's statement concerning the position of the gizzard; that there is no ground at all for supposing a separate male pore in segment xviii, or that the spermathecal apertures are necessarily in furrows 7/8 and 8/9 (though this last point is relatively unimportant) ; the intestinal caeca, whether they were accidental inflations of the gut-wall or not, would not be of generic importance; and, finally, we are in the dark as regards the nephridia. In all other respects the worms in the present collection resemble *Perichaeta stuarti* ; and I have therefore, after much hesitation, decided to unite them in the same genus, the diagnosis of which now runs as follows :—

Genus *Hoplochaetella*, Mchlsn. emend. Stephenson.

Setae in rings. Calcareous glands four pairs, in x-xiii. Micronephridia throughout the body ; meganephridia in addition from xx onwards, one pair per segment. Two pairs testes, free in x and xi. Two pairs long coiled prostates, opening on the posterior part of xvii and the anterior part of xviii, or in grooves 17/18 and 18/19. Vasa deferentia open in common with the ducts of the anterior pair of prostates. One unpaired female pore. Two pairs spermathecae with apertures on viii; accessory glands in the neighbourhood. No penial setae; displaced and modified setae on one or more of segments vii, viii, ix.

ON OTHER SUPPOSED SPECIES OF THE GENUS *HOPLOCHAETELLA*.

In 1909 Michaelsen (13) united with the genus *Hoplochaetella* as defined by him (Acanthodriline arrangement of posterior male organs, setae in rings, micronephridia) three species of worms originally described by Benham from New Zealand,—*Plagiochaeta rossii*, *P. ricardi*, and *P. montana* (the last two however with an element of doubt, owing to the fact that Benham had revised his earlier statement concerning the nephridial system).

Plagiochaeta is a genus of the subfamily Acanthodrilinae of which the type was described by Benham in 1892; the originally paired setae have undergone the perichaetine increase, the posterior male organs have the original Acanthodriline arrangement, the testes and funnels are enclosed in testis-sacs; the type of the genus is meganephric, with nephridiopores alternating in position in successive segments; there are penial setae, and the gizzard is rudimentary. Benham (4) subsequently described four new species; three of these were micronephric, but he did not at the time consider this peculiarity sufficient to warrant a generic separation. It was these three species which Michaelsen, with different views on the value of the nephridial condition, united with *Hoplochaetella*.

Benham, however, had already found that two of the three species were in reality meganephric (5); but this Michaelsen had not been willing to accept at its full value; he did so afterwards for *P. ricardi*, and Benham has since shown that his statement regarding the presence of meganephridia was correct also for *P. montana*. This leaves only *P. rossii* to be added to the genus *Hoplochaetella* (Benham and Cameron, 6).

Now the type of the genus *Hoplochaetella* is *Perichaeta stuarti*, and if my former arguments are correct, *Plagiochaeta rossii* differs from *Hoplochaetella* in two of the three points of cardinal importance,—setae, nephridial condition, and arrangement of posterior male organs. It cannot then go into, or even very near, *Hoplochaetella*, and it is necessary to separate it under another name as a new genus. I may add that while the general facies of *Perichaeta stuarti* agrees, so far as can be judged, with that of the species which I describe below as *Hoplochaetella*, there is nothing in the original description of *Plagiochaeta rossii* to remind us of *Perichaeta stuarti*; in *Plagiochaeta rossii* the prostates are confined to their proper segments, in which they are coiled into a ball, the spermathecal ducts have groups of botryoidal diverticula, and there are prominent porophores with spermatic ridges leading from the anterior to the posterior prostatic pore of each side.

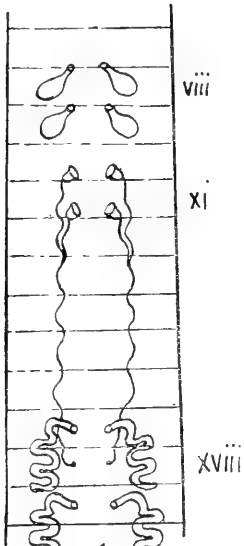
THE SYSTEMATIC POSITION AND RELATIONSHIPS OF THE GENUS *HOPLOCHAETELLA*.

That *Hoplochaetella*, as here defined, is the direct ancestor of *Erythraeodrilus* seems certain. It happens that *Erythraeodrilus* (both batches,—the original specimens collected in 1913, as well as the example in the present collection) and the five species of *Hoplochaetella* here described (though not the type species, *Perichaeta stuarti*), come from within a few miles of each other. The general facies is similar; and the two genera agree in such peculiarities as the point where the meganephridia begin, the position and relative sizes of the calcareous glands, the length and disposition of the prostatic ducts, the presence of accessory spermathecal glands, and the vascular commissure of segment xiv; some of these are so special (*e.g.* the accessory spermathecal glands, the vascular commissure in xiv) that they cannot be regarded as other than marks of close affinity.

The differences are :—the fusion of the septa in the region of the testes in the one, and the presence of testis-sacs of the usual type in the other; the three pairs of seminal vesicles and the absence of displaced setae in the spermathecal region of *Erythraeodrilus*; the (sometimes, apparently) common opening of the spermathecae of the same side in *Erythraeodrilus*; and especially,—the essential point,—the total disappearance of the posterior pair of prostates in the latter genus. What we have, in fact, in these two genera, is two successive stages in the reduction of the original Acanthodriline male apparatus.

This may be illustrated by the figures on page 360. Text-fig. 1 gives a diagrammatic representation of the primitive condition, as found in *Notiodrilus* (I use the name in the sense in which it was used, for example, by Michaelsen in his "Geographische Verbreitung der Oligochäten"); the testes are free in segments x and xi, the vasa deferentia open on xviii, the two prostates independently on xvii and xix, the spermathecae in grooves 7/8 and 8/9. In the Megascolecinae the reduction takes place by the union of prostatic and proper male apertures in segment xviii,—in the situation of the opening of the vas deferens (text-fig. 2). In the Octochaetinae, however, a different process is at work, which ends in *Eutyphoeus* in the amalgamation of the opening of the vas deferens with the anterior prostatic pore in xvii, and disappearance of the posterior prostates; at the same time the two pairs of spermathecae are reduced to one, and similarly the two pairs of testes (text-fig. 5). The concomitant reduction of the prostatic and spermathecal apertures is related to the fact that the prostatic apertures of one worm are apposed in copulation to the spermathecal apertures of another.

In *Hoplochaetella* we have the condition shown in text-fig. 3. The opening of the vas deferens has fused with that of the anterior prostate; the prostatic apertures themselves seem previously to have approached closer together, since they are found, not on the middle of segments xvii and xix, but in or almost in the grooves 17/18 and 18/19,—almost as if the first impulse was to follow the Megascolecine mode of reduction. But (if I may continue to use



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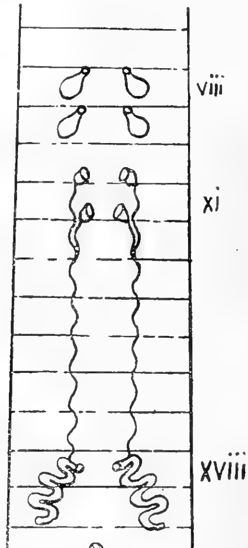

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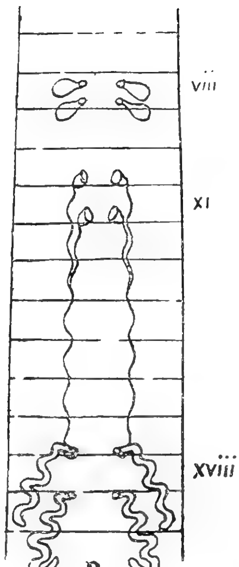

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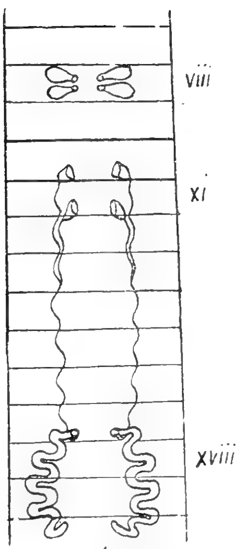

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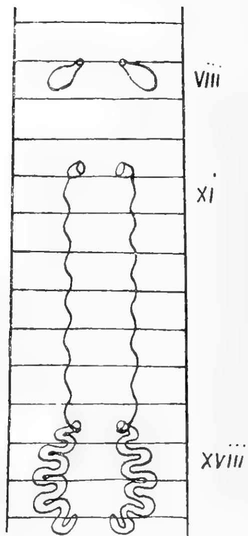

5.

FIG. 1.—Original Acanthodriline.
,, 2.—Megascolecine. (The number of spermathecae is variable in the Megascolecinae).
,, 3.—*Hoplochaetella.*
,, 4.—*Erythraeodrilus.*
,, 5.—*Eutyphoeus.*

such expressions) when the prostatic pores reached this position, the ending of the vas deferens was able to jump the interval, and united itself with the prostatic pore in furrow 17/18.

The next stage is *Erythraeodrilus* (text-fig. 4). Union between the end of the vas deferens and the anterior prostatic pores having been accomplished, the posterior prostates suddenly disappear. Two pairs of spermathecal openings are now superfluous, and the ducts of the spermathecae of the same side approach each other ; various stages of this are met with in the several specimens of *Erythraeodrilus kinneari* that have been studied (*v. post.*) ; in one, the two ducts of the same side appear to open practically at the same spot, on the middle of segment viii. We may suppose that the course of evolution is leading, first to the union of the spermathecal apertures, then to the disappearance of one spermatheca on each side ; then (if we may take a clue from *Eutyphoeus*) the remaining prostatic apertures will advance again to their original position on the middle of segment xvii, and the now single spermathecal apertures to their original position on furrow 7/8.

I need scarcely guard myself from misconstruction by saying that *Hoplochaetella* and *Erythraeodrilus* are not, of course, in the ancestral line of *Eutyphoeus* at all, since *Eutyphoeus* retains the primitive paired setae. But the same change which has led to *Eutyphoeus* appears to be going on in a parallel line of forms with the perichaetine setal arrangement.

Erythraeodrilus being thus the descendant, can we particularize regarding the immediate ancestors of *Hoplochaetella* ? In a previous paper (19) I supposed *Erythraeodrilus* to be a descendant of *Howascolex* (which has lumbricine setae, acanthodriline male organs and mixed mega- and micronephridia) by a process of microscolecine reduction of the male organs and perichaetine increase of setae. *Hoplochaetella* would thus show us the stage in which increase of setae has taken place, but not as yet the microscolecine reduction ; this is however being prepared for, since the male ducts already open in common with the anterior prostates ; thus *Hoplochaetella* would be intermediate between *Howascolex* and *Erythraeodrilus*. There is perhaps some little difficulty with regard to the nephridial system. It is true it is of a mixed nature,—meganephridia and micronephridia co-existing,—in both. But while in *Hoplochaetella* and *Erythraeodrilus* micronephridia exist throughout the body, and meganephridia only from segment xx onwards, in *Howascolex* meganephridia exist throughout, and micronephridia only make their appearance behind the anterior region, in the middle portion of the body. I do not, however, think that we yet know enough of the exact way in which the change from mega- to micronephridia has taken place (it has quite possibly taken place in more than one way) to enable us to say that this difference prevents our deriving the one from the other ; the condition in *Howascolex* is at any rate apparently less modified than that in *Hoplochaetella* and *Erythraeodrilus*.

There is another possibility as regards the derivation of *Hoplo-*

chaetella. It might be derived from *Plagiochaeta*,—or rather from *Perieodrilus*, a genus under which Michaelsen has placed those species, originally grouped as *Plagiochaeta* by Benham, which have the nephridiopores in the same line on each side (the type of the genus *Plagiochaeta* has them in two rows, alternating in successive segments). *Perieodrilus* has the acanthodriline arrangement of the posterior male organs and is meganephric, but has the perichaetine arrangement of the setae; it is in fact removed from *Notiodrilus* only by the development of the setae in rings instead of in pairs. From such a form *Hoplochaetella* differs in the partial breaking up of the nephridial system and the amalgamation of the openings of the vas deferens and anterior prostate.

If we take the first hypothesis, as I did for *Erythraeodrilus* previously, we find that we are in the presence of an element of our fauna which has relations with Madagascar [1] (the home of *Howascolex*). To some extent this is confirmed by the localities where *Hoplochaetella* and *Erythraeodrilus* have been found,—on the west coast of India. Bourne's *Perichaeta stuarti* was found, certainly, about 160 miles from the Malabar coast,—indeed nearer to the east than the west coast of the peninsula; but some of the present species were discovered actually on the shore, and seem to be euryhaline,—able to withstand the action of salt water,—and hence, probably, to endure a journey by sea (*cf.* the discussion by Michaelsen of the possible spread of *Microscolex* by the West-wind drift in the Southern Ocean, 12, 15, 16); the South-west monsoon blows steadily in the required direction for several months of every year. There is of course also the possibility that the introduction is of comparatively ancient date, by means of the land connection during the earlier Tertiary period.

On the second hypothesis *Hoplochaetella* will have had an Australasian origin. This is the present view; hitherto *Hoplochaetella* and *Octochaetus* have been the two genera common to India and New Zealand,—the indications of a communication between the two lands which probably at one period did not include Australia. The position is not very different if we suppose *Hoplochaetella* to be non-existent in New Zealand but to be derived from the New Zealand genus *Perieodrilus*.

Merely from the point of view of practical convenience, the first arrangement of the phylogenetic tree is preferable. As I have previously pointed out (19), the *Erythraeodrilus* branch can thus without difficulty be included in the Octochaetinae, by making the

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[1] Though Wallace, as is well known, gave up the theory of the existence of a former "Lemuria,"—a large tract of land including Madagascar, India, and Malaya,—and came to believe in the comparative fixity of the great land-masses of the globe (compare the view in his "Malay Peninsula" and "Island Life") later authors are not so conservative. Thus Gadow (9) supposes a permanent connection between Madagascar and India from Primary times up to the Oligocene, breaking up in late Oligocene; Depéret (8) supposes the connection between India and Madagascar to have been broken towards the end of the Cretaceous, but re-established during the Tertiary period; for the geological argument see, for example, Suess (21, vol. i, p. 417).

Octochaetinae begin with *Howascolex* ; they then retain the character of a monophyletic and compact subdivision of the family. If however we derive *Hoplochaetella* from *Perieodrilus*, we have either to include *Hoplochaetella* and *Erythraeodrilus* in the Acanthodrilinae, or to make a separate subfamily for them. As Michaelsen has pointed out (13) " the family Megascolecidae is a much-branched tree, which took its origin from the acanthodriline primordial form, that is to say, from *Notiodrilus* (*Eodrilus*). The greater branches of this tree, the different subfamilies, are well defined in their distal parts." The original form, with the small branches clustering round the base of the tree, constitute the group Acanthodrilinae; on the present supposition one of these small branches, scarcely large enough to form a separate subfamily, consists of *Perieodrilus—Hoplochaetella—Erythraeodrilus*.

The finding of additional intermediate forms between the various genera will establish the lines of filiation more certainly. The Megascolecidae are an especially favourable group for the working out of phylogenetic relations, because we still possess what we might paradoxically call a living Palaeontology. We can, for example, trace the main line of descent of the Megascolecinae, from the original Acanthodriline to *Pheretima*, with hardly a break, by means of actually existing genera ; it is as if *Phenacodus* and the subsequent stages in the phylogeny of the Horse were all alive today. In giving rise to descendants, the older genera have themselves lived on, scarcely modified ; and what we have to hope for is the discovery of the still missing intermediate forms. Some of them, at least, we may reasonably expect to find, still alive and accessible to a complete investigation.

The two following schemes represent the alternative possibilities regarding the position and descent of *Hoplochaetella* and *Erythraeodrilus* :—

— *Notiodrilus* —

Plagiochaeta

Diplotrema *Perieodrilus*

Howascolex

to Megascolecinae

Hoplochaetella *Octochaetus*

Erythraeodrilus *Eutyphoeus* *Dinodrilus*

— *Notiodrilus* —

Plagiochaeta

Diplotrema *Pericodrilus*

Howascolex

Hoplochaetella

Octochaetus

Erythraeodrilus

Eutyphoeus *Dinodrilus*

SYSTEMATIC ACCOUNT.

Fam. ENCHYTRAEIDAE.

Gen. **Fridericia.**

W. 88/1. Kierpur, Purneah Dist., Bihar. Sept. 1915. C. Paiva. A single specimen, not fully mature (or over-mature ?).

The specimen, diagnosed by the arrangement of the setae as belonging to this genus, but indeterminable as regards species, is mentioned here because the family is rarely met with in India.

Fam. MONILIGASTRIDAE.

Gen. **Drawida.**

Drawida kanarensis, sp. nov.

W. 132/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. Three specimens.

W. 133/1. Castle Rock, N. Kanara Dist., October 1916. S. Kemp. Three specimens.

External characters :—Length 60-70 mm.; maximum diameter 3½ mm. Colour pale grey, anterior end rather lighter. Segments 150-173, all very short behind the clitellum.

A prostomium is difficult to see in some cases; in one specimen it might be called zygolobous, though very small; in another it is perhaps prolobous.

Dorsal pores absent.

The setae are small and closely paired ; *aa* is slightly less than, or in some regions appears about equal to, *cd* ; *dd* is approximately equal to four-sevenths of the circumference.

The limits of the clitellum are rather indefinite, as the alteration in the body-wall is not great ; it is saddle-shaped, and extends over x-xiii, and perhaps partly on to xiv (=4 or more).

The male apertures are in furrow 10/11, external to the line of setae *b*, but considerably nearer to *b* than to *c* ; the lips of the groove are swollen here, and in one specimen papillae project from the groove at the site of the apertures.

The female apertures are in 11/12, in the line *b*.

The spermathecal apertures are in groove 7/8, just below *c*.

On segment xi are a pair of slightly raised and thickened patches, oval in shape, and one and a half times as broad as long ; they take up nearly the whole length of the segment, and are better marked in front, where they are continuous with the swollen lip bounding the male aperture; their surface is rather ridged, and they are each limited by a slight groove. They approach fairly near each other towards the middle line, so that the setae *ab* are on the inner portion of the patch ; the outer border is some distance below *c*. These patches were not found in the second batch of specimens.

Internal anatomy.—Septa 5/6 to 8/9 are thickened, especially the first three ; the rest are thin.

There are three large, hard, subspherical gizzards in segments xv, xvi, and xvii respectively ; the softer zones between them are little marked, a gizzard taking up a whole segment. In xiv is a much smaller gizzard, softer than the others, and narrower from side to side,—in other words the alimentary canal is not as broad here as it becomes in the next segment. In a specimen of the second batch which was dissected, there were four gizzards, in xiii-xvi, the first rather smaller.

The testis-sacs are attached to septum 9/10 in such a way that the larger part of the sac depends into segment x. A considerable portion however projects forwards into ix on the right side, though only a very small part does so on the left. The septum causes no constriction of the sac. The testis appears to be a diffuse proliferation of the inner wall of the sac. The vas deferens is a fine, much coiled tube on septum 9/10 ; the terminal portion is rather broader, and joins the prostate at its anterior and inner side.

The prostate is of moderate size, sessile on the body-wall, hemi-ovoidal in shape, with its transverse diameter greater than the anteio-posterior ; its surface is soft and yellowish, not smooth and shining.

There is no ovarian chamber, or in other words segment xi is opened into on opening the worm in the ordinary dissection, and masses of eggs fall out. The ovary is bushy, on septum 10/11. The funnel is a groove between two lips or ridges which curl upwards and inwards from below on septum 11/12. The ovisacs, large and ovoid, are contained in segment xiv, but a neck passes forwards to connect them with septum 11/12.

The spermathecal ampullae are large, and meet in the middle line, thus covering the rest of the contents of the segment ; in shape they are irregular, and in the dissected specimen were filled with a shining white opaque mass, doubtless spermatozoa. The duct is considerably coiled, and passes down on the posterior face of septum 7/8 ; its first part is narrower than the rest ; it joins the atrium without piercing the septum. The atrium is a cushion-like swelling, several times as thick as the end of the duct, which joins it in the centre of its upper surface ; it is partly embedded in the body-wall, and projects slightly into segment viii ; the septum can be separated forwards from over it, so that no part of the atrium is in segment vii, the septum being attached to the parietes in front of it. When opened, the atrium is found to be a hollow chamber.

Remarks.—This species is perhaps related to *D. barwelli* ; but the latter has dorsal pores, no eggsacs (?), no distinct spermathecal atrium, and pear-shaped prostates From the *pellucidus* group the present form is distinguished by the character of the surface of the prostate.

Special genital marks are not common in the Moniligastridae ; the "glandular" areas on segment xi are therefore of value for identification.

Drawida japonica (Mchlsn.) f. **typica.**

(Pl. xvi, fig. 1).

Murree; N. Punjab; alt. 7000 ft., 19-iv-1916. S. Gobind Singh. Numerous specimens.

External characters.—Length of a good average specimen 60 mm.; breadth 2 mm., or in the genital region may be 2·7 mm. Colour a greenish-grey, slightly darker dorsally. Segments 142.

Setae closely paired; *aa* is slightly less than *bc* behind the genital region, about equal to it in front; *dd* is equal to half the circumference. The setae are very small on segment ii, if indeed all of them are present; they are large on the genital region.

The nephridiopores may be present in three situations,—in line with setae *cd*, or at the level of the ventral pair of setae, or lastly not far from the middorsal line; but there is no rule, and no regular alternation. They are in all cases immediately behind the intersegmental groove.

The genital papillae,—a characteristic of the species,—are variable in their situation, but seem to be always present in the sexual animal. Each is an oval area slightly raised above the general surface, with its long axis transverse, and with a circular groove in its centre; the middle of each area is thus marked off from the peripheral portion, and is perhaps a little, but not much, raised above the level of the oval area in general. Fig. 1 will give an idea of the appearance of the areas; they are never in the same position in two specimens; in number they may be two, three or four; and they occur on segments vii, viii, ix, and xii. They may be situated on either the anterior or the posterior part of the segment, or more rarely at the middle of its length; they may be either to the right or the left of the middle line, or seldom midventral.

With regard to the *internal anatomy*, it need only be stated that there are two gizzards, in segments xii and xiii; they are annular thickenings of the gut-wall, separated by a thin-walled section of the tube.

Remarks.—This species is the most markedly peregrine member of the genus; it has been found in Japan, China (f. *siemsseni*), and the Bahamas (f. *bahamensis*, = *Moniligaster bahamensis*, Beddard). The immature *Drawida* from Simla, said by Michaelsen "probably, or rather doubtless" to belong to *M. willsi* (13), may with at least equal likelihood be referred to the present species.

Drawida hodgarti, sp. nov.

(Pl. xvi, fig. 2).

W. 70/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Four specimens.

External characters.—Length 113 mm.; maximum diameter 3·75 mm. Colour a uniform grey, nonpigmented. Segments 164; no secondary annulation. The rings of possibly sensory papillae found in some species are only very faintly indicated, and only in the anterior segments.

Prostomium prolobous.

Dorsal pores absent.

The setae are small and closely paired; *aa* is less than *bc*, and *d* is below the lateral line of the body.

The nephridiopores appear to be in line with the setae *c*.

No clitellum was visible on any of the specimens.

The male pores are slits with swollen anterior lip, in the intersegmental groove 10/11, with their centre just outside the line *b*.

The female apertures are doubtfully in *ab* or *b*.

The spermathecal apertures, with slightly swollen lips, are in 7/8 in or just internal to *c*.

There are no other genital markings.

Internal anatomy.—Septa 5/6, 6/7, 7/8, and 8/9 are considerably thickened, the rest all thin.

The gizzards are four in number, in segments xv to xviii; the alimentary tube is also slightly strengthened in segment xiv. There are softer annuli behind each gizzard in each of the four segments.

The last heart is in segment ix.

The testis-sacs are kidney-shaped, in segment x, the anterior end projecting slightly into ix on the left side in the specimen dissected but not on the right.

The prostates are small and tubular, with a smooth and shining surface (hence probably muscular); each is slightly coiled, and the free end, which points inwards, is somewhat dilated (fig. 2).

The closely convoluted vas deferens forms a soft mass below the testis-sac on the anterior face of septum 9/10; below it joins the anterior face of the prostate not far from its free ental end (fig. 2).

In the dissection segment xi appears open above,—not closed dorsally by the apposition of septa 10/11 and 11/12 to form an ovarian chamber; the floor of this space, above and at the sides of the alimentary canal, is formed by a membranous sheet which passes from the anterior to the posterior septum, so that the alimentary canal is excluded from the space which contains the ovaries and funnels.

Each ovary appears as a fringe on the posterior surface of septum 10/11, crescentic in form, tapering upwards nearly as far as the dorsal vessel. The ovisacs are small and finger-shaped, and (in the specimen dissected, at least) are confined to segment xii.

The spermathecal ampulla is small, roundly ovoid; from it is given off the somewhat wavy or coiled duct, which wanders down on the posterior face of septum 7/8, reaching the body-wall before becoming connected with the atrium. The atrium does not appear in segment viii at all; it is a finger-like process altogether in front of septum 7/8. It shows no dilatation at its base, *i.e.* there is no atrial chamber apart from the process itself. The spermathecal duct joins the atrium at its ectal end, within the body-wall.

Remarks.—The finger-like upwardly projecting atrium relates the present form to *D. travancorensis* and *D. jalpaigurensis*; the similarity to the former is increased by the absence of any other widening at the termination of the spermathecal duct, and to the latter by the coiled form of the prostate. It differs from both in the number or in the position of the gizzards, as well as from *D. jalpaigurensis* in the absence of genital markings.

Drawida affinis, sp. nov.

W. 131/1. Rangamati, Chittagong Hill Tracts, Bengal, 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 37 mm.; maximum diameter 3 mm. Colour a uniform medium gray. Segments 107, with, in addition, a small zone of regeneration consisting of eight very small segments; all the segments are very narrow from front to back.

The prostomium was small and could not be accurately examined, owing to its being withdrawn within the first segment.

Dorsal pores are absent.

The setae are closely paired; there is a relatively narrow interval between the ventral bundles, so that $aa : bc :: 3 : 5$, or $4 : 7$. The lateral bundles of setae are at the level of the lateral line of the body (dd = half the circumference).

The nephridiopores are in line with the setae *cd*.

No clitellum was visible, nor are there any genital markings.

The male apertures are in groove 10/11, with their centres in *b*; they are inconspicuous and slit-like.

The female pores were not visible.

There was possibly a slight indication of the spermathecal apertures in grooves 7/8 slightly ventral to *c*.

Internal anatomy.—Septa 5/6 to 8/9 are moderately thickened.

The gizzards are three in number, in segments xiii-xv, with softer annuli intervening.

The last hearts are in segment ix; they run freely, not being connected to the septa by mesentery, as is usually the case.

The testis-sacs are attached to septum 9/10, and are ovoid in shape and contained wholly in segment x. The vas deferens is narrow, and constitutes a coiled mass in x, on the posterior face of septum 9/10. The prostate is tubular, and consists of several closely applied coils or loops (more than in the last species); it is rather shiny in appearance, and becomes progressively narrower towards its ectal end; the vas deferens joins it at a point above (ental to) the middle of its length.

The ovarian chamber,—segment xi,—is constituted as in the last species; the alimentary canal is excluded by means of a membranous connection between septa 10/11 and 11/12 which arches over the gut, but the septa are not united together dorsally near their junction with the parietes. No ovaries or ovisacs were visible.

The spermathecae were small, empty and transparent; they were flattened against septum 7/8, and approximately circular in shape. A narrow coiled duct leads downwards. The atrium has the same shape and relations as in the last species; there is no swelling at its base.

Remarks.—This species is also one of the group which comprises *D. travancorensis*, *D. jalpaigurensis*, and the last described form (as well as several which follow), characterized by the elongated prostate and much elongated spermathecal atrium. The prostate has the simplest form in *D. travancorensis*, where it is simply pear-shaped; but others of the group are apparently less modified as regards the ovarian chamber.

The relatively narrow interval between the ventral setal bundles is rather characteristic of the present species.

Drawida rangamatiana, sp. nov.

(Pl. xvi, fig. 3).

W. 82/1. Rangamati, Chittagong Hill Tracts, Bengal. 17-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 137 mm.; maximum breadth 7·5 mm. Nonpigmented, light grey in colour. Segments 237; in the posterior third of the body the segments are very short.

There is apparently no prostomium.

Dorsal pores are absent.

The setae are closely paired. In the anterior segments *aa* is equal to *bc*, behind the genital region *aa* is two-thirds of *bc*, but in the middle of the body and towards the hinder end it is distinctly less than half *bc*; *d* is in the lateral line of the body, so that *dd* is half the circumference. All the setae are relatively very small, considering the large size of the worm.

The nephridiopores are in the line of the lateral setal bundles.

No clitellum was distinguishable.

The male apertures are in groove 10/11, with their centres between *b* and *c*, but nearer to *c*; the borders of these segments are much swollen where they are in relation with the apertures.

The female apertures are in 11/12, between *b* and *c*, but nearer *b*; the position is marked on one side by a thickening and whitening of the posterior lip of the groove.

The spermathecal pores are in 7/8, their centres just below *c*; the lips of the groove are swollen here, the swelling of the anterior lip extending upwards beyond *d*.

Internal anatomy.—Septa 5/6, 6/7, 7/8, and 8/9 are very stout and strong, especially the first two; 8/9 is the thinnest of the four; the rest are thin.

The oesophagus, thin-walled and filled with reddish powder, was in the single specimen available bulged alternately on the two sides in successive segments. The gizzards are four in number, in segments xvi to xix, and are separated by softer annuli.

The last hearts are in segment viii; there are two commissures on each side in this segment.

The testis-sacs are rather similar to those of *D. ghatensis*; though to be looked on as derived from septum 9/10, they occupy a much more posterior position than usual; on the one side the sac was situated in segment xii, bulging back septum 12/13; on the other it extended back into xiii. The forward connection of the sac with its place of origin is by means of a neck, as in *D. ghatensis*; but I could not isolate the neck cleanly from the surrounding structures, for example from the septa through which it passes; there was certainly a continuity of structure between it and septum 11/12. One testis-sac was opened and an attempt was made to turn out its contents and to identify the testis and funnel, but it was not successful; the contents were very firm, and not separable from the inner surface of the wall of the sac.

The vas deferens leads forwards from the testis-sac, and forms a very fine and tightly coiled tube, which joins the prostate rather lower down than its middle, *i.e.* rather nearer its ectal than its ental end. The prostate is a softish white, not shiny, closely curled cylindrical structure, of about the same diameter throughout, of moderate size and without any differentiated duct; it is contained in segment x.

The ovarian chamber does not reach the dorsal body-wall. The ovisacs are small and finger-shaped; they extend back into segment xiii.

The spermathecal ampulla is small and globular; the duct, thin and much coiled at first, and afterwards with a wavy course, runs downwards on the posterior face of septum 7/8. Where it pierces the body-wall there arises a long stalked appendage, the most conspicuous part of the whole apparatus; it stands erect in segment vii, free from and in front of the septum; its ental portion is dilated in the form of an elongated cone with rounded tip; the stalk which connects this with the body-wall is fairly stout, somewhat curved, smooth and slightly shiny, and longer than the dilated ental portion. Fig. 3 represents the appearance of this atrial appendage under the low power of the microscope; the lumen of the dilated portion was empty.

Remarks.—The relationships of this form are with the former group. The coiling of the prostate is as marked as in *D. affinis*, and the atrial appendage of the spermathecal apparatus is more marked and of a more characteristic shape. The resemblance of the testis-sac to that of *D. ghatensis* (14) has been mentioned. It is curious that the last heart is in segment viii (not ix, as usual), and that viii should contain two pairs of hearts.

Drawida papillifer, sp. nov.

W. 83/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 70 mm.; thickness 3·75 mm. Colour light grey, nonpigmented. Segments 148.

Prostomium damaged, perhaps prolobous.

Dorsal pores absent.

Setae closely paired; *aa* is rather less than *bc*; *dd* is equal to half the circumference.

Nephridiopores apparently in line with setae *d*.

The male apertures are indistinct, in groove 10/11, between *b* and *c* their centre rather nearer to *c*; they are slit-like, and their lips are not swollen.

I could not distinguish the female apertures.

The spermathecal apertures are in groove 7/8, their centre just below the line of setae *c*.

The clitellum takes up segments x-xiii=4; its hinder end is ndistinct.

There are a few very slightly marked darkish papillae on the genital region, distributed as follows:—On segment vii a pair, dorsal to *d* and just behind the level of the setal bundles; on x a pair, below *c* and just in front of the level of the setae; on xi a single papilla, just behind groove 10/11 and between the lines *b* and *c* but nearer to *c*.

Internal anatomy.—Septa 5/6 and 6/7 are much strengthened; 7/8 and 8/9 much less so,—only moderately stout; 8/9 is bulged forward by the testis-sacs. Septum 9/10 is thin, and is attached to the body-wall at the middle of segment x (according to the external grooves).

The gizzards are three in number, in segments xv, xvi, and xvii; they are separated from each other by soft annuli.

The last heart is in segment ix; on one side in this segment, deeply situated on the intestine, there was an additional commissure.

The testis-sacs are irregular in shape, and asymmetrical, the right being rather anterior to the other, and extending across the middle line in front, while the left extends considerably further back; they are suspended by septum 9/10, but the greater part of the right sac is in ix, and of the left in x,—indeed the hinder end of the left sac is on a level with groove 11/12. On opening one of the sacs the flocculent matter was found to be very adherent to the inner surface of the wall; it would seem that the inner surface proliferates over the greater part of its extent, the testis being diffuse. A folded mass on the wall, at the place where the vas deferens leaves the sac, probably represents the funnel along with compacted spermatozoa.

The vas deferens is narrow and much convoluted; it leads down from the testis-sac to the prostate, which it joins at about the middle of its length. The prostate is soft and glandular-looking; it is elongated, and bent with the angle directed forwards; the ental end is wider than the ectal, so that if it were straight it would be described as club-shaped.

Septa 10/11 and 11/12 are separate from each other at the periphery by the ordinary length of a segment; hence on opening the worm the ovarian chamber is opened up, and numerous small ova fall out; the chamber is closed below (around the alimentary canal), so that a needle can be passed from segment xii forwards into x along the side of the gut underneath the floor of the chamber.

The ovary is fringe-like, curving round the alimentary tube on the anterior wall of the ovarian chamber. The funnel on the posterior wall is an elongated groove with white lips, and with a similar curve. The ovisacs are large; the right extends back to septum 15/16; the left is curved ventrally so as to pass underneath the intestine, and is confined to segment xii, bulging back septum 12/13.

The spermathecal ampulla is an ovoid sac in the usual situation; the duct is long and convoluted, and leaves the ampulla rather below the middle of its greatest length, passing down to pierce the septum and join the base of the atrium. The atrium is of relatively large size; its upper part is constituted by an elongated ovoid sac, thin-walled, of regular shape, with a smooth surface and in size longer than, but not so broad as, the spermathecal ampulla; the lower part is a duct, half as wide and slightly more than half as long as the upper sac-like portion. The atrium is either erect in segment vii or lies forwards on the ventral body-wall.

Remarks:—This species again belongs to the same group as the former; but while the atrium of the spermatheca has developed still further, the elongation and coiling of the prostate is less than in the two forms immediately preceding. It is unfortunate that the species is represented by only one example, and that hence the value of the genital papillae as a distinguishing character is not easy to appraise.

Drawida nepalensis, Mchlsn.

(Pl. xvi, fig. 4).

W. 72/1. Rangamati, Chittagong Hill Tracts, Bengal. 13-vii-1915. R. Hodgart. Four specimens, one larger than the rest, and sexually mature.

W. 80/1. Kierpur, Purneah Dist., Bihar; under iron tub in open field. 10-ix-1915. C. Paiva. Nine specimens, the majority mature.

External characters.—Length 123 mm. (70 mm. Kierpur); diameter 5 mm. Colour light grey, almost white, nonpigmented. Segments 149.

Prostomium prolobous.

Dorsal pores absent; but the longitudinal muscular coat shows an interval middorsally behind each furrow, easily visible through the superficial layers; these gaps are well seen from the inner side of the body-wall, where they quite give the impression of dorsal pores (Michaelsen, "dorsal pores apparently absent"). The gaps are probably to be looked on as the remnants of pores. In a specimen of the second batch, on stripping off the cuticle and pressing on the body-wall, the spirit inside the body cavity welled out, in several regions, through these pores, as seen by the diffraction lines in the water in which the animal was lying; probably in addition to the longitudinal muscular coat being absent, the other layers of the parietes were thinned and easily gave way on slight manipulation. The series could be followed forwards to furrow 4/5.

The setae are small and closely paired ; in front of the clitellum *aa*=*bc*, while in the rest of the body *aa* is rather less than *bc*. In the anterior half of the body *dd* is greater than half the circumference but rather less than two-thirds ; behind the middle it is equal to half the circumference. The relations were almost the same in the Kierpur specimens.

The nephridiopores are in line with the lateral setal bundles.

In the Kierpur specimens a slightly marked clitellum was present on segments x-xiii (possibly xiv should be included).

The male apertures are in groove 10/11, on very prominent papillae which have their centres rather nearer to the line *b* than to *c* ; the papillae are bluntly conical on a circular or transversely elongated oval base ; the height of the papilla is about equal to the diameter of the base ; each is encircled by a groove, and the lips of furrow 10/11 are swollen in front of and behind the papilla for an extent equal about to the interval *bc*.

The female apertures are small, on groove 11/12, in line with *b*.

The spermathecal apertures, difficult to recognise, are in furrow 7/8 just below the line of seta *c*.

Internal anatomy.—Septa 5/6 to 8/9 are much strengthened ; 9/10 is excessively tenuous, and apparently attached well behind the corresponding groove ; all behind are very thin.

There are three gizzards in the dissected specimen of the first batch, in segments xv, xvi, and xvii, separated by softer annuli ; the oesophagus is bulged in ix (or ix and x), but not markedly, and there are no lamellae internally. The specimen of the second batch which was examined had four gizzards, in segments xiv-xvii.

The last heart belongs to segment ix, but is displaced backwards with septum 9/10 so as to lie at the level of the hinder end of the prostate.

The testis-sac of the left side is large and conspicuous, and lies entirely behind septum 9/10, in the space between this and the conjoined septa 10/11 and 11/12 ; it is bent with its convexity inwards, and extends across the middle line. The testis-sac of the right side is much further back ; its hinder end is at the level of septum 15/16, septa 12/13, 13/14 and 14/15 all being bulged backwards and constituting an investment for the sac ; perhaps 11/12 is so also, but this cannot be disentangled from the sac in the same way as the others ; the sac is connected with 9/10 (from which it must be supposed to originate) by a membranous expansion above the alimentary tube and heart. In the Kierpur specimen the sacs were also asymmetrical, that on the right side passing back beneath the ovarian chamber.

On opening the testis-sac the greater part of the flocculent mass which fills it can be dislodged from its walls, leaving only the thin transparent membrane. At one part of the wall is the much folded funnel with iridescent spermatozoa adhering, from which the vas deferens originates; anterior to the funnel, on the inner wall of the sac, the flocculent mass cannot be cleanly dislodged,—this patch represents the testis, a proliferation of the sac-wall

The vas deferens is a fine and excessively coiled tube, the scores of convolutions forming a large mass which lies against the testis-sac on its outer side. The first portion of the vas, which lies internal to the rest, is excessively fine,—much finer than the main mass; the general direction of the tube is forwards and downwards, and it terminates by joining the ental end of the prostate.

The prostate is a white cylindrical organ, bent in a loop on the left side with its convexity backwards and the ental end upwards, forming an **S** with the ental end of the **S** backwards on the right side; the ental end of the organ is slightly wider than the rest.

The ovarian chamber, enclosed above by the fusion of septa 10-11 and 11/12, is not opened into on opening the animal; there is apparently a free passage underneath the chamber by the side of the alimentary canal. The ovisacs arise from the posterior wall of the chamber; they are subcylindrical, with crenulated margins, and lie on the intestine one on each side of the middle line

The spermathecal ampulla, in the usual situation, is globular in form; a thin duct leads down in several loose coils on the septum, and after piercing the septum joins the base of the atrium in segment vii. The atrium (fig. 4) is very large, and, in the dissected specimen of the first batch, somewhat triangular in shape; in the natural condition the atria encircle the gut so that their straight dorsal edges almost meet in the middle line. In this specimen the organs are empty and laterally compressed, and a deep depression exists in its dorsal border; by manipulation this pit can be seen to be an invagination of the sac-wall which, when its lips are separated, appears funnel-shaped; if the pit were evaginated the atria would overlap the middorsal line. The lower end of the atrium narrows gradually to form a somewhat twisted duct. On opening the sac the inner surface is seen to be elevated into a number of transverse ridges, irregularly disposed and not distinctly annular; but there is no external annulation or grooving such as Michaelsen notes for his specimens. In the specimen from Kierpur, however, transverse ridges and folds were visible on the atrium, though not regularly disposed; and its margins were crenulated irregularly; the upper end was not invaginated.

Remarks.—I was kindly allowed to inspect the types of the species belonging to the Indian Museum; but unfortunately they arrived in such a damaged condition that I was unable to make any use of them.

I have given a complete description of the mature example from Rangamati, with notes on one of those from Kierpur, since they differ in details from Michaelsen's specimens. The two distinct parts of the vas deferens (which I think Michaelsen would have mentioned), the differences in the spermathecal atria, and details concerning the testis and funnel, are of minor importance; but I am inclined to attribute more value to the position of the testis-sacs (Michaelsen, "on septum 9/10, depending from it, forwards and backwards, into the 9th and 10th segments"), and perhaps also to the absence of copulatory organs (though these were not present in all of Michaelsen's specimens).

The asymmetry of the testis-sacs in the specimens described above is remarkable ; on one side there is an approach to the condition of *D. ghatensis* and *D. rangamatiana*. The indications of dorsal pores are also interesting.

I do not myself think that there is sufficient ground for suspecting an identity between *D. nepalensis* and Bourne's *D. uniqua*. Michaelsen (13) says at the beginning of his description that the two may perhaps prove to be identical ; and at the end, that "this species comes near to *D. uniqua* (Bourne), if it is not identical with it." But after mentioning the large and peculiar spermathecal atrium he adds : "I do not believe that Bourne could have overlooked the above-described very characteristic structure or that he would have abstained from mentioning it had it been present in his species." I fully agree that Bourne would certainly have given an unmistakable description of this peculiar structure, had it been present ; moreover, the prostates in the present species are far too long, and too twisted or bent, to be conceivably described as "teat-like" (as Bourne does for his form) ; nor are the ovaries free in the present species, as Bourne says for *D. uniqua*, but enclosed in a typical ovarian chamber (Michaelsen, "apparently enclosed"). At the time that Michaelsen wrote, it was doubtful whether any (endemic) species of the genus existed elsewhere than in South India, and it was reasonable to look with suspicion on species which contradicted conclusions otherwise apparently well established.

Fam. MEGASCOLECIDAE.

Subfam. *MEGASCOLECINAE*.

Gen. **Pontodrilus**.

Pontodrilus bermudensis, Bedd. f. **ephippiger** (Rosa).

W. 66/1. Near Chiquilim Point, Mormugao Bay, Portuguese India ; under stones at edge of brackish water. 29-ix-1916. S. Kemp. A number of specimens.

W. 126/1. Mormugao Bay, in small bay between Goa and Vasco, shore collecting, under stones. Sept. 1916. S. Kemp. Several specimens.

Gen. **Perionyx**.

Specimens belonging to this genus, unidentifiable because of immaturity, were found at Kalimpong and Pashok, in the Darjiling District, E. Himalayas.

Perionyx excavatus, E. Perrier.

W. 69/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Six specimens of moderate size and one very small one.

W. 81/1. Phagu, near Simla, alt. 9000 ft.; in very wet earth at edge of spring. 11-v-1916. N. Annandale and S. W. Kemp. Four specimens.

The specimens from Phagu are noted as having been, when captured, deep purple above with strong green iridescence, and much paler below.

There was really no gizzard; in segment vi the oesophagus was rather swollen, but the walls when cut into were not thickened. There was no widening of the oesophagus in segment xiii.

There were no diverticula on the spermathecae (examined microscopically also); this was not apparently due to the specimens being in an early stage of sexual maturity, since all the other parts of the genital system are well developed; the ovaries are large, and the seminal vesicles of segment xii reach backwards as far as septum 13/14. I have previously found the diverticula absent in a specimen from Dibrugarh, N. E. Assam (17).

Specimens which were immature, but referable with more or less of probability to this species, were obtained from the following localities:—

Kasauli, W. Himalayas. Baini Prashad. 31-vii-1916.
Talewadi, near Castle Rock, N. Kanara District, Bombay Pres. Oct. 1916. S. W. Kemp.

Perionyx pallidus, sp. nov.

(Pl. xvi, figs. 5, 6).

W. 89/1. Kalimpong, Darjiling Dist., E. Himalayas; alt. 600-4500 ft. 24-iv to 10-v-1915. F. H. Gravely. Several specimens, one mature.

External characters.—Length 80 mm.; thickness 3·25 mm. Colour pale, with purplish tinge dorsally at anterior end, and purple median stripe throughout the body. Body slightly depressed in the anterior portion. The mature specimen was regenerating the hinder end; another of the same size showed 118 segments.

Prostomium epilobous $\frac{1}{2}$; the sides of the tongue parallel.

Dorsal pores from furrow 4/5.

The setae are in rings which are quite closed ventrally, and almost closed dorsally. The middorsal interval varies slightly; in the anterior part of the body *zz* averages $1\frac{1}{2}$ *yz*, further back about $1\frac{1}{4}$*yz*. The setae are set closer together ventrally than laterally or dorsally; there is no difference in the size of the setae in different segments. The following numbers were counted:—53/v, 72/ix, 52/xi, 64/xii, 52/xix, and in the middle of the body 70.

The clitellum extends over segments xiii-xvi = 4; the body is slightly swollen here, and buff in colour; setae are present as elsewhere.

In segment xviii the midventral region is slightly depressed, and running across it in the position of the setal line is a groove, sharply cut and narrow, though rather wider and deeper at the position of the male pores; these are small cracks, one-tenth of the circumference apart, or with an interval of about seven intersetal spaces. A few black spots in the bottom of the groove represent the slightly modified penial setae; the other setae begin some little distance outside the groove.

The female aperture seems not to have developed.

The spermathecal apertures are in the furrows 6/7 and 7/8; they are small and slit-like, separated by a space equal to about seven intersetal intervals, or about the same as in the case of the male pores.

Internal anatomy.—Septa 5/6 and 6/7 are thin, 7/8, 8/9 and 9/10 are slightly thickened, and the rest thin.

There is a rudimentary gizzard in segment vi, slightly firmer and paler, through the presence of muscle fibres, than the rest of the oesophagus. The tube is swollen in segments xiii and xiv, and on opening it longitudinal lamellae were found in this region, but they were of no great height and might rather be called foldings than lamellae. The intestine begins in xvii; there is no typhlosole (in the anterior part).

The last heart is in segment xiii.

The excretory system is meganephric; I saw no difference between the nephridia of different segments, and the ducts terminate at the same level.

Testes and funnels are free in segments x and xi. The seminal vesicles are of moderate size, in xi and xii; they are fused in each segment dorsally over the alimentary canal; their contour is smooth, not cut up into lobes.

The prostates, of the *Pheretima*-type, are very small, and confined to segment xviii; the duct runs straight inwards.

The spermathecae are two pairs, in segments vii and viii, opening forwards into furrows 6/7 and 7/8. They are small, with a sac-like ampulla which is rather constricted at its middle, the upper portion being the wider. The duct is scarcely separately distinguishable, and is hardly more than the narrower end of the sac; it is short and half as wide as the ampulla. There is a fairly well-marked bulging on one side of the lower part of the sac in one of the organs which was mounted for microscopic examination (fig. 5); this may represent the beginning of a seminal chamber. A connective tissue strand passes upwards from the summit of the ampulla.

The penial setae (fig. 6) are scarcely modified, and represent a very early stage in their evolution (*cf. P. nainiana,* Michaelsen, 13). They have the ordinary form; in length they measure ·175 mm., in thickness 17μ; with the high power a few fine sculpturings are seen on the distal half of the shaft.

Remarks.—Of the species of this genus which have the spermathecal apertures in furrows 6/7 and 7/8, perhaps *P. aborensis* resembles the present form most closely; but the colour, the intervals between the male and spermathecal apertures respectively, the position of the last heart, and the fusion of the seminal vesicles of each of the two segments, seem sufficient to distinguish them. Differences in the male field separate the present species from *P.*

kempi, *pincerna*, *inornatus*, and *sikkimensis*; the last mentioned has also thickened septa and characteristic penial setae.

Perionyx gravelyi, sp. nov.

(Pl. xvi, figs. 7, 8).

W. 79/1. Pashok, Darjiling Dist., E. Himalayas; alt. 5500 ft. 26-v to 14-vi-1916. F. H. Gravely. A single specimen.

External characters:—Length 48 mm.; maximum breadth 2 mm. Colour dorsally a light purple, more marked at the anterior end, with a darker middorsal stripe, pale ventrally. Segments 89.

Prostomium epilobous $\frac{2}{3}$, tongue broad, cut off behind.

Dorsal pores begin at furrow 6/7.

The setae are in rings, which are almost closed dorsally and ventrally; the middorsal and midventral intervals are perhaps equal to $1\frac{1}{4}yz$ and $1\frac{1}{4}ab$ respectively in front of the genital region, and to $1\frac{1}{2}zy$ and $1\frac{1}{2}ab$ behind it. There are no noteworthy differences between the intersetal intervals. The following numbers were counted: 34/v, 40/ix, 40/xii, 32/xix, and 32 in the middle of the body.

The clitellum is very indistinct; it includes perhaps xiii or $\frac{1}{2}$xiii-xvi $= 3\frac{1}{2}$ or 4; setae and dorsal pores are present.

The male apertures are on segment xviii, in the form of slit-like transverse cracks just behind the level of the setae and between setae *a* and *b* on each side (fig. 7). Seta *a* is particularly black; *b* is slightly further out than the *b* of other segments, and *c* of segment xviii corresponds to *d* of other segments in position. The apertures and setae *a* and *b* are situated on papillae which meet and fuse in the middle line; there is a transverse groove in front of and behind the conjoined papillae, so that a strip of segment xviii is left unmodified at the anterior and posterior borders of the segment.

The female aperture was not visible.

The spermathecal apertures are in furrows 6/7 and 7/8, between the lines of setae *a* and *b*. They are thus, like the male pores, very near the midventral line.

Internal anatomy.—Septa 7/8, 8/9, and 9/10 are slightly strengthened; there is perhaps some slight thickening of the septa as far back as the prostatic region.

The gizzard is small, cylindrical, and moderately firm, in segment v. The oesophagus is somewhat swollen in xiv and xv,—in the latter segment transverse vascular channels are visible on the dorsal wall. The intestine begins by a gradual widening in segments xvii to xix; there is no typhlosole in the anterior portion.

The last heart is in segment xii.

Testes and funnels are free in segment x; funnels were seen in xi but testes were not identified. The vesicula seminalis of segment xi is large and single, extending across the middle line and down on each side of the oesophagus, taking up the whole length and breadth of the segment. In segment xii the vesicles may be described as a pair, but fused in the middle line behind septum 11/12, and thence depending back on each side so as to bulge septum 12/13 back nearly to the level of 13/14. All the vesicles are of simple outline and not lobed.

The prostates occupy segments xvii to xix, and are cut up into three lobes, corresponding to the three segments; they are however relatively small structures. The duct originates at the middle of the gland, and passes at first backwards to the level of septum 18/19, then obliquely forwards and inwards; the angle is perhaps characteristic; each duct is rather thin, soft, and broader towards its ectal end.

The spermathecae are situated in segments vii and viii, and their ducts are directed forwards. The ampulla is sac-like and irregular in shape; the duct is half as thick and nearly as long as the ampulla, from which it is not sharply marked off; there is no diverticulum.

The penial setae,—those on each side of the male apertures, *a* and *b* of segment xviii,—are but little modified. They are ·4 mm. in length, and 21μ broad at the middle; there is a slight curve in the proximal part of the shaft, and the tip is slightly bent; the tip is pointed, and near it there are a few fine dot-like sculpturings arranged more or less in transverse rows (fig. 8).

Remarks.—The present form belongs to the same group of species as the last; the characters of the male field and the penial setae are probably sufficient to distinguish it, though its characters are on the whole negative rather than positive.

Perionyx aborensis, Stephenson var. **heterochaetus**, nov.

(Pl. xvi, fig. 9).

W. 138/1. Pashok, Darjiling Dist., E. Himalayas; alt. 5000 ft. 26-v to 14-vi-1916. F. H. Gravely. A single specimen.

External characters.—Length 60 mm.; breadth 2·5 mm. Colour on dorsal surface dark purple anteriorly, brownish with darker median stripe behind; pale ventrally. The body is depressed, the ventro-lateral angles being fairly pronounced and the ventral surface slightly concave. Segments 100.

Prostomium epilobous $\frac{1}{3}$; tongue broad, not closed behind.

Dorsal pores from furrow 5/6.

The setae, in rings, have a rather peculiar arrangement. In the first thirty-four segments the setae on the dorsal surface are much larger, and set more widely apart, than behind; the change is sudden, and coincides with a change in pigmentation, which is darker and purpler in front, lighter and browner behind. In the anterior part of the body *zz* is a little greater than *yz*,—about $1\frac{1}{4}$ *yz*; behind there is hardly any difference. The ventral setae are comparatively small and close together throughout, and the ring is closed (*aa* = *ab*). The following numbers were counted:—30/v, 31/viii, 30/ix, 31/xii, 33/xix, and about 50 in the middle of the body.

The clitellum appeared to extend over segments xiii-xvii = 5, but was most marked in xiv-xvi; it is light in colour, and the setae and dorsal pores are retained.

The male area, on xviii, is a whitish patch which takes up the whole length of the segment; the lateral margins are rather swollen, and its centre is rather more concave than the rest of the ventral surface. The apertures are transverse grooves in line with the setae; the centre of each is about opposite to the setal interval *de*, the interval between the centres of the grooves being thus equal to $\frac{2}{15}$ of the circumference; the interval between the inner ends of the grooves is equal to the length of one of the grooves. Slight depressions, also transverse in direction, are present in front of and behind the grooves, which thus are bounded by slightly marked anterior and posterior lips. The setae begin on the outer margin of the male area.

The female aperture is on segment xiv,—a small transverse slit in the midventral line, surrounded by a whitish oval patch, the whole of which is included between the line of setae and the anterior border of the segment.

The spermathecal pores are situated in furrows 6/7 and 7/8, one-sixth of the circumference apart and about in line with seta *e*.

Internal anatomy.—Septa 6/7, 7/8, and 8/9 are slightly thickened.

There is a rudimentary gizzard in segment v, the oesophagus being somewhat swollen and its walls thickened. The oesophagus is also swollen in segments xi, xii, and xiii, where transverse vascular channels are to be seen in its wall; the interior here is rugose merely. The intestine begins in xix, behind the prostate; there is no typhlosole in its anterior part.

The last heart is in segment xii.

Testes and funnels, the latter included in large masses of iridescent spermatozoa, are present in segments x and xi; a mass of coagulum fills up segment x[1], very much resembling the seminal vesicles in the two succeeding segments, and differing only in being more easily detachable.

The seminal vesicles, in segments xi and xii, are large, and fill out their respective segments; they are flocculent masses, with simple outline, which meet in the middle line dorsally but do not fuse there with their fellow of the other side (doubtfully so in the case of the posterior pair).

The prostates are squarish blocks, confined to segment xviii. The duct is not very stout, and only slightly muscular apparently; it lies in a hilus of the gland for the most part, where it is curled

[1] I have little doubt that the seminal vesicles which I stated to be present in segment x in *P. depressus*, and said to be more intimately attached to septum 9/10 than to 10/11 (17) are really only masses of coagulum. These masses are mainly composed of spermatozoa, making their way, presumably, from the seminal vesicles, where they have been ripening, to the mouths of the funnels.

and twisted; if straightened out it would be of moderate length. Its ectal portion is rather stouter than the rest; it joins the body-wall at the outer margin of a slightly raised whitish cushion. No penial setal sacs were seen.

Ovaries and funnels were well developed, in segment xiii.

The spermathecae are situated in segments vii and viii, opening forwards into grooves 6/7 and 7/8. The ampulla is irregular in shape, and about as broad as long; the duct is very broad,—two-thirds as wide and two-thirds as long as the ampulla, so that the whole organ has a stumpy appearance. There is a single diverticulum, sessile on the inner side of the upper part of the duct; a few indistinct seminal chambers are visible on its surface (fig. 9).

Remarks.—The present form presents some similarities to *P. depressus*, in the depressed form, the general character of the male field, the prostatic duct, and the relations of spermathecal ampulla and duct. It appears to be even more closely related to *P. aborensis*; the differences are the numbers of setae (about 30 per segment in the anterior part of the body as against more than 60 in *P. aborensis*), the setal distribution (the peculiar arrangement in the present form is not, apparently, found in *P. aborensis*, where it is noted that the setae of segments viii and its neighbours are the largest), and the absence of spermathecal diverticulum in *P. aborensis*; the apertures are rather closer together in the present form.

As in so many cases, it is difficult to know quite what to do with a single specimen; had there been a number of specimens for examination its position could probably have been settled with some degree of certainty. The erection of a variety offers a temporary refuge; the varietal may be advanced to a specific name or may be dropped altogether, as subsequent specimens come under examination.

Perionyx nanus, sp. nov.

(Pl. xvi, fig. 10).

W. 78/1. Pashok, Darjiling Dist., **E. Himalayas**; 5000 ft. alt. 26-v to 14-vi-1916. F. H. Gravely. Two specimens, one mature.

External characters.—Length 53 mm.; diameter 1·5 mm. Colour brownish-purple dorsally, pale ventrally. Ventral surface flattened. Segments 100.

Prostomium epilobous $\frac{1}{2}$, tongue not closed behind.

Dorsal pores begin from furrow 5/6.

The setal ring is almost closed dorsally; and entirely closed ventrally in the anterior part of the body, but behind the anterior third a slight break can be distinguished. The following numbers occurred: *ca.* 36/ix; about the same, but too small to count accurately in xii; 35/xix, and in the middle of the body 34.

The clitellum extends over xiv-xvii = 4; it is well marked, and rather lighter in colour than the rest of the surface, smooth, the setae quite distinct but the intersegmental grooves less well marked than elsewhere.

The male apertures are on segment xviii, in line with *g* or the interval *gh*; they are wide apart, this interval representing a distance equal about to a quarter of the circumference; the pores are slightly behind the line of the setae, and are prolonged inwards towards the middle line by slight grooves. Surrounding each aperture is a whitish oval opaque thickened patch, which is itself surrounded by a more translucent lip; the aperture is situated excentrically in the oval patch, between the centre and the outer margin. The whole takes up the entire ventral surface of segment xviii, the lip on each side forming a prominence at the lateral margin of the ventral surface of the animal (fig. 10). There are no setae between the male apertures.

The female aperture was not actually visible, but was indicated by a very slightly paler transversely oval patch taking up the space between furrow 13/14 and the setal ring of xiv.

The spermathecal apertures are large and patent, widely apart (not quite one-third of the circumference) and near the lateral margin of the ventral surface, in furrows 6/7 and 7/8; they are bounded by distinct lips, and a gelatinous matter was protruding from them.

Internal anatomy.—No septa are notably thickened; 8/9 and 9/10 seemed slightly strengthened, and perhaps 7/8 and 10/11 very slightly so.

A rudimentary gizzard is situated in segment v, the outline of the thickening of the oesophageal wall being somewhat **Y**-shaped, the posterior portion is narrower, and the wall between the limbs of the **Y** is soft. The oesophagus is bulged in segment ix, with marked transverse striations (vascular channels). The intestine begins in xix.

The last heart is in segment xii.

Testes and funnels are free in segments x and xi (testes not certainly identified in xi; the funnels are conspicuous through the adherent iridescent spermatozoa). Segment x is filled with coagulum, as in the last species. The vesiculae seminales, large loose flocculent masses with only slightly indented margins, take up the whole length of segments xi and xii; those on xi fuse dorsally over the gut, while those in xii meet but are apparently still separable.

The prostates take up part of segment xvii and all of xviii and xix, and are indented by the septa. The duct is thin, soft, not muscular, of the same diameter throughout, and bent once on itself, the convexity of the loop being forwards; there is no modification of the body-wall where the duct joins it. No penial setal sacs were seen.

Ovaries and funnels were present in segment xiii.

The spermathecae are two pairs, in segments vii and viii; they are very simple in form,—roughly pear-shaped with a thick stalk. The ampulla is of some size, and fills out the whole length of the segment; each was, in the present specimen, full of a coagulated yellow gelatinous material. The duct is broad and short,—half as broad and a quarter as long as the ampulla, from which it is not sharply marked off. There is a single diverticulum, sessile and wart-like,—in one case hardly noticeable,—on the inner side at the junction of ampulla and duct; it contains glistening spermatozoa, but is not, apparently, chambered.

Remarks.—This species also belongs to the group of *P. aborensis* (spermathecal apertures in 6/7 and 7/8, simple form of spermathecae, and absence of penial setae); but its special characters,—small size, lateral position of the male and spermathecal apertures, characters of the spermathecal diverticulum and male field,—render it perhaps the most distinct of the group.

Perionyx m'intoshi, Bedd.

W. 87/1. Nepal Valley, alt. 4500—6500 ft. 26-vi-1916. Col. J. Manners-Smith. Two specimens, the larger softened.

Little is known about this interesting species, though it was one of the earliest of the genus to be described. The first worm to be described by Beddard under this name was represented by a single immature specimen from Akyab in Burma; this was later considered of doubtful validity by the author himself (3), as also by Michaelsen (10, 13). Our only other source of information is a second short account by Beddard (2); Vaillant, in his *Hist. nat. des Annelés* (1889), which I have not been able to consult, refers to the species, but apparently only from the point of view of classification and without having had any fresh material. It is therefore worth while to give an account of the specimens which have now come to hand.

External characters.—Length 230 mm.; diameter average 10, maximum 12·5 mm. (the softer specimen measured 280 mm. in length, and was of a maximum diameter of 17 mm., but in the condition of the worm these figures are not reliable). The colour is a lighter or darker purple dorsally (the two specimens differ), with the clitellum of a buff tint and the ventral surface pale. The segments of the longer worm were 225 in number; there was no secondary annulation.

The prostomium is epilobous $\frac{1}{2}$; the tongue being open behind

Dorsal pores are present from furrow 5/6.

The relatively small setae are in rings which are, often at any rate, closed both dorsally and ventrally; there are numerous gaps in various places on the dorsal surface, but since complete rings can be found the gaps may be accidental. The setae are closer together on the ventral than on the dorsal surface; the intersetal spaces are often very irregular. The following numbers were counted: 78/v, 72/ix 76/xii (but there were long gaps in each of these three series), *ca.* 90/xxiii, and 112 in the middle of the body.

The clitellum is not sharply delimited; it extends over $\frac{1}{2}$xiii-xx=$7\frac{1}{2}$; the furrows are still well marked, and setae are present.

The male area is a midventral depression on segment xix, which in the more mature of the two specimens is rather longer than broad; it takes up the whole of the length of the segment, and encroaches in front and behind on the adjacent segments; the depression is rectangular in shape, and has a well marked border, —rather less well marked however at the sides, near the male pores. These are round pits with distinct lips, situated very close together slightly behind the middle of the segment, the line of the setae bends forwards in front of the apertures.

The female aperture is single, and appears as a small transversely elongated pit, on segment xiv, midway between the line of the setae and the anterior limiting furrow.

The spermathecal pores are situated in furrows 7/8 and 8/9, fairly close together, but not, apparently, as close as the male pores.

There are no other genital marks.

Internal anatomy.—Septum 4/5 is thin, 5/6 slightly and 6/7-11/12 somewhat or moderately thickened; a number of those that follow, as far perhaps as 18/19, are slightly thickened. A large number of Nematode parasites were found in some of the anterior segments, in x and especially in xi.

The gizzard, in segment vi, is of fair size even relatively to the large size of the animal; it is moderately firm though not hard; the anterior end is the broader, and there is a constriction not far behind the anterior end, where a transverse sheet of muscle (not a septum) is inserted round the organ. There are no calcareous glands. The intestine begins in segment xviii

The meganephridia are disposed in the same longitudinal line throughout the body.

The last heart is in segment xiii.

Free funnels were found in segments x and xi, and testes in the former segment; testes were not identified with certainty in xi but the condition of the specimens left something to be desired, and this segment was packed with the Nematode parasites mentioned above. Vesiculae seminales are present in xi and xii; they are large, soft, and somewhat cut up into lobes at their surfaces; those in xii are large enough to bulge back the septum; in one specimen those of the same segment had fused together over the intestinal canal, in the other those of the two sides were separate. There appears to be, in addition to the above, a small empty rudimentary seminal vesicle in segment xiii, attached to the posterior face of septum 12/13.

The prostate, of the *Pheretima*-type, is confined to segment xix; it is cut up by indentations into lobes, and the short and stout though soft duct runs from the hilus transversely inwards to its exit.

Ovaries were present in segment xiii, attached to the posterior face of septum 12/13; the funnels were not seen. In both specimens rudimentary ovisacs were seen in xiv.

The spermathecae have the simplest possible form,—almost spherical sacs, prolonged into a short thin duct. There are no diverticula, though the ampullae themselves show a warty prominence or two

There are no penial setae.

Remarks.—A curious feature of both the specimens is the shifting backwards of the male apertures one segment, to xix ; this is accompanied by an extension of the clitellum also (Beddard describes the clitellum as including segments xiii-xix). There is some doubt as to the locality from which Beddard's (second and well characterized) specimens were obtained ; in his paper he says Seebpore, but subsequently (3) states that he had mislaid his notes and that it might be from Darjiling ; the locality of the present specimens renders this second supposition perhaps the more likely of the two.

Genus **Lampito**.

Lampito mauritii, Kinberg.

W. 136/1. Vareeg Islet, S. side of Mormugao Bay, Portuguese India ; shore collecting, under stones. August, 1916. S. W. Kemp. A single specimen.

Genus **Pheretima**.

Pheretima posthuma (L. Vaill.).

It is scarcely necessary any longer to particularize concerning the distribution of this almost ubiquitous worm, at any rate in those provinces where it has already been found. I have lately received, in the present collection belonging to the Indian Museum and otherwise, specimens from Ludhiana (Punjab), Allahabad, Agra, Lucknow (United Provinces), Rangamati (Bengal), Kierpur (Bihar), as well as from Ajmere in Rajputana, a part of the country of whose Oligochaete fauna we are still in ignorance.

A specimen from Kierpur, Purneah Dist., Bihar, showed a peculiarity which is worth passing mention. This was the accessory papilla on segment xvii on the right side. The accessory papillae are as a rule present on segments xvii and xix, almost in line with and somewhat resembling the papillae which bear the male pores on segment xviii ; this particular papilla however seemed so exactly like the true porophores that I opened the worm, and found that it represented the opening of an accessory prostate, instead of as usual a small bunch of cutaneous glands. This prostate was small, and attached by a strand of tissue to the septum in front ; but it had a well-developed duct, coiled and almost as thick as the one in segment xviii.

Pheretima houlleti (E. Perrier).

Allahabad, United Provinces. L. Karam Narain Bahl.

Pheretima heterochaeta (Mchlsn).

W. 139/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

Pheretima hawayana (Rosa).

W. 74/1. Nepal Valley, E. Himalayas; 4500-6500 ft. Col. Manners-Smith. A single specimen.

Pheretima annandalei, sp. nov.

(Pl. xvi, fig. 11).

W. 8/1. Casuarina woods at Singgora, Tale Sap, Siam. 20-1-1916. N. Annandale. A single specimen, the first four segments damaged.

External characters.—Length 58 mm.; thickness 4 mm. Colour varied, rather blotchy, generally pale, with a greenish tinge behind the clitellum; anteriorly buff, with a brownish pigmentation dorsally in the first few segments; clitellum drab-grey. Segments 63.

Prostomium ?

Dorsal pores not distinguishable in front of the clitellum; there may be one at the anterior border of the clitellum, in furrow 13/14.

The setae are in rings; the dorsal interval is small and rather irregular ($zz = 1\frac{1}{2}yz$ in front of the clitellum, less behind); the ring is almost or quite closed ventrally. The setae in front of segment x are rather larger than the average size, and those situated dorsally on segments x and xi are markedly small. There is in general no marked difference in the setal intervals in different parts of the ring, though they are closer ventrally in some of the anterior segments, *e.g.*, viii and ix. The following numbers were counted: 43/v, 59/ix, 55/xii, 51/xix, and 53 in the middle of the body.

The clitellum extends over segments xiv-xvi = 3; it is smooth and rather swollen, without setae or dorsal pores.

The male apertures are situated ventro-laterally, widely apart on segment xviii, the interval between them being about equal to one-third of the circumference; twelve setae intervene. The apertures are transverse slits, not much raised, with much puckered lips, in the line of the setae.

The female pore or pores may be represented by a small slightly raised white patch on segment xiv, near the anterior border of the clitellum.

The spermathecal apertures are small, with slightly tumid lips, in furrows 5/6, 6/7, 7/8 and 8/9; they are situated rather above the lateral line of the body, the interval between those of a pair, measured across the dorsum, being five twelfths of the circumference.

Genital markings are present as small papillae in the male and spermathecal regions. The posterior cluster, about a dozen in number, is situated midventrally on segments xviii and xix. The anterior, seven in number, is midventral on viii, in front of and behind the line of the setae.

Internal anatomy.—Septum 4/5 is thin; 5/6 and 6/7 are somewhat thickened, and have a dense fur of micronephridia on their anterior faces; 7/8 is thin. No more septa are to be distinctly recognized till 11/12, which is thin, as are all the rest. Septum 10/11 is probably represented by a thin membrane which covers the anterior seminal vesicle; this can be stripped forwards off the vesicle, by which it is much bulged forwards, and seen to get an attachment to the body-wall.

The alimentary tube is much bent on itself in segment v; in vi it is thin-walled and dilated. The gizzard is situated behind septum 7/8, and is large, firm, and squarish. The intestine begins in segment xv. A pair of simple conical diverticula arise in segment xxvii (probably, but the septa are very indistinct). The typhlosole begins at the level of the caeca; it consists of a vertical lamina, the sides of which are folded into a series of vertical ridges. Paired lymph-glands are situated on the intestine.

The last heart is in segment xiii.

The excretory system is micronephridial.

Testis-sacs contain the testes and funnels; the sacs are two pairs, those of a pair being quite separate, but those of the same side appear to communicate; the anterior is also connected with the anterior, the posterior with the posterior seminal vesicle. Both pairs of vesicles are very conspicuous, large and white; the anterior, which probably belongs to segment x, extends forwards to impinge on the hinder end of the gizzard; the posterior, in segment xii, extends backwards carrying before it septa 12/13, 13/14, and also to some extent 14/15. The posterior is of simple form, while the front margin of the anterior is slightly lobed.

The prostates take up segments xvii to xx; they are deeply indented into lobes, and in the normal position almost meet dorsally over the intestine. The shining and muscular duct is coiled circularly; it is of moderate stoutness, except at its ectal end, where it narrows, and then joins a copulatory pouch; the whole,—duct and pouch,—are contained in a membranous (probably muscular) sac, through which the duct can be seen, but which has to be torn through before it can be properly displayed. Duct, pouch, and sac form a large flat elevation on the body-wall, which impinges upon and rather bulges forwards and backwards the septa limiting segment xviii in front and behind.

The ovaries have the usual situation.

The spermathecae (fig. 11) are four pairs. The ampulla is irregular or of an elongated triangular shape; the stout duct, long and bent on itself, is nearly twice the length and half the thickness of the ampulla. The single diverticulum is a small ovoid iridescent sac attached by a thin wavy stalk to the duct at its extreme upper end, just below its junction with the ampulla. The loop formed by the duct is bound together by connective tissue, which has to be torn through before the various parts of the apparatus can be nicely laid bare.

Corresponding to the external papillae there is seen on the inner surface of the body-wall, on both sides of the ventral nerve cord, and between and behind the copulatory sacs, a group of small stalked glands, sometimes rather mushroom-like; a similar group exists in the spermathecal region.

Subfam. *OCTOCHAETINAE.*

Gen. **Hoplochaetella.**

Hoplochaetella suctoria, sp. nov.

(Pl. xvi, fig. 12; pl. xvii, figs. 13, 14).

W. 67/1. Sanvordem, Portuguese India; under stones near river subject to tidal influences. 11-ix-1916. S. Kemp. Five specimens.

External characters.—Length 140 mm.; thickness 6 mm. Colour a light brown dorsally, with rather darker median stripe; pale ventrally; setal rings on whitish lines. Segments 145.

Prostomium epilobous $\frac{2}{3}$, tongue not closed behind.

Dorsal pores from furrow 4/5.

The setae are disposed in rings; the middorsal interval is small,—about $2yz$, but it varies somewhat, and may be less than $2yz$ in the anterior part of the body; the midventral interval is similar to the middorsal. The setae of some of the anterior segments are enlarged, more especially those of segments iii-viii; in general, the ventral setae are set more closely than those on the lateral and dorsal aspects; this is especially noticeable in the posterior part of the body. The following numbers were counted:—66/v, 66/ix, 63/xii, 60/xxi, and 58 behind the middle of the body.

The clitellum was not distinguishable.

The external genital markings vary somewhat; it will perhaps be most convenient to describe the first specimen in some detail, and then briefly to allude to the differences in the others.

In the first specimen examined (fig. 12) the male field embraced segments xvii-xix, the most striking feature being the presence of three circular or obliquely oval clean-cut depressions with flat bottoms, which from their sucker-like appearance suggested the specific name; of these a pair were situated on segment xvii, their length antero-posteriorly being equal to the length of the segment, and the distance between the inner margins of the depressions being about equal to twice their longest diameter; the outer and anterior wall of each depression is steeper than the rest of the circumference. A similar depression is present on segment xix, but this is single, and to the right of the middle line, which it almost reaches by its inner margin; in this one it is the outer and posterior part of the circumference which is the best defined. The whole area which includes these three depressions, as well as the prostatic apertures to be mentioned immediately, is sunk below the general surface; the sunken region is triangular in shape, in accordance with the disposition of the sucker-like depressions, but the triangle is not symmetrical about the middle line.

The prostatic apertures are represented by two pairs of small transversely elongated, almost linear, pits in furrows 17/18 and 18/19 respectively; the anterior pair is situated rather internal to the depressions on xvii, which they almost touch by their outer ends; the right aperture of the posterior pair has its centre in line with that of the hinder sucker-like depression, and is situated tangentially to it (fig. 12).

The female aperture is situated midventrally on segment xiv, in front of the line of the setae.

The spermathecal apertures are two pairs, situated on segment viii, the anterior in the line of the setae, the posterior just in front of furrow 8/9. Each aperture appears as a small transverse slit with slightly raised whitish lip; the inner ends are not far from the middle line. In none of the specimens could I make out any actual pore within the transverse grooves; and this was commonly the case in other species of the genus also, so that the communication of the spermatheca with the exterior apparently takes place only for a limited interval.

A series of genital marks in the neighbourhood of the spermathecal apertures is visible on close examination of this region. These consist of a number of minute papillae, whitish, each with a black central dot. These dots are displaced setae: on delicate manipulation they can be felt to grate against a needle; I isolated some of them, and describe them below. The disposition of the displaced setae in this particular specimen is shown in fig. 13; briefly, there were three on segment vii, arranged more or less transversely near the midventral line behind the middle of the segment; a transverse row of six on the anterior half of segment viii; and five on the anterior half of ix, three to the right and two to the left of the middle line. An examination of the figure will show that the displaced setae correspond in position to gaps in the regular setal line, and further that the number in each group corresponds to the number of setae missing from the regular line; this is the case in the other species of the genus also.

There is considerable variation in these external genital characters. The sucker-like depressions may be more or less distinct; the single posterior depression may be accurately in the middle line; or it may be rather further back than in the specimen described above, over furrow 19/20; or finally the triangle may be reversed,—there may be one anterior and two posterior depressions. In the spermathecal region the anterior pair of spermathecal apertures (or the grooves which are to contain them) may be just in front of, rather than in the line of, the setae; and displaced setae may be absent on segment vii.

Internal anatomy.—The disposition of the septa in the anterior part of the body was not at first clear to me; the difficulty arises from the extreme tenuity of some of the septa, and the fact that others are fused together in the manner to be described. Dissection of more than one specimen was necessary; the result given below was found to hold, in general terms, for the other species of the genus also.

Septum 4/5, behind the pharyngeal mass, is thin, but shows the presence of a few muscular strands, and so is rather stronger than those which follow. Septa 5/6, 6/7 and 7/8 are very thin indeed,—the extreme of delicacy and transparency ; 6/7 is really behind the gizzard, since it can by gentle manipulation be peeled backwards from off its wall as far as its hinder end. Septum 8/9 is scarcely thickened ; ix is a wide segment containing the anterior seminal vesicles and posterior spermathecae ; 9/10 is slightly thickened, and is united peripherally with the following septum 10/11, and the next after, 11/12, in such a way that at first the three together appear as if they constituted one enormously thickened septum ; after separating them 10/11 and 11/12 are seen to be in reality not much thickened. Segments x and xi, enclosed between these fused septa, are narrow segments which contain the testes and funnels, as well as two pairs of hearts and calcareous glands. Septum 12/13 is somewhat thickened, and 13/14 and 14/15 perhaps slightly.

The gizzard, in segment vi, is large and subspherical ; the immediately preceding part of the alimentary tube is also fairly firm. Calcareous glands are present in segments x, xi, xii and xiii ; they lie within the arch of the heart, are kidney-shaped, well set off from the oesophagus, and compressed antero-posteriorly ; the two posterior pairs are larger than the two anterior. The typhlosole is a strongly marked vertical ridge. There are lymph-glands similar to those of *Pheretima* on the septa middorsally over the dorsal vessel ; these become more or less distinctly paired towards the hinder end of the animal.

The last heart is in segment xiii ; but there is a pair of commissural vessels, smaller than the hearts, though quite obvious, in xiv. The dorsal vessel is single

The excretory system is mixed mega- and micronephridial. Meganephridia exist as far forward as segment xii, but are quite small in front of xx,—indeed are hardly recognizable in xviii and xix. From segment xx backwards the meganephridium, in the form of a thin tube, is disposed in a large loop which reaches outwards on the body-wall to not very far from the middorsal line ; the micronephridia are numerous, arranged in a transverse row along the middle of each segment. The condition is the same towards the hinder end of the body,—a long fine loop behind the septum stretching to near the middorsal line, its ventral end about two-ninths of the half-circumference from the ventral nerve cord, and the micronephridia in a transverse row behind the meganephridium. In the anterior part of the body the micronephridia lose their transverse arrangement, and become scattered on the body-wall (from about segment xvii forwards) and very numerous ; there are the usual large tufts at the hinder end of the pharynx, and other similar but smaller tufts on each side in the most anterior segments of all.

Testes and funnels are free, in segments x and xi (the testes were rather doubtfully identified in xi) ; these segments are enclosed between the fused septa, as previously explained, and contain much coagulum,—probably masses of sperm-morulae and developing spermatozoa. There are two pairs of seminal vesicles, both of moderate size and both slightly lobed in outline; the anterior are in segment ix, attached to septum 9/10, the posterior in xii attached to 11/12.

The prostates are two pairs, together extending from segment xvii to xxv. Each is a long and convoluted tube thrown into a number of loops in each segment through which it passes. The posterior, after occupving segments xxv-xxii, suddenly in segment xxi, becomes thin,—a quarter of its former diameter; and so continuing through xx, becomes in xix a fusiform shining muscular tube, which turns obliquely inwards to end near the middle line at the anterior border of the segment; the thickest part of the duct (the fusiform swelling near its termination) is about as wide as the main portion of the gland. The anterior prostate begins on each side in segment xxi, thus overlapping the thin anterior portion of the posterior gland; it maintains its initial thickness through xx and xix, becomes thin in xviii, and the fusiform duct, of the same character as that of the posterior gland, curves inwards in xvii to open near the middle line at the hinder border of the segment.

The vas deferens comes down on each side to join the end of the ducts of the anterior pair of prostates on their outer sides. No such arrangement can be seen in connection with the posterior prostates.

Underneath the prostatic ducts in segments xvii and on the right side in xix, and therefore corresponding to the sucker-like depressions seen externally, are circular white cushions or elevations of the body-wall. This region (segments xvii, xviii and xix in their ventral portions) is characterized by dense clusters of micronephridia, which however are absent from the circular cushions just mentioned.

The ovaries are in segment xiii.

The spermathecae are two pairs; the ampulla is sac-like, broadly ovoid with pointed tip; the duct is broad and short, and not set off from the ampulla, of which it is merely a narrower continuation. There are numerous diverticula, about fifteen to a score, arranged as a complete circle round the lower part of the ampulla; each is a small rounded protuberance, broadly sessile (fig. 14). The ducts of the anterior pair of spermathecae run backwards under the peritoneal and connective tissue layers of the body-wall, becoming narrower as they do so, and ultimately pierce the parietes not far from the middle line at about the middle of the length of segment viii; this corresponds with the surface-marking previously described.

A number of accessory glands are associated with the spermathecae. These project into the coelom near the spermathecal apertures, are club-shaped in general form, and about a millimetre or a little more in length; they are not hollow diverticula from the base of the spermathecae, but solid masses of cells. A large nephridial tube is closely associated with each spermatheca; and in addition there are copious micronephridia all round them.

The displaced setae of the spermathecal region are not visible from inside, since their sacs are wholly imbedded in the body-wall. The only way to obtain them for examination is therefore to cut out a piece of the body-wall containing some of them, and to tease it out with needles on a slide. The ordinary setae of this region are ·44 mm. in length and 25μ in thickness below the nodulus ; they have the usual curve, the tip is blunt, the nodulus is distal to the middle of the shaft ; there are a few extremely fine sculpturings, —short transverse rows of dots,—scattered near the tip. The displaced setae are rather longer and slenderer,—·49 mm. in length and 24μ in thickness ; the tip is sharper, the distal portion tapers gradually, there is no distinct nodulus, and the proximal end of the shaft is bent in the opposite way from that of the normal seta, *i.e.* the curve is in the same direction as the distal curve, not in the opposite as usual ; transverse sculpturings, well marked and extending for some distance along the shaft, ornament the distal end, but these transverse markings are not arranged in regular rings.

Hoplochaetella kempi, sp. nov.

(Pl. xvii, figs. 15, 16).

W. 68/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. Nine specimens.

External characters.—The largest specimen was 103 mm. long and 4·5 mm. in thickness. Colour a rich brown above with darker middorsal stripe ; pale ventrally, the setae on whitish rings. Segments 106.

Prostomium very variable, epilobous $\frac{2}{5}$ to $\frac{4}{5}$; broad and triangular, or narrow and with parallel sides.

Dorsal pores commence from furrow 6/7.

The setae in rings ; ventrally $aa = 2\frac{1}{2}ab$ behind the clitellum, and about $2ab$ in front,—but ab itself is somewhat variable ; dorsally $zz = 2$ to $3yz$, but here again the middorsal interval and intersetal spaces are irregular, and this is the case laterally too. The intersetal spaces are greater, on the average, dorsally than ventrally throughout the body. The following numbers were counted :—52/v, 56/x, 45/xx, and 44 in the middle of the body.

The clitellum extends over segments $\frac{1}{2}$xiii–xvi $= 3\frac{1}{2}$; it is darker in colour than the general surface, and is smooth, but setae and dorsal pores are present.

The ventral surface is concave over segments xvii–xix. The prostatic pores are two pairs of well-defined pits, in furrows 17/18 and 18/19 ; these are fairly deep, transversely oval in shape, and in length from side to side about equal to two intersetal intervals ; the midventral interval between the pits of the same pair is greater than the long diameter of the pits, but less than twice the diameter ; the actual apertures are probably at the bottom of the pits,—this was seen to be the case in the posterior pair.

Conspicuous on the male field, in the specimen first examined, are two large broadly oval papillae, each surrounded by a deep clear-cut groove, the flat surface of the papilla being about on a level with the general surface. Of these the anterior is midventral, in furrow 16/17; the posterior has its centre on the anterior part of segment xx, but its size is such that it encroaches forwards on to segment xix, and so partially obliterates groove 19/20 (fig. 15); it is to the left of the middle line, and takes up in transverse extent a space equal to the distance between seta *a* and *f*. The antero-posterior length of each papilla is almost equal to the length of a segment. Setae are absent from xvii and xix midventrally, and from xx in the region of the papilla. The whole area of the male pores and papillae is whitish and thickened.

The female aperture is situated midventrally on segment xiv, in the centre of a small circular area in front of the line of the setae.

The spermathecal apertures are represented by two pairs of small elevations on segment viii; of these the anterior are situated between the row of setae and the anterior margin, the posterior just in front of furrow 8/9; all are pretty close to the middle line. There appear to be a few displaced setae on each of the anterior pair of papillae; but the curious thing is that there is no actual pore, no definite opening, either on the papillae or elsewhere; I looked for apertures carefully in the grooves, but there are certainly none there. This peculiarity seems to characterize all the species of the genus; and one is driven to suppose that the spermathecal apertures form only when actually required, at the time of copulation and oviposition; at any rate the openings are only virtual or potential at other times.

In this region there are other small elevations which bear setae; a pair on segment ix, just in front of the setal line, and a pair on vii actually in the line of the setae (in this latter case the special setae are therefore not "displaced").

In this species also the appearances on the genital region vary somewhat in different specimens. Thus it is commoner to find the anterior of the two papillae of the male area on the right side, balancing the posterior, as it were, which is on the left; or both anterior and posterior papillae may be midventral or almost so; or there may be only one papilla, posterior and on the right side. In the spermathecal region the special setae on their papillae are usually in line with the ordinary setae of segments vii and ix.

Internal anatomy.—The disposition of the septa is so similar to what has been described for the last species that nothing further need be said.

The gizzard, squarish in form and of moderately large size, is in segment vi. Calcareous glands, of large size, stalked and set off from the oesophagus, are present in segments xii and xiii; they are over-arched by the hearts, and in xii overlaid by the seminal vesicles; similar glands are also present in x and xi, but smaller and more deeply placed in the segment. The intestine begins in xvi; the typhlosole is a simple longitudinal vertical lamina, of relatively large size. Lymph-glands are again present on the intestine from its beginning, appearing as a row of minute lobules lying transversely across the dorsal vessel and attached to the posterior septum of each segment.

The first transverse vascular commissure is in segment viii, the dorsal vessel, though continued forwards over the gizzard, not giving off any regular series of branches in front (*cf. Erythraeodrilus*). The last vessel that can properly be called a heart is in segment xiii; but, as in the last species, there is a pair of very obvious commissures in xiv. The " hearts " are light in colour,—*i.e.* muscular and contractile; they are narrowed at their entry into the dorsal vessel, and in segments xii and xiii appear to have a connection with the supraintestinal also. The commissures of segment xiv are about half the diameter of the hearts, and do not sweep out so far in the segment; they are dark in colour, and are not contracted at their entry into the dorsal vessel.

The meganephridia are first plainly visible in segment xx; as in the last species they are long thin loops stretching outwards on the body-wall to near the middorsal line; each lies along the middle of the segment, and appears to be quite free from the septum in front. The micronephridia are numerous, arranged in a transverse band in each segment, though not in a single series; they form a dense fur all over the inner surface of the body-wall in the clitellar segments; and in front of this also they are densely set and without regular arrangement; there are considerable tufts at the hinder angles of the pharynx in segment v, as well as in the most anterior segments in front of this.

In segments x and xi, ventrally situated and (in xi at least) continuous across the middle line, there were seen fairly large iridescent lobed masses, not enclosed in a membrane, and representing clumps of spermatozoa round the funnels. The testes were not distinguished, and may have atrophied. The vesiculae seminales are two pairs, of moderate size, slightly lobed, in segments ix and xii.

The prostates are tubular; the two pairs have the same general arrangement as before. The anterior pair reaches back to segment xx or xxi, the posterior to xxiv. The ental end of the anterior gland is somewhat narrower than the main mass of the gland; in segment xix the main mass becomes a narrow shining duct, which crosses segment xviii, twisting about as it does so; the duct ends, widening rather rapidly, by getting into xvii and piercing the body-wall at the posterior border of the segment. In the posterior pair there is not much difference in the thickness of the glandular part throughout its extent; each becomes a narrow shining duct at the anterior border of segment xxi; this duct is convoluted as it crosses xx, widens as it enters xix, and, as seen from inside, pierces the body-wall at about the middle of the length of the segment. In both the anterior and posterior glands the terminal portion of the duct is directed inwards towards the middle line.

The vas deferens was identified on the outer side of the termination of the anterior duct ; it ends by entering the body-wall just behind and external to the prostatic duct.

Firm white cushions are seen on the inside of the body-wall, in situations corresponding to the large flat papillae seen externally. Except where occupied by the cushions the midventral region on the inner side of the body-wall in segments xvi–xxi is densely covered by rather large micronephridia.

Ovaries are present in segment xiii.

The spermathecal ampulla (fig. 16) is sac-like and ovoid in shape ; the duct is only slightly set off from the ampulla, is somewhat less in length than the ampulla, broad, especially at its upper end, but narrows considerably towards its termination. On the duct, at about the middle of its length, are two to four diverticula, small rounded knobs filled with white shining matter. In addition, the accessory glands are here numerous and conspicuous ; each is an elongated cylindrical structure, solid, soft, and white, with a short narrow stalk (fig. 16) ; on one side there were seven,—three in front of the anterior spermatheca, three between the two, and one near the posterior spermatheca ; on the other side there were six, one in front of the anterior, three between the two, and one behind the posterior spermatheca.

Hoplochaetella inornata, sp. nov.

(Pl. xvii, fig. 17).

W. 130/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. A single specimen.

External characters.—Length 101 mm. ; maximum thickness 6 mm. Colour light brown dorsally, pale ventrally ; the white circles on which the setae are implanted are a conspicuous feature. The anus is a vertical slit. Segments 79.

The prostomium is epilobous ; the tongue, with parallel sides, is bounded by grooves of which that on the right side goes back only through half of the first segment, while that on the left is continued on to segment ii.

Dorsal pores begin from furrow 6/7.

The setae are on rings which are closed dorsally, and almost closed ventrally ($aa = 2ab$ or less) ; there is no regular variation in the intersetal intervals between the dorsal and ventral surfaces, or between one region of the body and another. The setae of segments viii–xii are very small. The following numbers were counted :—84/v, 80/ix, *ca.* 84/xii, 85/xx, and 91 in the middle of the body.

The clitellum extends over segments $\frac{1}{2}$xiii–xvi $= 3\frac{1}{2}$; it is smooth, brown, and markedly constricted ; setae are visible and the intersegmental furrows are indicated, but there are no dorsal pores.

The prostatic apertures are two pairs, on segments xvii and xix, at the hinder and anterior borders of these segments respectively. They are in the form of small pits, fairly close together, the anterior rather closer than the posterior; each pit has a distinct lip, the outline of the whole being not quite circular, but broadly oval in a transverse direction; the lip in each case extends over the adjacent intersegmental furrow, obliterating it for a short distance, but the pits are just within the boundaries of their respective segments.

The female aperture is represented by a small pit in a small white circular area, midventrally situated on segment xiv in front of the line of the setae.

The spermathecal apertures are represented by two pairs of small papillae on segment viii, the anterior pair midway between the setal line and the anterior furrow, the posterior midway between the setae and the posterior furrow; the papillae are transversely oval in form, and not far from the middle line, the posterior pair being closer together than the anterior; a slight darkening of the centre is all that represents the end of the spermathecal duct. It is interesting to notice how exactly the position of the prostatic apertures corresponds to that of the spermathecal papillae; segment xviii, which intervenes between the pairs of prostatic pores, is a much shorter segment than viii; and the smaller interval between the posterior pair of spermathecal apertures answers to the smaller interval between the anterior prostatic pores when the worms are facing in opposite directions in copulation.

The setae of segment viii are absent ventrally; they begin external to the line of the outer margins of the spermathecal papillae. There are a few dark dots in the posterior spermathecal papillae which may be displaced setae.

Internal anatomy.—The arrangement of the septa is exactly as before.

The pharyngeal mass is in front of septum 4/5; in segment v the oesophagus becomes broader and fairly firm; the gizzard is in vi, barrel-shaped and limited in front and behind by a firm annular ridge. Calcareous glands, kidney-shaped and attached by the hilus, are present in segments x–xiii, small in the two anterior, larger in the two posterior segments. The intestine begins in xvi; lymph-glands lie across the dorsal vessel. In segment xv a large yellowish kidney-shaped mass lies dorsally on the oesophagus and dorsal vessels, its convexity backwards; it is firm, with a slightly rough surface, takes up the whole length of the segment, and is considerably wider than the alimentary tube at this point; it is probably a lymphoid mass. The typhlosole is as before.

The last heart is in segment xiii, and the first in viii; the dorsal vessel is continued forwards over the gizzard as in the foregoing species, and there is the same distinction between the heart in xiii and the stout vascular commissure in xiv as was noted there.

The meganephridia are first visible in segment xx; the nephridia have throughout the same arrangement as in the last species.

Testes and much folded iridescent masses representing the funnels covered with ripe spermatozoa are free in segments x and xi. The anterior seminal vesicles, in segment ix, are large, yellowish and very conspicuous masses, very slightly lobed ; the posterior pair in segment xii are not so large and are more cut up into lobes, though still not deeply.

The anterior prostate on each side extends back to segment xxiii ; the glandular part becomes in segment xx a thin coiled duct which passes forwards through xix, swells gradually in xviii, becoming broad, firm and muscular, and curving inwards towards the middle line ends in segment xvii. The posterior gland, beginning behind in segment xxviii, passes forwards to xxiv, where similarly it becomes a thin coiled duct ; this becomes gradually thicker in xxi and xx, and ends in xix, the final portion of its course being almost straight.

The two vasa deferentia of the right side were identified in their course backwards underneath the peritoneum ; they pass the duct of the anterior prostate on its outer side, and end curving rather inwards behind it.

Ovaries and funnels are present in segment xiii. A minute lobulated appendage of septum 13/14 on its posterior face is probably a small ovisac.

The spermathecal ampulla (fig. 17) is an irregular sac, narrower below, and continued into the duct without any sharp demarcation. At about the place where the one passes into the other is a ring of small white shining sessile diverticula, about a score in all ; but these do not form a single circle all round,—they are arranged two deep on each side of the duct, where they are more closely set than in front or behind. Beyond the diverticula the duct is stout, shining, and narrows slightly towards its ectal end ; in length the portion below the diverticula is about half that of the ampulla.

Between the openings of the spermathecae of the same side, and so about the middle of segment viii, is a group of five rather twisted accessory glands, implanted quite near each other ; they are similar to those previously described, each with a narrow cylindrical duct which is much shorter than the elongated glandular portion.

A character of this specimen which was not noted in the previous species is the presence of accessory glands in the region of the prostatic apertures also. There are three pairs, in segments xvii, xviii and xix respectively. Those in xviii are the largest ; they are massive and solid-looking, rather rectangular in shape, take up the whole length of the segment, and nearly touch each other in the middle line. Those in xvii and xix are only about half the size of those in xviii ; they are on the inner side of, and rather conceal the end of, the prostatic ducts. All have short stout stalks ; the stalks of the glands in xvii and xix appear to become continuous with that of the gland in xviii by passing through the septa where these are attached to the parietes.

Hoplochaetella bifoveata, sp. nov.

(Pl. xvii, fig. 18).

W. 129/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. A single specimen.

External characters.—Length 82 mm. ; diameter at the clitellum, which is bulged, $5\frac{1}{2}$ mm., behind this 4 mm. Colour light brown above, with a darker middorsal stripe ; pale below ; setae on slightly whiter transverse rings. Segments 62 ; possibly the specimen has been damaged, since the last segment is of full size, and is not followed by any zone in which differentiation of new segments is going on.

Prostomium epilobous $\frac{1}{2}$, very broad,—perhaps somewhat distorted, as the buccal cavity is everted.

Dorsal pores commence from furrow 5/6.

The middorsal setal interval is irregular in front of the clitellum, perhaps because a number of setae have dropped out here and there ; normally zz may be equal to $2yz$; a short distance behind the clitellum the setae become very small and difficult to see on the dorsal surface, but the interval is perhaps about the same. Ventrally they can be better distinguished against the paler background ; $aa = 2ab$ throughout the greater part of the body, $= 2\frac{1}{2}ab$ for some distance behind the clitellum, and is irregular or $= 2ab$ in front of the clitellum. On the whole the setae are more closely set ventrally than laterally or dorsally ; this is best seen behind the middle of the body. The following numbers were counted : 49/v, 62/x, 60/xii, *ca.* 50/xxii.

The clitellum extends over segments $\frac{1}{2}$xiii-xvi $= 3\frac{1}{2}$; segments xvii and part of xviii are also somewhat modified. The clitellar region is smooth, brownish in colour both dorsally and ventrally, and much swollen ; setae are visible, but no dorsal pores.

The conspicuous features in the male area (fig. 18) are two large depressed areas, shallow and saucer-like, with only slightly raised rim. These are situated midventrally in the position of grooves 16/17 and 19/20, but in each case the depression extends further onto the posterior of the two segments (as far as the setal line) than on the anterior. From side to side each takes up approximately a space equal to the interval between the prostatic pores of the same pair ; and in each case the anterior margin of the depression is the better defined, and is rather straighter.

The prostatic apertures are two pairs of small transversely oval shallow depressions with raised lips, in furrows 17/18 and 18/19, not very far from the middle line ; the actual openings of the ducts are however invisible, or are perhaps represented by dark dots near the inner and anterior margin of the depressions. It might be more accurate to say that the posterior pair of pits are on the most anterior part of segment xix rather than in groove 18/19 ; grooves do not really exist here, and the pits are rather nearer to the setal line of xix than to that of xviii.

The female aperture seems to be situated just in front of the line of the setae midventrally on segment xiv, on a small white transversely oval papilla.

The spermathecal papillae are two pairs, on segment viii, the anterior pair midway between the setal ring and the anterior intersegmental furrow, the posterior just in front of the posterior furrow. Setae are absent from the midventral region of segment viii, but displaced setae are found on all the spermathecal papillae. A pair of small papillae are also present in segment ix, in or slightly in front of the setal ring and in line with the spermathecal papillae ; on these too displaced setae are seen.

Internal anatomy.—The specimen was in poor condition internally ; it is however remarkably similar to the last species. The septa, circulatory system, and nephridia require no comment. The barrel-shaped gizzard is in segment vi ; of the four pairs of calcareous glands those in segments xii and xiii are smaller than in the preceding species.

The testes and funnels are as before ; the two pairs of vesiculae seminales are yellowish, of fair size and slightly lobed. Each of the prostatic ducts is extremely thin in its course from the end of the glandular portion to its terminal swelling. The vasa deferentia pass by the outer side of the termination of the anterior duct while still separate, then turn behind it, unite, and end. There are small accessory glands in the neighbourhood of the prostatic apertures, in front of and behind the termination of each of the ducts. In addition, two large white cushions occupy the middle line in positions corresponding to the external depressions.

The ampulla of the spermatheca is of a longer or shorter ovoid form, narrowing below where its outline is more irregular. On this lower narrower part are situated two, three or four seminal chambers, of moderate size, sessile, white and shining. Below this the sac is continued into the duct, narrow and almost wholly within the body-wall. There are a number of accessory glands, of the former type, in the neighbourhood of the spermathecae. The whole is very like the organs in *H. kempi* (fig. 16).

Hoplochaetella affinis, sp. nov.

(Pl. xvii, figs. 19, 20).

W. 128/1. Mormugao Bay, Portuguese India (Donna Paula Bay and vicinity) ; shore collecting. August, 1916. S. Kemp. Six specimens.

W. 125/1. Mormugao Bay, Portuguese India (Vareeg Islet, S. side of Mormugao Bay) ; shore collecting, under stones. August, 1916. S. Kemp. Two specimens, one damaged.

W. 127/1. Mormugao Bay, Portuguese India (small bay on S. W. side of Mormugao Head) ; shore collecting. September, 1916. S. Kemp. Two specimens, in rather poor condition internally.

The description is based on the first batch of specimens, which are to be considered as the types. The other batches differ slightly from the first, and are referred to subsequently.

External characters.—Length 140 mm.; maximum diameter 7 mm. Colour brown dorsally, with a darker middorsal stripe; pale ventrally; setae on white circular ridges. Segments 130.

Prostomium comparatively small, epilobous $\frac{3}{4}$.

Dorsal pores begin from furrow 5/6.

The setal rings show an irregular dorsal break; in the anterior part of the body $zz = 2—3yz$, for some distance behind the clitellum $= 4—5yz$, and more posteriorly $2—3yz$. The ventral break is smaller and more regular; in front of the clitellum $aa = 1\frac{1}{2}ab$, and behind $2ab$. The intersetal distances are also more regular on the ventral side than on the dorsal; in some regions the setae on the dorsal side are arranged distinctly as couples, with a fair interval between the couples,—equal to twice the space between the individuals of a couple. The numbers counted were:—72/v, 80/ix (including 8 displaced), 74/xii, 65/xix, and 60 in the middle of the body.

The clitellum is very indistinct; it is marked by a slight reddish tinge on the dorsal surface, and extends over $\frac{1}{2}$xiii—$\frac{1}{2}$xvi, or perhaps xiii-xvi,—three or four segments.

The male area (fig. 19) saucer-like and depressed, with a thickened lip; in one case the inner margin of the lip, instead of sloping into the central depression, is much sharper, and actually overhangs. The shape of the area is oval, with its long axis antero-posterior; it covers (without the thickened lip) segments xvii-xix, and its breadth is two-thirds of its length.

In this depression are situated the prostatic apertures,—small darkish transversely oval spots, with perhaps a rather whiter border, on segments xvii and xix respectively, near the posterior and anterior borders; those of a pair are roughly distant from each other about one-third of the width of the ventral surface as seen on looking down on it. In addition, contained within the depressed area, are two transversely oval dark-coloured slightly sunken patches, midventrally (or very slightly asymmetrically) situated on segments xvii and xix; they are rather on the posterior portions of their respective segments, and do not reach the anterior border of these, but on the other hand they may transgress the hinder limit of the segment and encroach on the one behind. The anterior of these sunken patches is between the anterior pair of prostatic pores, and the posterior rather behind the posterior pores; the transverse extent of each is about equal to the interval between the prostatic pores of a pair. In an earlier stage these markings are narrower antero-posteriorly; the one seems to originate in groove 17/18, in line with the anterior prostatic apertures, and the other in the line of the setae of xix, and so behind the posterior pair of pores. The whole area is not at first delimited by a raised lip.

The female aperture is a small depression midventrally situated between the setal ring and the anterior margin of segment xiv.

The spermathecal pores are represented by two pairs of small papillae on segment viii, one pair near the posterior border of the segment and the other in front of the setal ring, slightly nearer to the ring than to the anterior margin of the segment. The distance between the papillae of a pair appears to be rather less than that between the prostatic apertures of the same pair ; longitudinally, the interval between successive spermathecal apertures is equal to that between successive prostatic apertures. There are no actual pores on these spermathecal papillae, but their centres are slightly darker.

The displaced setae of the spermathecal region had in one of the specimens the following disposition: in segment ix the setae *abcd* on each side were displaced forwards so as to lie in a line near the furrow 8/9 ; on segment viii *ab* on each side are similarly displaced, and *cd* appear to be in close association with the spermathecal papillae ; on segment vii three setae near the midventral line are displaced backwards towards the intersegmental groove.

Internal anatomy.—The septa, alimentary tract, circulatory and nephridial systems are as in the last two species

Testes and funnels are free in segments x and xi. The anterior seminal vesicles, in segment ix, are of very large size and irregular shape, wedged in between the other organs, and indented in front by the posterior spermathecae ; the hinder pair of vesicles, in segment xii, are of moderate size, with a lobulated margin ; they extend inward dorsally towards the middle line.

The anterior prostates extend backwards to segment xx or xxi ; the glandular part of the posterior occupies segments xxii to xxiii or xxiv. Succeeding to the glandular part in each is a fine much-coiled narrow duct of some length, which widens into a fusiform shining dilatation at its termination ; this end portion may have a longitudinal direction, or may bend inwards with a gentle convexity towards the front. Two rather indefinite soft white cushions occupy on the inside of the body-wall the position of the dark sunken area on the male genital field.

The ovaries are in segment xiii ; there were no ovisacs in xiv.

The spermathecal ampulla (fig. 20) is somewhat conical in form, with rounded apex and rather constricted at its base : below this constriction are a number of diverticula or seminal chambers, oval in shape with their long axis in the same direction as that of the ampulla, glistening, sessile, and arranged in an incomplete circle ; the gap in the circle is on the outer side ; in number there were 9 on each anterior spermatheca, and 10 and 12 on the two posterior. The duct, which may be considered as beginning at the constriction mentioned above, has the form of an inverted cone, its base upwards, narrowing very considerably towards the body-wall ; it is rather shorter than the ampulla. Accessory glands are present in the neighbourhood, the largest being situated between the posterior pair of spermathecae

The third batch of specimens differs from the first markedly in colour ; they are pale, and for the most part nonpigmented, though there is a slight brown colouration dorsally over the anterior end, and a pale brown middorsal stripe throughout the whole length. The dorsal pores begin one segment earlier, in groove 4/5.

The setae appeared to me to be much smaller than those of the specimens first examined; but this might be due to the different state of preservation,—they might seem smaller in a softer specimen, and might appear to project more in a harder and more contracted one. The dorsal interval is equal to $2yz$ or less in front of the clitellum, and is on the average $2\frac{1}{2}yz$ behind this. The ventral interval is equal to $2\frac{1}{2}ab$ in the anterior part of the body (irregular however in the preclitellar segments), and to $2ab$ in the posterior half. The setae are rather wider apart dorsally than ventrally, but I did not notice any pairing of the setae. The largest setae are those on the ventral surface in the preclitellar region.

The sunken pigmented patches on the male genital field are here sunken flat papillae, dark in colour but with a whitish margin, and surrounded by a groove; they are situated on furrows 16/17 and 19/20 respectively,—the anterior further forwards and the posterior further back, than in the type specimens. In one of the two worms in this batch the anterior papilla was double, one on each side over the position of groove 16/17, the centre of each in a line with the outer edge of the anterior prostatic pit; thus the whole male area, being widened anteriorly, becomes triangular instead of oval.

There were no distinct diverticula on the spermathecae, probably because there was no glistening mass of spermatozoa contained within.

I should perhaps have separated the specimens described above from the type as a distinct variety characterized by the different colour, the different position of the genital markings and first dorsal pore, and perhaps the setal characters. The second batch of specimens enumerated at the head of the account of this species (Vareeg Islet) however decided me against this; here the brown colouration was well marked, as in the type specimens, but the dorsal pores began from groove 4/5 as in the examples just commented on; the setae, too, appeared to be similar in size to those of the latter, while the position of the anterior genital "papilla" was intermediate,—on the anterior part of xvii, neither so far forward as in the one nor so far back as in the other of the previous batches. It seems best therefore to regard the species as a variable one, but not to attempt to divide it.

Genus **Erythraeodrilus**.

Erythraeodrilus kinneari, Stephenson.

(Pl. xvii, fig. 21).

W. 65/1. Castle Rock, N. Kanara Dist., Bombay Pres. Oct. 1916. S. W. Kemp. A single specimen, mutilated posteriorly.

Before giving a few notes on the specimen in the present collection I may add some remarks on the type specimens of the species, which were kindly sent for re-examination and comparison with the example now obtained, by the Director of the Zoological Survey. This is the more necessary as owing to a regrettable accident in the post, the tube containing the specimens was broken on the return journey, and the types are now practically valueless.

The specimen which I previously (19) took as the basis of my description, with the well-marked papillae on segment xviii, has spermathecae and spermathecal diverticula as shown in the figure (19, fig. 8) ; the diverticula are numerous and in two groups, the individual chambers being very fairly independent of each other. The " accessory spermathecae ", as I called them in my previous account, are not hollow sacs, but stalked glands similar to those in the various species of *Hoplochaetella* described in the present paper. The manner of opening of the spermathecae is correctly described ; externally there appears a slight whitening in the setal line of segment viii at two places, one on each side of the middle line, the interval between them being about equal to that between the male apertures. The prostates are in the form of a series of loops. There is, as stated, no heart in segment xiii ; but in xiv there is a vascular commissure similar to that described in *Hoplochaetella* (*cf.* p. 390 *ant.*).

In the other dissected specimen there is only one accessory spermathecal gland on each side (as against two and three in the type). The anterior pair of spermathecae cannot be followed so far back as in the former specimen, and the duct really seems to pierce the body-wall in front of the groove 7/8 ; the posterior pair as before pierce the body-wall at the level of the setal ring in viii. The ampulla of the spermatheca is irregular in shape ; the duct is about as long as the ampulla, broad at its origin, still further swollen at the level of origin of the diverticula, and contracting considerably towards the external aperture. The diverticula are about ten in number, arranged more or less distinctly in two groups of about five each ; though distinct enough, the separate diverticula are not stalked (they might almost be called stalked in the previous specimen), and rather resemble the chambers which so commonly surround, more or less completely, the base of the ampulla in species of the genus *Eutyphoeus.* The ectal portion of the duct is distinctly muscular. The gizzard is barrel-shaped. There is no heart in segment xiii, but the commissural vessel is present in xiv, as in the previous example. Externally, the male apertures are further apart than in the type specimen,—about a quarter of the circumference instead of one-seventh. In the spermathecal region there are slight papillae which seem to correspond to the apertures ; these are (i) in the setal ring of segment viii, about at the situation of setae *e* on each side and (ii) just in front of groove 7/8, in line with the same setae ; these correspond to the sites at which the ducts of the spermathecae seem to pierce the parietes as seen from the inside. There is a fifth papilla in this region, also in the setal ring of segment viii, at the site of seta *b* on the left side.

In the third, undissected, specimen of the original batch, the male papillae are not more than one-seventh or one-eighth of the circumference apart. There is one pair of slightly marked spermathecal papillae,—slight whitenings of the surface rather than definite papillae,—in the line of the setae of segment viii, the interval between them corresponding to that between the male pores; no second pair is indicated. This specimen was probably not as fully mature as the others.

I may now briefly describe the specimen in the present collection

External characters.—Length 40 mm.; diameter 2 mm. Colour grey (original colour ?). Segments 64.

Prostomium ? (buccal cavity everted).

Dorsal pores from furrow 3/4.

Setae in rings; middorsal interval small, = $2yz$ or less; midventral also small, = about $1\frac{1}{2}ab$. There appear to be about 34-36 setae per segment both in front of and behind the clitellum, and 28 towards the end of the fragment.

Clitellum smooth, brown in colour, extending over $\frac{1}{2}$xiii-$\frac{1}{2}$xvi = 3; setae indicated.

The male apertures, on segment xvii, are not very close together,—about a quarter of the circumference apart; they are situated on whitish papillae which take up the whole of the space between the line of the setae and the furrow which limits the segment posteriorly.

The female aperture is single and conspicuous, on segment xiv, in a whitish circular patch situated between the line of the setae and the anterior border of the segment.

The only signs of apertures in the spermathecal region are a pair of small pale papillae, not very easily distinguishable, in the line of the setae, about in the situation of seta *d*.

There are no other genital marks

Internal anatomy.—The septa are all thin.

The gizzard is large and barrel-shaped. Calcareous glands are present in segments x, xi, and xii; there is no marked difference in size throughout the series.

The last heart is embedded in septum 13/14, which is bulged backwards, so the heart at first appears to be in segment xiv; it really however belongs to xiii.

The meganephridia begin from segment xx.

Testes and funnels are present in segments x and xi; in xi they are contained within testis-sacs,—large soft structures, much resembling seminal vesicles; in segment x they are also probably in sacs, though this was not so clearly demonstrated. The vesiculae seminales are in segments ix, x and xii; they are large, soft, and not much cut up into lobes; those in xii meet over the alimentary canal.

The tubular prostates are one pair; each is a series of simple loops which begins behind about segment xx, passes forwards to xvi, and then bends back again; succeeding the glandular part is a thin tube, short and twisted, which becomes stout and shiny near its termination, just before it pierces the body-wall

Ovaries and funnels are present in segment xiii.

The spermathecae (fig. 21) are two pairs; the ampulla is sac-like, and set off from the duct; the duct is about as long as the ampulla, fairly stout, shiny, and narrowing somewhat towards the ectal end; from its upper end are given off two diverticula, rounded in form, each containing more than one chamber (2-4). The anterior spermathecae seem to end between segments vii and viii; the posterior appear to be implanted in the body-wall, one just behind the setal ring, the other in the line of the setae. There is only one small accessory gland, just in front of the ending of the posterior spermatheca; it has a narrow stalk, and is about as long as the duct of the spermatheca.

Genus **Octochaetus.**

Octochaetus fermori, Mchlsn.

Kasauli, W. Himalayas, 6000 ft; under stones. 20-vii-1916. Baini Prashad. A single specimen.
Hoshiarpur, Punjab. 14-vii-1916. Ibrahim.

Octochaetus barkudensis, Stephenson.

(Pl. xviii, figs. 25-27).

W. 13/1. Barkuda Island, Chilka Lake, Ganjam Dist., Madras Pres., 16 to 22-vii-1916. N. Annandale and F. H. Gravely. A number of specimens, some mature.

As this species is known from only one mature example (20), I may add here a description of the features of the present more ample batch of specimens.

External characters.—Length of the largest specimen 91 mm., and thickness 3 mm.; average length and thickness 60 mm. and 2 mm. respectively. Colour a medium grey, no difference between dorsal and ventral surfaces. Segments 136, triannulate from segment vii as far as the clitellum.

Prostomium epilobous $\frac{1}{2}$, tongue not cut off behind.

Dorsal pores from furrow 12/13.

From the anterior end to some distance behind the clitellum $aa = 3\frac{1}{2}ab = 1\frac{1}{4}bc$; $cd = 1\frac{1}{2}ab$ and so is slightly greater than $\frac{1}{2}bc$. Further back aa and bc become progressively narrower relatively to the intervals between the two setae of a bundle; so that aa is less than $3ab$, and $bc = 2ab$; dd is rather more than half the circumference.

The genital markings (fig. 25) present several points of difference as compared with the previous specimen. On segment viii, pretty constantly in sexual specimens, are a pair of transversely oval cushion-like elevations, which include the setae *ab* on each side; they do not take up quite the whole length of the segment, and do not quite meet in the middle line. On segment xvi also are typically a pair of circular or roundly oval papillae, meeting or almost meeting in the middle line and extending outwards to beyond the line of seta *b*,—that is, to the outer border of the ventral surface; they are quite flat, and take up the whole length of the segment, encroaching also on to segment xv; they may be scarcely raised above the general surface; and, in one instance at least, could be distinguished into a central whitish portion surrounded by a darker groove, with a whitish lip outside all. On segment xviii there may be a pair of similar, even larger papillae extending forwards on to xvii, and meeting in the middle line with only a narrow groove between them; these obviously correspond to the approximately rectangular cushions on this segment, which also are separated from each other in the middle line by a narrow groove, described in the original account. In one specimen there was present on segment xxii midventrally a large transversely oval papilla, taking up the whole length of the segment and extending to between setae *a* and *b* on each side

The female apertures are small, and placed near each other in a darker patch rather in front of the middle of the length of segment xiv. The spermathecal apertures seem not to be visible externally.

Internal anatomy.—The first septum may be 4/5, as stated in the previous account; but here its attachment seemed, in two specimens dissected, to be either at 5/6 or between 4/5 and 5/6.

The calcareous glands are large, but asymmetrical; on the left side the gland is mostly in segment xv, on the right in xvi,—the disposition being such that the anterior part of the left gland gets in front of the posterior part of the right, the dorsal vessel passing obliquely between them; the opening of the glands seems to be in xv on both sides; the glands are lobed, and septum 14/15 is markedly bulged forwards on the left side.

In the former account I stated that the testes and funnels were free; the statement has now to be modified, at any rate for the present specimens. Testis-sacs are present; that in segment xi is large, single, and extending dorsally covers over the hearts and alimentary tube; in one of the dissected specimens it was constituted by a fine membrane stretching between septa 10/11 and 11/12, while in the other it was free from both septa, with a slightly lobed border. The anterior sac in one case resembled the posterior in being constituted by a membrane stretching between the septa; in the other it was, like the posterior in that specimen, free from the septa, and indeed narrow from front to back.

The prostates are of moderate size, and are composed of a number of closely apposed coils; the duct is thin and twisted, of considerable length when extended, and without any thickening in its course.

The shape of the spermathecal ampulla varies very considerably. The diverticula may be absent, or there may be one, or two; again they may be sessile, or narrowed at the base, or even definitely stalked; three or four chambers may be indicated in the diverticulum, or the surface may be smooth without any lobulation; some of these variations are shown in the figures of spermathecae from the dissected specimens (fig. 26)

The penial and copulatory setae have the shapes previously described. In some of the copulatory setae of segment viii, towards the base what I previously described as a lateral flange cut up into teeth appears rather as a series of distinct spines curved like petals or scales, applied to the surface of the seta (fig. 27).

Octochaetus castellanus, sp. nov.

(Pl. xvii, fig. 22; pl. xviii, figs. 23, 24).

W. 134/1. Castle Rock, N. Kanara Dist., Bombay Pres. October 1916. S. W. Kemp. A single specimen, in poor condition.

External characters.—Length 48 mm.; maximum diameter 2 mm. Colour? Segments roughly 125; in some regions the separate segments are not distinguishable.

Prostomium ?

Dorsal pores perhaps from furrow 5/6.

The setae are widely paired, $aa = 1\frac{2}{3}\, ab = bc = 1\frac{1}{2}cd$; $dd =$ approximately half the circumference.

The prostatic pores, on segments xvii and xix, are small pits situated, in each segment, on a common elevation with a rounded margin; the pores themselves are medial from the line of setae *a*. The seminal grooves are bowed outwards, and run on rather broad curved ridges, so that there is a circular depression in the middle of the male area.

The female aperture is single and midventral, on segment xiv.

The spermathecal apertures are perhaps indicated at the site of setae *a* on segments viii and ix.

Internal anatomy.—Septa 9/10 and 10/11 are slightly thickened; all are present after the first few.

There is a long, soft, and bulged portion of the oesophagus in front of the gizzard; the gizzard is conspicuous, relatively large, barrel-shaped, situated in segment vii. There is one pair of calcareous glands in xiv, of moderate size and symmetrical.

The nephridia cannot be identified on the body-wall; there are large tufts at the side of the oesophagus, in front of the gizzard and spermathecae.

The testes were not identified; funnels were present, free, in segments x and xi, the largest seeming to be that in the hinder segment on the left side, but I would not lay any stress on this slight difference. Seminal vesicles are present in segment xii; they are deeply lobed, and rather small.

The prostates are in segments xvii and xix; they are relatively small, and thrown into several loops; the duct, thin, semi-transparent, and apparently not muscular, is half as wide as the opaque glandular part, and runs straight inwards.

The spermathecae (fig. 22) are two pairs of rather small organs situated near the middle line. The ampulla is spherical, and the duct, with a rather curved course, is about as long as the ampulla and one-third as thick; the diverticulum is single, club-shaped, and attached near the ental end of the duct on its inner side; the spermatic chamber is single. The length of the diverticulum is less than that of the ampulla. So far as can be made out internally, the external openings of the spermathecae would be between the setal line and the anterior border of segments viii and ix respectively.

The length of the penial setae (fig. 23, *a* and *b*) varies, ·87—1 mm.; the thickness at the middle is 14μ; they are thus of very considerable length relatively to their thickness. The main part of the shaft has only a slight curve; but the curve of the distal end varies somewhat, so that two types can be distinguished. In the first, the curve of the distal end merely continues the curve of the shaft, and the tip is tapering and bluntly pointed; a few teeth, of moderate size and fairly closely applied to the shaft, are present some little distance above the tip. In the second, the distal end is considerably bent, it may be to nearly a right angle; the tip is thinned and rather expanded, and in a few almost spatula-like, the end being also less clearly defined and slightly bifid; the teeth are more numerous. The shorter length given above represents the first type, the longer the second.

The copulatory setae (fig. 24) belonging to segments viii and ix are ·61 mm. long and 20μ in thickness at the middle of the shaft. The shaft is bowed, at the ends more so than in the middle. The distal portion of the shaft,—almost half,—is cut up along both its convex and concave borders into a series of rough notches, seven or eight on each side, and a thin web appears to span each notch. The tip is rather claw-shaped, and bluntly pointed.

Genus **Eutyphoeus**.

Eutyphoeus incommodus (Bedd.).

Rurki, United Provinces. August (about), 1916. Ibrahim. Not quite mature, hence identification not absolutely certain.
Agra, United Provinces. September, 1916. L. Haru Ram.

Eutyphoeus waltoni, Mchlsn.

Hoshiarpur, Punjab. 14-vii-1916. Ibrahim.
Lucknow, United Provinces. August (about), 1916. Ibrahim.
Agra, United Provinces. September, 1916. L. Haru Ram.

Eutyphoeus gigas, sp. nov.

(Pl. xviii, figs. 28-30).

W. 73/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 250 mm.; thickness behind clitellum 9 mm. Colour purplish-brown dorsally, with darker median stripe; pale ventrally. Segments 212; segment iv is biannulate, v triannulate, vi also triannulate but the posterior annulus is beginning to be divided; vii is quadriannulate, and viii has five annuli through the division of the anterior annulus; the same annulation is continued back to the clitellum, except that some segments may have even more numerous secondary annuli.

The prostomium is minute, prolobous, withdrawn under cover of segment i.

Dorsal pores are present from furrow 11/12.

The setae are paired; in front of the clitellum $ab = \frac{1}{3}$ to $\frac{2}{5}$ aa, $= \frac{2}{3}$ cd; $aa = bc$, and dd is two-thirds of the circumference. Behind the clitellum $ab = \frac{1}{3}$ aa (rather less immediately behind the clitellum), $= \frac{2}{3}$ or $\frac{3}{4}$ cd, while aa is greater than bc, about $1\frac{1}{4}$ or $1\frac{1}{3}$ bc; dd is three-fifths of the circumference. Behind the middle of the body $ab = \frac{3}{5}$ aa, $= \frac{3}{4}$ cd; $aa = 1\frac{1}{3}$ bc; and dd is little more than half the circumference.

The clitellum begins just behind the setae of xiii; it includes the whole of xvii. It is smooth, and there are no dorsal pores, but setae are present, or the indications of them.

The male apertures (fig. 28) are situated in pits on segment xvii; these pits are large and circular, with their centres in line with seta *b*, and their inner borders internal to the line of *a*. The apertures are transverse slits which are borne on papillae at the bottom of the pits. The papilla being in the outer part of the pit, the centre of the aperture is slightly outside the line of seta *b*.

The female aperture was seen on the left side only, on segment xiv, as a transverse slit corresponding in extent to the interval *ab*, in front of which setae it is situated.

The spermathecal apertures are comparatively small, slit-like, the lips not swollen, in furrow 7/8 just outside the line of seta *b*.

In furrow 15/16 are a pair of transverse depressions, elongated and rather irregular in shape, pointed at their inner and outer ends and broadest in the middle of their extent; these extend inwards to near the middle line and almost meet each other there; and as their middle point is external to seta *b* they are fairly extensive. On the hinder part of segment xvi, behind the setae *ab* and extending equally for a short distance to the inner side of the line of *a* and to the outer side of the line of *b*, are a pair of small oval areas, surrounded by a narrow groove and somewhat depressed in the middle.

Internal anatomy.—Septum 4/5 is strong, 5/6 very strong; 6/7 and 7/8 are absent; 8/9 and 9/10 are somewhat thickened, 10/11 slightly thickened; the last three are very close together, so that segments ix and x are very short segments internally. Segment xi is absent as a separate cavity; septum 11/12 is a membrane-like sheet of tissue which binds the heart of segment xi to the alimentary canal, and also attaches the vesiculae seminales to the wall of the gut (see the description of the septa in *E. waltoni*, by Stephenson (18), with which the present species agrees). Septum 12/13 is thin, and bulged backwards by the seminal vesicle so as to lie against 13/14.

The gizzard is large, firm, and subspherical, in the posterior part of the very considerable free space between septa 5/6 and 8/9. Calcareous glands are present in segment xii; they are only visible on opening the gut, when the condition is seen to be that which I have described for *E. bishambari* (18); externally they are indicated only by the oesophagus being swollen, and rather dark in colour and hard. The intestine begins in segment xv; in xxviii are a pair of caeca, of an elongated conical form resembling those of *Pheretima*; they lie wholly in xxviii, that of the right side being directed transversely towards the middle line above the intestine, that of the left being doubled underneath the intestine.

The last heart is in segment xiii. The dorsal vessel ends anteriorly in front of septum 8/9, at the hinder end of the large free space, by giving origin to two transverse commissures on each side; these lie close together behind the gizzard; and since they belong to segments viii and vii the gizzard is morphologically in segment vii.

The micronephridia are arranged behind the clitellum in perfectly regular transverse rows, one row in each segment, and about a dozen nephridia on each side; they are irregular in the clitellar region and for some distance in front of it, absent in the "free space" between septa 5/6 and 8/9, and irregular again in front; there are the usual tufts on each side of the pharynx, and thick clusters round the base of the spermathecae.

Testis-sacs are present in segment xi, opaque white in colour, and communicating with the seminal vesicles in xii; the heart of segment xi, covered by a connective tissue membrane representing septum 11/12, passes down internal to the sac. As the specimen was single I did not carry out the dissection which would have been necessary to ascertain whether the sacs communicate with each other beneath the alimentary tube. The seminal vesicles, one pair, extend forwards as far as septum 10/11, and push septum 12/13 back to the level of 13/14; they are large and appear wrapped round the alimentary tube; their margins are somewhat lobate.

The prostates extend through segments xvii to xx, and consist of a number of closely applied coils; each narrows at its anterior end to form a firm, shining and muscular duct, one-third of the diameter of the glandular portion; maintaining the same thickness it takes an inward direction, with many coils and loops, to its ending.

Ovaries and funnels not identified.

There is one pair of spermathecae (fig. 29); each consists of an antero-posteriorly elongated sac, irregular in shape, attached to the parietes by a broad base, from which the sac projects both forwards and especially backwards; the region on its under surface where the sac is attached to the body-wall is the only thing that can be described as a duct. There are two diverticula, one on each side, opening at the base of the ampulla; each consists of a sac and duct, the sac compound, showing a dozen to twenty chambers which cause a lobulation of the surface, and the duct stout, slightly curved, and about as long as the terminal sac.

The penial setae (fig. 30) are in length 5·3 mm., and in thickness near the base 50 μ ; near the tip the thickness is still 44 μ. The shaft is almost straight, slightly bowed towards the tip, where it tapers rather rapidly to a fine point The distal portion of the shaft, about ·85 mm., is ornamented (except the extreme tip) with very numerous and densely crowded transverse markings, each consisting of a few points set side by side.

Remarks.—Several species of *Eutyphoeus* run to a large size ; thus *E. paivai* may be 195 mm. in length, and *E. waltoni* 230 mm., while *E. chittagongianus* is the same length as the present specimen.

A rather curious feature of the present species is the presence of intestinal caeca resembling those of *Pheretima*.

Subfam. *TRIGASTRINAE.*

Gen. **Eudichogaster.**

Eudichogaster chittagongensis, sp. nov.

(Pl. xviii, figs. 31-33).

W. 71/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Two specimens.

External characters.—Length 30 mm. ; diameter 1·5 mm., the swollen preclitellar portion 2 mm., the constricted clitellar region just under 1 mm. ; a curious appearance is given by the bulbous anterior end followed by the constricted clitellum. Colour an indefinite grey. Segments approximately 121.

Prostomium epilobous $\frac{1}{2}$ or a little more ; it is triangular, the blunt apex being directed posteriorly ; the apex may be continued backwards as a shallow groove as far as the furrow between the first and second segments.

The dorsal pores begin immediately behind the clitellum.

The setae are paired. Behind the clitellum $ab = \frac{1}{3}aa = \frac{2}{5}bc = \frac{2}{3}cd$, and d is below the lateral line of the body ; towards the hinder end of the body the setae are less closely paired, and $ab = \frac{1}{2}aa, = \frac{2}{3}bc = \frac{2}{3}cd$, bc and cd being equal or very nearly so, while d is about the lateral line of the body.

The clitellum is smooth and constricted, and extends over segments $\frac{1}{2}$xiii-$\frac{1}{2}$xvii (over the whole of xiii on the ventral surface).

There is a depression behind the slightly excavated posterior border of the clitellum ; this depression, elongated in the transverse direction, thus takes up the hinder part of segment xvii, but does not extend beyond it. On its sloping sides are the male apertures, short obliquely placed slits, their anterior ends nearer the middle line than the posterior ; they are situated between the lines of setae a and b, which are absent from segment xvii (fig. 31).

The female apertures, on segment xiv, appear as transverse cracks one on each side just in front of seta a.

The spermathecal apertures are possibly represented by whitish patches on segment viii in the site of the ventral pair of setae (*ab*); a single seta, apparently *b*, is present in each patch.

There are no other genital markings.

Internal anatomy.—Septa 4/5 to 7/8 are thin; the rest of those in the anterior part of the body,—8/9 to 12/13,—are slightly strengthened.

The gizzards are large, in segments v and vi. Calcareous glands are present as small white swellings in segments x, xi, and xii. The typhlosole is a simple vertical lamina.

The last heart is in segment xii.

The excretory system is micronephridial; the arrangement varies a little in various parts of the body. Behind the prostatic region the nephridia are in three or four rows, of which the dorsal row consists of more elongated loops than the rest; the organs are not of the flat circular type met with in some species, but are thin tubes in the form of loops; if there are four rows, the two ventralmost are close together. Behind the middle of the body there are three rows, of the same relative size as further forwards. Near the hinder end the lowermost of the three nephridia increases relatively and absolutely in size, and is the most conspicuous of the three,—a twisted tube which has its inner end in the line of setae *a* and its outer end external to *b*; of the other two, one lies between *c* and *d*, and the other dorsal to *d*; these two are less easily seen.

In segment x are a pair of large opaque white shining masses with deeply lobulated margins; these are the most prominent things in the dissection; they are attached to septum 10/11, meet each other in the middorsal line above the other structures of the segment, and extend deeply down in the segment but without being attached to the ventral body-wall. These represent testis-sacs and seminal vesicles conjoined; on opening one, a funnel was found deeply placed, but the testis was not identified. There are no other anterior male organs.

The prostates, one on each side, are very small; they are situated in segment xvii, and are placed in a direction transverse to the long axis of the body. The duct is much narrower than the gland, of the same diameter throughout, and rather bent; if straightened out it would be almost as long as the glandular portion; the general direction of the duct is transversely inwards.

The ovaries are situated in segment xiii. There are a pair of well-marked and relatively large ovisacs in segment xiv.

The spermathecae lie in segment viii; each is a twisted tube, without distinction of ampulla and duct. On one side (fig. 32, *a*) the tube appeared of equal diameter throughout, except for a slight dilatation at its ental extremity; on the other side it was more irregular (fig. 32, *b*, which represents it under the low power of the microscope). The external opening is near the middle line and behind the anterior limit of the segment in which they lie,—possibly, as surmised from the external characters, in the situation of setae *a*; but the worm is extremely small for dissection. The simple form of the spermathecae does not appear to be due to immaturity; the clitellum is remarkably well defined and thick, and all the other organs are present.

The penial setae (fig. 33) are ·58 mm. in length, and approximately 3·5μ in thickness; they are rather whip-like,—slender, tapering gently, with pointed tip and rather wavy course; they are without ornamentation

Remarks.—The present form shows resemblances to *E. parva* (Fedarb), but differs in the absence of seminal vesicles in segment xi, in possessing penial setae, and in the shape of the prostates and narrowness of the prostatic ducts.

Gen. **Dichogaster.**

Dichogaster bolaui (Mchlsn.).

W. 84/1. Rangamati, Chittagong Hill Tracts, Bengal. 15-vii-1915 R. Hodgart. Three specimens, in a bad state of preservation.

Dichogaster affinis (Mchlsn.).

W. 137/1. Tale Sap, Siam. 20-i-1916. N. Annandale. A single specimen.

The identification is not absolutely certain, as the specimen was not fully mature.

Subfam. *OCNERODRILINAE.*

Gen. **Ocnerodrilus.**

Ocnerodrilus (Ocnerodrilus) occidentalis, Eisen.

W. 90/1. Botanic Gardens, Singapore; among dead leaves in tank, 24-xii-1915. N. Annandale. About a dozen specimens, in poor condition, some fragmentary.

Fam. GEOSCOLECIDAE.

In addition to the following species, the collection contained a quite immature specimen of this family, obtained from a small isolated almost dry pool in sand, at Balighai (Chilka Survey, 8-iv-1915).

Gen. **Pontoscolex.**

Pontoscolex corethrurus (Fr. Mull.).

W. 91/1. Penang Hill, at edge of a small stream, alt. 1200 ft. 10-ii-1916. N. Annandale.

Fam. LUMBRICIDAE.

Gen. **Helodrilus.**

Helodrilus (Allolobophora) caliginosus (Sav.) subsp **trapezoides** (Ant. Dug.)

Simla, 7000 ft., W. Himalayas. Oct. 1916. S. L. Ghose. Several specimens.

Helodrilus (Bimastus) parvus (Eisen).

Kasauli, 6000 ft., W. Himalayas. 31-viii-1916. Baini Prashad. Several specimens.

Helodrilus (Eisenia) foetidus (Sav.).

W. 86/1. Sevok, Darjiling Dist., E. Himalayas. 10-v-1915. J. N. Masson. A single specimen.

Helodrilus (Helodrilus) mariensis, sp. nov.

Murree, W. Himalayas (N. Punjab); alt. 7000 ft. 15-iv-1916. Gobind Singh. Several specimens.

External characters.—Length about 100 mm. (the specimens were much curled up); maximum thickness 6 mm. Colour greenish grey, equable throughout, except that the clitellum has a buff tinge. Segments 151. The anterior end tapers rapidly; the posterior is cut off straight, so that the anus is situated in the middle of a flat posterior surface; four segments are to be seen on this flat face. The anterior end is round in transverse section, but the clitellar and post-clitellar regions are flattened ventrally; at the middle of the body the dorsal surface becomes flattened also,—indeed concave,—and a section would appear four-sided, the dorsal side being the longest; towards the hinder end all four surfaces are concave, and the ventral setal bundles are placed at the ventro-lateral angles, the dorsal bundles being however below the dorso-lateral angles (text-fig. 6).

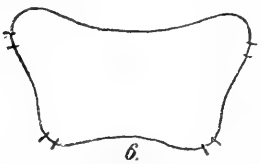

FIG. 6.—*Helodrilus mariensis*, transverse section behind middle, to show shape, and position of setae.

Prostomium epilobous $\frac{1}{3}$.

Dorsal pores from furrow 4/5.

The setae are closely paired throughout; $aa = 1\frac{1}{2}bc$, except towards the posterior end, where it is $1\frac{1}{3}bc$. In front of the clitellum the dorsal bundle is situated below the lateral line of the body; in the middle of the body they are about in the lateral line; while towards the hinder end they are above the lateral line, and, as said, below the dorso-lateral angle of a section of the body.

The clitellum extends over segments xxvii-xxxiv = 8. In fully mature specimens there are tubercles at the site of the ventral setae of all of these segments except the last, which almost form a "wall" on each side; the tubercles seem to be best marked on segments xxix or xxx to xxxiii. The ventral setal bundles of segments x and xi, or ix, x and xi, are also situated on glandular cushions or tubercles.

The male pores are situated on segment xv, on large round papillae which take up the whole of segment xv and parts of xiv and xvi. The apertures themselves are outside the line of setae b; the porophores about touch this line by their inner borders.

The female and spermathecal apertures were not visible.

Internal anatomy.—The first septum distinguishable by dissection is 5/6, which is somewhat thickened ; 6/7 is considerably thickened, 7/8, 8/9, and 9/10 are all very strong, 10/11 is about equal to 6/7, and 11/12 to 5/6. The next two septa, 12/13 and 13/14, are also slightly thickened.

The gizzard occupies segments xvii, xviii and a small part of xix; it is firm and cylindrical. The typhlosole is simple and rounded.

The oesophagus in segment x is swollen; and, besides the general swelling of the tube, there are a pair of small yellowish projections on each side of the dorsal vessel and in front of the hearts; in segment xiii the tube is also distinctly bulged, in an evenly rounded manner, and is vascular; in xiv it is quite narrow. On opening up the oesophagus, the inner surface of the wall is seen to be strongly ridged from its beginning in segment vi ; the small projections in segment x are distinct crypts, also ridged, and in open communication with the general lumen; in xii the ridging is longitudinal, and more regular than in front; in xiii the wall is very vascular, but the ridging has ceased.

The last heart is in segment xii.

The excretory system is meganephric.

Testes and funnels are free in segments x and xi. Vesiculae seminales, of moderate size, are present in segments xi and xii, attached to the anterior septum of the segment.

Ovaries, funnels, and ovisacs are present in the usual segments.

The spermathecae are two pairs, small, ovoid, sessile, and situated in segments x and xi at the anterior border of each; they seem to open in grooves 9/10 and 10/11, in line with the dorsal setal bundles.

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EXPLANATION OF PLATE XVI.

FIG. 1.—*Drawida japonica*; genital region, showing copulatory organs. ♂, male papilla.

,, 2.—*Drawida hodgarti*; prostate with the vas deferens entering; the spirally curved portion is the ectal end of the prostate.

,, 3.—*Drawida rangamatiana*; appendage of spermathecal atrium, as seen by transparency under the low power.

,, 4.—*Drawida nepalensis*; appendage of spermathecal atrium.

,, 5.—*Perionyx pallidus*; spermatheca as seen under the low power by transparency. *a*, bulging perhaps representing an incipient seminal chamber.

,, 6.—The same; penial seta, × 235.

,, 7.—*Perionyx gravelyi*; region of male apertures.

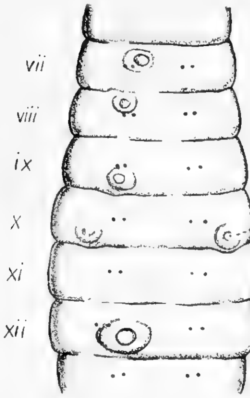
,, 8.—The same; penial seta, × 150.

,, 9.—*Perionyx aborensis* var. *heterochaetus*: spermatheca.

,, 10.—*Perionyx nanus*; region of male apertures.

,, 11.—*Pheretima annandalei*; spermatheca.

,, 12.—*Hoplochaetella suctoria*; region of male apertures. *x*, sucker-like depression; *pr.*, prostatic apertures.



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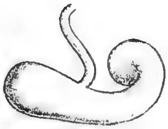
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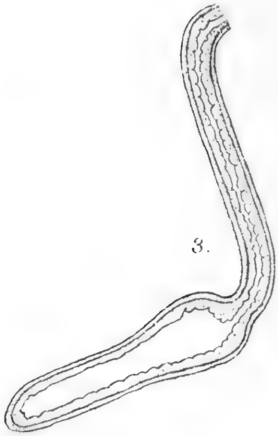
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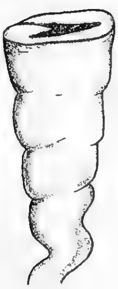
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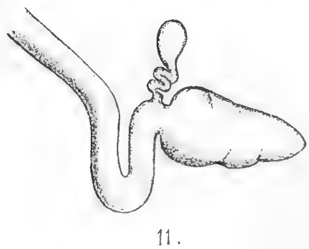
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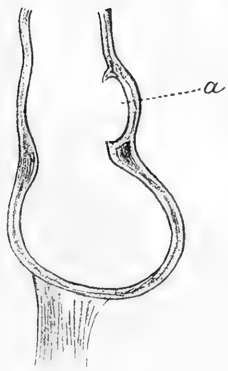

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J. Stephenson, del. A. Chowdhary, lith.

INDIAN OLIGOCHAETA.

EXPLANATION OF PLATE XVII.

FIG. 13.—*Hoplochaetella suctoria*; region of spermathecal apertures. *x*, group of displaced setae; *sp.*, spermathecal apertures.

,, 14.—The same; spermatheca.

,, 15.—*Hoplochaetella kempi*; region of male apertures. *x*, papilla surrounded by groove; *pr.*, prostatic apertures.

,, 16.—The same; spermatheca, represented with an accessory gland alongside.

,, 17.—*Hoplochaetella inornata*; spermatheca.

,, 18.—*Hoplochaetella bifoveata*; region of male apertures. *x*, depression; *pr.*, prostatic apertures.

,, 19.—*Hoplochaetella affinis*; region of male apertures. *pr.*, prostatic apertures.

,, 20.—The same; spermatheca.

,, 21.—*Erythraeodrilus kinneari*; spermatheca.

,, 22.—*Octochaetus castellanus*; spermatheca.

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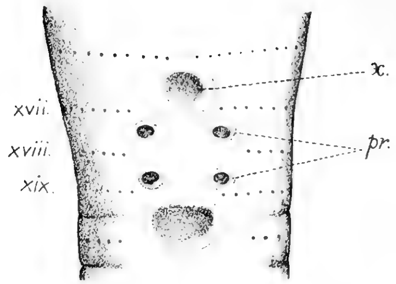

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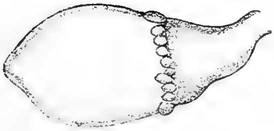

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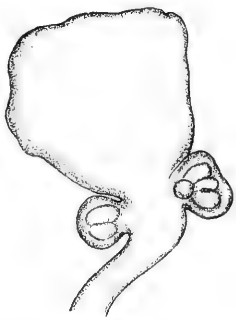

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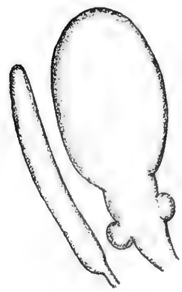

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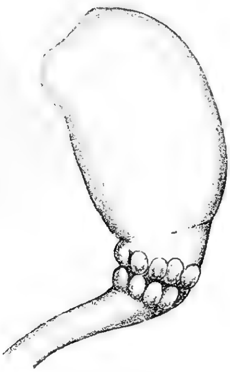

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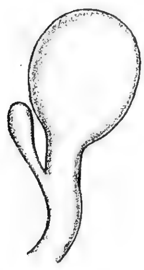

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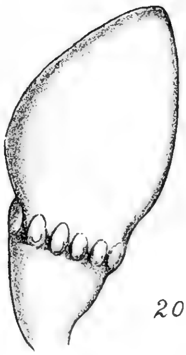

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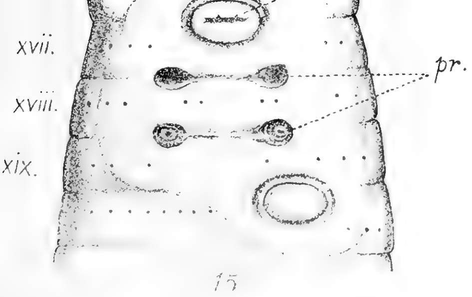

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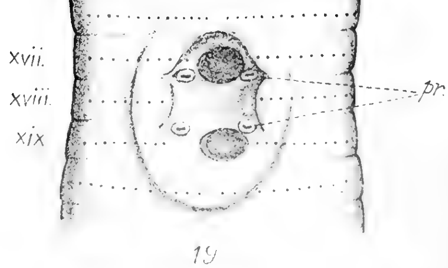

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J. Stephenson, del. A. Chowdhary, lith.

INDIAN OLIGOCHAETA.

EXPLANATION OF PLATE XVIII.

FIG. 23.—*Octochaetus castellanus*; penial setae, of two types, a and *b*; × about 360.

,, 24.—The same; copulatory setae of segment viii, × about 300.

,, 25.—*Octochaetus barkudensis*; male genital region of a specimen showing well-marked copulatory papillae.

,, 26.—The same; two spermathecae, *a* and *b*, showing variations in form.

,, 27.—The same; portion of shaft of copulatory seta of segment viii.

,, 28.—*Eutyphoeus gigas*; region of male apertures.

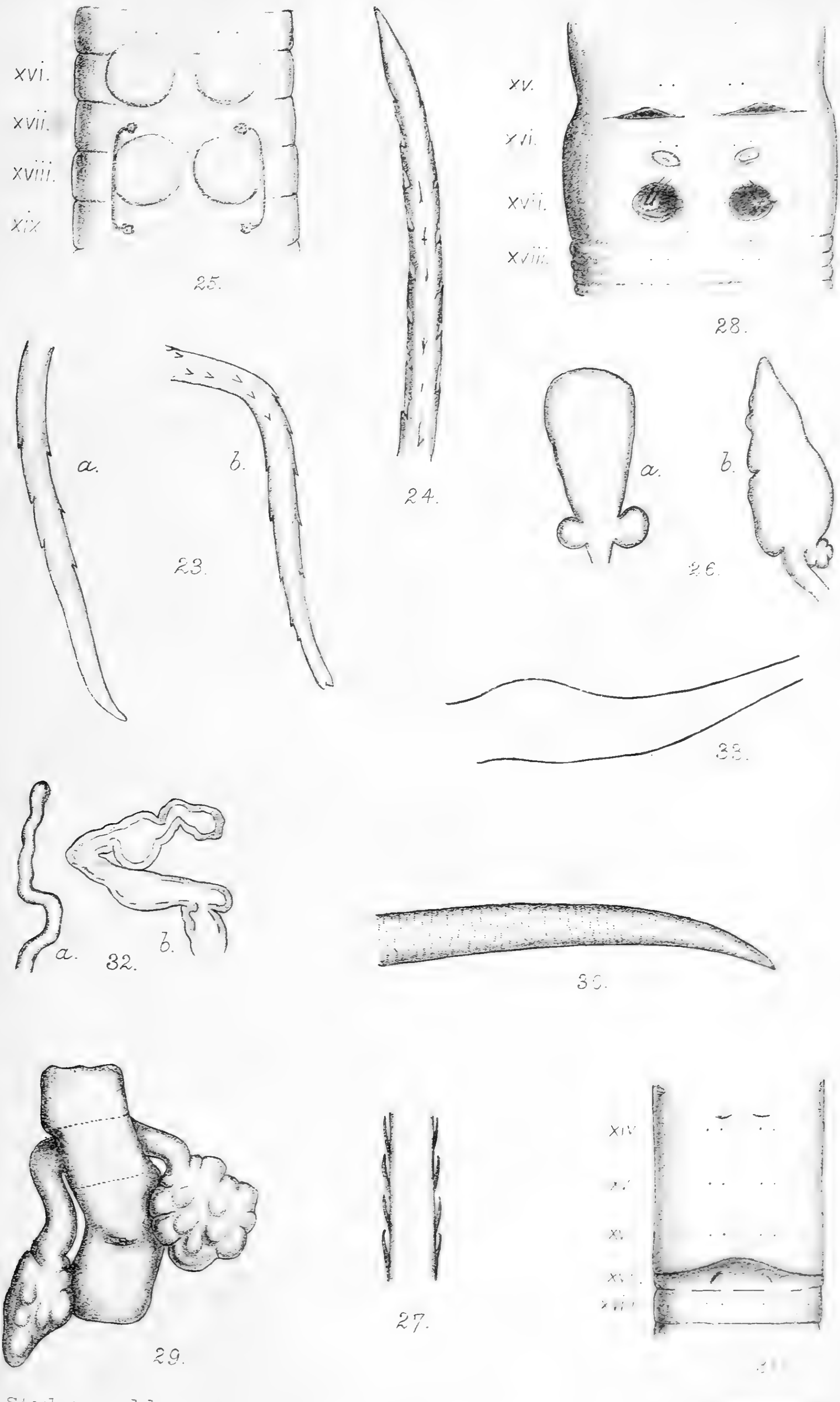
,, 29.—The same; spermatheca; the dotted lines indicate the portion of the under surface which is attached to the body-wall.

,, 30.—The same; penial seta, the distal end; × 160.

,, 31.—*Eudichogaster chittagongensis*; genital region.

,, 32.—The same; two spermathecae; *a*, as seen in the dissected specimen; *b*, a second, seen by transparency under the low power.

,, 33.—The same; outline of penial setae.



J. Stephenson, del.

INDIAN OLIGOCHAETA.

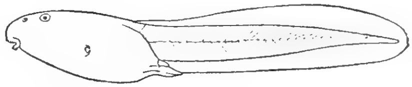
MISCELLANEA.

BATRACHIA.

The occurrence of *Rana pleskii*, Günther, in Kashmir.

The frog *Rana pleskii* is known from the Chinese Province of Sze-chuen, from North-eastern Tibet and from the Provinces of Tsang and U in the south of the latter country. It is common in these provinces at altitudes of from 13,000 to 15,000 feet and breeds in small streams and pools.

I have described the tadpole in *Rec. Ind. Mus.* II, p. 345. To my description I need only add that the mouth-disk is cup-like,



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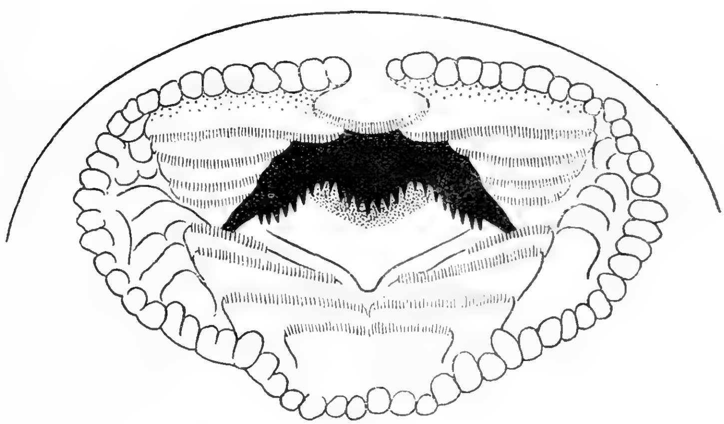

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FIG. 1.—Tadpole of *Rana pleskii* from Lake Kreshen, Kashmir, nat. size.
,, 2.—Mouth-disk × 18.

and that the rows of horny teeth, which vary from four to five on each lip, are supported on thick fleshy ridges, which are sometimes sub-divided by longitudinal grooves. The upper beak is apt to be worn on the edge and may thus assume somewhat different shapes. The structure and appearance of the tadpole are very characteristic, and I do not think that there can be any doubt as to its identity. In the last few years I have received specimens that agree exactly with those collected by Capt. Stewart in Tibet, from four different localities in Kashmir, at altitudes between 9,000 and 12,000 feet. These specimens were sent by the late Mr. H. C. Bion of the Geological Survey of India; by Col. F. Smith, R.A.M.C.; and by Mr. F. J. Mitchell, Honorary Director, Trout Culture, Srinagar, Kashmir.

The following are the Kashmir localities:—

Outlet of Gangabal Lake, *ca.* 11,700 ft.; Nagabera, 10,000-10,500 ft.; Lidarwart, *ca.* 9,000 ft.; Lake Kreshen, 12063 ft.

N. ANNANDALE.

BIRDS.

Myiophoneus temmincki.

Amongst a dozen specimens of the Himalayan Whistling-Thrush recently lent me by the Indian Museum were half-a-dozen from Gilgit, Kashmir, which ranged so much larger than the others —wings and tail of the largest male (No. 15546) 188 and 152 mm. respectively—that it seemed probable they might represent a distinct race. Still later, however, I received the rest of the Indian Museum series which comprises about forty specimens obtained from localities between Afghanistan and the Shan States, Gilgit and "south of Irawadi"; and though none are so large as the larger Gilgit examples, yet several approach those in length of wing and tail:—Kulu, ♂, 182 and 137; Simla, 177 and 140; South of Irawadi, 179 and 132. Such individuals bridge the difference between birds from Gilgit and other localities so that it seems that a distinction cannot be maintained, but it is perhaps desirable to draw attention to the point that it may receive further consideration.

Amongst the collection is a Whistling-Thrush from Komseng obtained by Mr. S. W. Kemp during the course of the Abor Expedition and referred to by Stuart Baker (*Rec. Ind. Mus.* VIII, 1913, p. 278) as a typical *temmincki*. This, however, hardly seems to be the case as all the other specimens of *temmincki* in the Museum have the feathers of the nape and inter-scapulary region pointed, with pointed terminal shining patches, while in the Komseng bird, which is not in worn plumage, the same feathers have rounded ends and broad rounded patches. Though apparently adult, the specimen is rather small (wing 160, tail 116 mm.) and one would like to see more skins from the region in which it was taken. It is quite distinct from *eugenii*.

C. BODEN KLOSS.

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