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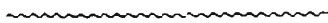
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THE SIJU CAVE, GARO HILLS, ASSAM.

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THE SIJU CAVE, GARO HILLS, ASSAM.

PART I.

By STANLEY KEMP, *Sc.D.*, *Superintendent*, and B. CHOPRA, *D.Sc.*,
Assistant Superintendent, Zoological Survey of India.

(Plates I, II.)

INTRODUCTION.

Although a large amount of work has been done on the faunas of the caves of Europe and N. America, little has hitherto been attempted on this subject in the Oriental Region. The caves that exist in Southern Asia are, so far as is known, not of large size, many of them are situated far from the main lines of travel, and the little faunistic work that has been carried out has not revealed the existence of peculiarly adapted cave-animals, such as have been found in other parts of the world. It is, perhaps, for these reasons that the faunas of Indian caves have hitherto been investigated only in a sporadic manner; such knowledge as we possess is for the most part limited to isolated records and descriptions of species collected in a haphazard manner and no concerted investigation of any single cave has yet been attempted.

In Burma and the Malay Peninsula caves are more numerous than in any part of India proper, a fact which is to be explained by the greater abundance of limestone, and our knowledge of the fauna of these caves has been admirably summarized by Dr. N. Annandale and Dr. F. H. Gravely.¹

Caves also exist in the limestone of Assam but they appear to be less numerous than in Burma and our knowledge of their fauna has hitherto been extremely scanty; the Siju cave, with which this paper is concerned, is probably the largest. In other parts of India caves of any size are very few in number and we have no knowledge whatever of the fauna they may possess.

The existence of a large cave at Siju has been known for many years. Mr. T. D. LaTouche, formerly of the Geological Survey of India, penetrated it to a considerable distance in the year 1881, and has kindly given us a copy of his notes on the subject (see pp. 8, 9); but it had evidently been explored to its furthest limit at a still earlier period (see footnote to p. 8). In 1919 Mr. R. Friel, I.C.S., then Deputy Commissioner of the Garo Hills, visited the cave and made a small but extremely interesting collection of the fauna. Among other animals he discovered a fresh-water prawn with eyes less than half the normal size and a long-legged Reduviid bug not hitherto known to science.

We visited Siju during January and February 1922, at a period when the underground stream to which the cave owes its origin was at its lowest, and spent about three weeks in examining the cave-fauna and topography. Our thanks are due to Mr. J. C. French, I.C.S., Collector of Mymen-

¹ Annandale, Coggin Brown and Gravely, *Journ. Asiat. Soc., Bengal* (n.s.) IX, p. 391 (1914).

singh, and to Mr. N. E. Parry, I.C.S., Deputy Commissioner of the Garo Hills, for the help they gave us in making arrangements for the somewhat difficult journey from rail-head to Siju village. We wish also to express our appreciation of the services rendered by Mr. R. A. Hodgart, Zoological Collector ; without his energetic assistance our results would be much less complete than they are.

TOPOGRAPHY.

In general character the Siju Cave may be described as an underground water-course running in a tunnel of nummulitic limestone, with chambers or caverns—often of considerable dimensions—at various points in its course. The floors of the caverns are always covered with angular limestone slabs which have fallen from the roof and are, for the most part, at any rate, above flood-level.

The direction of the cave, speaking generally, is north-west. It extends to a depth of about three-quarters of a mile and, so far as we were able to discover, admits daylight only by the entrance.

A plan of the cave, which we made with the help of a prismatic compass and an Abney level is shown on plate I ; for convenience of reproduction it is divided into three sections. To the Garos the cave is known by the name of “ Dobakhol ” which means “ the Cave of Bats.”

The mouth of the cave is situated in a cliff on the right bank of the Someswari river, between the villages of Upper and Lower Siju, in Lat. $25^{\circ}21'$ N. and Long. $90^{\circ}41'$ E. It is about 85 ft. above the dry-season level of the river and approximately 950 ft.¹ above sea-level. The path which leads to the mouth lies up the boulder-strewn course of the stream to which the cave owes its origin.

The entrance (Plate II, figs. 1, 2) is a passage about 350 ft. in length, 28 to 35 ft. in breadth and 22 to 25 ft. in height. The floor, which is nearly horizontal, is composed of fine gravel with occasional stones. The stream issues from a narrow tunnel on the western side of the inner end and flows at no great speed to the mouth, where it disappears temporarily beneath large boulders. The course of the stream, as will be seen from the plan, is somewhat complicated and probably alters from season to season ; on the occasion of our visit it was for the most part not more than 2 ft. deep, but in some of the pools and in the side-tunnel was as much as 4 ft. The entire passage is no doubt flooded in the rainy season. In the walls there are numerous vertical fissures, some of which extend to a considerable depth, and between the fissures, throughout the whole length of the entrance passage, there is a thick horizontal shelf of rock from 6 to 8 ft. above ground-level. This shelf, which is shown in the photographs on Plate II, is no doubt to be explained by water action and differences in the hardness of the rock. The stream must at one time have flowed at a higher level in a narrower channel and it was not until it had cut its way through the hard layer of which these shelves are composed that it was able to hollow out the broader passage beneath them. Daylight may be reckoned to extend to about 150 ft. from the entrance, from 150 to 350 ft. is the region of twilight and beyond 350 ft. is total darkness.

¹ For this figure we are indebted to officers of the Hydro-electric Survey of Assam.

At the inner end of the entrance-passage is a spacious cavern inhabited by large numbers of bats (*Cynopterus sphinx gangeticus*). It is nearly 250 ft. in length, 70 ft. in greatest breadth and at least 50 ft. in height, the roof as in most of the other caverns being perfectly flat. The floor is heaped with slabs and boulders which have fallen from the roof and is consequently much higher in many places than the level of the stream, which here runs in a narrow side tunnel. The only water in the cavern itself is a small rivulet which enters from a fissure in the north-eastern wall and forms a few small pools before joining the main stream. At the inner end the cavern forms a *cul-de-sac* and is heaped with boulders to a considerable height; at the further limit the air is intolerably stuffy and the place otherwise rendered unendurable by swarms of bat-parasites. The nauseating smell of bats pervades the whole cavern. The floor was at one time thickly covered with bat-guano, but the supply has been exploited commercially and little now remains. The ground is, however, richly manured and supports an abundant fauna.

In the south-western wall of the cavern, at about 500 ft. from the entrance, there is a low arch, about 5 ft. high, by which access is obtained to the main stream and the inner parts of the cave. The stalactites shown in plate II, fig. 3 are found on the right-hand side immediately before one enters this arch. On reaching the stream a faint glimmer of daylight can be perceived through the narrow tunnel by which the water makes its exit. Progress at this point was rendered difficult owing to the fact that the water entirely filled the tunnel and was in places from $4\frac{1}{2}$ to 5 ft. deep. It was, however, possible to avoid the deepest parts by taking to a small L-shaped passage on the further side of the stream. The floor in this passage is bare rock and it is no doubt a water-course during the flood-season. Beyond this passage, up to a point 1,400 ft. from the mouth, the cave has the form of a tunnel and is quite straight, except for a short right-angle bend at about 850 ft. The tunnel varies in breadth from 12 to 28 ft. and, excluding a deep longitudinal fissure in the roof, is in most parts from 9 to 10 ft. in height; at 850 ft. from the entrance, however, it rises to 20 ft. and at 1,300 ft. to about 25 ft. At 775 ft. there is a small cavern heaped with boulders on the north-eastern side and between 1,300 and 1,400 ft. there is a dry side-passage on the same side, 30 ft. in width and 8 to 10 ft. above stream-level. The floor in this side-passage is mainly composed of fine sand deposited during the flood-season.

The floor of the main tunnel is for the most part covered with water from wall to wall. The greatest depth did not exceed 4 ft. at the time of our visit and it was possible to traverse the whole length without entering water more than half this depth. Between distances of 900 and 1,400 ft. from the entrance the river-bed is filled with water-worn stones and boulders, nearly all composed of gneiss. The fact that huge boulders of this material, sometimes as much as 8 ft. in length, should have been carried into the middle of a limestone tunnel, gives some indication of the tremendous force of the stream during the flood-season. The difference in level is very small and (without having made careful levelling observations) we estimate that the stream at 1,400 ft. is little more than 20 ft. higher than at the mouth.

At 1,400 ft. from the entrance the tunnel widens out into a cavern 70 ft. broad and from 40 to 80 ft. in height. The roof has here partially collapsed and the river-bed is completely choked, so that it is not possible to follow its course further; as noted below, however, the river is again found in the deeper parts of the cave.

On leaving the water-channel progress is possible only in a northerly direction by clambering over huge boulders towards the roof of the cavern. The route is a difficult one and we found it necessary to bring in a bamboo ladder to help us over some of the largest boulders. On reaching a height of about 80 ft. above stream-level at 1,400 ft. a passage 12 ft. broad and little more than $3\frac{1}{2}$ ft. high is found close under the roof and on creeping through this opening the largest cavern in the cave-system is entered. It is about 200 ft. long and nearly 100 ft. broad and we estimated that the roof, which appeared to be quite flat, was 70 ft. above the highest point we reached or 180 ft. above stream-level at 1,400 ft. The whole floor of this cavern is a tumble of huge slabs and boulders of limestone, some of them 20 ft. in length, which have fallen from the roof. According to the Garos a large fall, doubtless caused by an earthquake, occurred some 9 or 10 years ago. The limestone differs noticeably from that of the tunnel further back, for it contains layers of soft shale which have doubtless contributed in causing the extensive collapse which has occurred.

From the small opening mentioned above a way can be found over boulders and masses of slippery shale to a point about 110 ft. above stream-level at 1,400 ft. and from this onwards the ground trends steeply downwards. The air at the highest point is stagnant and very oppressive. A considerable amount of water drips from the roof at various points and at 1,775 ft. from the mouth a small stream falls straight down in the middle of the cavern from a height of about 90 ft. There is a pool near this waterfall, the water of which forms two streams that rapidly vanish among the boulders. This large cavern is not inhabited to any great extent by bats, though some were seen. The boulders are not covered with any thick deposit of guano and the fauna appears to be extremely scanty. This may be more apparent than real for it is impossible to collect satisfactorily in such a place.

At the inner end the cavern contracts to breadths varying from 25 to 40 ft. and the height diminishes to 8 or 10 ft. The floor is undulating and is composed mainly of boulders and stones. Just before reaching a point 2,000 ft. from the entrance a small stream crosses the cave. It issues from an elaborate series of small tunnels on the north-eastern side, forms a pool in the floor, and passes out in a south-westerly direction. The passage through which the stream flowed was too small and the water in it too deep to enable us to follow its course, but there can be little doubt that the stream eventually discharges into the main water-channel. The pool in the floor was at least $4\frac{1}{2}$ ft. deep in the middle with a muddy bottom and thick mud on the banks. A few inches below the surface of this mud we found vegetable debris which must, of course, have been washed in from some outside source.

The main passage continues beyond the stream and at 2,100 ft. from the mouth opens into a cavern 120 ft. long and 50 ft. broad,

partially filled with limestone slabs and boulders. At its further end the cavern is completely choked by these boulders. Few bats seem now to inhabit the cavern, but many must have done so in former times for the entire floor is covered to a depth of several inches with dry bat-guano, in appearance closely resembling ground coffee. Notwithstanding this fact the fauna is extremely poor.

Although this cavern is choked at its inner end it is possible to proceed further by taking to one of the parallel side-tunnels already mentioned. Through a small passage in the north-eastern wall entrance is obtained to a tunnel 7 ft. high and 4 ft. wide, oval in section, and with a floor of bare rock. This tunnel, together with another that lies parallel to it, no doubt forms a water-way in the flood-season; pot-holes were not uncommon and some still contained water. At 2,300 ft. from the entrance there is a deposit of fine mud, left when the flood-waters subsided, and beyond this a small pool at the point where the tunnel again opens into the main passage. It is here possible to proceed backwards for a short distance up a broad passage which was no doubt at one time continuous with the cavern at 2,200 ft. Our measurements show that this passage is choked for a distance of about 50 ft.

Proceeding further inwards, after passing two large rock pillars, a flat roofed hall, 35 ft. in height, 70 ft. long and 18 ft. wide, is entered. The floor is here covered with water-worn stones, mostly of gneiss, cemented in position with fine mud, and here and there are angular limestone boulders. A small tunnel on the south-western side runs parallel with this chamber and at the time of our visit was still full of water.

From 2,500 ft. onwards the course of the main passage changes. Hitherto it has been running almost without interruption in a north-north-west direction; here it abruptly turns to the west and with the exception of a few right-angle bends continues in this direction up to a point 3,050 ft. from the entrance. In this section the breadth varies from 8 to 15 ft. and the height from 15 to 30 ft. The floor is composed of water-worn stones firmly cemented in position, with occasional limestone boulders and in certain places with deposits of mud. The passage is no doubt full of water during the rainy season and, as will be seen from the plan, a number of pools still remained at the time of our visit.

At 3,050 ft. from the mouth the passage slopes gently downwards and opens at right angles into a tunnel with a stream flowing through it. In the time at our disposal we were not able to follow this tunnel downstream for any considerable distance and it is indeed doubtful if we would have been able to do so owing to the depth of water. We consider it certain, however, that the river is the same as that which we left at 1,400 ft. Up-stream the river runs in a perfectly straight tunnel in exactly the same direction as that between 900 and 1,400 ft. Its course is full of water-worn pebbles, mostly of gneiss, and for a considerable part of its extent it is possible to walk on a smooth shelf of rock which exists at water-level on the north-eastern side. The tunnel is from 13 to 20 ft. in breadth and from 15 to 25 ft. in height; the water was nowhere more than 2 ft. deep and the fall in level is very slight.

At 3,550 ft. from the entrance the straight tunnel ends. The main stream enters it from the north-east side and to the south-west is a cavern

80 ft. long, 60 ft. broad and about 40 ft. high. The cavern is partially filled with blocks which have fallen from the roof, the floor so formed extending upwards at an angle of 25° . Rather considerable streams flow on either side of the cavern and discharge into the main channels. A bat, *Hipposideros lankadiva*, is very abundant in this part of the cave-system; it seems, however, to rest by preference on the walls and roof of the main channel, overhanging the water, and this probably accounts for the very scanty deposits of guano which exist.

As will be seen from the plan there is an elaborate series of side-passages in this part of the cave. All these were situated well above the level of the river on the occasion of our visit; but they are no doubt flooded during the rainy season and in some of them small streams were still flowing. The main stream itself takes two right-angle turns and is in places at least 6 ft. deep. Progress is only possible by taking to the side-passages and the precise course of the main channel between 3,600 and 3,750 ft. is, for this reason, doubtful. At 3,800 ft. the stream is running due south in a tunnel 16 ft. broad and 18 ft. high. A little beyond this the tunnel trends to the west and diminishes in height and the end of the cave-system appears to be reached at 3,900 ft. from the entrance in a low, more or less circular chamber, partly filled with limestone boulders. From the walls of this chamber two streams emerge, the larger coming from a passage scarcely 3 ft. broad and containing a considerable depth of water.

Whether there is any way of proceeding further must remain a matter of conjecture: it is not impossible that an opening leading to further passages might be found if carefully sought for. It will be observed, however, that several separate streams join the main channel between 3,550 and 3,900 ft. The river has, in point of fact, broken up into a number of tributaries and this consideration leads us to believe that further progress, if possible, must be very limited.¹

We may note here that the volume of the stream appears to be smaller in the entrance passage than in the deeper parts of the cave. We were not able to make precise observations on this point, but there is a possibility that some other passage exists through which part of the stream finds exit.

Mr. T. D. LaTouche, who visited the cave in 1881 when making geological investigations in the Garo Hills, has kindly allowed us to quote the following extract from his notes:—

“ In the nummulitic limestone near Siju there were several caverns, one of which was known to be of very considerable extent, as it had been explored some time before by Mr. Sanderson, then Superintendent of the Government Kheddans, or elephant-catching operations, in the Garo Hills. With some difficulty I persuaded Bong, the head-man of Siju and two of his men to show me the place and invest gate it. The mouth of the cave, known to the Garos as Dobakhol, ‘the Bats’ Hole,’ lies on the right bank of the Sume-

¹ Shortly after our arrival at Siju we were informed that an army officer had explored the cave some 40 or 50 years ago, had spent an entire day in it and had left a bottle at the furthest point he reached. At 3,900 ft. from the entrance we found a bottle wedged with stones in a crevice about 4 ft. above water-level. It was half-full of dirty water, with the cork driven inside and, if it had ever contained any record, the paper on which it was written had completely perished. An iridescent deposit on the outside of the glass appeared to indicate that it had been lying a long time in the position in which we found it.

sari, about a mile below the village of Siju, but is not easily discernible, as it is partly concealed by a mass of limestone fallen from the cliff above. Well provided with candles, we left Siju early one morning, and paddled down to the cave in a dug-out. Immediately on entering, the appropriateness of the Garo name became evident. We found ourselves in a huge chamber, the upper part of which was filled with great clusters of bats, hanging like stalactites, several feet in length, from the roof. As we brought in our lights, these clusters gradually dissolved, and presently the air was thick with bats, in such enormous numbers that it was with difficulty we made our way through them. The noise of their wings was deafening, like the roar of an express train, and the stench was simply appalling. But they extended only so far from the entrance as the daylight penetrated, and after fighting our way for some hundred yards we found ourselves free of them. Here a fresh difficulty presented itself, for a pool of water, too deep to be forded, barred our progress. We were all good swimmers, however, and Bong leading the way with a lantern we soon reached the inner end, and entered a second huge chamber, with a small streamlet trickling down its shingly floor. At the upper end of this chamber we found a passage which might have been artificially constructed, a tunnel some 7 or 8 feet in diameter, as perfectly circular in section as a town sewer, with beautifully polished walls, and quite straight. Down the centre of the floor of this ran a narrow channel, evidently cut by the stream during the dry season, when the water is low. At one or two points arched passages led off from this into similar tunnels on either side, one of which we involuntarily explored on our return. These passages extended for a very long distance, and we then emerged into a wider and much higher gallery, as high and broad as a railway tunnel, the floor of which was covered with loose fragments of limestone. There was a remarkable absence of stalactites or stalagmite here and in the other parts of the cave that we visited; from which I conclude that during the rainy season it must be more or less filled with water. So far as we went there was no change in the height and width of the tunnel, nor did there appear to be any branches on either side, and it kept a remarkably straight course. It was afternoon when I decided to turn back, and as we had entered the cave at about 7 o'clock in the morning, we must have penetrated it to a considerable distance. Our progress, however, was slow. I had taken off my boots in order to swim the pool, and was not so accustomed as the Garos to walking in bare feet, specially over such stony ground. Soon after we turned back, indeed, I twisted my foot on a loose stone, and would have fared badly if it had not been for Bong, who picked me up on his back, and carried me with the greatest ease till we came to the smooth passages. Midway down these we happened to take the wrong turning and did not discover our mistake until we had followed it down to a pool of water, exactly similar to the one at the true entrance, and had swum across when we found blackness in front of us instead of the dim twilight which should have been visible. It did not take long to find the correct road, however, and in due course we reached the bats' quarters, to find that, it being now fairly late in the evening, the place was almost deserted by them."

These notes are of considerable interest from a topographical point of view. The first pool that Mr. LaTouche and his companions were obliged to swim was presumably situated at about 350 ft. from the entrance but has now been reduced in size by the fall of boulders at 400 ft. The *cul-de-sac* which we found heaped with debris at 500 ft. was apparently an open passage forty years ago and we imagine that the circular tunnel, 7 or 8 ft. in diameter, through which Mr. LaTouche passed, must have connected with the "much higher gallery, as high and broad as a railway tunnel" at some point between 700 and 1,000 ft. as shown on our plan.¹ It is difficult to determine how far Mr. LaTouche penetrated, but it is extremely probable that the main water-channel was not choked at 1,500 ft. as it now is, and that he was able to follow it up without making the large diversion which we were compelled to take.

¹ The small cavern heaped with boulders at 775 ft. was undoubtedly at one time the entrance to a passage.

It is thus clear that the topography of the cave is subject to very considerable alteration. In places where the rock is less hard the stream has been able to hollow out ever-widening caverns in the limestone until in course of time an earthquake brings down a portion of the roof. Such a fall if extensive, may completely choke the water-channel and cause the stream to take to side-passages similar to those which we found at 2,000 ft. When these are sufficiently enlarged a repetition of the process must again occur. The considerable falls of rock in the cavern at 500 ft. have clearly diverted the water-channel and the same thing on a much larger scale has no doubt occurred between 1,500 and 3,000 ft. The long dry passages which are a feature of this section were almost certainly excavated by the main stream, but the latter has been completely diverted from its original course by the enormous mass of boulders which has fallen between 1,500 and 1,700 ft.

It is interesting to note that the bats which formerly inhabited the entrance hall now live in the cavern at 500 ft.

GEOLOGY.

The entire cave so far as we examined it is formed in nummulitic limestone and the late Mr. E. Vredenburg of the Geological Survey of India to whom we submitted specimens of the rock kindly informed us that the nummulite is either *N. laevigatus* or *N. perforatus*. The formation is middle Eocene, whereas that in which the Burmese caves occur is Permo-carboniferous.¹ It does not of course follow from this fact that the cave at Siju is of later origin than those in Burma.

The layers of soft shale which occur in the limestone at about 1,600 ft. from the entrance have already been noticed in our account of the topography. The straight course of the tunnel with its rectangular bends indicates that the stream has followed the jointing of the rock.

There is gneiss in the neighbourhood of Siju, but in our experience it occurs in the cave only in the form of water-worn pebbles and boulders in the stream-bed. The presence of large boulders of this material in the section between 600 and 1,200 ft. is not easy to explain. Possibly the stream once skirted the gneiss formation and possibly it still does so in the unexplored section of tunnel lying between 1,500 and 3,100 ft. The pebbles of the same rock between 3,200 and 3,500 ft. must have been introduced into the main channel by some of the tributaries which probably touch the gneiss at points which we were unable to reach.

The only stalactitic formations that we found are those situated at 500 ft. from the entrance and shown in Plate II, fig. 3. At several points, however, more particularly between 500 and 800 ft. from the entrance, there are masses of travertine with delicately ribbed or honey-combed surface, deposited by flood-water pouring into the cave through fissures. Of these masses that on the south-eastern side of the *cul-de-sac* at 500 ft. is much the largest. The scarcity of stalactites and other recent calcareous deposits is probably due to the floods which sweep through the cave in the rainy season; it is a feature in which the Siju cave differs markedly

¹ See Coggin Brown, *Journ. Asiat. Soc. Bengal* (n.s.) LX, p. 399 et seq. (1914).

from many of those in Burma and the Malay Peninsula and even in other parts of Assam.

AIR CURRENTS AND TEMPERATURES.

In the Jalor caves in Siam, probably owing to the fact that there are apertures in the roofs of many of the larger caverns at some distance from the entrance, a strong wind blows outwards at certain times of the day and inwards at others. We found no such wind in the Siju cave and though the air no doubt circulates to some extent it always appeared to be quite still. Even at the inner extremity the air was not particularly oppressive, though, as we have already noted, it became hot and stagnant as soon as one ascended in the large caverns to any considerable height above the level of the main water-course. Some of the small streams which we met possibly originate above ground and the presence of vegetable debris in the mud at 2,000 ft. from the entrance indicates that this is true of at least one of them. In the dry season the small tunnels through which these streams flow perhaps afford passage to air as well as water.

The air temperature at stream-level appeared to vary regularly with the depth: at 500 ft. we found it to be $21.0^{\circ}\text{C}.$, at 2,000 ft. $23.4^{\circ}\text{C}.$ and at 3,600 ft. $25.8^{\circ}\text{C}.$ At the highest point of the cavern between 400 and 500 ft. the air temperature was $26.8^{\circ}\text{C}.$ and in a similar position at 1,600 ft. it was $26.4^{\circ}\text{C}.$ The temperature of the water of the main channel was $22.1^{\circ}\text{C}.$ at the entrance and $22.8^{\circ}\text{C}.$ at 3,600 ft. In the stream at 2,000 ft. the temperature of the water was $23.2^{\circ}\text{C}.$ and in small pot-holes of still water at 2,100 ft. it was 23.7 . We made no observations on the humidity of the air which was no doubt high.

FAUNA OF THE CAVE.

The topography of the Siju Cave has no doubt exercised a great influence on the fauna which inhabits it and, as will be realized from the foregoing account, the locality is not one in which any large number of species is likely to occur. During the rainy season the greater part of the cave must be flooded and the torrents which pour through its narrow tunnels must make access to the inner parts extremely difficult. Even in the dry season the water often fills the whole breadth of the tunnel and must form an impassable barrier to many species. The caverns on the other hand are mostly above flood-level and many of them contain deposits of bat-guano; they may be expected to afford food and shelter to those animals which have been able to reach them, providing a safe retreat during the flood-season and a centre from which further immigration may be attempted.

To an active aquatic fauna the cave should present no obstacles and we had hoped that the perennial stream which flows through it would have yielded species of great zoological interest. In this we were in a large measure disappointed for the only aquatic animal which shows adaptations to cavernicolous conditions is the prawn *Palaemon cavernicola* which had previously been discovered in the cave by Mr. R. Friel.

In other respects the fauna is perhaps more abundant than might have been anticipated consisting so far as we were able to discover of the 102 species mentioned in the following list.

LIST OF THE FAUNA OF THE SIJU CAVE.

			Distance from mouth of cave in feet.
MAMMALIA.			
Chiroptera.			
	<i>Cynopterus sphinx gangeticus</i> K. Andersen.	...	400—500
	<i>Hipposideros lankadiva</i> Kelaart	...	800—3,600
	<i>Rhinolophus lepidus subbadius</i> Blyth	...	0—300
Rodentia.			
	<i>Mus nitidus nitidus</i> Hodgson	...	450, 1,400—3,600
Carnivora.			
	<i>Felis</i> sp.	...	0—3,900
PISCES.			
	<i>Psilorhynchus sucatio</i> (Ham. Buch.)	...	300—600
	<i>Barbus hexastichus</i> McClelland	...	0—600, 2,000
	<i>Barilius bendelisis</i> (Ham. Buch.)	...	300—600
	<i>Barilius barna</i> (Ham. Buch.)	...	300—600
	<i>Danio aequipinnatus</i> (McClelland)	...	300—600
	<i>Nemachilus</i> sp.	...	0—100, 1,700
	<i>Ambassis nama</i> (Ham. Buch.)	...	300—600
	<i>Ophiocephalus gachua</i> (Ham. Buch.)	...	300—600
BATRACHIA.			
	<i>Rana (Hylorana) afghana</i> (Günther) ¹	...	900
	<i>Megalophrys</i> sp. (tadpole only) ¹	...	0—350
MOLLUSCA.			
Gastropoda.			
	<i>Paludomus blanfordiana</i> Nevill	...	0—500
	<i>Melanoides pyramis</i> (Hutton) (shell only)	...	3,600
	<i>Opeas gracile</i> (Hutton) (shells only)	...	3,600
	<i>Opeas cavernicola</i> , sp. nov.	...	450—500
CRUSTACEA.			
Decapoda.			
	<i>Paratelphusa (Barytelphusa) falcidigitis</i> Alcock	...	0—2,400
	<i>Palaemon hender-soni</i> de Man	...	0—3,200
	<i>Palaemon cavernicola</i> , sp. nov.	...	550—3,600
Isopoda.			
	<i>Porcellio assamensis</i> , sp. nov.	...	0—450
	<i>Philoscia dobakholi</i> , sp. nov.	...	800—3,600
	<i>Philoscia</i> sp.	...	800—1,200
	<i>Cubaris cavernosus</i> Collinge	...	300—3,800
ARACHNIDA.			
Tartarides.			
	<i>Schizomus sijuensis</i> , sp. nov.	...	2,500, 3,500—3,600
Araneae.			
	<i>Scytodes semipullata</i> Simon.	...	1,000, 2,100, 2,400
	<i>Theridion rufipes</i> Lucas	...	100—500
	<i>Vendilgardia assamensis</i> , sp. nov.	...	300, 1,000
	<i>Heteropoda robusta</i> , sp. nov.	...	0—2,400
Chernetidea.			
	<i>Chelifer</i> (s. l.) 1 or 2 spp.	...	400—500, 2,100—2,200
Opiliones.			
	<i>Metassamia septemdentata</i> , sp. nov.	...	400—500, 800—1,200
	<i>Sijucavernicus kempfi</i> , gen. et sp. nov.	...	1,000, 1,800—3,800
Acari.			
	At least 4 spp.	...	450—500

¹ N. Annandale det.

LIST OF THE FAUNA OF THE SIJU CAVE—*contd.*

			Distance from mouth of cave in feet.
MYRIAPODA.			
Diplopoda.			
	<i>Trachyiulus mimus</i> , sp. nov.	...	2,000—2,200, 3,600
Chilopoda.			
	<i>Lamnonyx diversidens</i> Silvestri	...	350—500
	<i>Himantosoma typicum</i> Pocock	...	2,150, 3,600
	<i>Cryptops kemp</i> i, sp. nov.	...	450
	<i>Paracryptops indicus</i> , sp. nov.	...	350—450
	<i>Thereuonema reconditum</i> , sp. nov.	...	400—500, 2,100
INSECTA.			
Thysanura.			
	Machilid (1 damaged spec.)	...	0
Collembola.			
	<i>Cyphoderopsis</i> , sp. nov. ¹	...	450—500, 800, 3,500— 3,600
	<i>Lepidocyrtus</i> , 2 spp. nov. ¹	...	0, 100—500
	<i>Paronella</i> sp. nov. ¹	...	0
Orthoptera.			
	<i>Pycnoscelus surinamensis</i> L.	...	350—400
	<i>Speonemobius decoloratus</i> , gen. et sp. nov.	...	0
	<i>Larandopsis choprai</i> , gen. et sp. nov.	...	0, 500
	<i>Kempiella longipes</i> , gen. et sp. nov.	...	200—3,600
Dermaptera.			
	<i>Forcipula borellii</i> , sp. nov.	...	300—500
	<i>Chelisoches morio</i> F.	...	0, 400—500
	<i>Timomenus lugens</i> Bormans	...	0
Rhynchota.			
	<i>Metrocoris nigrofasciatus</i> Distant	...	300, 400, 2,000 ²
	<i>Myiophanes kemp</i> i, sp. nov.	...	350—500
	<i>Bagauda cavernicola</i> Paiva	...	350—500
	<i>Heleocoris</i> sp.	...	200
Diptera.			
	<i>Ramphidia</i> sp.	...	2,000
	<i>Limnophila</i> (<i>Troglophila</i>) <i>cavernicola</i> , sp. nov.	...	3,600
	<i>Atrichopogon cavernarum</i> , sp. nov.	...	100—500, 1,700
	<i>Haematopota annandalei</i> Ricardo	...	1,200
	<i>Pegomyia kemp</i> i, sp. nov.	...	450—800
	<i>Limosina ornata</i> de Meijere	...	450—500.
	<i>Limosina notatipennis</i> , sp. nov.	...	400
	<i>Limosina tenebrosa</i> , sp. nov.	...	200
	<i>Phyllomyza tenebrosa</i> , sp. nov.	...	450—500
	<i>Idypaspistomyia latipes</i> Meigen var.	...	400
	<i>Conicera kemp</i> i sp. nov.	...	400—500
	<i>Hercostomus praetentans</i> , sp. nov.	...	450
	<i>Nycteribia</i> (<i>Acrocholidia</i>) <i>eraxesta</i> (Speiser)	...	400—3,600
	<i>Eucampsipoda hyrtl</i> i, Kolenati	...	400—500
	Streblid, sp. indet.	...	400—500
Lepidoptera.			
	<i>Pyralis manihotalis</i> Guénée	...	100—500
	<i>Tinea pyrosoma</i> , sp. nov.	...	450—500
	<i>Tinea antricola</i> , sp. nov.	...	400—500, 1,200, 2,150, 3,600
Coleoptera.			
	<i>Tachys micraulax</i> , sp. nov.	...	100—500
	<i>Abacetus lucifugus</i> , sp. nov.	...	100—350, 3,550
	<i>Anaulacus fasciatus</i> Schm. Goeb.	...	500
	<i>Anchista binotata</i> Dejean	...	350—500
	<i>Philonthus annandalei</i> , sp. nov.	...	100—300
	<i>Philonthus kemp</i> i, sp. nov.	...	100—300
	<i>Lithocaris vilis</i> Kr. ²	...	100—300

¹ These species will be described by Prof. G. H. Carpenter in a future number of this volume.² M. Cameron det.

LIST OF THE FAUNA OF THE SIJU CAVE—concl'd.

		Distance from mouth of cave in feet.
INSECTA—cont'd.		
Coleoptera—cont'd.		
<i>Oxytelopsis pseudopsina</i> Fauv. ¹	...	450—500
<i>Orectochilus</i> sp. ¹	...	100—400, 2,100, 3,600
<i>Megapenthes vespertilionis</i> , sp. nov.	...	400
<i>Carcinops 14-striatus</i> , Steph.	...	400
<i>Cercyon</i> sp.	...	450
<i>Euxestus parki</i> Woll.	...	500
<i>Holoparamaecus</i> sp.	...	400
<i>Palorus exilis</i> Mars.	...	550
<i>Diaclina rufotincta</i> Fairm.	...	400
<i>Hylophilus kempfi</i> , sp. nov.	...	400—500, 800, 2,000
Hymenoptera.		
<i>Neonteira typica</i> , gen. et sp. nov.	...	100—450
<i>Triglyphothrix striatidens</i> Emery	...	400
OLIGOCHAETA.		
<i>Enchytraeus cavicola</i> , sp. nov.	...	500
<i>Drawida troglodytes</i> , sp. nov.	...	2,000
<i>Megascolides antrophyes</i> , sp. nov.	...	2,000
<i>Dichogaster bolawi</i> (Mich.)	...	350—500
<i>Glyphidrilus spelaeoles</i> , sp. nov.	...	2,000, 3,000

For assistance in the compilation of this list we are indebted to our colleagues in India and to authorities in Europe and America and we wish here to express our thanks to those who have so generously devoted their special knowledge to the examination of the material we collected. Without their co-operation a very large proportion of the species we obtained would have remained undetermined and our results as a whole would have been lacking in authority. In Part II of this paper reports on most of the constituent parts of the fauna will be found.² The names of those who have identified species not mentioned in Part II are given as footnotes to the preceding list.

Included in our list are certain species which should not be regarded as part of the cave-fauna proper. The tadpole of *Megalophrys* sp., the Thysanuran, the Collembolan *Paronella* sp., the cricket *Speonemobius decoratus*, the earwig *Timomenus lugens*, the waterbug *Heleocoris* sp. and the three Staphylinid beetles *Philonthus annandalei*, *P. kempfi* and *Lithocaris vilis* were found only in the entrance passage and do not appear to have succeeded in penetrating into regions of total darkness. Five other species, found much beyond the reach of daylight, appear to us to belong merely to the category of casual visitors. A large frog, *Rana* (*Hylorana*) *afghana*, was discovered sitting on the wall at a depth of 900 ft., the Tabanid *Haematopota annandalei* on a boulder near the water-fall at 1,775 ft., the Dolichopodid *Hercostomus praetentans* at 450 ft. and the two Tipulids *Limnophila* (*Troglophila*) *cavernicola* and *Ramphidia* sp. at depths respectively of 3,600 and 2,000 ft. These five species are all represented in our collections by single specimens.

¹ M. Cameron det.

² The reports on the Chernetidea, Acari, Thysanura and Collembola have not been received in time for inclusion in this paper. In his account of the Orthoptera and Dermaptera Dr. Chopard has also given records and descriptions of species from the Hsin Daung cave, Yawngwhe, S. Shan States, and from the Lakadong cave in the Jaintia Hills, Assam. Similarly Prof. Silvestri has included the description of a Myriapod from the Batu caves in Selangor.

Without further evidence we do not think they should be regarded as part of the cave-fauna, though we are unable to suggest how they came to occur in the situations in which we found them. The shells of the Gastropods *Melanoides pyramis* and *Cpeas gracile* from 3,600 ft., were probably washed into the cave from some outside source.

The true cave-fauna thus consists of 86 species and of these only 33 penetrate beyond a depth of 600 ft. A considerable part of our collection consists of species which are known to occur in daylight and most of the hitherto undescribed forms resemble their outdoor relatives and are not modified in response to their peculiar environment. The number of species showing definite adaptation to cavernicolous conditions is extremely small.

Land Fauna.

We have already referred to the difficulties which must confront animals in their attempts at immigration into the cave and to the advantages that the large dry caverns may be expected to afford to those that have succeeded in overcoming these difficulties. Our collections illustrate the effects of these topographical influences, though there appear to be other undetermined causes which have prevented certain elements in the fauna from extending further inwards.

The fauna of the entrance hall (0-350 ft.) need not be considered at any length. The level floor is no doubt submerged every year when the stream rises and though—as we learn from Mr. LaTouche's note—it was once inhabited by bats, few now live there and any guano that may be deposited must be washed away in the flood-season. Apart from the few species (mentioned above) which do not enter total darkness, the fauna of the entrance hall consists of a number of forms also found in the cavern beyond; all these occur very sparingly.

The large cavern between 400 and 500 ft. contains a very rich fauna, as will be seen from the list of species on pp. 12-14; it comprises about 68 species. This community is a most interesting one, for though nearly all the species occur in daylight also there is little doubt that by far the greater number breed and spend the whole of their lives in the total darkness of the cavern. The explanation of the abundant life in this portion of cave is at once evident: it is the abode of myriads of bats (*Cynopterus sphinx gangeticus*) and the floor is in consequence richly manured with guano, a food supply which as Racovitza has remarked is “très recherchée par les cavernicoles.” The cavern is also for the most part above flood-level and while comparatively easy of access from the entrance, no doubt affords to the fauna some measure of protection from the enemies it would meet outside.

Of the animals which feed directly on bat-guano the most important, as affording the main food supply of the predaceous section of the fauna, appear to be a brown mite, the cricket *Kempiella longipes*, the cockroach *Pycnoscelus surinamensis*, the moth *Tinea antricola*, the Histerid beetle *Carcinops 14-striatus*, the Tenebrionids *Palorus exilis* and *Diaclina rufotincta*, the mollusc *Opeas cavernicola* and the oligochaetes *Enchytraeus cavicola* and *Dichogaster bolau*.

All these are abundant forms ; the mite occurs in incredible numbers under stones in places where the floor is moist and the oligochaetes are plentiful beneath the surface in the same situation. The cockroach swarms in light dry soil and the larvae of *Tinea antricola* are extremely common on rocks and boulders powdered with guano.

There is thus an ample food-supply for predaceous ground-living animals such as the Myriapoda, the earwigs, the Carabid and Staphylinid beetles and the ant.

Of the animals on the walls of the cavern the large Araneid *Heteropoda robusta*, which does not spin a web, presumably preys on the crickets and Opiliones, but in spite of its abundance we never saw it feeding. The Theridiid spider *Theridion rufipes* spins irregular webs across crevices and feeds mainly on the moths *Pyrallis manihotalis* and *Tinea antricola*, both of which are also eaten by the two long-legged bugs *Myiophanes kempfi* and *Bagauda cavernicola* which are common on the walls of the cavern. The bugs, however, also feed on other species. We found them eating the spider *Theridion rufipes* — possibly their main food-supply—and they also suck the young stages of their own species. The earwig *Chelisoches morio* was observed eating the Pyralid moth and this is perhaps its regular habit, for, unlike *Forcipula borellii*, it is generally found walking on the walls and on boulders.

The majority of the animals in the cavern seemed quite indifferent to light and, so long as they were not actually touched, paid no attention to a strong lamp placed quite near them. The Chironomid *Atrichopogon cavernarum*, the Muscid *Limosina ornata*, the moth *Tinea pyrosoma* and the flying Hylophilid beetle *Hylophilus kempfi* were, however, definitely attracted by light.

The only animals in the cavern which exhibit any modifications which can be correlated with life in total darkness are the mollusc *Opeas cavericola*, the Isopod *Cubaris cavernosus* and possibly the moth *Tinea antricola*. The adaptations of these species are noted on pp. 20, 21.

The two bugs *Myiophanes kempfi* and *Bagauda cavernicola* with their excessively long and slender legs and antennae present the appearance of true cave animals, but are evidently not specially adapted to life in such places. The former has been found near Tura in the Garo Hills, but is apparently rare outside caves ; the latter is at present known only from the Siju Cave, but will probably be found outside in course of time. The family and genera to which these species belong contain other non-cavernicolous species of similar colouration and with the same extreme length of leg and antenna. A parallel case is to be found in the long-legged centipede *Thereuonema reconditum*, except that similar related forms are much more abundant outside caves.

It seems as if these forms had at the time of their immigration found themselves already well adapted to cave life, perhaps by reason of their long appendages, and had therefore flourished in their new environment without special modification.¹ The evidence is all against the view that their modifications are a response to cavernicolous conditions.

¹ Instances of a precisely similar nature are met with in *Diestrammena*, an Orthopteron with very long antennae, and *Stygophrynus*, a Pedipalp with very long antenniform legs. Both these genera are found in caves in India and the Malay Peninsula, though neither occur at Siju.

The fauna of the deeper-lying parts of the cave is very limited and many species found in the cavern at 400 to 500 ft. have been unable to make further progress. There are for instance no mites beyond 500 ft., no cockroaches, earwigs, bugs or Hymenoptera, practically no beetles except the *Hylophilus*, no Diptera except the Chironomid *Atrichopogon cavernarum* and the Anthomyid *Pegomyia kemp*i (the latter extending only to 800 ft.) and no Lepidoptera except *Tinea antricola*.

This striking diminution in the fauna is no doubt in a large measure due to the difficulty which many species have experienced in passing upstream through the long tunnel between 600 and 1,300 ft., but this explanation does not appear to account for all the deficiencies. Species which are habitually found on the walls of the outer cavern should have had no difficulty in penetrating further, yet only a single cricket has succeeded in doing so, and the earwig *Chelisoches morio* and the two long-legged bugs are entirely absent. To all insects which can fly, moreover, the topographical difficulties should have been of small account.

Another deterring influence may be a lack of food but this again does not afford an altogether satisfactory explanation. If bat-guano is the food-supply on which most of the species ultimately depend — and there is little doubt that it is — scanty deposits are available in the large cavern between 1,500 and 1,900 ft., while between 2,100 and 2,200 ft. an enormous supply is available, the entire floor being covered to a depth of several inches. Notwithstanding this fact the fauna of the latter cavern consisted only of one pseudoscorpion, the moth *Tinea antricola*, with occasional specimens of the long-legged Myriapod *Thereuonema reconditum*.

Excluding aquatic animals and those (mentioned on p. 14) which appear to be merely casual visitors, the terrestrial fauna of the inner parts of the cave, at distances exceeding 1,500 ft. from the entrance, consists of the following species:—

MAMMALIA.

Chiroptera.

**Hipposideros lankadiva* Kelaart.

Rodentia.

Rattus nitidus nitidus Hodgson.

Carnivora.

Felis sp.

CRUSTACEA.

Isopoda.

**Philoscia dobakholi*, sp. nov.

**Philoscia* sp.

Cubaris cavernosus Collinge.

ARACHNIDA.

Tartarides.

**Schizomus sijuensis*, sp. nov.

Araneae.

**Scytodes semipullata* Simon.

Heteropoda robusta, sp. nov.

Opiliones.

**Sijucavernicus kemp*i, gen. et sp. nov.

MYRIAPODA.

Diplopoda.

**Trachyiulus mimus*, sp. nov.

Chilopoda.

**Himantosoma typicum* Pocock.*Thereuonema reconditum*, sp. nov.

INSECTA:

Collembola.

Cyphoderopsis gracilis, sp. nov.

Orthoptera.

Kempiella longipes, gen. et sp. nov.

Diptera.

Atrichopogon cavernarum, sp. nov.*Nycteribia* (*Acrocholidia*) *euxesta* (Speiser).

Lepidoptera.

Tinea antricola, sp. nov.

Coleoptera.

Abacetus lucifugus, sp. nov.*Hylophilus kempi*, sp. nov.

OLIGOCHAETA.

Drawida troglodytes*, sp. nov.Megascolides antrophyes*, sp. nov.**Glyphidrilus spelaeotes*, sp. nov.

This list comprises only 23 species and the number is further reduced to 18 if we leave out of account the mammals, which are, of course, free to enter or leave the cave at will, the bat-parasite and the carabid beetle *Abacetus lucifugus*, of which a single chance specimen was found at the edge of the stream at 3,550 ft. The species which were found *only* in the inner parts of the cave and are absent from the cavern between 400 and 500 ft. are distinguished by an asterisk (*).

Aquatic fauna.

The aquatic fauna of the cave proved on the whole less interesting than was hoped. It includes eight species of fish, one gastropod mollusc, three decapod crustacea, two water-bugs and one gyrenid water-beetle. The only one of these that shows any sign of modification is the prawn *Palaemon cavernicola*; all the others belong to species also known from outside the cave.

Most of the fish in our collection were obtained by Garo fishermen, whom we brought into the cave for the purpose of catching them. Fish were not uncommon in the stream up to a depth of 600 ft. from the entrance but became much scarcer in the inner parts. Two species, however, *Nemachilus* sp. and *Barbus hexastichus* penetrate to a depth of at least 1,700 and 2,000 ft. respectively. Individuals of some of the species are paler than those obtained in daylight but the story we were told of a white cave-fish seemed to refer merely to slightly decolourized specimens of *Barbus hexastichus*, which appear almost white when seen in the water by lamp-light,

The conspicuously banded gastropod, *Paludomus blanfordiana*, is abundant in the stream which issues from the mouth of the cave and extends inwards to a depth of about 500 ft.

Of the three aquatic insects one is a water-bug of the genus *Heleocoris*, represented in our collection by a single specimen obtained in the stream in the entrance hall. The other two are the gerrid bug *Metrocoris nigrofasciatus* and a gyrenid water-beetle belonging to the genus *Orectochilus*; both of these are surface forms and both are rare in the cave; the former penetrates to a depth of 2,000 ft., while the latter makes its way to the extreme inner end. All three species occur commonly in the stream outside the cave-mouth.

Of the three Decapod Crustacea two, *Paratelphusa falcidigitis* and *Palaemon hendersoni*, are common Assamese species. Odd specimens of the *Paratelphusa* were found at various depths up to a maximum of 2,400 ft., mostly under stones in the stream-bed. *Palaemon hendersoni* is abundant in pools in the entrance hall, but is seen more and more sparingly as greater depths are reached. It was, however, found as far as 3,200 ft. from the mouth. The colour of cave-specimens is slightly paler than those from the stream outside, but no other appreciable difference can be detected.

The third Decapod, *Palaemon cavernicola*, is restricted to the inner parts of the cave and is of particular interest owing to its partial adaptation to cave life and as being the only true cavernicolous Decapod known from Asia. The nearest point to the entrance at which the species was found was in the small pool in the L-shaped passage at 550 ft. In the inner regions it appeared to be most abundant in the stream at 2,000 ft. and in the pools between 2,200 and 3,000 ft. It was perhaps equally common in the main water-channel, but was less easy to see owing to the surface ripples. The species was not infrequently taken in company with *P. hendersoni* and was slightly but quite definitely attracted by light. The specimens found in pools of still water were no doubt left there when the flood-water subsided. In such situations they evidently find difficulty in maintaining themselves and we frequently saw dead specimens being devoured by others. In the main stream at 3,500 ft. we once discovered a number of specimens eating a dead bat (*Hipposideros*).

We failed to find any aquatic Isopods or Amphipods in the cave and the water everywhere was perfectly clear and without a trace of plankton. An attempt to hatch small crustacea from dry mud taken from the side-tunnel at 2,300 ft. proved a complete failure.

General Considerations on the Fauna.

In their valuable summary of our knowledge of the zoology of the caves of Burma and the Malay Peninsula,¹ Dr. Annandale and Dr. Gravely have drawn attention to the fact that the fauna is as a whole far less specialized than that of the caves of Europe and North America. This small degree of specialization is also a feature of the Siju fauna. The vast majority of the animals we collected belong to

¹ *Journ. Asiat. Soc., Bengal* (n.s.) IX, p. 422 (1914).

species which occur, or may be expected to occur in out-door situations and the few that do exhibit adaptation to cave life are only partially or incompletely modified. At Siju we seem to find a cave fauna in an early stage of evolution and we look in vain for the final results of environmental conditions, which in other parts of the world have yielded species of extreme zoological interest. From the low degree of specialization of the fauna it seems legitimate to infer that the cave is of comparatively recent origin.

One interesting feature of the fauna is the common occurrence in the cave of species which appear to be rare outside. The long-legged bug *Myiophanes kempi* may be cited as an instance and if we had sufficient knowledge of the relative abundance of other species shown in our list the same fact would almost certainly be evident in some of them also. There is thus some indication that the peculiar environment is extremely favourable to certain animals. This of course is not an exclusive feature of caves; it applies equally well to lagoons of water that is brackish or seasonally variable in salinity or to any situation in which the physical conditions are abnormal. Species which succeed in establishing themselves in an environment in which peculiar physiological adaptability is necessary for their existence are limited in numbers and, being able to survive under conditions in which the majority of their enemies and competitors would perish, are naturally in a favourable position to increase and multiply.

Classified on the lines which Racovitza has advocated¹ the fauna of the Siju cave consists principally of "Troglophiles." There are "Trogloxènes" also but most of these we have excluded from consideration (see p. 14) as not constituting part of the cave-fauna proper. Of true "Troglobies" there are few or none.

The only species in the cave which exhibit definite adaptation to cavernicolous existence are the following :—

Mollusca.

Opeas cavernicola, sp. nov., 450 to 500 ft. Of 100 living specimens examined 6 per cent show no trace of retinal pigment and the lens is apparently absent. In the remaining 94 per cent the lens is present; the retina is densely pigmented but, as seen from without, occupies a smaller area than in allied out-door species. The optic nerve is strongly developed in all the specimens and the eye, which apparently forms an efficient sense-organ even when without pigment, is actually larger than in the allied *O. gracile*.

Crustacea Decapoda.

Palaemon cavernicola, sp. nov., 550 to 3,800 ft. The cornea of the eye is reduced to less than half the normal size and shows no variation in dimensions. The usual black pigment is, however, present and in its microscopic structure the eye shows no signs of degeneration. The two distal optic ganglia are reduced in size but the proximal ganglion is fully as large as in

¹ *Arch. Zool. expér. et gén.* (4) VI, p. 437 (1907).

prawns of similar size with normally developed eyes. The antennae and antennules show no excessive development. The colour is semitranslucent and whitish, without the pigmentation characteristic of allied out-door forms. It is perhaps significant that what pigment there is, apart from the eyes, is of a bright red colour. The eye is functional and the species is attracted by light.

Crustacea Isopoda.

Philoscia dobakholi, sp. nov., 600 to 3,600 ft. Almost white in colour with greatly reduced eyes.

Cubaris cavernosus Collinge, 300 to 3,800 ft. Eyes reduced but colour not abnormal.

The moth *Tinea antricola* in its pale colouration exhibits a certain modification but no structural peculiarities are apparent.

In spite of the remarks by Dr. Chopard on p. 81, we do not consider that the cricket *Speonemobius decoloratus* shows any marked adaptation to cave life. It was found at the entrance, in broad daylight, and apart from its pale colouration exhibits no significant characters.

Owing to our scanty knowledge it is not at present possible to make a detailed comparison of the Siju fauna with that of other Asiatic caves. The only species in our list which are known from other caves are:—

Cubaris cavernosus, described by Collinge from caves near Cherrapunji in Assam.

Chelisoches morio F. which is commonly found in other Assamese caves and in those of the Malay Peninsula.

Atrichopogon cavernarum, sp. nov., which is also known from the Batu caves in Selangor (see p. 107).

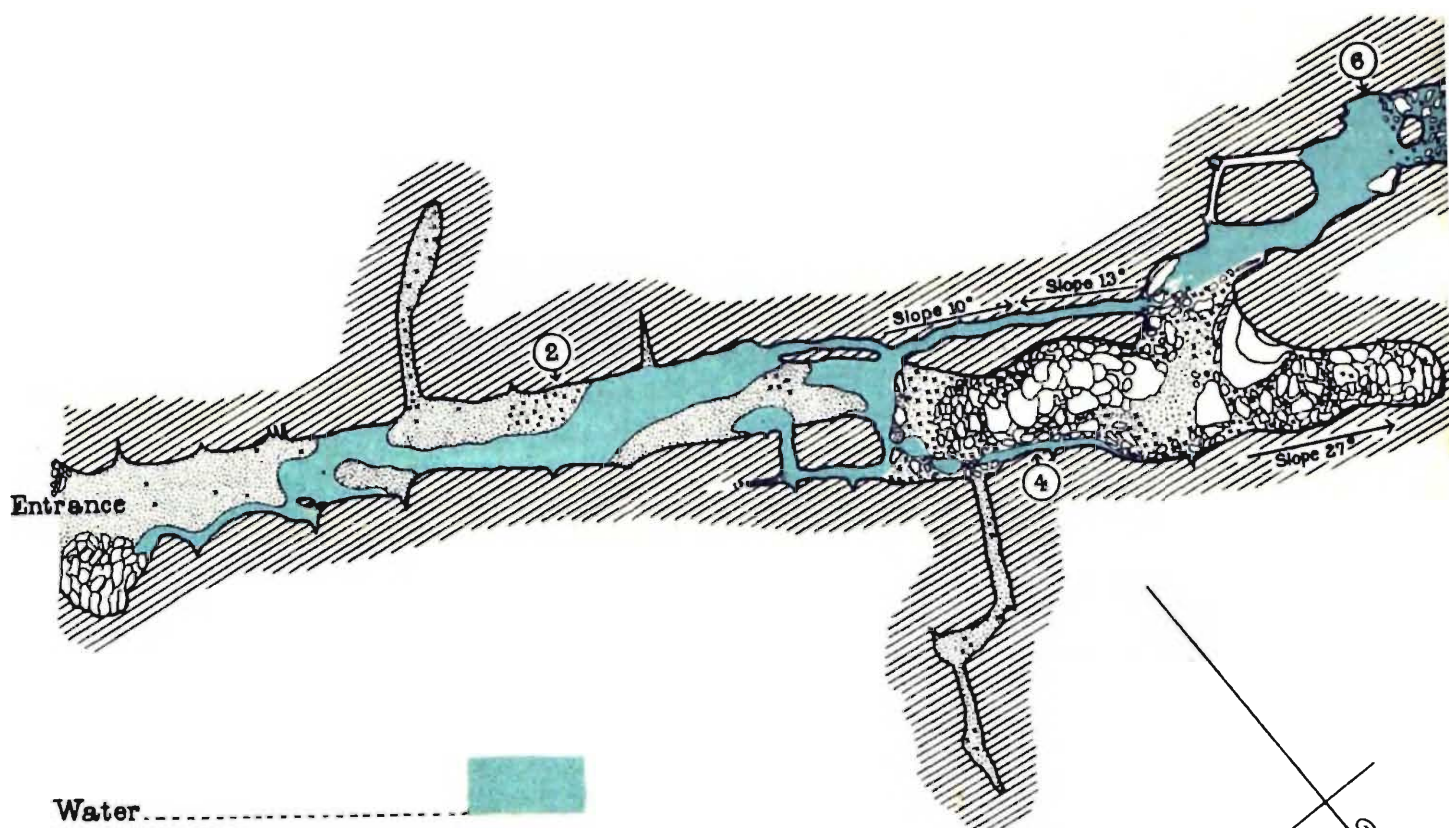
Tinea antricola, sp. nov., which is probably also found in the Moulmein caves in Burma (see p. 114).

If our list is compared with that of the fauna of the Burmese and Malayan caves compiled by Annandale and Gravely it will be found that only one species (*Ch. morio*) and very few genera are common to both. No true comparison is, however, possible, for the Burmese and Malayan caves have not been investigated with any degree of thoroughness and it may be expected that a number of Siju insects belonging to species with a wide range of distribution will in course of time be found in them.

In a few particulars the Siju fauna shows an interesting resemblance to that of the caves at Shimoni and Kulumuzi in tropical Africa examined by MM. Alluaud and Jeannel. The analogy lies entirely in the Arthropods: in the Myriapods in the occurrence of a species of *Lamnonyx* and in the insects in the abundance of a beetle of the genus *Hylophilus* and in the presence of long-legged bugs belonging to the genera *Myiophanes* and *Bagauda*. It is this last fact that is most striking, for bugs of these two genera, which are widely distributed in India in the open, have not been found elsewhere in Africa.

In the fauna of the Siju cave there are some very remarkable deficiencies. It might have been expected that small Gastropod molluscs such as *Hypselostoma*, *Opisthostoma* and *Ditropis*, which have been found in bat-guano in the Jalor caves, would also have occurred at Siju,

but though a minute search was made with this object in view none could be discovered. Another noteworthy deficiency is the complete absence of the large Pedipalps (*Stygophrynus*) which form a very striking feature of the fauna of the Moulmein and Jalor caves. The only Thysanuran we obtained was found in the entrance hall and no specimens were seen of the Phasgonurid (Stenopelmatid) genera *Diestrammena*, *Rhaphidophora* and *Tachycines*. One or other of these genera is to be found in the Jalor and Batu caves, in those of Burma and in all the Assamese caves which have hitherto been examined. In the Siju cave they are entirely absent, their place being taken by three hitherto unknown Gryllid genera.

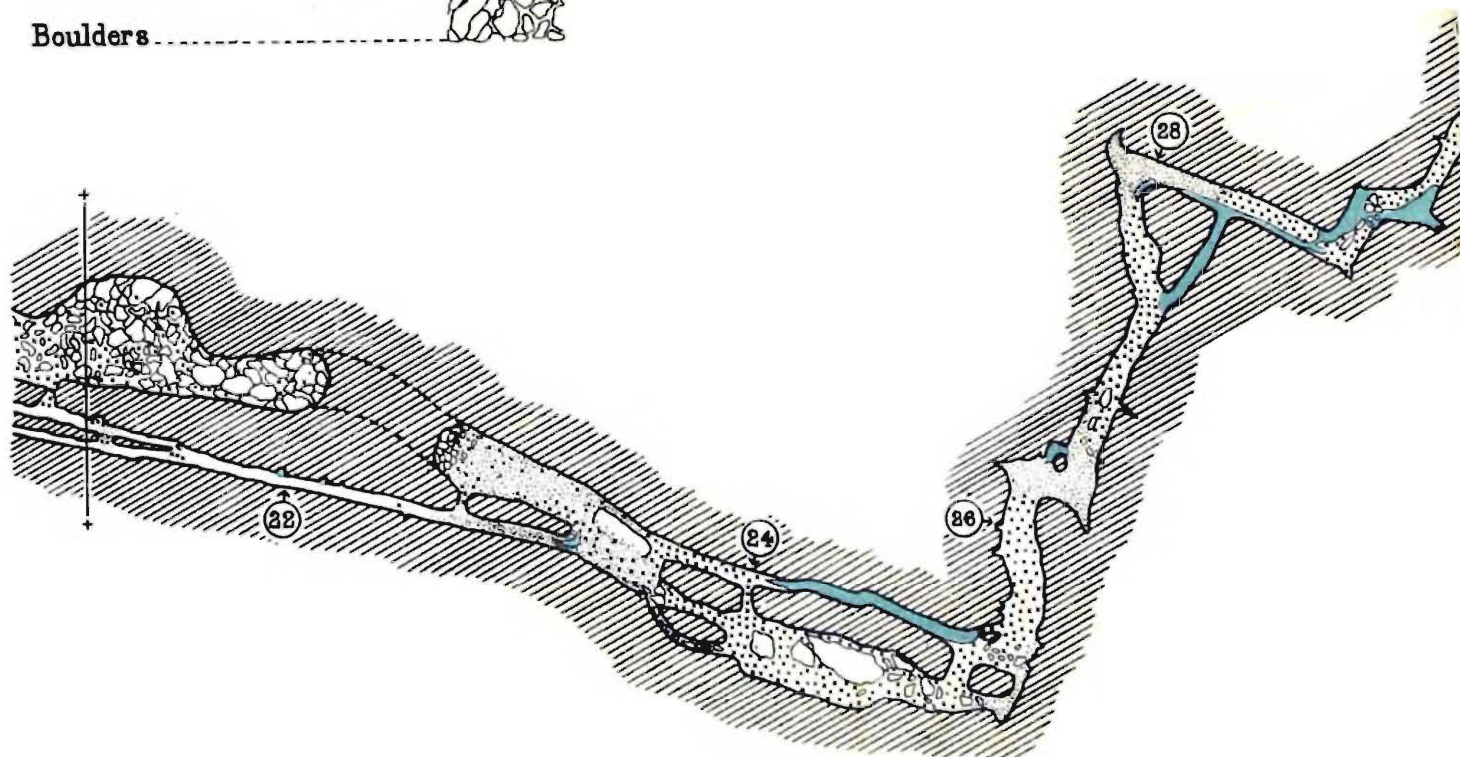


Water.....

Fine Gravel, Sand or Mud.....

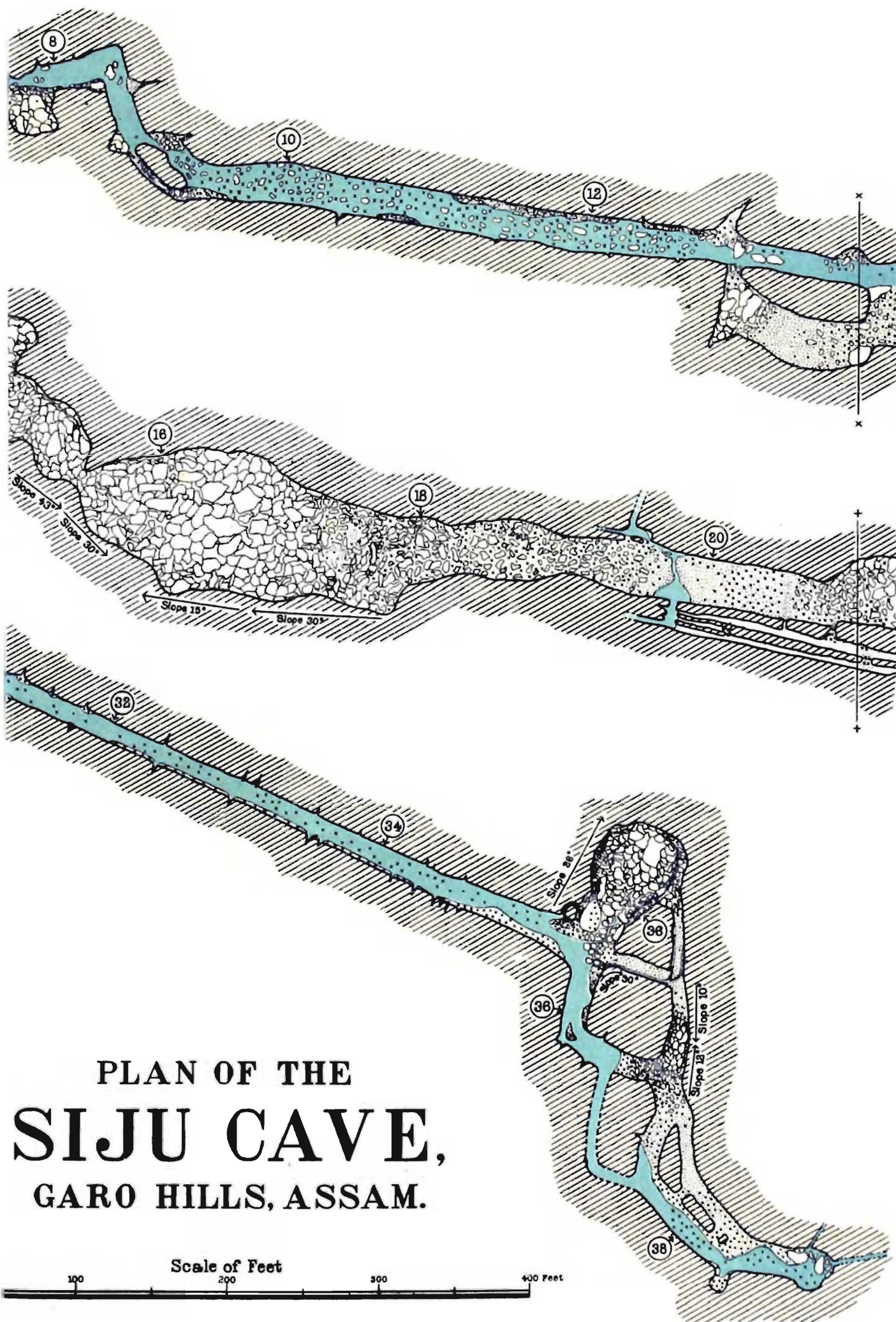
Stones.....

Boulders.....



Gradients, where considerable, are indicated by marginal arrows.

The figures in circles indicate the distance from the entrance in hundreds of feet.



EXPLANATION OF PLATE II.

- FIG. 1. The mouth of the Siju Cave, looking outwards from a point about 150 ft. from the entrance.
- FIG. 2. The entrance passage, looking inwards from the same point as fig. 1. The peg in the water in the foreground is at 200 ft. from the entrance.
- FIG. 3. The stalactitic formation at 500 ft. from the entrance. The sloping rock above the stalactites and the boulders behind the boy are covered with a layer of bat-guano on which innumerable larvæ of the moth, *Tinea antricola*, were feeding. Photographed by flashlight.
- FIG. 4. The spider, *Heteropoda robusta*, on the wall of the cave, about half natural size. Photographed from life by lamp-light.



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PART II.

NOTES ON THE MAMMALS OF THE SIJU CAVE, GARO HILLS, ASSAM.

By STANLEY KEMP, *Sc. D., Superintendent, Zoological
Survey of India.*

Five species of Mammal frequent the cave and of these we obtained specimens of four : three bats and a rat. Two of the bats (the *Cynopterus* and the *Rhinolophus*) have kindly been determined by Mr. H. C. Robinson of the Federated Malay States Museums and the rat and the remaining bat (*Hipposideros*) by Mr. Martin A. C. Hinton of the British Museum. Mr. Hinton has contributed a note on the *Hipposideros*, which had not previously been recorded outside Ceylon.

CARNIVORA.

Family FELIDAE.

Felis sp.

Footmarks of a small cat were seen at various points in the cave up to a distance of 3,800 ft. from the entrance, but we did not succeed in obtaining any specimens. On one occasion in the tunnel at about 3,400 ft. we disturbed a comparatively large animal which went splashing off in the water ahead of us. It was probably the cat, but it kept beyond the range of our lights and we were unable to get even a glimpse of it.

RODENTIA.

Family MURIDAE.

Rattus nitidus nitidus (Hodgson).¹

This rat is common in the cave and its footmarks were frequently seen in places where mud or fine sand had been deposited by the floods. The species ranges to the extreme inner end of the cave. We trapped a specimen at 1,400 ft. and found two other recently killed individuals in the narrow side-tunnel at 375 ft. from the entrance. The latter were both fresh and in excellent condition and we were unable to discover how they had come by their end.

Rattus nitidus was described from Nepal and is known also from Sikkim and Kumaon. A subspecies, *R. nitidus obsoletus* Hinton, is described from the Chin Hills in Burma.

¹ For synonymy and references see Hinton, *Journ. Bombay Nat. Hist. Soc.* XXVIII, p. 1063 (1922).

CHIROPTERA.

Family PTEROPODIDAE.

Cynopterus sphinx gangeticus K. Andersen.¹

This bat inhabits the cavern between 400 and 500 ft. from the entrance and occurs there in very great numbers; once the colony is disturbed it is possible to bring down specimens by almost any chance shot fired towards the roof. In former times, as we learn from Mr. La Touche's note (p. 9), the species inhabited the entrance hall, but few if any individuals now live there.

In Part I of this report we have drawn attention to the abundance of the fauna in the cavern which these bats inhabit and have pointed out that this is almost certainly due to the deposits of bat-guano. The guano was exploited commercially by a Calcutta firm some time ago and the accumulations of many years were then removed. The deposits were again being worked in a desultory fashion at the time of our visit, but we learnt that the quality had greatly deteriorated owing to the admixture of sand and gravel and that the enterprise was being abandoned; it is only on projecting shelves of rock and at other points difficult of access that any reasonably pure supplies can now be obtained. What effect the removal of the guano may have had on the fauna of the cavern we do not know, but fresh deposits are, of course, slowly accumulating and the whole soil is impregnated with guano, so that it seems probable that the food-supply for the fauna is still more than sufficient.

Cynopterus sphinx in its typical form occurs over the greater part of India and in Burma. The subspecies *gangeticus* was described from Lucknow.

On specimens of this bat we obtained large numbers of parasitic Diptera, consisting of an undetermined Streblid and of two species of Nycteribiid which have been identified by Major W. S. Patton, I.M.S., as *Nycteribia (Acrocholidia) euxesta* (Speiser) and *Eucampsipoda hyrtli* Kolenati.

Family RHINOLOPHIDAE.

Rhinolophus subbadius Blyth.

This bat appears to be rare in the Siju Cave and seems to be solitary in habit. On several occasions we noticed a small bat flying in the main tunnel and side-passages within 600 ft. from the entrance, but the only specimen we obtained was shot at dusk at the entrance. Parasitic diptera from this specimen have been determined by Major Patton as *Nycteribia (Acrocholidia) euxesta* (Speiser).

Rhinolophus subbadius was described from Nepal and has been recorded from Mussoorie in the United Provinces and the Garo Hills.

Hipposideros lankadiva Kelaart.

Mr. Martin Hinton, who has kindly identified this species for us, writes as follows:—"I can find nothing in the skull nor in the skin to

¹ K. Andersen, *Cat. Chiropt. Brit. Mus.* (2nd ed.) I, p. 604 (1912).

distinguish these bats from *H. lankadiva* Kel., a species otherwise known to occur only in Ceylon. On the Indian mainland the place of *H. lankadiva* is supposed to be taken by *H. indus* and its subspecies, which are all considerably smaller forms.¹ It would seem, therefore, that Dr. Kemp's discovery in the Siju Cave affords us with an interesting case of discontinuous distribution; but, of course, *H. lankadiva* may in future be discovered in the Peninsula."

"The Bombay Natural History Society's Mammal Survey also obtained many large bats of the genus *Hipposideros* from caves in the Garo Hills and the other hill ranges of Assam. I have gone through all the Mammal Survey material and find all the specimens to be referable to *H. armiger*, which, as is well known, is a large species belonging to a very different group."

Hipposideros lankadiva is the only bat we found in the cave at distances exceeding 500 ft. from the mouth. On our first visit we found a number hanging over the water at various points in the tunnel between 600 and 1,400 ft., but our passage disturbed them and as we proceeded further day by day we found that the bat had retreated before us. When we first reached the end of the straight tunnel at 3,550 ft. the species was found in incredible numbers, closely covering the entire walls and the roof. The bats appeared to be dazed with our lights and many fell into the water or on to our backs and shoulders, the former swimming vigorously with fully-spread wings until they found some object — possibly a human leg — up which to climb. On our subsequent visits we were glad to find the numbers greatly reduced and we imagine that most of them must have moved to the unexplored section of river-tunnel lying between 1,400 and 3,200 ft.

On one occasion we waited till dark at the cave-mouth to watch the bats emerge. Two *Rhinolophus* were seen as daylight was fading, followed shortly after by many hundreds of a larger species. Several of these were shot but all proved to be *Cynopterus*. It would be interesting to know whether the *Hipposideros* at 3,550 ft. find their way out by the complicated route shown in our plan or whether they have discovered another and easier exit which escaped our notice.

In our experience *H. lankadiva* now inhabits the tunnel through which the main water-channel flows and most of the guano is consequently washed away by the stream. The scanty deposits in the cavern at 3,600 ft. are no doubt due to this species. In our account of the topography (p. 7) we have alluded to the very dense deposits which exist in the cavern between 2,100 and 2,200 ft. Very few bats now live there; we saw only a few individuals and were unable to obtain specimens. We think, however, that the guano is that of *Hipposideros* and that the cavern in former times was inhabited by this species.

¹ These, as in Wroughton's 'Summary,' *Journ. Bombay Nat. Hist. Soc.* XXV, p. 579 (1918), were formerly referred to *H. lankadiva*; but Dr. K. Andersen, *Ann. Mag. Nat. Hist.* (9) II, p. 382 (1918), revising the whole group, regards the small mainland forms as a distinct species, his *H. indus*.

FISH OF THE SIJU CAVE, GARO HILLS, ASSAM.

By SUNDER LAL HORA, *D. Sc.*, Assistant Superintendent,
Zoological Survey of India.

The fish fauna of the Siju Cave comprises eight species, as many as five of which belong to the family Cyprinidae. The other three are placed among the families Cobitidae, Percidae and Ophiocephalidae. With the exception of a species of the genus *Nemachilus*, which I have not been able to determine definitely, all have been referred to species already known. It is interesting to find two specimens of *Psilorhynchus sucatio* (Ham. Buch.) in the collection. This species has so far been known only from the base of the Darjiling Himalayas.¹ Specimens of all the species, except *P. sucatio*, were quite common in the stream outside the cave.

The fish, as a whole, are casual visitors to the cave; most of the specimens in the collection were captured between 300 and 600 feet from the entrance, while only a few individuals were taken at greater depths. *Barbus hexastichus* McClelland has penetrated to a length of 2,000 feet in the cave, whence one half-grown and three young specimens are represented in the collection. Two specimens of *Nemachilus* were taken in a pool 1,700 feet from the entrance and one example of *Ophiocephalus gachua* at 1,350 feet. In all these three species the colour has considerably changed, but in no other respect do they exhibit adaptation to a life in perpetual darkness. Three young specimens of *Barbus hexastichus* from 2,000 feet from the entrance possess normal colouration, but in all probability they had not been in darkness for a sufficiently long time to undergo any appreciable change.

Family CYPRINIDAE.

***Psilorhynchus sucatio* (Ham. Buch.).**

1921. *Psilorhynchus sucatio*, Hora, *Rec. Ind. Mus.* XXII, p. 731, pl. xxix, figs. 1, 1a.

This species is represented by two specimens, which do not exceed 61mm. in length including the length of the caudal fin. They were taken between 300 and 600 feet from the entrance, and agree very closely with specimens from the base of the Darjiling Himalayas.

Distribution:—Darjiling Himalayas and Garo Hills, Assam.

***Barbus hexastichus* McClelland.**

1889. *Barbus hexastichus*, Day, *Faun. Brit. Ind. Fish.* I, p. 308.

This is by far the commonest species found inside the cave and several specimens, including fry and half-grown fish, are represented

¹ Hora, *Rec. Ind. Mus.* XXII, p. 734 (1921).

in the collection. The following table shows the depths at which specimens were obtained in the cave :—

No. of specimens.	Distance from entrance.
2	0—100
13	300—600
1	400
4	2,000

Of the four specimens taken at a point 2,000 feet from the entrance, three are young and appear to be quite normal as regards colouration ; each possesses a well-marked black rounded spot before the base of the caudal fin. The remaining specimen has lost its normal colour ; the head and body are dull white, except for a light grey streak along the dorsal surface. The dorsal fin is provided with a black stripe in its distal half and the posterior margin of the caudal is infuscated with black. The rostral barbels are streaked with black posteriorly. This specimen is 13 cm. in length.

Distribution :—Kashmir, throughout the Himalayas, Sikkim and Assam.

Barilius bendelisis (Ham. Buch.).

1889. *Barilius bendelisis*, Day, *Faun. Brit. Ind. Fish.* I, p. 347.

There are five young specimens of this species in the collection. They were taken between 300 and 600 feet from the entrance.

Distribution :—India, except the coast of Malabar, Kanara and Sind. Also found in Ceylon.

Barilius barna (Ham. Buch.).

1889. *Barilius barna*, Day, *Faun. Brit. Ind. Fish.* I, p. 350.

Several young and half-grown specimens of *Barilius barna* were taken between 300 and 600 feet from the entrance.

Distribution :—Gangetic plain, Orissa, Bengal and Assam.

Danio aequipinnatus (McClelland).

1889. *Danio aequipinnatus*, Day, *Faun. Brit. Ind. Fish.* I, p. 356.

Seven specimens of this species were taken between 300 and 600 feet from the entrance.

Distribution :—Darjiling Himalayas, Assam and Tenasserim.

Family COBITIDÆ.

Nemachilus sp.

The earlier species of the genus *Nemachilus* from Assam, most of which were described by McClelland in his Monograph of Indian Cyprinidae, are in a state of great confusion and at present it is very difficult to determine their specific limits correctly. McClelland's descriptions of the species are applicable to more than one form, and his figures do not help much in their identification. Under the circumstances,

I have thought it advisable to describe and figure the specimens from the Siju Cave without giving them any specific name.

From the cave there are only three specimens; one was taken within a hundred feet from the entrance, while the other two were netted in a pool 1,700 feet from that point. The latter are considerably modified as regards their colouration. There are, however, several specimens of the species from outside the cave, and it is on these that the following description is chiefly based.

D. $2/8$.

A. $1/5$.

The length of the head is contained about 4 to 5 times in the total length without the caudal; it is two-thirds as broad as long. The eyes are not visible from below and their diameter is contained 5 to 5.3 times in the length of the head. The snout is longer than the post-orbital part of the head and is slightly less than twice the diameter of the eye. The barbels are longer than the diameter of the eye; the mandibular barbel, when adpressed, reaches below the posterior limit of the orbit or extends slightly beyond it. The mouth is situated on the under surface slightly behind the tip of the snout and is bordered by fairly well-developed lips. The lower lip is interrupted in the middle and the upper lip shows a slight incision at the same point. The male is provided with a free triangular pad of skin below the anterior margin of the orbit.

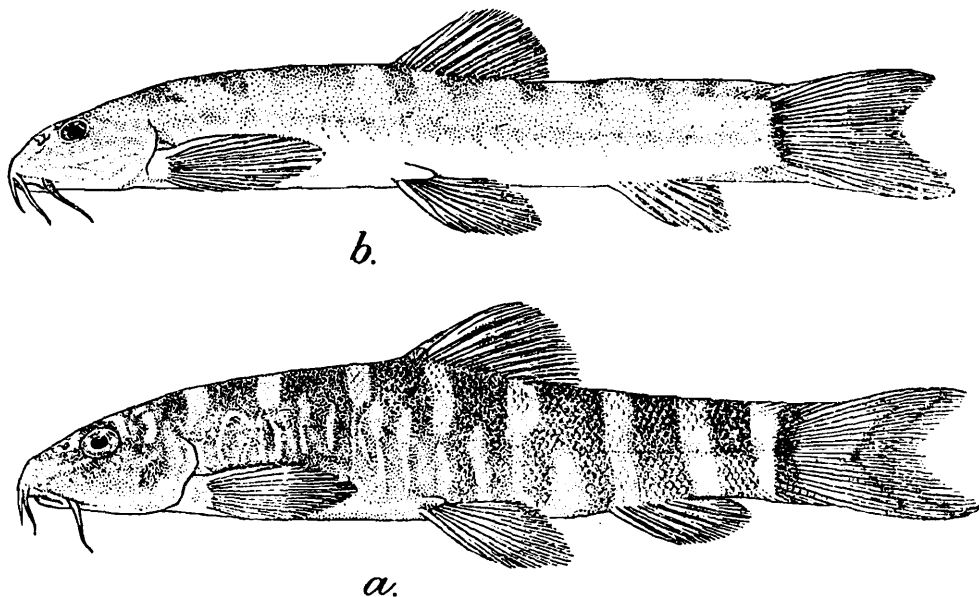


FIG. 1.—*Nemachilus* sp.

a. Normal specimen from outside the cave.

b. Decolourized specimen found in the cave at 1,700 feet from the entrance.

The longest ray of the dorsal fin is almost equal to the depth of the body below it. The origin of the dorsal is almost opposite that of the ventral and its commencement is somewhat nearer to the base of the caudal than to the tip of the snout. The pectoral is almost as long as the head and is separated from the ventral by a considerable distance. The latter just extends to the anal opening and does not reach the base of the anal fin. The caudal is bilobed, with the lower lobe slightly longer than the upper.

In specimens preserved in spirit there are usually 8 to 10 dark brown bands across the back, which break up into secondary bands below the lateral line. They are separated by narrower bands of pale olivaceous colour. The last band of the series before the base of the caudal fin is much darker in colour. The upper surface of the head is grey and is marked with a number of white streaks. The under surface of the head and body is pale. The first ray of the dorsal fin is provided with a black spot at its base and all the rays of this fin are infuscated with black in the middle of their length. The pectoral, ventral and anal fins have similar markings, but not so conspicuous. The caudal is provided with two **V**-shaped bands near its extremity.

Specimens from 1,700 feet are uniformly pale in colour with about 9 short light grey bands on the back and a stripe of the same colour along the lateral line. The upper surface of the head is marked with a few spots and there is a short grey band before the base of the caudal fin. The head and body in these abnormal specimens are comparatively more depressed, and the paired fins greatly stretched outwards, showing thereby that the cave individuals are better adapted to a life in rapid-running waters than those collected from outside. Moreover the eye is smaller in these specimens and its greatest diameter is placed longitudinally.

Working with the Fauna volume and Day's *Fishes of India* I identified the Siju specimens as *Nemachilus spilopterus*, but on looking up the original description of the species by Cuvier and Valenciennes, I find that my specimens do not belong to that form. In *N spilopterus* the caudal fin is rounded and the pectorals are separated from the ventrals by their own length.

Measurements in millimetres.

Total length including caudal	...	...	44.5	52.5	46.0
Length of caudal	...	...	8.0	10.0	8.6
Length of head	...	...	8.0	10.8	9.5
Breadth of head	...	...	5.8	6.8	6.0
Height of head near occiput	...	...	4.7	6.5	5.2
Length of snout	...	...	3.2	4.8	4.0
Diameter of eye	...	...	1.5	2.1	1.8
Length of caudal peduncle	...	...	5.5	6.7	5.5
Least height of caudal peduncle	...	...	4.2	5.2	4.0
Longest ray of dorsal	...	...	6.5	7.8	8.0
Longest ray of anal	...	...	4.8	7.0	5.2
Length of pectoral	...	...	8.0	9.9	8.0
Length of ventral	...	...	7.0	8.5	7.2

Family PERCIDAE.

Ambassis nama (Ham. Buch.).

1889. *Ambassis nama*, Day, *Faun. Brit. Ind. Fish.* I, p. 486, fig. 149.

There are 5 specimens in the collection belonging to this species. They were taken between 300 and 600 feet from the entrance.

Distribution :—India, Assam and Burma.

Family OPHIOCEPHALIDAE.

Ophiocephalus gachua (Ham. Buch.).

1889. *Ophiocephalus gachua*, Day, *Faun. Brit. Ind. Fish.* II, p. 364.

This species is represented in the collection by two specimens. One was taken between 300 and 600 feet from the entrance, while the other is from 1,350 feet. The latter has lost the characteristic colouration of the species and is of a uniform brown colour. The fins are uniformly grey.

Distribution :—India, Ceylon, Burma and the Andamans.

MOLLUSCS OF THE SIJU CAVE, GARO HILLS, ASSAM.

By N. ANNANDALE, D. Sc., F.A.S.B., Director, and B. CHOPRA, D. Sc.,
Assistant Superintendent, Zoological Survey of India.

Only two species of molluscs were found living in the Siju Cave, one aquatic, the other terrestrial. The aquatic form (*Paludomus blanfordiana*) is evidently a mere visitor: individuals from the cave do not differ from those found in streams outside. It is otherwise, however, with the land-snail, for which we have thought it most convenient to provide a new specific name, viz., *Opeas cavernicola*. This species is very closely allied to the widely-distributed *O. gracile*, empty shells of a race of which were collected in the innermost part of the cave in circumstances which suggest that they had been washed in through some crevice. The eyes of *O. cavernicola* are modified in a very interesting manner.

With the specimens of *O. gracile* a single broken shell of the aquatic species *Melanoides pyramis* (Hutton) was found and another was collected at 350 feet from the entrance.

The following species were found in the immediate vicinity of the cave, but not inside it:—

Acrostoma reevei (Brot),
Cyclophorus affinis Theobald,
Oxytes oxytes (Benson).

Family MELANIIDAE.

***Paludomus blanfordiana* Nevill.**

1876. *Paludomus labiata*, Hanley and Theobald (*nec* Benson), *Conch. Ind.*, pl. cviii, fig. 9.

1881. *Paludomus blanfordiana*, Nevill, *Journ. As. Soc. Bengal*, L, part ii, p. 159, pl. v, figs. 3, 3A.

Specimens found in the stream at the entrance to the cave and also for 500 feet in from that point agree well with the figure cited from the *Conchologia Indica* except in being considerably smaller. The species has already been recorded from Pegu and Ariakan in Burma and from Gowhatty (Gauhati) on the Brahmaputra.

***Opeas gracile* (Hutton).**

1906. *Opeas gracile*, Pilsbry in Tryon's *Manual of Conchology* XVIII, p. 125, pl. xviii, figs. 3-6.

1914. *Opeas gracile*, Gude, *Faun. Brit. Ind., Moll.* II, p. 355.

The shell is well described by Pilsbry in the work cited, but exhibits considerable plasticity, and numerous races occur even within the limits of the Indian Empire. Nothing seems to be known of the anatomy, but we hear from Col. Godwin-Austen that he proposes to describe it shortly.

O. gracile has a very wide range in tropical countries and has probably been carried from one to another with potted plants, among which it is often found. In dry weather it buries itself in the earth, emerging only after heavy rain to feed on mosses and algae such as grow on flower-pots, tree-trunks, etc. The eggs, which are spherical and of relatively large size, have stout calcareous shells. *O. gracile* is frequently accompanied and preyed upon by the carnivorous mollusc *Ennea bicolor*, which has some slight resemblance to itself. This has been observed in Ceylon, on the islands of the Chilka Lake, in Calcutta and in the Philippines.

Shells of *Opeas* were found at two spots in the Siju Cave, at 3,600 feet from the entrance and between 450 and 500 feet, at both place on high ground covered with bat-guano and above flood-level. At 3,600 feet from the entrance only a few shells were found and all were empty. They were accompanied by a single dead and broken shell of *Melanoides pyramis* on which remains of the periostracum still existed. These shells we assign to *O. gracile*. At between 450 and 500 feet, however, living snails of the closely allied species described below were abundant on the bat-guano, mostly on the higher ground but a few also lower down near the stream.

About a dozen shells of *O. gracile* were collected at the inner locality. They are very uniform in shape and several of them are considerably larger than any of the form we call *O. cavernicola*. They differ from these in outline as well as size, the whorls being less swollen, the mouth having the outer lip straighter and the body-whorl being more nearly quadrate. We believe that the shells represent a local race of *O. gracile*, perhaps endemic on the Garo Hills. We do not give this race a name because Col. Godwin-Austen informs us that he possesses shells from the Garo Hills and proposes to describe them shortly. The presence among them of an aquatic shell suggests that they may have been washed into the cave in a time of flood through some crevice.

The specimens from the other locality in the cave have much greater interest. We propose to refer to them for the sake of convenience as :—

***Opeas cavernicola*, sp. nov.**

The first point to be observed in the shells of this species is that they fall into two very definite series, which at first sight we were prepared to regard as distinct species. The texture and structure of shells of the two series are, however, identical. We can find no difference either in the external anatomy, in the colouration of the animal, in the structure of the eye or in the radula. Pilsbry has pointed out that in many species of the genus *Opeas*, including *O. gracile*, two definite forms occur, one with a longer and narrower shell than the other. Apparently, however, there is as a rule no other difference. In our two series there is the same difference, but in one series the largest shells have two whorls more than the largest shells in the other, in one $8\frac{1}{2}$, in the other $6\frac{1}{2}$. This, of course, is a much greater difference than a mere difference of outline, but, nevertheless, we consider it best to regard the two forms as specifically identical. In *O. gracile* (*fide* Gude) the number of whorls may vary from 9 to 12, while in *O. cavernicola*

itself we find that eggs are occasionally present in shells of elongate form with only $6\frac{1}{2}$ whorls. We believe, therefore, that in the stable conditions prevalent in the cave the two dimorphs of the species are becoming more distinct. Possibly this may ultimately result in the formation of two quite different species, but we do not believe that this has yet occurred. We will call the form with the elongate shell the *forma typica* of *O. cavernicola* and the broader form, var. *vamana*.

Forma typica.—The shell closely resembles that of *O. gracile* as represented by specimens from the valley of the Ganges. The whorls, however, are less swollen, the apex a little blunter, the sutures more impressed and the mouth distinctly U-shaped, not extending backwards along the outer side of the body-whorl. The columella is straight and vertical and its fold well developed. The shell is thinner than that of

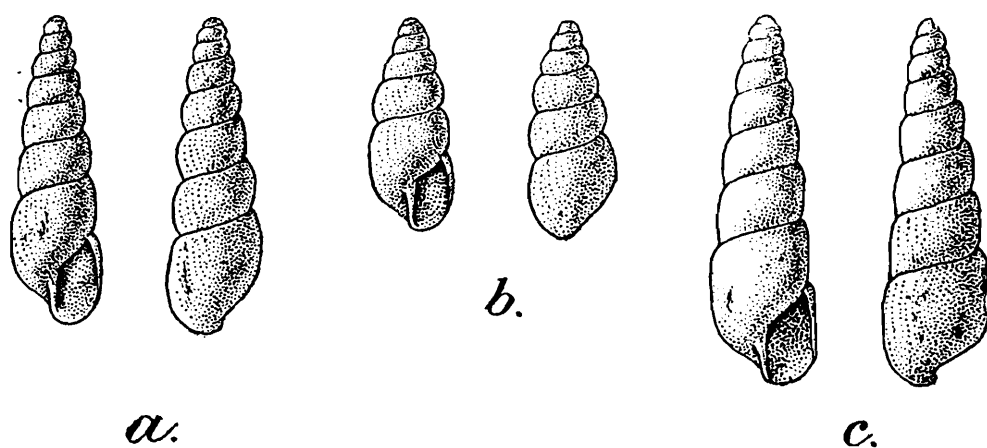


FIG. 1.—Shells of *Opeas* from the Siju Cave.

a. Type-specimen of *O. cavernicola*.

b. Type-specimen of *O. cavernicola* var. *vamana*.

c. Shell of local race of *O. gracile*.

the typical *O. gracile* and perhaps slightly paler. There are $8\frac{1}{2}$ or 9 whorls. The shell differs from that of *O. innocens* Preston¹, an allied form from the Farm Cave near Moulmein, in being longer and much less nearly cylindrical. The mouth also is less ovoid and the columella straighter. We have examined the type of Preston's species.

Type-specimen.—M 12065/2, Zoological Survey of India (*Ind. Mus.*).

var. VAMANA.—The adult shell has only $6\frac{1}{2}$ whorls and is much shorter than that of the *forma typica*. The individual whorls are also shorter and relatively broader and increase in size more rapidly. The apex is blunter. The body-whorl is much more swollen and the mouth is proportionately larger.

Type-specimen.—M 12062/2, Zoological Survey of India (*Ind. Mus.*).

Measurements of six shells of each of the two series are given below in millimetres :—

Forma typica.

Greatest length of shell	10.5	14.0	11.8	11.8	10.7	10.5
Greatest breadth of body-whorl	3.0	3.5	3.3	3.1	3.0	3.2
Greatest length of aperture	2.7	3.2	3.1	3.1	2.7	2.8
Greatest breadth of aperture	1.5	1.7	1.5	1.4	1.4	1.6

¹ Preston, *Rec. Ind. Mus.* V, p. 33, fig. 2 (1910).

var. vamana.

Greatest length of shell	6.8	8.8	7.1	8.8	7.8	8.5
Greatest breadth of body-whorl	2.8	3.3	3.0	3.1	2.9	3.0
Greatest length of aperture	2.4	2.8	2.4	2.8	2.6	2.8
Greatest breadth of aperture	1.3	1.5	1.5	1.6	1.4	1.5

No. 1 in each series of measurements is the type-specimen.

The proportion of the total length of the shell to the maximum diameter, therefore, varies from about $3\frac{1}{5}$ to 4 in the *forma typica* and from $2\frac{2}{5}$ to a little over $2\frac{4}{5}$ in the variety, while the proportion of the total length to that of the mouth varies from $3\frac{4}{5}$ to $4\frac{2}{5}$ in the former and from $2\frac{4}{5}$ to slightly over 3 in the latter.

At the place where the species was found some parts of the cave-floor are considerably higher than others. In examining the collections we find that whereas the *forma typica* predominates in that from the lower spots, the variety does so in that from the higher. In 60 specimens from the former there are 12 of the variety, while in 39 from the latter there are 24.

In the living animal of both forms the foot is long and narrow and narrowly rounded in front with a slight notch in the centre. Its upper surface is rugulose and there is a series of short transverse grooves along each margin. There is a distinct smooth mid-dorsal ridge, which does not quite extend to the extremity, on the region behind the shell. When fully expanded the foot does not much extend behind the upper end of the body-whorl. The eye-stalks are fairly stout and of moderate length. The eyes are situated a short distance from the extremity on the upper surface. There is a short broad snout with a small tubercle on either side, representing the true tentacle. The anterior margin of the snout, which does not extend as far forward as that of the foot, is convex.

Eggs, which occur to the number of 3 or 4 in many individuals captured in February, are spherical, with thick, smooth white calcareous shells, and have a diameter of 1.1 mm. Gude found eggs of a diameter of .75 mm. in *O. gracile*.



FIG. 2.—Radular teeth of *O. cavernicola*.

The radula is identical with that of *O. gracile* from Calcutta. The formula is approximately 10–13. 11–13. 1. 11–13. 10–13, but the marginals and laterals are not clearly differentiated. It might, therefore, be expressed more accurately as 23.1.23. The transverse rows of teeth are nearly straight. The central is small and more or less distinctly trilobate, the central cusp being relatively long and bluntly pointed. The laterals are tricuspid, the central cusp being very long in those near the centre of the row, where it is lanceolate and sharply pointed. The lateral cusps are small and triangular, projecting at an acute angle from the base of the central cusp. As the teeth proceed outwards the central cusp becomes relatively smaller and actually shorter, while

the lateral cusps become larger, so that in the true marginals the three cusps are equal. The central cusp also becomes blunt at the apex.

The colour of the exposed soft parts of all races of *Opeas gracile* that we have observed, or that have been described by others, is a bright lemon-yellow. In the cave species it is never so bright but varies from a pale lemon-yellow to pure white. We have not been able to correlate differences in depth of colouration with pigmentation or lack of pigmentation of the eye, or with differences in the shape of the shell. The shell itself is very pale in all forms of *O. gracile* and is practically colourless in some forms that live in the open. In *O. cavernicola* it is very pale-straw coloured. The loss of colour, apart from the eyes (which we will discuss immediately), is, therefore, hardly greater than that observed in individuals of certain species of fish captured in the cave.

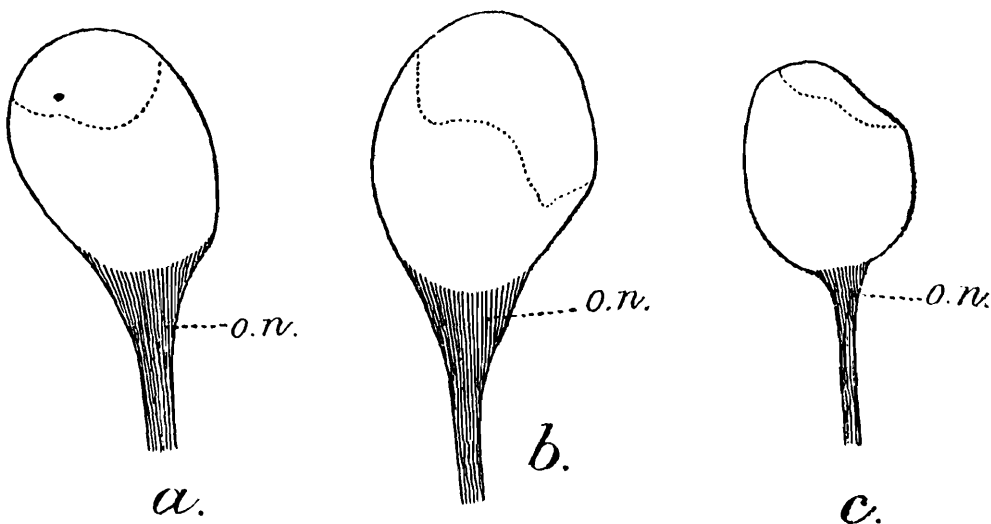


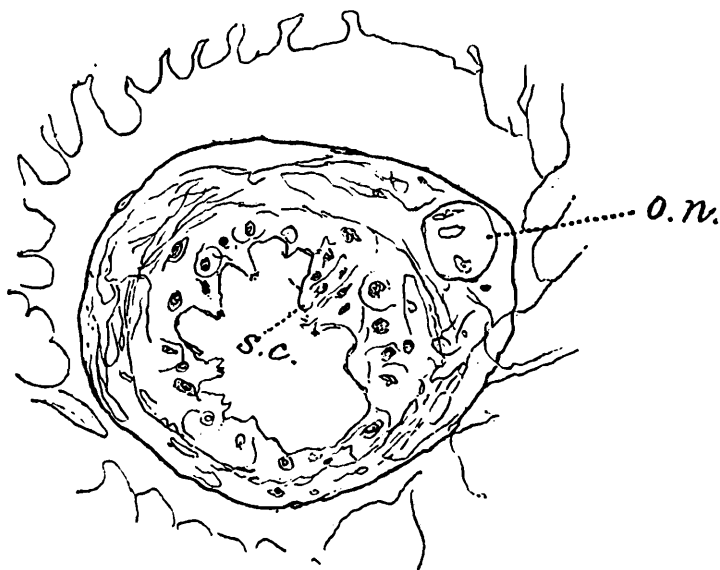
FIG. 3.—Eyes of *Opeas* dissected out of the sheath of the retracted eye-stalk. *a, b.* eyes of two individuals of *O. cavernicola* with pigmented retina. *c.* eye of *O. gracile* from Calcutta. All $\times 300$.

The most interesting feature of the cave species is undoubtedly the condition of the eyes. In all the many individuals examined these organs differed from those of any individual of *O. gracile* found living in normal conditions either in Calcutta or on Barkuda Island. In some the eye was completely invisible, although the eye-stalk was always well developed, in others it was black and conspicuous but apparently very small. We examined 100 snails brought alive to Calcutta and found that the eye was invisible in any condition of expansion in 6, while in one it was pigmented on one side but invisible on the other. In the remaining 93 individuals it was of a dense black colour, in which we could detect no variation. There seemed to be a certain variation in size, but it was found impossible to measure so sensitive a structure accurately.

We have cut sections of the eyes of the three forms and dissected out the complete organ in those in which it is pigmented. Our preparations show that the structure of the optic organ of both species is somewhat peculiar. The eye in *O. gracile* is situated some distance behind the tip of the eye-stalk on its upper surface and is elliptical in outline. It is set in the stalk somewhat obliquely, in such a way that the pigmented retina extends over a part of the exposed surface on its inner

margin. The cornea, which is relatively small, is flattened. The condition of the lens seems to be peculiar, for it shows no definite outline in sections, but has the appearance of having been of a semi-liquid consistency. The optic nerve, which enters the eye on its internal surface, is well developed and apparently quite normal. The pigment of the retina, which is contained in the cells in the form of minute but distinct granules, is excessively abundant. We have not been able to eliminate it from our sections, in which it obscures the retinal structure.

In *O. cavernicola* with pigmented eyes the cornea is not so much flattened and appears in life to be distinctly smaller, but the complete optic organ, while varying somewhat in size, is always larger than in *O. gracile*. The pigment is not so dense, and seems to be somewhat deficient in the distal part of the pigment-cells, in which the granules are much more sparsely scattered than in *O. gracile*.



g. 4.—Oblique transverse section through eye of *O. cavernicola* with unpigmented retina. *O.n.* = optic nerve. *S.c.* = sense cells of retina.

In the optic nerve there is no structural difference between these two species, but curiously enough, the nerve is distinctly stouter in the cave-form than in the other, thus corresponding to the size of the optic organ. In both species it is spread out at the base of the retina, forming a definite cup of nervous tissue. In the cave-species this cup is distinctly better developed than in the other.

Individuals of cave species with unpigmented eyes provide greater facilities for the study of retinal structure than those with pigmented eyes. Although the eye is invisible in the living snail, it is in most respects just as well developed as in the other phase. In only two points can we detect a definite difference, namely, in the complete absence of pigmented cells from the retina and in the apparent absence of a lens. As to the latter point we cannot be quite sure. Our sections,

owing to climatic difficulties, have not been altogether satisfactory and it is quite possible that the lens may have dropped out. This, however, does not seem probable in view of the condition of the lens as seen in pigmented eyes.

The sense-cells of the retina are well developed and, although our sections are not as thin as we would have liked, they show the minute hair-like processes of the distal extremities of the cells and also the radiculæ at their base quite clearly.

The optic nerve is in the same condition as in the cave form with pigmented eyes.

An important point observed in the living individuals of the three forms, namely, *O. gracile* from Calcutta, *O. cavernicola* with pigmented eyes and *O. cavernicola* with invisible eyes, was that we could detect no difference in the movements of their eye-stalks, or in the sensitiveness of these structures. In all three the eye-stalk was retracted as soon as any object was brought within a few centimetres, and this was done, so far as could be judged, with equal rapidity in pigmented and in unpigmented eyes.

These facts suggest interesting conclusions. Firstly, it is evident that even in individuals which have lost the optic pigment altogether, and probably also the lens, the eye is just as much an organ of sense as it is in normal individuals. Much has been written on the sense of sight in molluscs and we need not here add any further to the literature on the subject. We may, however, point out that it is quite possible that the eye-stalks have always sensory functions other than optic.

The second conclusion to be drawn is that the eye is becoming modified in *Opeas cavernicola* along two different lines of evolution. In one direction it is becoming reduced as an optic organ, but actually increasing in size, as an organ of sense; in the other it is losing its optic function by an actual disappearance of definite structures. In the former the evolution is both indefinite and liable to variation; in the latter it is as a rule definite and where variation occurs it affects, so far as we know, not both members of a pair of organs but one of the two of a pair of organs. We saw no specimen in which the retinal pigment was present only to an extent sufficient to give an appearance of a dull or greyish eye. In every eye examined the pigment was either abundant or absent, and in our sections we can detect no trace of the pigment-cells, which have apparently disappeared completely, though in individuals with pigmented eyes they are sufficiently large to obscure the sense-cells.

The phenomena that have occurred in this snail are, therefore, not altogether analogous to those observed in the other animals with reduced eyes from the cave, namely, the prawn *Palaemon cavernicola* and the wood-lice *Philoscia dobakholi* and *Cubaris cavernosus*. Dr. Kemp has not been able to find any variation in the size of the eyes of the former, although they are always very small, nor has he found any individual in which retinal pigment had been lost. The general colouration of the prawn, moreover, seems to have been more uniformly affected than that of the snail. As to the wood-lice, the eyes of *P. dobakholi*, though

always pigmented, are very small and apparently exhibit marked variation in size, while the colour of the animal is very pale. In *C. cavernosus*, on the other hand, the eyes though small are not quite so much reduced and the animal is deeply pigmented.

We have assumed in this argument that *Opeas cavernicola* is descended from individuals of a race of *O. gracile* with normal eyes. This assumption seems to be justified not only by the close similarity of the two forms but also by the general distribution of *O. gracile*, its occurrence in other situations in the Garo Hills and the fact that it exhibits a marked tendency towards the evolution of distinct races. Possibly the ancestors of the cave-form may have entered the cave not from the main entrance but from some crevice in the interior. This is suggested to us by the presence at the inner end of the cave of dead shells of a race of *O. gracile*, associated with a worn but recent shell of *Melanoides*, an aquatic genus not found living in the cave.

CRUSTACEA DECAPODA OF THE SIJU CAVE, GARO HILLS, ASSAM.

By STANLEY KEMP, *Sc.D.*, *Superintendent, Zoological
Survey of India.*

Plate III.

Three species of Decapod Crustacea were found in the cave, but two of them (*Paratelphusa falcidigitis* and *Palaemon hendersoni*) are common out-door forms which have succeeded in making their way up the stream to which the cave owes its origin. The third, *Palaemon cavernicola*, is a species hitherto unknown which shows partial adaptation to underground existence in its general lack of pigmentation and in the reduced size of the eyes.

Family POTAMONIDAE.

Paratelphusa (Barytelphusa) falcidigitis Alcock.

1910. *Paratelphusa (Barytelphusa) falcidigitis*, Alcock, *Cat. Ind. Decap. Crust.*, 1, fasc. 2, p. 94, pl. vii, figs. 24, 24a.

Twelve specimens of this species were found in the cave at distances varying from 0 to 2,400 ft. from the mouth. All except one, which was found walking on dry land in the cavern at 450 ft., were obtained crawling among stones in the river-bed. All the specimens but one are males and in the largest, which is of this sex, the carapace is 61 mm. in breadth and 44 mm. in length. The specimens do not differ either in structure or colour from individuals found in out-door localities and the species is no doubt a mere straggler into subterranean waters.

Paratelphusa falcidigitis is common in the stream leading from the cave-mouth to the Someswari River, but in pools in the bed of the river the allied but quite distinct *P. (B.) harpax* Alcock appears to be the predominant form. The latter species does not enter the cave.

Paratelphusa falcidigitis is known only from Assam: from the Khasi Hills, Garo Hills, Naga Hills and Northern Cachar. *P. harpax* has been recorded from the same localities and from Silchar, Sylhet and Sadiya; it seems, however, to have a more extended range, as we have recently received from Mr. M. Mackenzie a large male, with carapace 82 by 58 mm. obtained near Sepaya in the Saran district of Bihar.

Family PALAEMONIDAE.

Palaemon hendersoni de Man.

1907. *Palaemon (Parapalaemon ?) hendersoni*, de Man, *Trans. Linn. Soc. (2) Zool.* IX, p. 446, pl. xxxiii, figs. 66-68.

1913. *Palaemon hendersoni*, Kemp, *Rec. Ind. Mus.* VIII, p. 303, pl. xix, figs. 19-23.

1918. *Palaemon hendersoni*, Kemp, *Rec. Ind. Mus.* XIV, p. 95.

This species was common in the outer parts of the cave and was particularly abundant in pools in the river-beds at 300 to 350 ft. from the mouth. In the inner parts it occurred more sparingly; it was found

in some numbers in the main channel between 600 and 1,300 ft. and was taken in the streams at 1,700 and 2,000 ft. A single individual was captured at 3,200 ft. It was frequently found in company with *P. cavernicola*, but in the inner parts of the cave was much scarcer than that species. It could be distinguished at a glance by its large eyes and dark pigmentation.

Specimens from the cave do not differ in any structural details from those found outside; but in colouration a slight difference was noticed, for though blotched and streaked with pigment in normal fashion, the pigment itself was usually of a decidedly paler shade. This is presumably due to the direct effect of absence of light on the chromatophores of the individual.

The range of this species extends from the Darjiling district, through Assam to Burma, where it is found at least as far south as the Southern Shan States. It appears to be restricted to hilly country but has not been found at high altitudes.

I have pointed out (*loc. cit.*, 1918) that Burmese specimens differ slightly from those found in the Darjiling district or in Assam in the character of the rostrum. The specimens from the cave agree, as might be expected, with those from other parts of Assam. In the colouration of very large males there is probably no real difference between specimens from the two provinces, for one such male, obtained in the stream outside the cave, was tinged with blue on the antennal scale and had blue chelipeds, thus approaching the uniformly blue male which Dr. Annandale found in the Southern Shan States.

***Palaemon cavernicola*, sp. nov.**

The rostrum varies considerably in length. As a rule it reaches about to the end of the antennular peduncle, but sometimes, more particularly in half-grown individuals, it extends a little beyond this point, while in some very large specimens it reaches only to the end of the second antennular segment. The rostrum is straight, deep in lateral view, the upper border slightly and the lower border very strongly convex. Dorsally it bears from 5 to 9 teeth, usually 6 or 7¹, which are small and with the interspaces set with plumose setae. Two or three of the posterior teeth stand on the carapace behind the posterior limit of the orbit and the interval between the first and second teeth is sometimes, but not always, greater than that between the second and third. The remaining teeth are as a rule more or less evenly spaced, the foremost being rather remote from the apex. On the convex ventral portion of the blade there are from 1 to 3 teeth, usually 2²; the hindmost is generally placed a little in front of the middle point and in the interspaces there are plumose setae.

The carapace does not differ in any noteworthy particular from that of *P. hendersoni*, but the surface in large males is less scabrous than in that species and the ridge that runs backwards from the antennal spine

¹ Of sixty-eight specimens seven have 5 dorsal teeth, twenty-two have 6, thirty one have 7, seven have 8 and one has 9.

² Of sixty-eight specimens ten have 1 ventral tooth, fifty-three have 2 teeth and five have 3.

to a point immediately above the origin of the hepatic is rather more strongly defined.

The eyes (Pl. III, figs. 2, 3) are characteristic and exhibit partial adaptation to cavernicolous conditions. In the allied *P. hendersoni* (Pl. III, fig. 5) the length of the cornea in dorsal view is about equal to that of the stalk and its breadth, as in all other species of the genus known to me, is conspicuously greater than that of the stalk: the inner border of the stalk is moreover straight or slightly concave and the usual ocular spot is clearly visible, partially fused with the cornea. In *P. cavernicola* the length of the cornea in dorsal view is very much less than that of the stalk, its breadth is little more than half that of the stalk, the inner border of the stalk is swollen and very conspicuously convex and the ocular spot is entirely missing. As in many species of the genus the cornea is somewhat flattened dorsoventrally.

The antennular peduncle is normal in form and the spine at the distal end of the basal segment reaches almost to the end of the second segment. The outer flagellum, as in *P. hendersoni*, is cleft almost to the base, the fused portion comprising only some 5 or 6 segments. In the proportionate lengths of the flagella of the antennule and antenna the species does not appear to differ from *P. hendersoni* and the form of the antennal scale is the same.

The mandible (Pl. III, fig. 4) differs from that of related forms and from most if not all species of the genus in possessing a palp composed of two segments only. The palp is normal in length, the reduced number of segments being due to the absence of the articulation between the ultimate and penultimate members of the series. The three teeth of the incisorprocess are rather blunter than usual. The remaining oral appendages and the maxillipeds differ in no respect from those of *P. hendersoni*. The third maxillipeds reach to the middle of the terminal segment of the antennular peduncle.

The first legs reach beyond the antennal scale by the chela and, in very large males, by a portion of the carpus as well. In the proportionate lengths of the segments they differ little from those of *P. hendersoni*, but the carpus is frequently rather longer in relation to the chela, sometimes twice its length. There are some longish hairs on the lower edges of the basis and ischium, a setose patch at the distal end of the carpus and near the base of the chela, and the usual tufts of setae on the fingers.

The second legs are usually equal or subequal; in a few specimens in which they are conspicuously unequal it is probable that one leg of the pair has been lost at some period and subsequently reproduced. In large individuals of both sexes they reach beyond the scale by the chela and the greater part of the carpus.

In the largest male the ischium, merus, carpus and palm are scabrous, being covered with minute sharp-pointed tubercles which are most conspicuous on the under surfaces of the two first-named segments; between the tubercles very short bristles may frequently be seen. The merus is about 3.5 times as long as broad. The carpus is conical with a deep notch or depression in the distal margin on its supero-internal aspect; it is rather less than three-quarters the length of the merus and its

greatest breadth is slightly more than half its length. The chela is about 3.7 times the length of the carpus, with the palm slightly but quite decidedly longer than the fingers. The palm is a little flattened dorso-ventrally and is almost 2.5 times as long as broad. The fingers are thinly coated from base to tip with dark brown fur which arises from shallow and irregular longitudinal grooves, much less conspicuous than in *P. hendersoni*. On the inner edge of the dactylus in its proximal half are two rather widely separate teeth. On the fixed finger there is one tooth which fits between those on the dactylus and, close to the base, a rounded crest divided at its summit into four or five lobes.

In females and in younger males the limb is less scabrous. The carpus is proportionately rather longer and is more slender, the length being always considerably more than twice the distal breadth. The fingers are always distinctly longer than the palm, but are less conspicuously covered with fur, especially towards the tips; they show scarcely a trace of the grooves underlying the fur and the teeth on the inner margins, if present, are small and inconspicuous.

Six specimens yield the following measurements (in mm.) :—

Sex.	Total length.	Length of carapace.	Length of second leg.	SECOND LEG.					
				Length of merus.	Length of carpus.	Breadth of carpus.	Length of palm.	Breadth of palm.	Length of finger.
♂	54	18.5	51.5	9.3	6.7	3.4	11.4	4.6	13.4
♀	53.5	16.5	40.7	7.8	5.8	2.5	9.6	3.3	10.8
♀	47.5	15.2	34.8	6.7	5.2	2.0	6.8	2.4	8.5
♂	46	13.1	34.4	6.7	5.1	2.1	6.9	2.7	8.2
♀	36	11.0	24.5	4.7	3.9	1.4	4.7	1.7	5.3
?	28.5	8.0	16.6	3.5	3.1	0.9	2.9	1.1	3.2

The last three legs are rather stout; the third reach beyond the scale by the length of the dactylus, the fifth to or rather beyond the end of the antennular peduncle. In each pair the propodus bears short spinules and some setae, the latter, in the fifth pair only, forming a thick tuft at the distal end. In the third and fourth pairs the propodus is about 2.5 times as long as the dactylus, in the fifth pair fully 3.5 times. The dactylus is slightly curved, bears a number of rather long setae, and ends in a yellow claw.

The telson bears the usual tuft of setae in the middle of the dorsal surface near the base and the usual two pairs of dorsal spines. The anterior pair of spines is placed behind the middle of the telson-length;

the posterior about midway between the anterior pair and the apex. The apex itself is rather broad with a prominent median point. The inner of the two pairs of terminal spines may reach by almost half their length beyond the median point: the outer spines are very small. Below the spines the apex is thickly fringed with plumose setae.

The eggs borne by ovigerous females are very large, from 1.9 to 2.1 mm. in length and from 1.4 to 1.7 mm. in breadth. The largest specimen is a male, 54 mm. in length from the tip of the rostrum to the tip of the telson.

When living the species was in general of a semitranslucent whitish colour. The hepatic and gastric organs were somewhat greyish and the gonad white or yellowish white. In the pools of still water in which the majority of the specimens were obtained the prawn would have been almost invisible were it not for the conspicuous white patch of the gonad. On close examination minute red chromatophores could be detected on the eyestalks and scattered over the carapace and abdomen. Those on the eyestalks were much the most evident, forming a stripe along the inner border and a patch on the upper side. The small cornea was jet black. All the appendages were colourless and the eggs were pale sage green or pale grey.

The modifications which this species has undergone in response to the unusual conditions in which it lives are, on the whole, not very striking, for the only characters in which it differs from normal members of the genus *Palaemon* are (1) colour, (2) greatly reduced eyes, and (3) reduction in the number of segments in the mandibular palp.

Colour, as Annandale and Gravelly have pointed out in their account of the fauna of the limestone caves of Burma, is more readily affected by cavernicolous conditions than structural characters, and the general lack of pigment in *Palaemon cavernicola* is no doubt correlated with its underground existence. Except for the black corneal pigment and the minute red chromatophores noticed above it is quite typical of cavernicolous crustacea.

The colouration in my opinion is to be regarded as a character of the species and is not due (as it is considered to be in the pale variety of the snake *Coluber taeniurus*, which inhabits the Batu and Jalor caves) to the direct effect of absence of light on the individual. This at any rate is true if arguments drawn from analogy with *P. hendersoni* are admissible, for specimens of this species, obtained in the cave at considerable distances from the mouth, are blotched with pigment in exactly the same way as those from out-door localities, though the pigment itself is usually rather paler in shade.

The fact that the chromatophores which exist are red is perhaps significant, for red is a particularly common colour among crustacea living in the deep sea where light is feeble or absent.¹ Red is, however, potentially present in the lipochrome pigmentation of most if not all

¹ Reference may also be made to *Barbouria poeyi* Rathbun, a Hippolytid found in brackish water in a cave near the sea-shore in Cuba. The whole of the body is described as being translucent crimson in life, with the antennae and first legs white. As in *P. cavernicola* the eyes are pigmented. (Rathbun, *Bull. Mus. Comp. Zool. Harvard* LIV, p. 457, 1912).

decapod crustacea and can be produced in freshwater Palaemonidae, as in many other families of Caridea, by the action of boiling water or alcohol on the olive, brown or blue pigments which ordinarily prevail. It is quite exceptional to find all the chromatophores naturally of this colour in *Palaemon*.

The reduction in size of the cornea is the most striking structural character of the species and it differs in this respect from all previously known species of the genus. In its proportionate size there is extremely little variation and the character appears to be fixed and definitely specific. Externally the facets are less conspicuous than in the eye of *Palaemon hendersoni*, but internally, as may be seen in sections,¹ all the normal visual elements are to be found, apparently without the least sign of degeneration. Three optic ganglia are present as in the normal eye, but whereas the two distal ganglia seem to have undergone reduction in size, *pari passu* with that of the cornea, the proximal ganglion is as large as, or even perhaps larger than it would have been if the whole eye were normal in its dimensions (Pl. III, fig. 3). In this respect a parallel may be drawn with *Palaemonetes eigenmanni*, a blind cave shrimp of Cuba, in which, though the visual elements are completely degenerate and the two distal optic ganglia have apparently altogether disappeared, the proximal ganglion is still very large and occupies, as in *P. cavernicola*, the greater part of the eyestalk.²

Apart from the structural evidence there is proof that the eyes are functional in the fact that the species when alive is slightly but quite definitely attracted by light. So far as I have been able to observe the species is not modified for life in subterranean waters by an increase in the length of its sensory appendages or by an increased number of sensory hairs on these appendages.

The reduction in the size of the eye affords a problem which it is not easy to explain in a satisfactory manner. In itself it does not seem to be of any use to the animal and it is difficult to understand how it can have been brought about. It differs essentially from that of the land mollusc (*Opeas*) found in the same cave in that there is no evidence of individual variability and that no specimen with complete lack of ocular pigment was found in the large series examined. In the mollusc this occurred in 6 per cent of individuals.

In the reduced number of segments in the mandibular palp the species appears to be unique in the genus, but it is improbable that the character is in any way concerned with life in subterranean waters. In the allied genus *Leander* the palp is normally three-segmented, but occasionally (e.g., *L. squilla* and *L. semmelinki*) it is two-segmented.

Apart from the reduced cornea and the structure of the mandibular palp the species is distinguished from *Palaemon hendersoni*, which appears to be its nearest ally, by the characters commonly used in the distinction of species of the genus. In *P. hendersoni* the ventral teeth of the rostrum are generally placed closer to the tip, the fluting of the fingers of the second leg is much deeper and, if specimens of the same size and sex be

¹ The eyes were partially decalcified in weak hydrochloric acid, sectioned in paraffin and stained with van Gieson (haematoxylin followed by picro-fuchsin).

² See Pike, *Biol. Bull. Woods Hole, Mass.* XI, p. 267 (1906).

compared, the carpus of the second leg is comparatively much stouter and shorter in relation to the chela.

From the information available I conclude that the species has been evolved from *P. hendersoni*, or from some similar form, which succeeded in establishing itself in the subterranean water-ways in the neighbourhood of Siju and I think it unlikely that it will ever be found elsewhere.

The credit for the discovery of this species rests with Mr. R. Friel, I.C.S., who when visiting the cave in 1917 brought back two specimens in addition to other examples of the cave-fauna.

Palaemon cavernicola is a common species in the Siju cave and penetrates to its furthest limit at a distance of nearly three-quarters of a mile from the mouth. Besides occurring in the main river-channel it was found abundantly in small streams at depths of 2,000 and 3,600 ft. and in practically all the still pools in the section between 2,200 and 3,000 ft. Several were discovered in isolated pot-holes little more than $2\frac{1}{2}$ ft. broad. The nearest point to the entrance at which the species was seen was in a small pool in the L-shaped passage about 550 ft. from the mouth. In this pool some five or six specimens were found but the species was on the whole scarce in the outer parts of the cave. In the rainy season it is probable that specimens are occasionally carried out of the cave by the flood-waters.

The prawns appeared to be more abundant in isolated pools and small streams than in the main channel, but this was probably due to the fact that they were much less easily detected in the latter, owing to the rapid flow and the ripples on the surface. Their presence in isolated pools is no doubt to be explained by changes in water-level. At the close of the rainy season the floods probably abate very rapidly, leaving the prawns imprisoned in the pools. In such situations they find it difficult to maintain themselves until the next year's floods bring release, for the water of the pools is perfectly clear and contains no other visible organisms on which they can feed. They must be dependant for food on drowned insects or other animals—a very scanty and precarious supply—or on the mud which covers the floor of the pools and may contain organic debris. These sources of food appear to be inadequate, for we noticed numbers of dead individuals, some of which were being devoured by the survivors.

It is not, indeed, easy to understand what the species finds to eat in the streams and main water-channel, for here also food-supplies seem very scarce. They would, however, have better opportunities of obtaining dead insects and could roam further in search of the vegetable debris which, in some places at any rate, is washed in by the floods. They also possibly feed on bat-guano which, although rapidly washed away by the current, must at some points fall into the water in abundance. On one occasion we found a number of prawns eating a bat which had been drowned; they had cleaned the skull very perfectly and were evidently determined to waste no morsel of their feast. But whether dead bats are sufficiently numerous to form a staple source of food is doubtful: in our experience they were very scarce.

On one occasion we were astonished to find a prawn on the top of a boulder about 2 ft. above the surface of the stream and on the thin layer

of mud which covered the boulder we noticed a number of tracks made by prawns. I have never before seen a prawn deliberately leave the water and on this occasion there seemed no object in the exploit, unless it were to look for food, for the stone was completely surrounded by water. The prawns in the pools and pot-holes, though they appeared to be starving, either lacked the initiative of this specimen or realized that the distances that separated them from a more favourable environment were too great for their capacity.

On placing a strong light on the edge of a pool the prawns showed some slight response, moving, if not frightened, slowly and a little uncertainly towards it.

Our collection consists of 72 specimens, ranging in length from 13 to 54 mm., but contains only a small number of fully developed males and very few ovigerous females. We could easily have obtained more half-grown specimens if we had so desired. The eggs borne by the females are all in a very early stage of development and we found no larvae.

The following Palaemonidae have hitherto been recorded from subterranean waters :—

PALAEEMONINAE.¹

Palaemonetes antrorum Benedict,² from an artesian well at San Marcos, Texas.

Palaemonetes eigenmanni Hay,³ from a cavern at Ashton, Cuba.

Palaemonetes calcis Rathbun,⁴ from a cave in western Cuba.

Euryrhynchus wrzesniowskii Miers,⁵ from a well at Cayenne.

Euryrhynchus burchelli Calman,⁶ from a well at Pará.

TYPHLOCARIDINAE.

Typhlocaris galilea Calman,⁷ from a well on the shores of the Lake of Tiberias.

Typhlocaris lethaea Parisi,⁸ from the Grotto of Lethe, Bengasi, Cyrenaica.

Of the species in this list those belonging to the genus *Euryrhynchus* alone retain the normal pigmentation of the eye. The eye itself is, however, reduced in size, much as in *P. cavernicola*. In all the others the pigment has completely disappeared.

Palaemon cavernicola is the only known species of the genus which shows any adaptation to cavernicolous existence and is the only cave Decapod yet found in the Oriental region.

¹ The genus *Palaemonias* Hay from the Mammoth Cave of Kentucky belongs to the family Atyidae.

² Benedict, *Proc. U. S. Nat. Mus.* XVIII, p. 615 (1896).

³ Hay, *Proc. U. S. Nat. Mus.* XXVI, p. 431, fig. 2 (1903).

⁴ Rathbun, *Bull. Mus. Comp. Zool. Harvard* LIV, p. 451, figs. 1-5 (1912).

⁵ Miers, *Proc. Zool. Soc. London*, 1877, p. 662, pl. lxvii, figs. 2-2b; Calman, *Ann. Mag. Nat. Hist.* (7) XIX, p. 297, fig. 1 (1907).

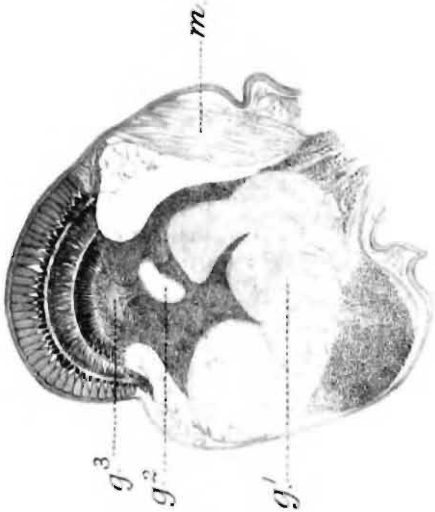
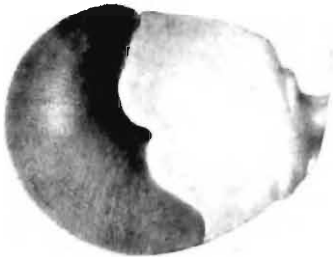
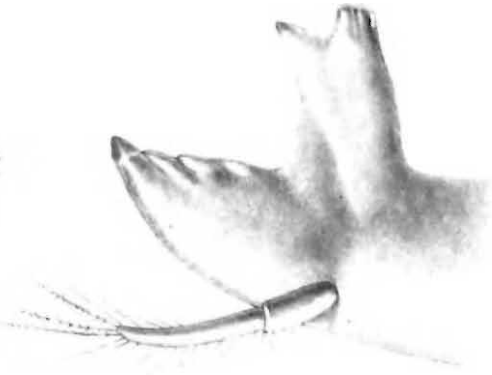
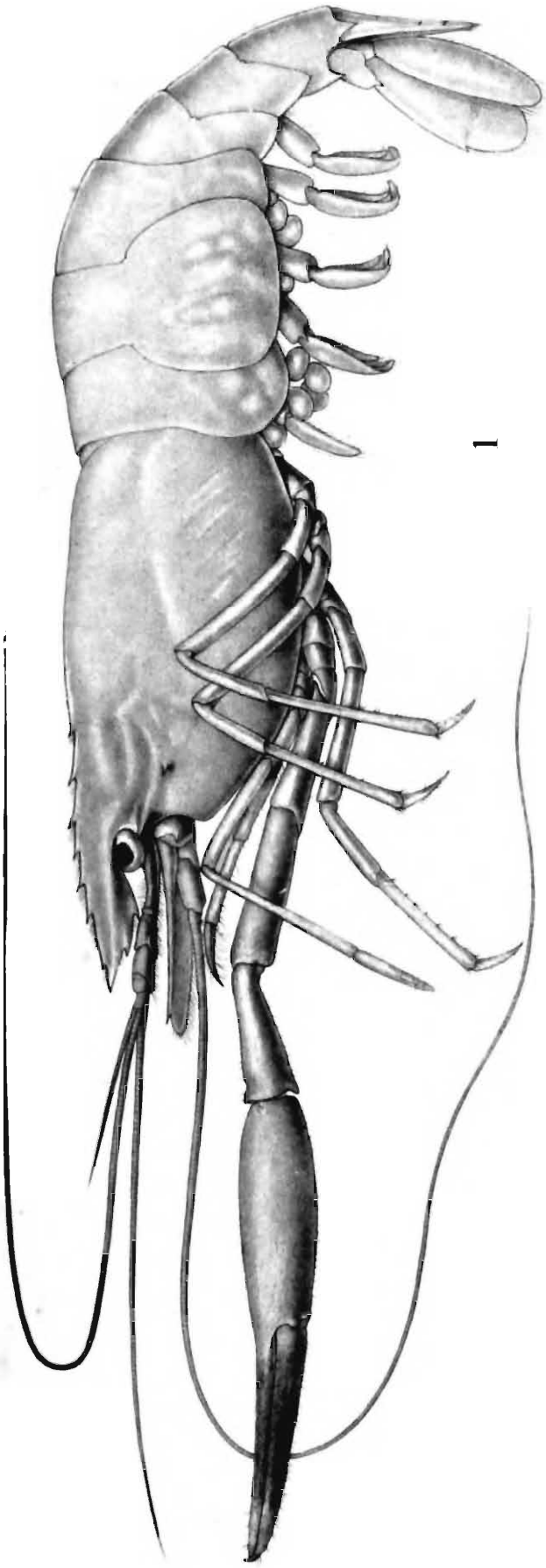
⁶ Calman, *loc. cit.*, p. 297, figs. 2-8.

⁷ Calman, *Trans. Linn. Soc. (2) Zool.* XI, p. 93, pl. xix (1909); Annandale and Kemp, *Journ. Asiat. Soc. Bengal* (n.s.) IX, p. 245.

⁸ Parisi, *Atti Soc. Ital. Sci. Nat. Milano* LIX, p. 241 (1920).

EXPLANATION OF PLATE III.

- Fig. 1.—*Palaemon cavernicola*, sp. nov., ovigerous female.
,, 2.—Eye of *P. cavernicola* in lateral view, further enlarged.
,, 3.—Vertical section of the eye of *P. cavernicola* highly magnified.
 *g*¹, *g*², *g*³, ganglia; *m*, muscle.
,, 4.—Mandibular palp of *P. cavernicola*, magnified.
,, 5.—Lateral view of eye of *P. hendersoni*, showing ocular spot;
 same magnification as fig. 2.



A. Chowdhary del.

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ISOPODA OF THE SIJU CAVE, GARO HILLS, ASSAM.

By B. CHOPRA, M.Sc., Assistant Superintendent, Zoological
Survey of India.

In the collection from the Siju Cave four species of terrestrial Isopods are represented, belonging to three genera of the tribe Oniscoidea. Of the family Oniscidae two genera, *Porcellio* and *Philoscia*, live in the cave, while the Armadillidae are represented by a species of *Cubaris*. Of the four species three have been named; of these, two, belonging to *Porcellio* and *Philoscia*, are believed to represent undescribed forms, while the third appears to be the species that has been described by Collinge¹ under the name *Cubaris cavernosus*. The fourth belongs to *Philoscia* and is inadequately represented in the collection. The names of the species, together with their range inside the cave are given here :—

Oniscidae.

<i>Porcellio assamensis</i> , sp. nov.	0—450 ft.	from entrance.
<i>Philoscia dobakholi</i> , sp. nov. ...	600—3,600 ft.	„
<i>Philoscia</i> sp. ...	800—1,200 ft.	„

Armadillidae.

<i>Cubaris cavernosus</i> Collinge ...	300—3,800 ft.	„
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The three named species are fairly common in the cave, but individuals of the large "Pill" Isopod, *C. cavernosus*, are by far the most abundant. In the introductory part of this report Dr. Kemp and I have pointed out that the portion of the cave between 350 and 500 feet from the entrance has the richest fauna, both in numbers of species and of individuals. This is also true so far as the Isopods are concerned. The two species, *P. assamensis* and *C. cavernosus*, that occur in this part of the cave have the largest number of individuals living in this region, and the number falls very appreciably on both sides of it. This is probably due, as has been pointed out, to the abundance of food-supply in this section of the cave.

So far as characters generally associated with cave-life go, the three species of Isopoda collected in the Siju Cave do not show an advanced degree of adaptation to their environment. Of the three, *Philoscia dobakholi* shows the greatest modification; its colour is almost totally bleached and the eyes are considerably reduced. In *C. cavernosus* also the eyes are partly reduced, but the colouration does not show any indication of a subterranean life. The species lives, however, almost exclusively in the region of total darkness, and extends, with *Philoscia*, up to the inner end of the cave. The third species (*P. assamensis*) seems to be an outside form, which has perhaps invaded the cave but recently and has not yet succeeded in penetrating to any great depth. It has well-developed eyes and a dark colour.

¹ Collinge, *Rec. Ind. Mus.* XII, pp. 123-124 (1916).

I have not studied the minute structure of the eye in any of the Siju Cave Isopods, but in the general reduction of the optic organ the two species mentioned above seem to resemble in some respects the snail *Opas cavernicola*, the structure of the eye of which has been studied in detail by Dr. Annandale and myself. Only the visible portion of the optic apparatus of this snail, however, as has been pointed out by us, is reduced, though in about 6 per cent of the individuals the eye is totally unpigmented. In the prawn *Palaemon cavernicola* also the eyes are much smaller than in closely allied outside forms, but the visual elements show no sign of degeneration.

Two cave Isopods are already known from Assam. *Cubaris cavernosus*, now recorded from Siju also, was originally described from a cave near Cherrapunji in the Khasi Hills. The other, *Burmoniscus kempfi* Collinge, was collected in the Maosmai Cave in the same district.

Genus **Porcellio** Latreille.

The genus is very closely allied to *Oniscus* Linn. from which it differs principally in having a two-segmented antennal flagellum and the opercular rami of two or more pleopods provided with air-cavities. The genus comprises a very large number of species, Budde-Lund alone describing or mentioning about ninety of them in his *Isopoda Terrestria*.

Except for the form that Collinge¹ recorded from South India under the name *P. sp.*, the genus *Porcellio* is, so far as I am aware, not hitherto known from India. The same author² described a species from Allahabad under the name of *P. immsi*, but he later³ referred it to his new genus *Hemiporcellio*, and also added to it two other species, *H. carinatus* and *H. hispidus*, collected from the shores of the Chilka Lake. Chilton⁴ has also recognized *Hemiporcellio* as distinct from *Porcellio*, and has referred to Collinge's *H. carinatus* two specimens collected from a small island in the Chilka Lake. No diagnosis of the genus as distinct from that of the species has hitherto been given, and on examination of Chilton's specimens I have not been able to find any strongly marked characters by which the two genera can be easily distinguished.

Verhoeff⁵ has recently split up the genus into a large number of sub-genera, but I am somewhat doubtful of the utility of this arrangement, as, apart from all other considerations, it seems likely to introduce more confusion than ever in this already perplexingly large genus. Budde-Lund⁶ also has set up about twenty-one sub-genera, based principally upon the denticulation of the outer lobe of the first maxilla.

The species from the Siju Cave resembles *P. maculipennis* Budde-Lund,⁷ but so far as I can make out from the brief description of the latter, unaccompanied by any figures, the two appear to be distinct. Budde-Lund's species was collected at Palon in Burma.

¹ Collinge, *Rec. Ind. Mus.* XI, p. 144 (1915).

² Collinge, *Ann. Mag. Nat. Hist.* (8) XIV, pp. 207, 208, pl. ix, figs. 1-9 (1914).

³ Collinge, *Rec. Ind. Mus.* XI, p. 145 (1915).

⁴ Chilton, *Mem. Ind. Mus.* V, p. 477.

⁵ Verhoeff, *Sitzungsb. Ges. Naturf. Freunde Berlin*, 1907, p. 245 (1907); and *Jahresh. Ver. Vaterl. Naturk. Wurt.* LXXIII, p. 166 (1917).

⁶ Budde-Lund, *Isopoda* in Voeltzkow's *Reise in Ostafrika*, *Wiss. Ergeb.* II, p. 281 (1909).

⁷ Budde-Lund, *Ann. Mus. Civ. Stor. Nat. Genova* (2) XIV, p. 608 (1894).

Porcellio assamensis, sp. nov.

Body somewhat oval, elongated, with its greatest breadth markedly less than half its length. Dorsal surface slightly convex and covered with fine granules aggregated especially along the sides of the thorax, and with large tubercles arranged in two sub-median rows.

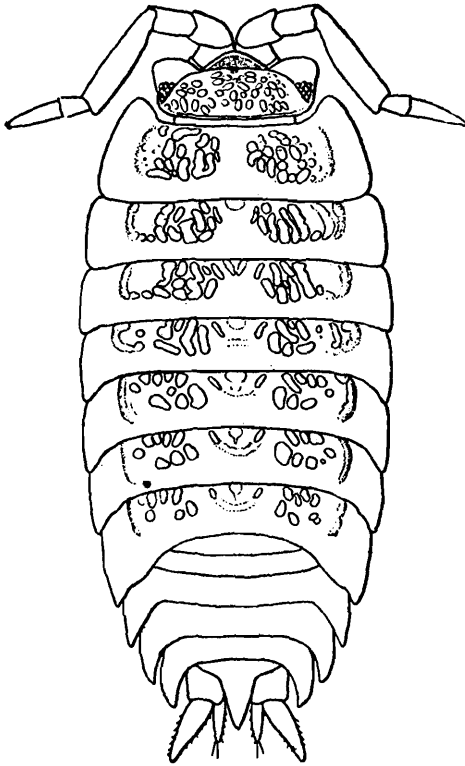


FIG. 1.—*Porcellio assamensis*, sp. nov., dorsal view: $\times 10$.

Cephalon distinctly separated from the first thoracic segment, and surrounded to some extent by the forwardly projecting lateral parts of the latter. Breadth somewhat less than half the length. Anterior margin conically produced in the middle; lateral lobes large, prominent and bluntly rounded at their free margins. Surface of the head beset with large tubercles. Eyes well developed, oval, situated at the sides of the head at the base of the lateral lobes.

Thoracic segments large, sub-equal, convex from side to side, their lateral parts prominent, lamellar, subcontiguous, those of the first segment projecting anteriorly so as to enclose the

head on its sides, and extending almost as far forwards as the base of the lateral lobes. Lateral parts of the anterior three segments terminating behind bluntly, those of the last four more or less acutely.

Pleon less than half the length of the thorax and only slightly narrower. All the six segments distinct, the first two considerably shorter than the rest, their lateral parts entirely concealed by the seventh thoracic segment. Lateral parts of the third, fourth and fifth segments well developed, narrow, lamellar and strongly curved back; those of the last extending considerably beyond the middle of the terminal segment. Sixth segment triangular, with the apex drawn out posteriorly in a long pointed process; length somewhat less than the breadth at the base.

Antennules (Fig. 2a) small, insignificant, three-segmented, with second segment proportionately small, terminal smaller than the basal, conically tapering and provided with a small number of apical cilia.

Antennae (Fig. 2b) somewhat short and rather strongly built, hardly ever reaching beyond the end of the second thoracic segment when fully turned backwards. Peduncular segments, especially the first four, deeply grooved ventrally; first three short, fourth about one and a half times longer than third, fifth longest, more than twice the length of the third. Flagellum shorter than the last peduncular joint; two-segmented, with the terminal segment considerably more than twice the length of the basal. All antennal segments covered with hairs—peduncular somewhat sparsely, flagellar more densely. Last flagellar segment provided

at its tip with a stout, styliform bristle, dividing distally in a compact penicil of fine setae.

Epistome convex, conically produced and provided with setae.

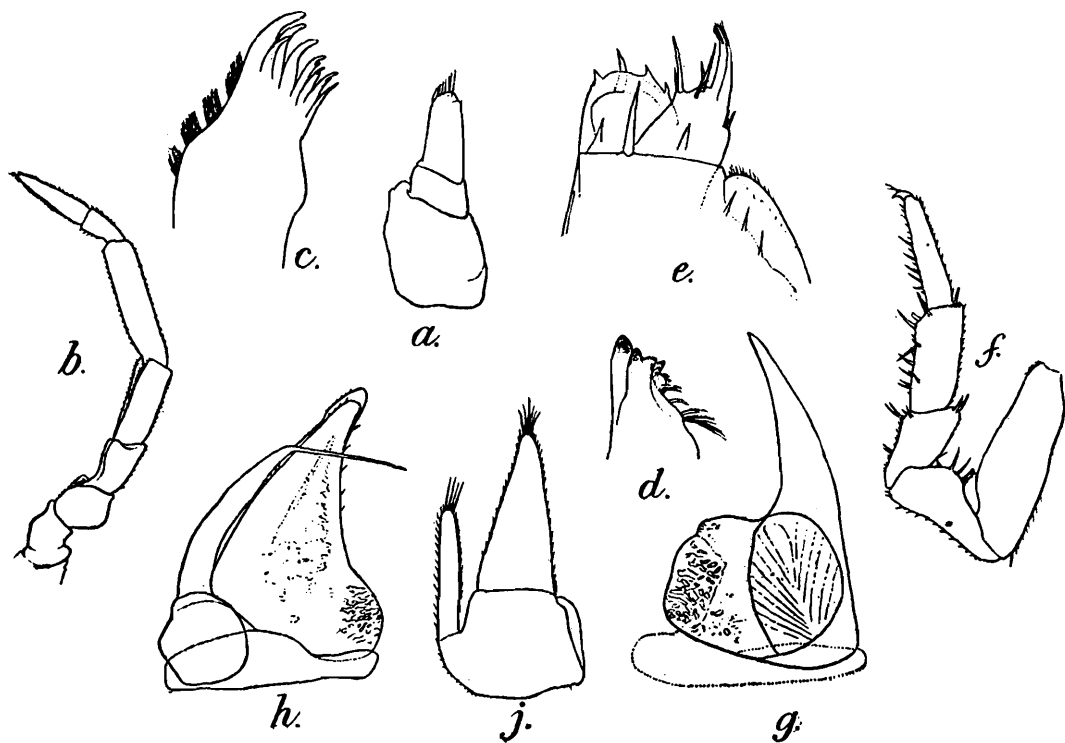


FIG. 2.—*Porcellio assamensis*, sp. nov.

a. Antennule : $\times 85$

b. Antenna : $\times 15$.

c. Terminal portion of outer lobe of first maxilla : $\times 85$.

d. Terminal portion of mandible : $\times 50$.

e. Terminal portion of maxilliped : $\times 85$.

f. Thoracic leg : $\times 25$.

g. First pleopod of male : $\times 35$.

h. Second pleopod of male : $\times 35$.

j. Uropod : $\times 35$.

Outer lobe of first maxilla (Fig. 2c) terminating in four large incurved spines, the outermost the largest, and four shorter spines bifid at their extremities. Part of outer margin behind the outermost large spine deeply setose.

Mandibles (Fig. 2d) with a double row of strongly chitinous teeth at the apex, a membranous hairy lappet behind, followed by a number of "penicils."

Maxilliped (Fig. 2e) with the outer palp terminating in a large multi-spinous process, with one or two small spines on its outer side, and two large and two small ones on the inner side. Inner palp broad, with three blunt tooth-like spines having broad bases, and one large pointed spine in the middle. A large pointed spine at the base of the outer palp at its inner margin, and a smaller one about its middle. Outer margin of maxilliped behind the palp provided with a number of short spines.

Legs (Fig. 2f) increasing in size from first to last; last pair in male hardly stouter than in female, with the carpal joint rather dilated. All legs strongly setaceous.

Opercular rami of all five pairs of pleopods provided with air-cavities; those of the first two pairs in the female somewhat bilobed. First pleopod of male (Fig. 2g) with exopodite less than half the length of

endopodite ; the former a rectangular plate, the latter with the basal half broad, provided with powerful muscles, and with the distal half narrowing to an acute point. Second pleopod of male (Fig. 2*h*) with its exopod longer than that of the first, triangular, its apex pointed, outer margin bearing a small number of short spinules ; the endopod consisting of a broad, rounded basal joint, followed by a long narrow second joint curving outwards to an acute point, and reaching considerably beyond the end of the exopod.

Uropoda (Fig. 2*j*) extending considerably beyond the telson ; basal segment somewhat flattened dorso-ventrally, narrower posteriorly than at its anterior margin and extending up to about the middle of the telson ; the inner ramus narrow, linear, arising from the inner lateral corner of the basal plate, extending beyond the middle of the outer ramus, setaceous and terminating in a tuft of about four long setae ; outer ramus distinctly longer in male than in female, articulating at the posterior margin of the basal plate, broad at the base, fairly thick, tapering to an acute point, considerably longer than the basal joint, provided with setae along the margins and terminated by about six long hairs.

Colour dark brown on dorsal surface, with white opaque patches arranged submedianally on the thorax. Colour somewhat lighter in some specimens, probably varying with age.

Length of adult up to 8 mm.

The species does not extend far into the cave, having been met with only up to 450 feet from the entrance. The types are from 400 feet and are registered in the collection of the Zoological Survey of India under No. C 555/1.

Genus *Philoscia* Latreille.

This genus also is closely allied to *Oniscus*, but is easily distinguished from it by the absence of well-developed lateral lobes on the head, the less expanded lateral parts of the thoracic and abdominal segments and the abruptly narrowing abdomen. From *Porcellio* it differs in having a three-segmented antennal flagellum. The genus comprises quite a large number of species, Budde-Lund alone describing over 20 of them in his *Crustacea Isopoda Terrestria*.

From India proper, so far as I know, only one named species of this genus has been described, at least in recent years. This is *P. tenuissima* Collinge¹ from Madras. The same author² has also recorded two other species from N. E. Assam and the Abor country, but was unable to give them specific names. Another form, also unnamed, is recorded by Collinge³ from the Andamans. A species from the Mouimein Caves in Burma has been described by Budde-Lund⁴ under the name *P. coeca*, but, so far as I can make out, it does not agree with the Siju cave form. The latter may, however, possibly be identical with Collinge's *P. sp. 1* or *P. sp. 2* from Assam.

¹ Collinge, *Rec. Ind. Mus.*, XI, p. 145, pl. v, figs. 1—10 (1915).

² Collinge, *Rec. Ind. Mus.*, VIII, pp. 465, 466 (1914).

³ Collinge, *Rec. Ind. Mus.*, X, p. 207 (1914).

⁴ Budde-Lund, *Ann. Mus. Civ. Stor. Nat. Genova* (2) XIV, pp. 611, 612 (1894).

Budde-Lund¹ and Sars² attach considerable importance to the number of "penicils" behind the cutting part of the mandible. In *Philoscia* there is said to be a single "penicil," while in *Oniscus* the number of such structures always exceeds one. Chilton³ also seems to consider this character of great importance, for he regards the generic identity of *Oniscus punctatus* Stimpson as doubtful only because the mandibles in this species do not bear a number of "penicils" behind the cutting part, he having found one on each mandible, "though another one or sometimes two are situated on the setose membranaceous lappet just internal to the cutting edge." Budde-Lund suggests that this species may possibly belong to *Philoscia*, but as Chilton points out the presence of well-marked lateral lobes on the head and a number of other characters are against this view. In the Siju Cave species, described below, the condition is exactly like that described by Chilton—two penicils arising from the membranous lappet, a single penicil behind, followed, at some distance, by the usual large, curved penicil.

***Philoscia dobakholi*, sp. nov.**

Body oblong oval, somewhat widening in an antero-posterior direction, attaining its greatest breadth at about the posterior end of the thorax. Breadth less than half the length. Dorsal surface convex, shining, smooth, not provided with tubercles or granules.

Cephalon distinctly separated from the first thoracic segment and

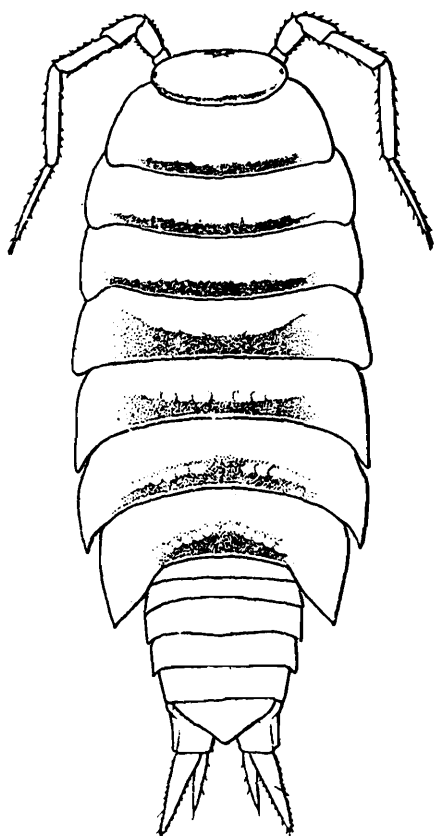


FIG. 3.—*Philoscia dobakholi*, sp. nov., dorsal view : $\times 10$.

less than half as broad as long. Frontal margin regular, only slightly arched; median lobe absent. Antero-lateral corners of the head rounded and not produced into projecting lateral lobes. Eyes greatly reduced, composite, formed of a small number of eye-spots aggregated together and situated in the antero-lateral angles of the head.

Thoracic segments large, slightly convex from side to side. First segment longest, its anterior and posterior margins strongly curved, the former rounded and projecting appreciably beyond the sides of the head. Remaining segments sub-equal, fifth and sixth widest. Side plates of first three segments rather poorly developed, posteriorly rounded; those of the last four successively increasing in size, posteriorly drawn out and terminating in somewhat sharp points. Side plate of the last segment reaching up to, or even beyond, the posterior border of the third abdominal segment.

¹ Budde-Lund, *Crust. Isop. Terrest.*, pp. 202 and 207 (1885).

² Sars, *Crust. Norway II*, Isopoda, pp. 171 and 172 (1899).

³ Chilton, *Trans. Linn. Soc. London* (2) VIII, p. 134 (1901).

Abdomen small, a little less than one-fourth of the total length of the body and abruptly much narrower than the thorax. All the six somites distinct, the first appreciably smaller¹ than the rest, with its lateral parts almost entirely concealed by the seventh thoracic segment. Second segment also somewhat smaller than the rest, its lateral parts generally free. Lateral parts of third, fourth and fifth somites very small, slightly projecting posteriorly. Terminal somite of about the same length as that preceding it, sub-triangular, terminating in a blunt point posteriorly and extending beyond the middle of the basal segment of the uropod.

Antennules (Fig. 4a) extremely reduced, three-segmented, with the two basal segments broad; second comparatively short; terminal longer than the basal, conically tapering, provided with cilia along its margin and a tuft of two or three longer cilia at the apex.

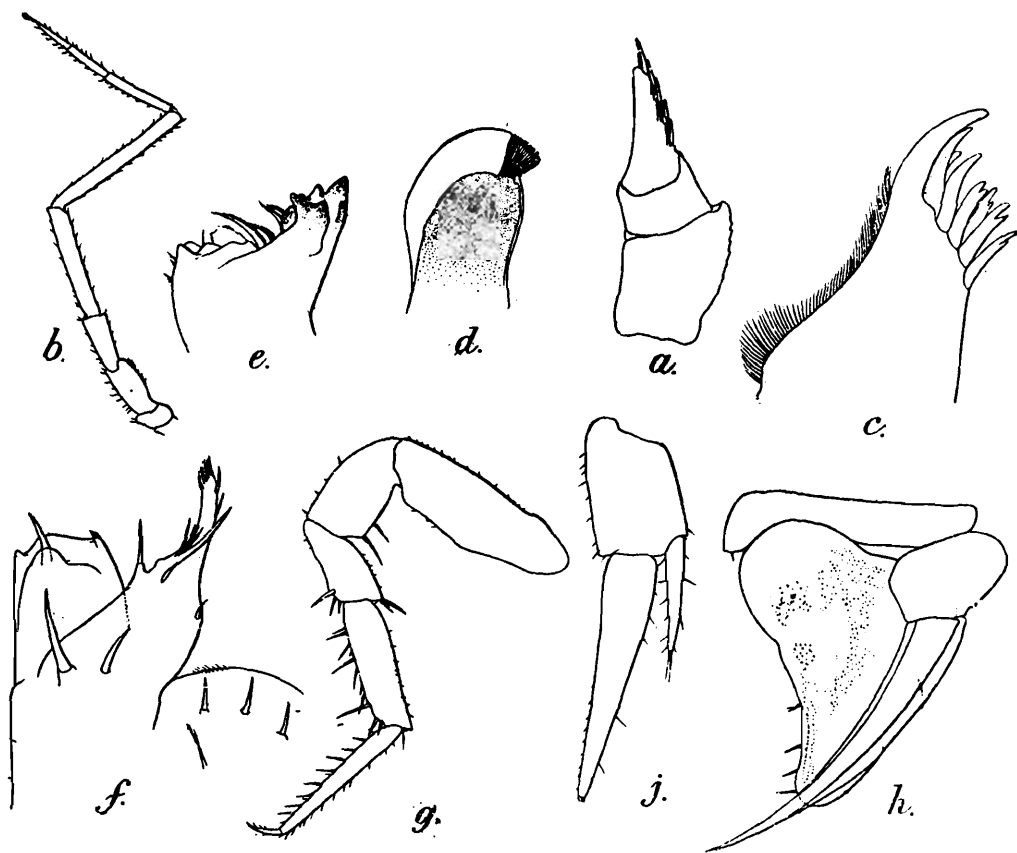


FIG. 4.—*Philoscia dobakholi*, sp. nov.

a. Antennule : $\times 85$.

b. Antenna : $\times 10$.

c. Terminal portion of outer lobe of first maxilla : $\times 85$.

d. Terminal portion of second maxilla : $\times 40$.

e. Terminal portion of mandible : $\times 50$.

f. Terminal portion of maxilliped : $\times 85$.

g. Thoracic leg : $\times 14$.

h. Second pleopod of male : $\times 35$.

j. Uropod : $\times 25$.

Antennae (Fig. 4b) long and slender, reaching almost to the end of the third thoracic somite when fully turned back. Peduncular joints not grooved ventrally; first joint short; second and third also short; fourth

¹ In two specimens the first abdominal segment is fairly large and its margins are not appreciably concealed by the last thoracic segment.

almost as long as the basal three put together ; fifth longest, more than three times longer than the third. Flagellum longer than the last peduncular joint, three-segmented, with the first segment longest, second and third subequal. All the segments sparsely provided with cilia along their margins, and the terminal flagellar joint with a stout styliiform bristle, dividing distally in a compact penicil of fine setae.

Outer lobe of the first maxilla (Fig. 4c) terminating in four large curved spines, the outermost being the largest, and four more almost straight, only a little shorter than the innermost curved spine, and having their free extremities deeply bifid. Outer margin of maxilla, behind the outermost spine, deeply setose. Inner lobe rounded as usual and provided with two large setose spines.

Second maxilla (Fig. 4d) thin and plate-like, terminating distally in two lobes ; outer lobe larger, in the form of a plate pointed toward inner end ; inner lobe terminating in a dense mass of fine setae.

Mandible (Fig. 4e) provided with a double row of chitinous teeth, a setaceous membranous lappet, two " penicils " arising from the surface of the latter, a single " penicil " behind, followed at a little distance by the usual long curved " penicil."

Maxilliped (Fig. 4f) with the outer palp terminating in a large multispinous process, with about five spines (four in a cluster and one separate) on its inner side and a small spine on its outer side near the base ; inner palp broad, its anterior margin fringed with fine setae, provided with one long spine in the middle, and three or more which are short and blunt, one at the inner margin and two or more at the outer. Two spines at the base of the outer palp—a long one near the inner margin and a shorter one about the middle.

Legs (Fig. 4g) long and slender, increasing in size from the first to the last, all markedly setaceous ; carpus swollen in anterior pairs ; last pair almost equally developed in the two sexes.

Opercular rami of none of the pleopods provided with air-cavities. those of the anterior pairs somewhat bilobed in both sexes. First pair in the male with the endopod slightly longer than the exopod, the former with the basal portion somewhat broad and provided with a powerful muscle, the distal half tapering and terminating in an acute point ; the exopodite plate-like and sub-triangular, provided with a few spines along its outer margin. Second pleopod of male (Fig. 4h) with the exopodite sub-triangular, its apex bluntly rounded, provided with a few spines along its outer margin ; the endopodite consisting of the usual two joints, a broad basal followed by a long and narrow distal joint, somewhat curved, ending in a fine point and extending considerably beyond the end of the exopodite.

Uropod (Fig. 4j) with the basal segment more or less rectangular, extending considerably beyond the end of the telson, setaceous and provided with a lateral expansion at the base of which the inner ramus articulates ; the latter narrow, linear, not reaching up to the middle of the exopodite, provided with setae and terminating in a small tuft of long setae. Outer ramus of about the same length in the two sexes ; considerably longer than the basal, thick at the base, tapering pos-

teriorly, ending in a blunt point and provided with hairs along the margins.

Colour almost white, with the lateral margins of the thorax and the abdomen of a slightly darker shade than the rest of the body. Colour a little less bleached in specimens from the outer part of the cave than in those procured in greater depths.

Length of the body reaching up to 10 mm.

The species does not occur in the outer parts of the cave, no specimens having been found nearer than 800 ft. from the entrance. The species commonly lives under stones, etc., near the water-edge; it is extraordinarily agile and specimens are difficult to procure. Specimens were obtained from the following points in the cave :—

800—1,200 ft. from the entrance. TYPES (C 552/1).

2,000—2,100 " " "

3,500—3,600 " " "

The structure of the mandible in the present species does not appear to be exactly in accord with the generic definition, for besides the single "penicil" behind the membranaceous lappet there are two others arising from the lappet itself. This condition, as pointed out above, is exactly like that described by Chilton in *Oniscus punctatus*. In all other characters, however, *P. dobakholi* does not show any material difference from other species of the genus.

The specific name of this Isopod refers to the Garo name of the cave, "Dobakhol," meaning literally a "bat-cave."

Philoscia sp.

One specimen, somewhat damaged, differs considerably from the rest, and possibly represents a new species. It is a female about 5 mm. long and was collected along with specimens of the preceding species from under stones in the tunnel between 800 to 1,200 ft.

The principal differences from the foregoing species are :—

1. The body is broader anteriorly, the breadth being half the length.
2. The lateral parts of the last three thoracic segments are better developed and are posteriorly acute; those of the last segment extend beyond the end of the third abdominal somite.
3. The first two abdominal somites are very small and their lateral margins are completely covered by the last thoracic somite.
4. The telson is more broadly pointed.
5. The inner ramus of the uropod is proportionately longer, extending considerably beyond the middle of the outer.

Besides, there are some minute differences in the mouth parts also, but I have not been able to study them in detail.

Cubaris cavernosus Collinge.

1916. *Cubaris cavernosus*, Collinge, *Rec. Ind. Mus.* XII, pp. 123, 124, pl. xvi, figs. 1-9.

I refer to this species, with a little doubt, a large number of specimens collected from the Siju Cave. I have not been able to examine

Collinge's specimens, collected from a cave near Cherrapunji, but from his figures and description I find that the Siju Cave specimens show a great resemblance to them. There are a few differences between the two, but in view of the great resemblance, I prefer, for the present at any rate, to regard them as belonging to Collinge's species.

Body oval, convex dorsally, with prominent rugose lateral patches on the thoracic segments; breadth somewhat greater than half the length.

Cephalon small, almost completely surrounded on sides by lateral parts of the first thoracic somite. Breadth less than half the length. Lateral lobes well developed, median lobe absent. Eyes small, but not found imperfect in any specimen.

First thoracic segment very large, remainder subequal. Lateral margins of first segment anteriorly surrounding the head, extending almost up to the anterior end and posteriorly drawn out. Lateral plates of first three segments somewhat curved upwards; those of segments 2—5 small, excavate. Lateral parts of last two somites large and only very slightly excavate. First two segments provided with the usual "notch and groove."

First two abdominal somites very small, their lateral parts completely covered by the seventh thoracic segment. Lateral parts of segments 2—5 large, backwardly directed. Telson as described by Collinge, but proportionately somewhat broader at the base.

Antennules and antennae as in Collinge's specimens, but the outer lobe of the first maxilla terminating in a different way, there being five stout curved spines and five (or even six in some specimens) smaller ones. Second maxilla thin, plate-like, terminating distally in two lobes; outer lobe large, fringed with setae on a portion of its margin; inner also setaceous, brush-like. Mandible of the usual shape, with a double row of chitinous teeth followed by a number of penicils. Maxilliped as described by Collinge, but with the outwardly directed spines at the base of the large multispinous process smaller in the Siju Cave specimens than in those figured by Collinge.

Thoracic legs stout, more strongly built in the male than in the female.

Opercular rami of the pleopods not provided with air-cavities. First two pleopods of the male having the usual shape; exopodite of the first pair sub-triangular, less than half the length of the endopodite; the latter with the basal half broad and provided with a strong muscle, distal half strongly curved, tapering acutely and pointing outwards. Second pleopod of male with the exopodite large, triangular and bluntly pointed at apex, both margins covered with fine setae; endopodite with the basal segment broad, distal long and narrow, drawn out into an acute point, strongly curved outwards and not reaching beyond the exopodite. Uropoda exactly as described by Collinge.

Colour lavender gray, with whitish patches arranged in two sub-median rows on the dorsal surface of the thorax. Colour lighter in larger specimens.

Length in my specimens hardly reaching 10 mm.

This is the commonest species of Isopod in the cave. A large number of specimens were found between 300 and 3,800 ft. from the entrance. The largest number of individuals was captured in the outer bat-chamber. In the inner parts of the cave specimens of this species were found living with *Philoscia dobakholi*. Specimens were collected from the following spots :—

300—450 ft. from the entrance.			
800—1,200	„	„	„
2,000—2,100	„	„	„
3,500—3,600	„	„	„
3,800	„	„	„

TARTARIDES FROM THE SIJU CAVE, GARO HILLS, ASSAM.

By F. H. GRAVELY, D.Sc., F.A.S.B., Superintendent, Government Museum, Madras.

One mature male and female and four immature specimens were collected at 3,500-3,600 feet from the entrance to the cave, and one immature specimen, apparently of the same species, at 2,500 feet from the entrance. The species is a new one.¹

Schizomus (*s. str.*) **sijuensis**, sp. nov.

The female comes nearest to *S. dispar* according to Hansen and Sørensen's key (1905, p. 39), but differs in its much more acute lower

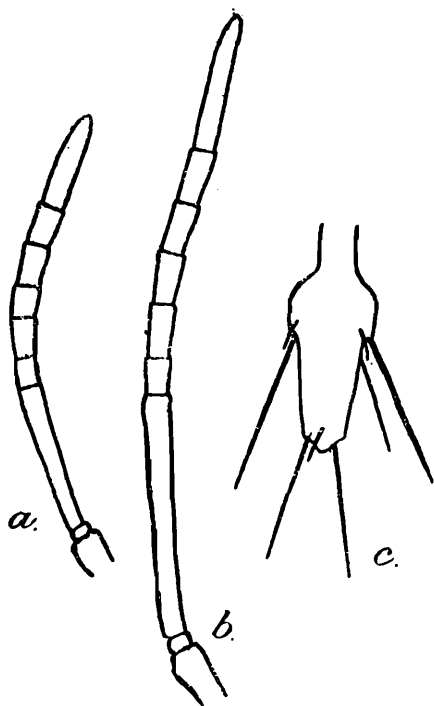


FIG. 1.—*Schizomus sijuensis*, sp. nov.

a. Foot of antenniform leg of female: $\times 30$.

b. Foot of antenniform leg of male: $\times 30$.

c. Caudal appendage of male from above: $\times 30$.

front angle of the palpal trochanter. In this it more closely resembles *S. similis*, Hirst (1913, p. 33, figs. 1-2) from which it is separated by its more slender palps, and *S. cavernicola*, Gravelly (1912, p. 107) from which it is separated by its somewhat more slender build and much greater size as well as by the absence of any greenish tinge in the integuments. *S. cavernicola* was described from "two specimens, both adult females" about 4 mm. long and their relatively dark colouring may almost certainly be taken to indicate that they are mature or nearly so. The present species retains its pale immature colouring till it is larger than this—how much larger the material available does not show—and adult specimens of an ochraceous, not greenish brown are about 9 mm. long. In *S. cavernicola*, moreover, the build is somewhat less slender in all parts than in *S. sijuensis*, the first tarsal joint of the antenniform legs being, for instance, distinctly wider than long (1912, fig. A), whereas in *S. sijuensis*

it is about as long as wide in young specimens and a little longer in adults (fig. a). In the male all the appendages are longer and consequently more slender than in the female (fig. b). In other respects the two sexes are not widely different, except for the usual sexual characteristics in the tail (fig. c).

¹ I have not seen Kraepelin's description of *S. sauteri* from Formosa (1911, p. 100), but as no Tartarid is yet known to have more than a very limited geographical range it is most unlikely that this species would be found in Assam.

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ARANEIDS FROM THE SIJU CAVE, GARO HILLS, ASSAM.

By LOUIS FAGE, D.Sc., *Muséum d'Histoire Naturelle, Paris.*

Les Araignées récoltées dans la "Siju Cave," et que le professeur Stanley Kemp a bien voulu me communiquer, forment une collection peu importante par leur nombre. Quatre espèces seulement :—

Scytodes semipullata E. S.,
Theridion rufipes Lucas,
Vendilgardia assamensis, sp. nov.,
Heteropoda robusta, sp. nov.,

ont été rencontrées par les zoologistes qui ont exploré cette grotte.

Les recherches ont été faites avec le plus grand soin et il paraît vraisemblable que ces quatre espèces représentent bien la population d'Araignées caractéristique de cette grotte. Or ni les unes ni les autres ne portent la trace d'une adaptation quelconque au milieu cavernicole. Le *Scytodes semipullata* et le *Theridion rufipes* font partie de la faune épigée voisine ; quant aux deux formes nouvelles, elles se placent, chacune dans leur genre, à côté d'autres espèces lucicoles, dont elles ne diffèrent par aucun caractère adaptatif en rapport avec le milieu souterrain.

Il est curieux de noter que l'étude des autres habitants de la "Siju Cave" conduit exactement aux mêmes conclusions. C'est à peine si, dans les récoltes variées qui y furent faites, on trouverait une demi-douzaine d'espèces dont on pourrait, à la rigueur, interpréter certains caractères comme une conséquence de cet habitat particulier. Aucune d'elles en tout cas ne fait figure le véritable troglobie. Malgré les apparences contraires, ses vastes dimensions (près d'un kilomètre de longueur) et la présence d'une eau abondante, la "Siju Cave" se montre donc peu favorable à l'entretien de la vie cavernicole. Peut-être même faudrait-il admettre qu'elle ne renferme qu'une faune temporaire ou d'introduction récente.

Famille SICARIIDAE.

Scytodes semipullata E. S.

Trois ♀ de 8 et 9 mm. de longueur, prises à 1,000, 2,100 et 2,400 pieds de l'entrée.

Les individus que je rapporte à cette espèce du Thibet Chinois et du Tonkin offrent la même coloration caractéristique du céphalothorax et de l'abdomen que le type, mais sont de taille plus forte. D'autre part, les annulations des fémurs (5 anneaux), des tibias (4 anneaux) et des métatarses (4 anneaux) y sont beaucoup plus nettement marquées. Il semble que exemplaires qui ont servi de modèle à la description d'Eug. Simon¹ n'avaient pas atteint leur complet développement. Le mâle de cette espèce demeure toujours inconnu.

¹ E. Simon. Étude sur les Arachnides du Tonkin, *Bull. Sc. France et Belgique* XLII, 1908, p. 75.

Famille THERIDIDAE.

Theridion rufipes Lucas.

Un ♂ et très nombreuses ♀ pris à 100, 300, 400, 450 et 500 pieds de l'entrée.

Espèce cosmopolite déjà citée de Ceylan, de l'Inde et du Tonkin.

Famille ARGIOPIDAE.

Sub-Famille *THERIDIOSOMATINAE*.**Vendilgardia assamensis**, sp. nov.

Un ♂ et neuf ♀ pris à 300 et 1000 pieds de l'entrée.

♀.—*Longueur* 2.5 mm.—*Coloration* : céphalothorax, pièces buccales et appendices brun fauve ; abdomen brunâtre, plus foncé près des tilières ; un fin liseré noir marginal au céphalothorax ; extrémité des tibias rembrunies ; sternum brun olivâtre.—*Céphalothorax* au moins aussi large que long, partie céphalique régulièrement convexe, partie thoracique brusquement déclive et marquée d'une impression transverse sur sa pente postérieure.—*Yeux* antérieurs (texte-fig. 1a) équidistants et

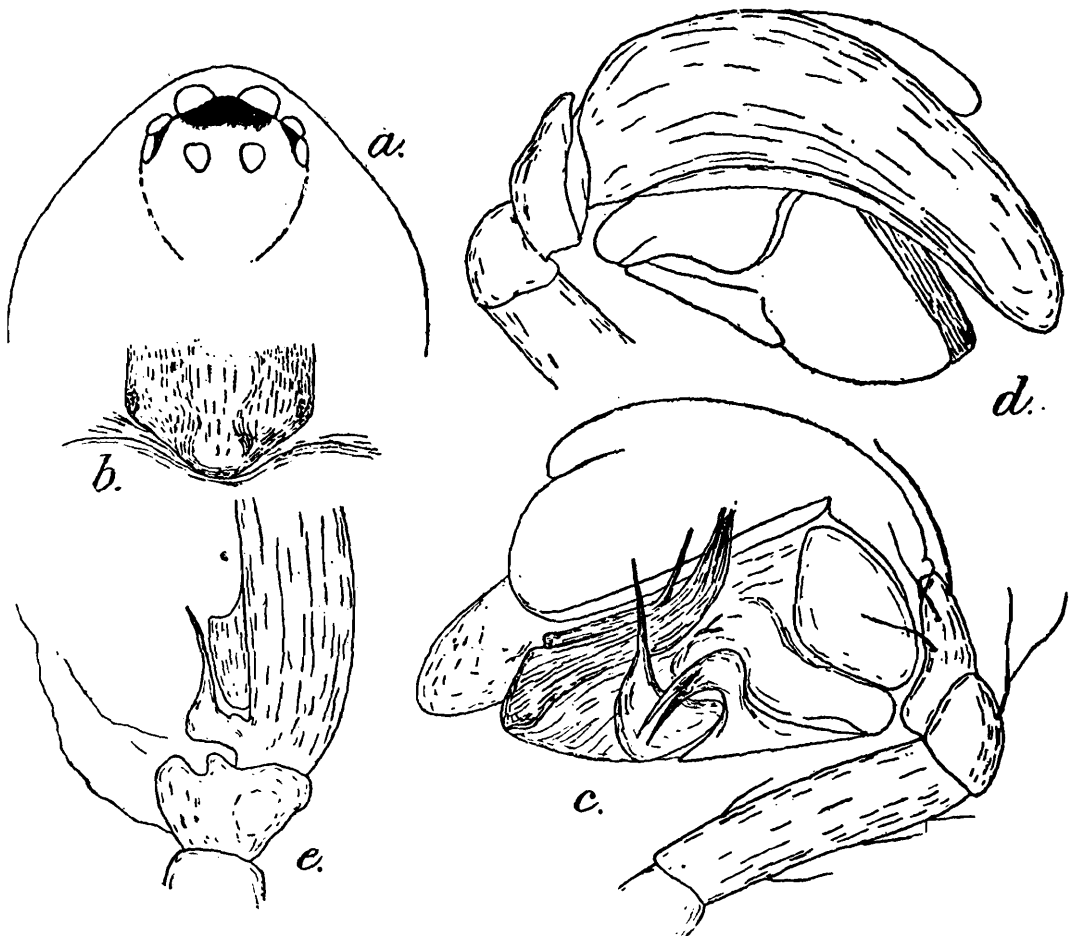


FIG. 1.—*Vendilgardia assamensis*, sp. nov.

a. Aire oculaire $\times 44$. b. Epigyne vu en dessus $\times 44$. c. Patte-mâchoire, ♂, face externe $\times 71$. d. Tarse et bulbe de la patte-mâchoire, face interne $\times 71$. e. Tibia et base du tarse de la patte-mâchoire vus en dessus $\times 71$.

très rapprochés, en ligne fortement récurvée, les médians une fois et demie plus grand que les latéraux ; ceux-ci égaux et contigus à ceux de

la deuxième ligne qui est nettement procurvée ; les médians postérieurs un peu plus grands que les latéraux et un peu plus rapprochés l'un de l'autre qu'ils ne le sont de ces derniers.—*Bandeau* légèrement concave, deux fois plus haut que le diamètre des yeux médians antérieurs.—*Sternum* cordiforme, prolongé entre les hanches postérieures largement disjointes, marqué en dessous et de chaque côté de la pièce labiale d'un point testacé arrondi.—*Pièce labiale* plus large que longue, arrondie au sommet.—*Lames maxillaires* aussi larges que longues, coupées carrément au sommet.—*Chélicères* au moins deux fois plus longues que le bandeau, atténuées à l'extrémité ; leurs marges très obliques armées, en dessus, de deux fortes dents isolées et d'une dent angulaire plus petite, en dessous, d'une série de fines granulations.—*Patte-mâchoire* grêle et allongée ; fémur = tibia + patella = $\frac{1}{2}$ tarse, celui-ci mutique à l'extrémité, mais armé de nombreux crins spiniformes.—*Pattes ambulatoires* longues et robustes, surtout celles de la première paire dont le fémur est aussi long que l'ensemble du tibia et de la patella et un peu plus petit que le métatarse et la tarse réunis ; tous les articles revêtus de longs crins spiniformes ; tarse armé de trois griffes, les supérieures pourvues de trois à quatre denticules couchés, l'inférieure brusquement coudée, très longue et sétiforme.—*Abdomen* ovale, large, parsemé de longs crins dressés.—*Epigyne* en plaque volumineuse, aussi large que longue, arrondie en arrière et recouvrant la fente épigastrique (texte-fig. 1b).

♂.—*Longueur* 2 mm.—*Bandeau* plus élevé que chez la ♀, au moins égal à trois fois le diamètre des yeux médians.—*Patte-mâchoire* : fémur > tibia + patella ; celle-ci arrondie < le tibia qui est redressé et échancré latéralement au bord antérieur ; tarse plus grand que l'ensemble des articles précédents, étroit et régulièrement arqué, rebordé et embrassant le bulbe du côté interne ; paracymbium, vu en dessus, formant une courte apophyse parallèle au tarse qui est ici partiellement rebordé, large à la base, puis brusquement effilé et se terminant en pointe aiguë.—*Bulbe* extrêmement volumineux, faisant largement saillie sous le tarse, lisse et bilobé à sa partie supérieure, donnant naissance en avant à une lamelle noire contournée se terminant du côté externe en plusieurs pointes dressées ; du même côté se voit une forte apophyse, large à la base, recourbée en demicercle et terminée par deux pointes très grêles dirigées obliquement en bas et en avant.

Il est possible que la sous-famille des Theridiosomatinae, à laquelle appartient cette intéressante espèce, doive se réduire aux deux seuls genres *Theridiosoma* et *Vendilgardia*. Les genres *Ongulnius* et *Andasta*, connus uniquement par des femelles, y sont peut-être encore à leur place, mais le genre *Phricotelus* paraît avoir beaucoup plus d'analogies avec les Théridiides du groupe des *Mysmena*.

Tandis que le genre *Theridiosoma* a des représentants dans toutes les régions chaudes et tempérées, sauf en Afrique, le genre *Vendilgardia* était jusqu'ici propre au nouveau continent ; on le connaît du Mexique, du Vénézuéla, du Brésil et des Antilles. Il est donc particulièrement intéressant de pouvoir lui rapporter une espèce de l'Inde. Ce *Vendilgardia assamensis* s'éloigne à vrai dire des espèces américaines par quelques particularités de l'appareil copulateur mâle qui suffiront peut-être un jour à caractériser un nouveau genre : la tarse de la patte-

mâchoire est extrêmement simple, en forme de languette régulièrement incurvée, tandis qu' il est concave chez les espèces américaines et forme une saillie terminale recouvrant mieux le bulbe ; le paracymbium est ici effilé en longue pointe aiguë tandis que chez les autres espèces il est plus court et spatulé à l'extrémité comme chez les *Argiope* et les *Araneus*. Le bulbe du *Vendilgardia assamensis* est également plus simple, bien qu'il possède cette apophyse inférieure recourbée et bifide qu' on ne retrouve pas chez les formes américaines.

Eug. Simon¹ a noté que le *Vendilgardia theridionina* E. S., dont il a observé les mœurs au Vénézuéla, construit sa toile sous la voute des rochers humides. Il est possible qu' on doive au même attrait pour l'humidité la présence du *Vendilgardia assamensis* dans la "Siju Cave."

Famille CLUBIONIDAE.

Heteropoda robusta, sp. nov.

Vingt-deux ♀ prises depuis l'entrée jusqu' à 2,400 pieds de l'entrée.

♀.—*Longueur* du corps 32 mm., longueur des pattes de la deuxième paire 90 mm.—*Coloration* : tégument fauve rougeâtre ; ceux du céphalothorax rembrunis en arrière au dessus de la bordure blanche, une fine

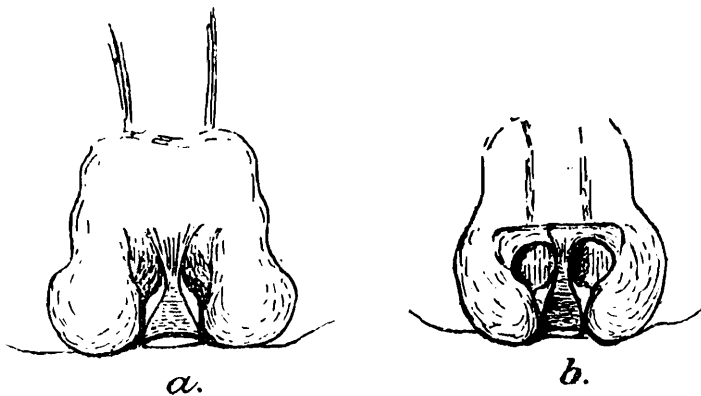


FIG. 2.—Epigyne vu en dessus $\times 15\frac{1}{2}$.

a. *Heteropoda robusta*, sp. nov.

b. *Heteropoda sexpunctata* E. S.

ligne noire médiane très nette s'étendant du groupe oculaire au bord postérieur ; bandeau éclairci dans la milieu et garni de poils épais d'un blanc jaunâtre ; groupe oculaire noir ; chélicères noires, garnies de pubescence fauve peu serrée ; sternum et hanches teintées de rougeâtre ; abdomen sans taches en dessous, marqué en dessus de six taches disposées par paires et plus en arrière d'un chevron noirâtre ; fémurs ornés d'un très large anneau apical s'étendant en dessous, et, sur leur face antérieure de deux taches rondes, marquées chacune d'une petite tache blanche correspondant à la base d'une épine.—*Yeux* médians antérieurs plus petits que les latéraux.—*Pattes ambulatoires* : tibia III plus long que le céphalothorax ; tibia IV armé d'une seule épine dorsale, située dans la moitié apicale ; tous les tarses et les métatarses scopulés.—*Epigyne* : lobes latéraux confondus en avant en une plaque épigastri-

¹ Hist. Nat. des Araignées, Vol. I, p. 916, 1895.

que rougeâtre, séparés en arrières, l'intervalle occupé par une pièce médiane pédiculée en avant puis brusquement élargie en arrière.

♂ inconnu.

Cette énorme espèce qui paraît abondante dans la "Siju Cave" et qui s'y reproduit (sa ponte et ses jeunes y ont été rencontrés) se rapproche par la taille, par l'ensemble de la coloration et aussi par la forme générale de l'épigyne de l'*Heteropoda procera* L. K.¹ d'Australie, mais s'en distingue nettement par la présence d'une épine dorsale aux tibias postérieurs. Elle est en réalité beaucoup plus voisine de l'*Heteropoda sexpunctata* E. S.,² petite espèce des bas plateaux de l'Himalaya dont elle paraît représenter une forme géante. Elle s'en distingue toutefois, non seulement par sa taille, mais aussi par l'absence de carène transverse antérieure à l'épigyne.

¹ Die Arachniden Australien, p. 667, 1875.

² Bull. Soc. Zool. France, Vol. X, p. 14, 1885.

OPILIONES AUS DER SIJU-HOEHLE IN DEN GARO-HILLS IM ASSAM.

Von Dr. C. FR. ROEWER, Bremen.

Die mir im 14 Tuben von Herrn Prof. S. Kemp in Calcutta zur Bearbeitung übergebenen Opilioniden aus der Siju-Höhle in den Garo-Hills (Assam District) gehören sämtlich der Familie der Assamiidae an, bis auf einige wenige ganz junge und daher nicht bestimmbare Tiere, die allem Anschein nach der Phalangiidae—Subfamilie der Gagrellinae zuzurechnen sind.

Familie. ASSAMIIDAE Soerensen.

Subfamilie ASSAMIINAE Roewer.

Genus **Metassamia** Roewer.

Metassamia septemdentata, sp. nov.

Länge : Körper 6·5 ; 1-4 Femur 6 : 11 : 8 : 10 ; 1-4 Bein 19 : 39 : 14 : 32 mm.

Augenhügel niedrig, quer-oval, völlig glatt und unbewehrt.—Vor ihm am Stirnrande der übliche, schräg-aufrechte Kegelzahn ; unterer Stirnrand des Carapax mit einem medianen und jederseits davon an den Carapax-Vorderecken mit je drei wagerechten (statt der sonst üblichen zwei) Kegelzähnen.—Körper im übrigen matt-glatt, nur 3 Area des Scutums mit einem mittleren Paare kräftiger Dornen und 1-3 freies Tergit sowie alle freien Sternite mit je einer winzigen Körnchen-Querreihe ; 2 und 3 Coxa mit je einer vorderen und hinteren Höckerchen-Randreihe. 1 Cheliceren-Glied mit völlig glattem dorsalen Buckel.—Palpen normal, ihr Femur apical-medial mit 1 Dörnchen und dorsal mit einer äusserst winzigen Körnchen-Längsreihe.—Beine völlig unbewehrt, nur 1 und 2 Trochanter frontal mit je 2-4 Körnchen ; 1-4 Femur gerade ; Zahl der Tarsen-Glieder : 6-7 ; 13-14 ; 8-9 ; 9-10 ; Endabschnitt des 1 Tarsus 2- und des 2 Tarsus 3- gliedrig.

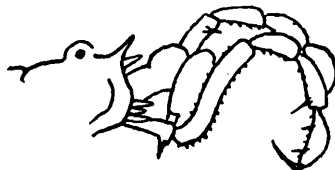


FIG. 1.—*Metassamia septemdentata*, sp. nov.
Carapax von rechts mit Cheliceren und Palpen.

Färbung des Körpers dorsal vollständig schmutzig-braungelb, blass-gelb nur das mittlere Dornenpaar der 3 Area, der Scutum-Seitenrand sowie der Hinterrand des Scutums und aller drei freien Tergite.—Körper ventral blasser gelb, doch freie Sternite dunkler und 1-4 Coxa

und Operculum genitale rostgelb wie auch die einfarbigen Cheliceren und Palpen.—Beine dunkel rostbraun, 1-4 Trochanter rostgelb, 2 Tibia apical weissgelb geringelt und 3 und 4 Tarsus weissgelb.

Assam: Garo Hills, Siju-Cave. "400 to 500 ft. and 800 to 1,200 ft. from entrance:" 18 (♂ + ♀).—Typ. Museum Calcutta.

Genus **Sijucavernicus** nov.

Augenhügel im vorderen Carapax-Drittel, unbewehrt.—Carapax-Stirnrand oben-median unbewehrt.—Scutum neben der 3 Coxa leicht eingeschnürt und hinten rechtwinkelig; alle Areae gänzlich unbewehrt und ohne mediane Längsfurche.—Stigmen unter Brücken-zähnen in der Furche zwischen der 4 Coxa und dem Abdomen verborgen; 4 Coxa lateral-basal (hinter der 3 Coxa) ohne einen grösseren Dorn.—1 Chelicerenglied mit einem deutlich abgesetzten dorsal-apicalen Buckel.—Palpen normal, Femur apical-medial mit einem Dörnchen; Zähnen der ventralen Längsreihe viel kürzer als der Femur-Durchmesser.—Beine lang und dünn; Endabschnitt des 2 Tarsus 3-gliedrig; 1-4 Tarsus jeweils mehr als 6-gliedrig, variabel; Doppelklauen des 3 und 4 Tarsus einfach, nicht kammzahnig.—Secundäre Geschlechtsmerkmale fehlen.

Sijucavernicus kempii, sp. nov.

Länge: Körper 4; 1-4 Femur 7: 11: 7: 9; 1-4 Bein 20: 35: 20: 27 mm. Augenhügel niedrig quer-oval, fast glatt und nur äusserst fein und spärlich regellos bekörnt.—Vor ihm median ist der Carapax-Stirnrand unbewehrt, unterer Carapax-Stirnrand mit den üblichen 5 wagerechten (2: 1: 2) Kegelzähnen, deren laterale Paare nur relativ klein sind.—Körper im übrigen matt-glatt und dorsal wie ventral völlig unbewehrt.—Fläche der 1-4 Coxa dicht und fein bekörnt; 2 und 3 Coxa mit je einer vorderen und hinteren Höckerchen-Längsreihe.—1 Cheliceren-Glied mit einem längsovalen, dicht und rauh bekörnten dorsal-apicalen Buckel.—Palpen normal, ihr Femur apical-medial mit einem Dörnchen.—Beine völlig unbewehrt, nur 1 Trochanter frontal mit 1 Körnchen; 1-4 Femur gerade; Zahl der Tarsen-Glieder: 6-7; 12-16; 7-8; 9-10; Endabschnitt des 1 Tarsus 2- und des 2 Tarsus 3-gliedrig.—Secundäre Geschlechtsmerkmale fehlen.

Färbung des Körpers, der Cheliceren und Palpen einfarbig rostgelb, anwärts etwas schmutzig gebräunt.—Beine rostbraun, alle Tarsen weissgelb.

Assam: Garo Hills, Siju-Cave: 18 (+) und ca. 7 pull. "1000, 1,800-2,000, 2,100-2,900, 3,500-3,600, 3,800 ft. from entrance."—Typ. Museum Calcutta.

MYRIAPODA FROM THE SIJU CAVE, GARO HILLS, ASSAM.

By F. SILVESTRI.

Six species of Myriapods were collected by Dr. S. Kemp and Mr. B. Chopra in the Siju Cave at points ranging from the entrance to 3,600 ft. The species *Trachyiulus mimus* found at this distance from the entrance has the eyes as well developed as species living in the open, and it is necessary, therefore, to admit that it is a recent inhabitant of the cave. Of the other five species, four (Cryptopsidae and Geophilidae) belong to families the members of which live always in the dark in the open also, viz., under stones, logs, etc., and seek humidity in the soil.

The species of *Thereuonema* all prefer humid dark situations and like other Scutigeridae are frequently found in caves. I take this occasion to describe a form of giant *Thereuonema* collected by Dr. Annandale in the Batu Caves (Malay Peninsula).

DIPLOPODA.

Fam. TRACHYIULIDAE.

Trachyiulus mimus, sp. nov.

(FIG. I.)

Corpus terreum plus minusve pallidum praesertim capite, colle et ventre; tuberculis porigeris nigris.

Caput laevigatum ocellis 5 uniseriatis gradatim ab externe ad internum parum minoribus, ad colli marginem anticum, instructum, antennis articulo quinto quam ceteri aliquantum longiore, clypeo breviter 7-dentato.

Collum quam caput parum latius, supra etiam postice laevigatum lateraliter carina integra submarginali et carinis duabus abbreviatis aucto, margine laterali ipso exciso.

Trunci segmentum primum quam collum parum angustius, praezona laevigata, metazona supra et lateraliter carinis parvis 17 instructa. Segmenta sequentia a quarto ad decimum secundum gradatim parum latiora, praezona postice lineata, metazona supra inter tubercula porigera carinis 5, sub tuberculis porigeris etiam carinis 5, carinis omnibus subparvis media longitudine transversaliter interrupta, tuberculis porigeris sat magnis, obtusis a segmento quarto incipientibus.

Sterna ut praezonarum parte antica vix foveolata. Segmentum praeanales laevigatum, postice rotundatum, valvulas anales vix obtegens. Valvulae anales immarginatae; lamina infraanalis lata brevis, postice late rotundata.

Pedes breves setosi, ungue terminali spina quam unguis parum brevior instructo.

Segmentorum numerus ad 68.

Long. corp. ad mm. 45, lat. colli 2, lat. segmenti vicesimi 2.5, long. antennarum 2.20, pedum paris decimi 1.70.

♂. Mandibularum stipes in processum longum triangularem productus; hypostomatis basilare quam idem feminae c. $\frac{1}{5}$ latius; trunci segmenti primi sternum parvum, pedum articulo primo externe in processum longum crassum parum arcuatum producto et interne in processum quam lateralis parum brevior, magis attenuatus apice retrorsum vergente; cetero pede primi paris uniarticulato apice attenuato, introrsum vergente; pedes paris secundi 6-articulati; penes breves.

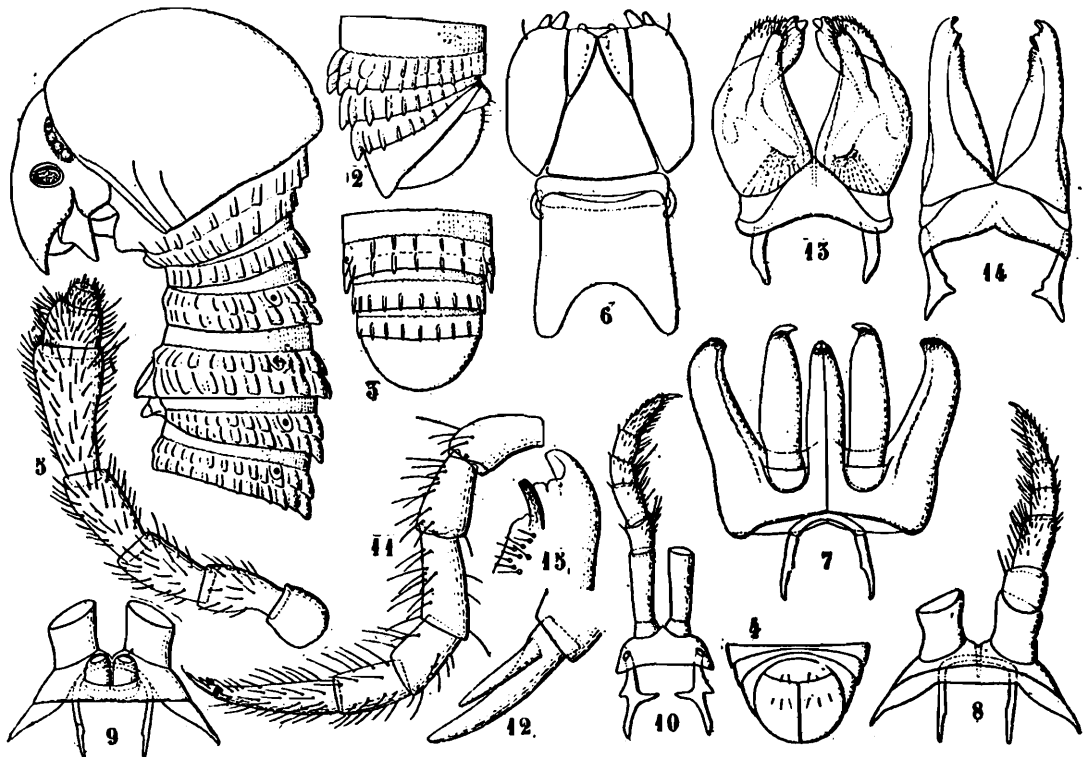


FIG. I.—*Trachyiulus mimus*; mas: 1. corporis pars antica lateraliter inspecta; 2-4. ejusdem pars postica lateraliter, supra et subtus inspecta; 5. antenna; 6. hypostoma; 7. pedes primi paris cum sterno antice inspecti; 8. pedes secundi paris cum sterno antice inspecti; 9. eorundem pars basalis cum penibus et sterno postice inspecti; 10. pedes tertii paris cum sterno; 11. pes paris decimi; 12. ejusdem pars apicalis; 13. organi copulativi pars antica; 14. organi copulativi pars postica; 15. ejusdem pars apicalis altera.

Organi copulativi par anticum et posticum vide fig. 1, 13-15.

Habitat. Exempla nonnulla vidi in Siju Cave, Garo Hills, Assam (2,000-3,600 ft. from entrance. Feb. 1922).

Observatio. Species haec inter ceteras hucusque descriptas magnitudine praetarsi spina infera et maris notis distincta est.

CHILOPODA.

Fam. GEOPHILIDAE.

Lamnonyx diversidens Silv.

A few specimens collected between 350-500 ft. from the entrance.

Himantosoma typicum Poc.

A specimen collected at 2,150 and another at 3,600 ft. from the entrance; both are males and have 57 pairs of legs.

Fam. CRYPTOPSIDAE.

Cryptops kempi, sp. nov.

(Fig. II.)

Corpus flave-ochroleucum totum, pedum maxillarium unguibus ferrugineis.

Caput lamina cephalica fere $1/7$ longiore quam postice latiore, postice libera, tergiti primi partem anticam obtegente, laevigata, setis paucis instructa, sulcis duobus posticis abbreviatis et sulcis duobus anticis dimidium caput haud attingentibus instructa, antennis 17-articulatis, articulo decimo c. $1/3$ longiore quam latiore, articulis a quarto ad ultimum setis brevissimis vestitis.

Trunci tergum primum sulcis duobus submedianis distinctis parallelis sulcum arcuatum anticum attingentibus, secundum etiam sulcis duobus tantum submedianis, tergita cetera, tertium ad antepenultimum, sulcis duobus submedianis et sulcis duobus sublateralibus arcuatis abbreviatis notata; tergum penultimum sulcis tantum duobus submedianis; tergita omnia immarginata.

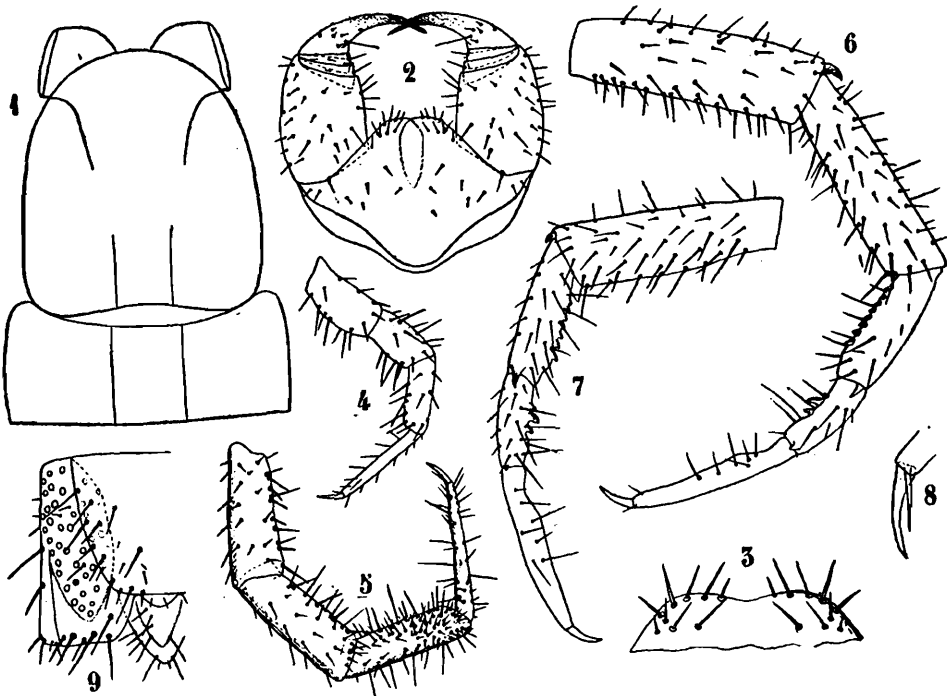


FIG. II.—*Cryptops kemp*i: 1. caput et collum prona; 2. pedes maxillares; 3. eorumdem subcozarum pars antica magis ampliata; 4.-6. pes primi, penultimi et ultimi paris a trochantero interne inspecti; 7. pes paris ultimi a femore externe inspectus; 8. pedis paris decimi pars apicalis; 9. corporis pars postica supina.

Sterna secundum ad penultimum cruciatim profunde signata, setis brevibus et brevioribus parum numerosis instructa.

Pedes maxillares subcoxis antice latis margine medio parum profunde sinuato utrimque late rotundato, setis sat robustis 5+5 submarginalibus instructis et setis nonnullis sparsis, ungue terminali longe attenuato, acute aliquantum arcuato.

Pedes ambulatorii, tarso excepto, infra setis subspiniformibus sat numerosis armati et supra setis nonnullis, tarso attenuato, setis parum

robustis et parum numerosis instructo, ungue terminali elongato robusto seta antica basali quam unguis fere $1/3$ brevior. Pedes paris penultimi tibia infra et ad apicem etiam lateraliter setis subtilibus numerosis, brevibus et sat longis instructa, nec non setis quatuor robustis spiniformibus.

Segmentum ultimum pediferum tergito postice triangulari supra medio profunde depresso, sternito lateribus parum convergentibus angulis posticis parum rotundatis, subcoxis poris c. 40, parte minore obtectis, instructis, trochantero infra et lateraliter setis numerosis robustis et spina apicali supera interna brevi arcuata armato, femore etiam setis sat robustis numerosis et spina supera laterali externa, tibia serie dentium 8 et utrimque spina apicali supera armato, articulo primo tarsali serie dentium 3 et setis nonnullis subtilibus.

Long. corp. mm. 15, lat. tergiti primi 1.40, long. pedum paris decimi 2.10, paris ultimi 4.40.

Habitat. Siju Cave (450 ft. from the entrance).

Observatio. Species haec ad *C. haasei* Attems proxima est, sed saltem armatura pedum paris ultimi distincta est.

Paracryptops indicus, sp. nov.

(Fig. III.)

Corpus ochroleucum capite ferrugineo.

Caput lamina cephalica paullum ad basim latiore quam longiore, superficie punctis tantum nonnullis setiferis instructa, sulcis nullis, postice a tergito primo oblecta, antennis 17-articulatis, ab articulo 4° sat dense et brevissime setosae, articulo decimo parum minus quam duplo longiore quam latiore.

Trunci tergita primum et secundum laevigata, tergita tertium ad penultimum sulcis duobus submedianis parallelis et duobus sublateralibus arcuatis distinctis, medio dorso carina longitudinali vix distincta.

Sterna secundum ad penultimum sulco transversali profundo, sulco longitudinali postice abbreviato.

Pedes maxillares subcoxis antice in processus duos laminares margine arcuato nudo, superficie aliquantum longe a margine setis brevibus 6-7 instructa, articulo ultimo, ungue incluso, etiam brevi, margine externo articuli secundi marginis externi longitudinem subaequante, unguis parte apicali subrecta.

Pedes ambulatorii tarso excepto infra setis sat numerosis, sat longis et robustis subspiniformibus instructi, tarso integro; pedes paris penultimi trochantero setis brevissimis robustis spiniformibus paucis sparsis instructo, femore interne spinula nonnulla, externe per dimidium faciem setis minimis vestito, tibia externe ut articulus praecedens vestito, tarso biarticulato.

Segmentum ultimum pediferum tergito postice aliquantum rotundato fovea mediana elongata instructo, sternito parum ad basim latiore quam longiore, lateribus parum convergentibus, angulis posticis rotundatis, subcoxis poris c. 40 instructis et setis nonnullis posticis ventralibus sat robustis, trochantero tantum setis brevissimis spiniformibus nonnullis ventralibus, cetero subnudo, articulis ceteris subnudis setis nonnullis brevissimis, tibia serie dentium 9, articulo primo tarsali serie

dentium 3, articulo secundo tarsali parte proximali infera arcuatim aliquantum producta.

Long. corp. ad mm. 20, lat. tergiti primi 1.3, long. pedum paris decim 2.48, paris ultimi 5.30.

Habitat. Siju Cave (350-450 ft. from entrance).

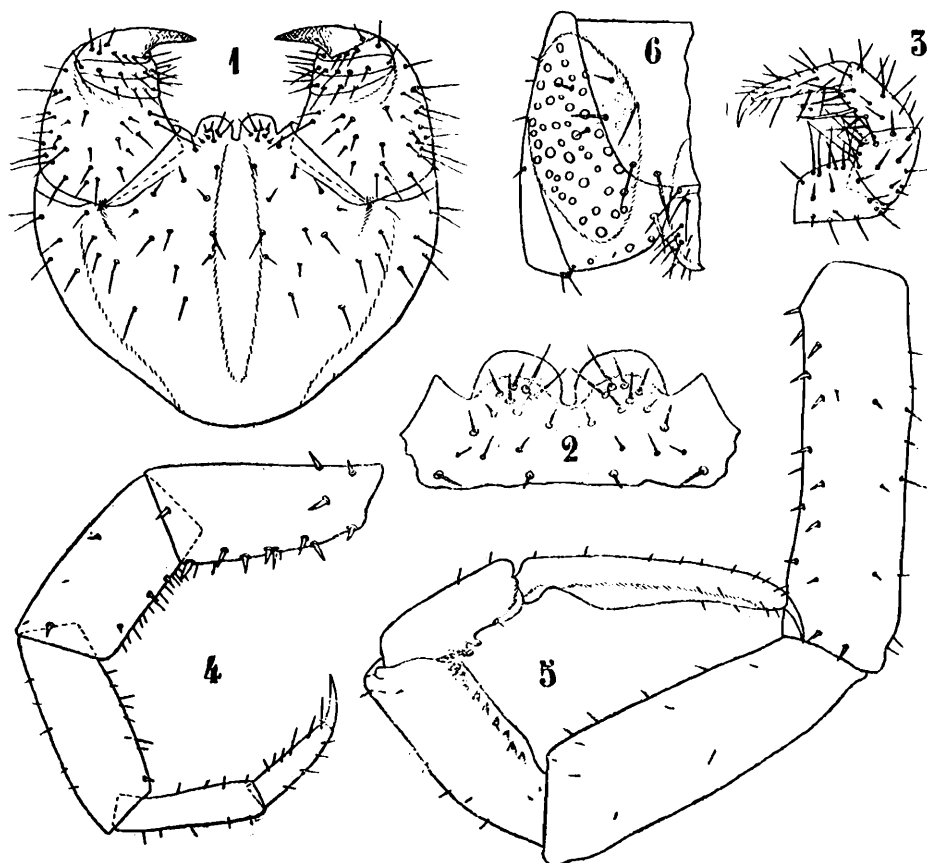


FIG. III.—*Paracryptops indicus*: 1. pedes maxillares; 2. eorundem subcoxarum primi pars antica magis ampliata; 3-5. pes paris primi, penultimi et ultimi interne inspecti; 6. corporis pars postica supina.

Observatio. Species haec ad *Paracryptops weberi* Poc. finitima est, sed pedum maxillarium articulo ultimo aliquantum longiore et pedum segmenti ultimi armatura bene distincta est.

***Thereuonema reconditum*, sp. nov.**

(Fig. IV.)

♀. Corpus supra fulvo-vinosum medio dorso et area stomatifera paulum pallidioribus, ventre pedibusque fulvescentibus.

Caput oculis bene evolutis inter sese magis quam oculi diametros longitudinalis distantibus, antennis flagelli sectione prima laminam secundam stomatiferam superante, articulinis 50-51 composita, latioribus quam longioribus, setis brevissimis numerosis et setis nonnullis brevibus apicalibus instructis (antenna laeva exempli alii flagelli sectione prima cum parte sequente confusa).

Laminae dorsuales spinis sparsis cum seta laterali numerosis, setis nonnullis brevibus separatis, antice et lateraliter, et superficie tota spinulis minimis conicis pernumeris instructa, margine laterali et postico

fere usque ad stomata serie spinarum cum setis, setis quam spinæ parum longioribus, armato.

Stomata brevia laminae quintæ long. mm. 0.40, quam areae stomatiferæ, bene convexæ, latitudo fere tripla breviora. Lamina octava (a prima stomatifera) lateribus aliquantum convergentibus, angulis posticis latissime rotundatis, margine medio subrecto, superficie et margine spinis omnino vel fere destitutis, setis numerosis marginalibus et setis nonnullis sparsis instructa.

Pedes setis numerosis, primi paris spinis nullis, septimi paris spinis paucis distantibus per femori carinas duas dorsuales et spina nonnulla per tibiæ dorsum ut fig. IV, 7-8 demonstrat; pedes penultimi spinis aliquantum magis numerosis per femoris et tibiæ dorsum et etiam per trochanteris partem ventralem. Primi paris tarsus articulinis 13+34, septimi paris 6-8+26-31, penultimi paris 7+38, paris ultimi tarsi long. mm. 47.

Appendices genitales parte proximali lateribus aliquantum divergentibus, articulo libero integro aliquantum arcuato supra setis nonnullis instructo.

Lamina supraanalis lateribus convergentibus, postice rotundata supra, præter spatium medianum nudum, spinulis setiformibus brevissimis vestita et setis nonnullis brevibus robustis instructa. Laminae

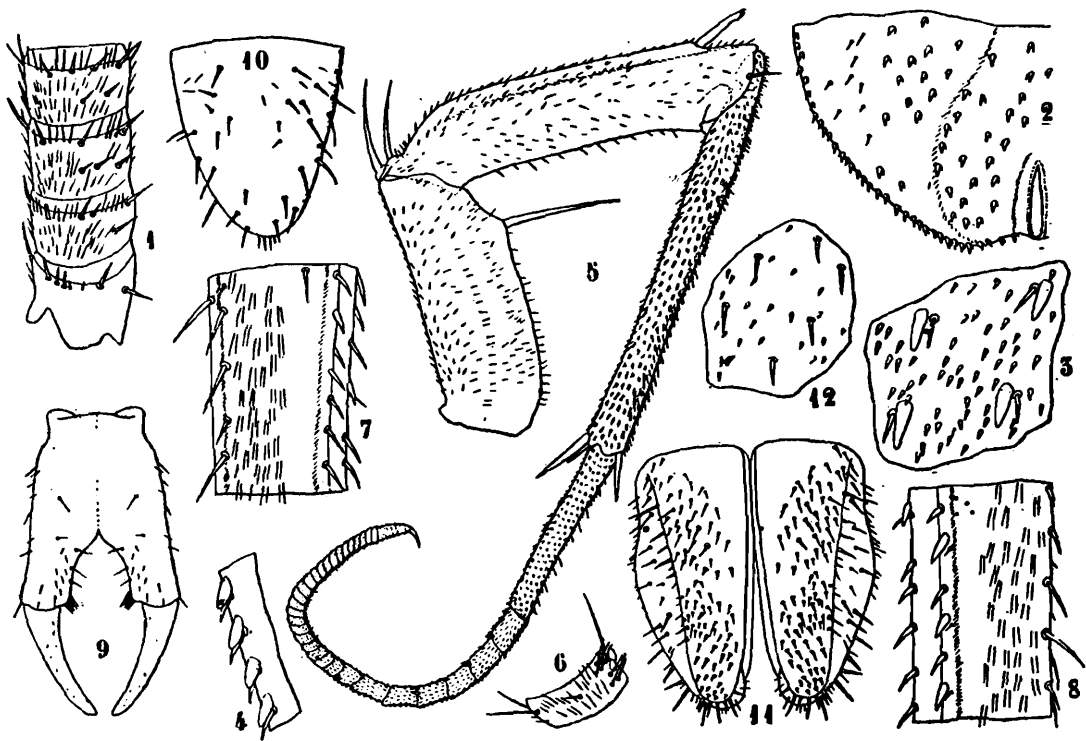


FIG. IV.—*Thereuonema reconditum*: 1. antennæ flagelli pars proximalis; 2. laminae dorsualis quintæ pars cum stomate spinulis omissis, 3. ejusdem particula cum spinulis magis ampliata; 4. ejusdem laminae marginis lateralis particula; 5. pes paris septimi; 6. tarsi articulinus partis distalis; 7-8. ejusdem pedis tibiæ pars proximalis antice et postice inspecta; 9. feminae appendices genitales; 10. lamina supraanalis; 11. laminae subanales subtus inspectæ; 12. pulli laminae dorsualis quintæ particula multo ampliata.

subanales infra spatio subrectangulari parum magis elevato, postice haud productæ, superficie infera elevata setis brevioribus robustis, cetera spinulis setiformibus brevissimis vestita et setis nonnullis brevibus robustis instructa.

Long. corp. ad mm. 22, lat. 3; long. antennarum 40, pedum paris primi 20, septimi 19, penultimi 23, ultimi 61.

♂ juvenis, corp. long. mm. 13, antennarum flagello sectione prima articulinis 38, pedum paris primi tarso articulinis 11+26, paris septimi 5+20, penultimi 5+26.

Pullus: corp. long. 6, antennarum flagelli sectione prima articulinis 29, pedum paris primi tarso articulinis 8+21, paris septimi 4+16, penultimi 4+21, Laminae dorsuales spinulis minimis sat numerosis et setis sparsis brevioribus instructae, spinis destitutae.

Habitat. Siju Cave (400-500 ft. from entrance, pulli from 2,100 ft.).

Observatio. Species haec a *Thereuonema longicorne* (Fabr.) colore et pedum armatura praesertim distinctissima est, a *T. jeae* (Poc.) flagelli sectione prima brevior et pedum armatura et tarsi articulinis minus numerosis distincta est.

***Thereuonema nobile*, subsp. *dolichopoda*, nov.**

(Fig. V.)

♀. Corpus dorso rufo-vinoso area stomatifera isabellina, ventre pallide terreo, pedibus subtestaceis, femore parte mediana excepta atro-violaceo, tibiae parte proximali vix vinosa.

Caput oculis magnis diametro longitudinali c. mm. 2, antennis corporis longitudinem superantibus, flagelli sectione prima laminam quintam stomatiferam superante, articulinis 73-82-85 composito, articulinis elongatis paucis, praesertim proximalibus, latioribus quam longioribus, aliis subaeque longis atque latis, aliis parum longioribus quam latioribus, setis minimis vestitis et articulinis c. dimidiaie partis proximalis superficie apicali supero-antica spinula 1-2 aucta.

Laminae dorsuales spinis sparsis cum seta laterali numerosis, praesertim super aream stomatiferam, setis nonnullis separatis per partem anticam et superficie tota spinulis conicis minimis pernumerosis aucta; margine laterali et laterali-postico serie spinarum cum setis lateralibus inter sese paullum remotarum armato. Stomata longa, laminae quintae mm. 3 longa, areae stomatiferae latitudinem aequantia.

Lamina octava lateribus postice convergentibus, angulis posticis rotundatis, margine postico medio vix inciso, superficie nuda, tantum postice et per marginem totum spinis armata.

Pedes articulo tertio et quarto subtus postice serie spinarum subcontiguarum armato, articulo quarto subtus antice serie spinarum inter sese aliquantum remotarum in corporis partis postica contiguarum, supra seriebus tribus spinis subcontiguarum, tibia subtus antice et postice spinis nonnullis inter sese multo remotis, supra (tibiis pedum 1-4 exceptis) seriebus tribus spinarum contiguarum et tarsi articulinis proximalibus spinula nonnulla postica, praesertim ad spicem.

Pedes primi paris tarso articulinis 29-33+67-73, septimi paris 18+39 penultimi paris 15+56; pedes ultimi quam corpus triplo longiores.

Appendices genitales parte proximali lateribus aliquantum divergentibus angulo apicali interno setis numerosis brevibus instructo, articulo libero aliquantum arcuato, margine interno integro, nudo.

Lamina supraanalis lateribus aliquantum convergentibus, postice rotundata, superficie spatio mediano longitudinali angusto nudo, cetera spinulis elongatis setiformibus minimis vestita et setis sparsis brevibus sat robustis sat numerosis instructa.

Laminae subanales infra per spatium rectangularem elevatae, lateribus aliquantum divergentibus postice subconicae aperturam analem aliquantum superantes, parum arcuatae convexitate dorsuali, superficie infera setis brevissimis robustis instructa superficie cetera eidem laminae dorsualis simili.

Long. corp. ad mm. 55, lat. 8, long. antennarum 120, pedum primi paris 70, septimi paris 50, penultimi 99, ultimi 170.

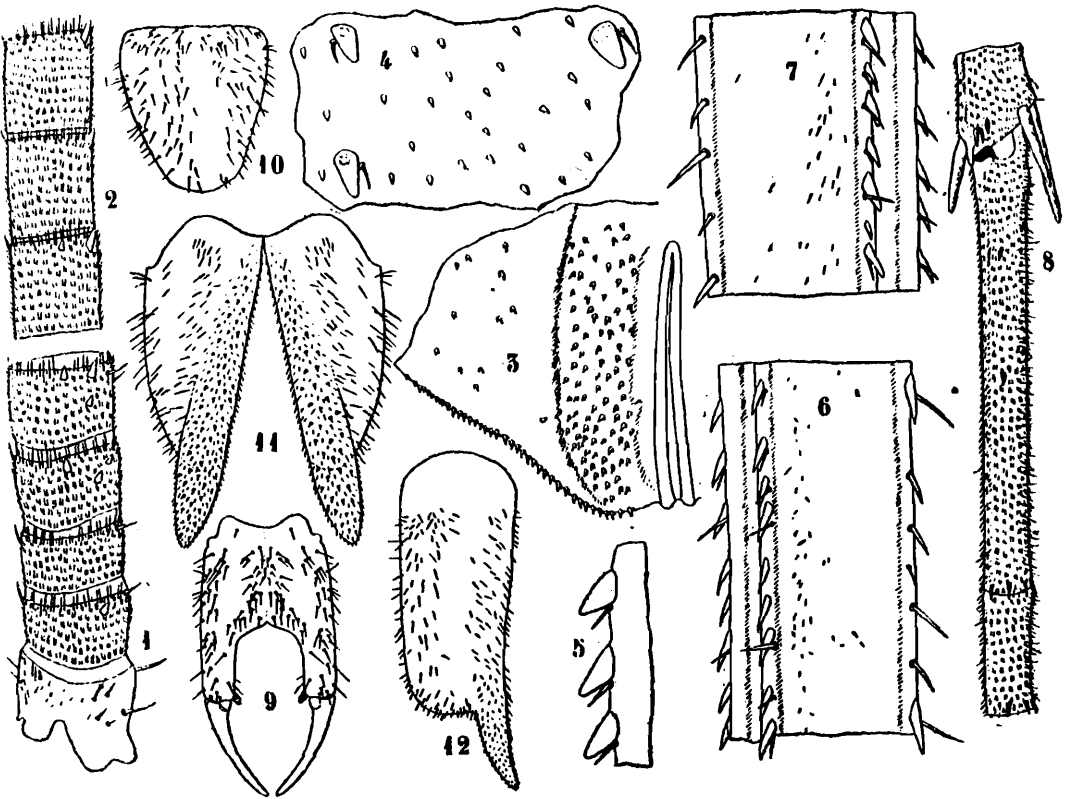


FIG. V.—*Thereuonema nobile* subsp. *dolichopoda*: 1. antennae flagelli pars proximalis; 2. ejusdem pars mediana; 3. laminae dorsualis quintae pars cum stomate spinulis omissis; 4. ejusdem particula cum spinulis magis ampliata; 5. ejusdem laminae marginalis particula; 6. tibiae paris septimi pars proximalis antice inspecta; 7. ejusdem pars postice inspecta; 8. tibiae septimae pars apicalis et tarsi pars proximalis; 9. feminae appendices genitales; 10. lamina supraanalis; 11. laminae subanales subtus inspectae; 12. lamina subanalis externe inspecta.

♀. Exemplum immaturum corp. long. mm. 32, lat. 5, long. antennarum 90, pedum primi paris 50, septimi 40, penultimi 83.

Antennarum flagelli sectionis primae articulini 80.

Pedes primi paris tarso 27+69, paris septimi 17+43, paris penultim 13+57

Habitat. Exempla nonnulla Dr. Annandale in "Batu Caves," apud Kuala Lumpur, Malay Peninsula legit.

Observatio. Subspecies haec a forma typica *T. nobile* Templ. (= *T. decipiens* Verh.) ex Nicobari a me inspecta antennarum flagelli sec-

tionis primae articulinis partim longioribus, pedibus fere $1/3$ longioribus, laminis subanalibus aliquantum divergentibus saltem distinguenda est.

Exemplum ♀ ex Kateball (ins. Nicobari), quod ut *T. nobile* considero, corp. long. ad mm. 55, lat. 8, long. pedum primi paris 45, septimi paris 38, penultimi paris 70.

Flagelli sectio prima articulinis 7-8 composita.

Tarsus primi paris articulinis 29+56, septimi paris 25+41, penultimi paris 17+57.

ON SOME CAVERNICOLOUS ORTHOPTERA AND DERMAPTERA FROM ASSAM AND BURMA.

By L. CHOPARD, D. Sc.

(Plates IV, V.)

Thanks to Dr. N. Annandale and his collaborators I have had the opportunity of working out a third series of Indian cavernicolous Orthoptera and Dermaptera¹. This series is chiefly composed of collections made by Dr. S. Kemp and Mr. B. Chopra in the Siju Cave (Garo Hills), to which a few species from Lakadong Cave (Jaintia Hills), collected by Mr. R. Friel, have been added and also several obtained by Dr. Annandale in a cave in the Southern Shan States of Burma.

The study of this collection has proved most interesting; not only are 6 of the 10 species new, but 4 of them show distinctive features of such importance as to form the types of new genera. But still more interesting is the fact that two of these species belong to groups which, till now, had showed no truly cavernicolous representatives. Such is the case with a remarkable Nemobiid and with an earwig belonging to the genus *Forcipula*. If the latter does not show very distinct characters of adaptation to cavernicolous life, save the absence of wings and a pubescence more abundant than usual, the former² is remarkably decolourized and shows clearly the influence of cavernicolous life in a group in which, as stated above, it had not yet been detected.

Lastly I would lay stress on the discovery in the Lakadong Cave of a most remarkable, quite blind, species of *Diestrammena*, the first blind cavernicolous Stenopelmatid known. It is, indeed, very curious to see that those insects which are so often taken as beautiful examples of adaptation to cavernicolous life present, as a rule, scarcely reduced organs of sight and that the blind species here referred to is absolutely isolated, no congeneric form showing any definite transition to it. Further the blind *Diestrammena* does not possess longer palpi, limbs or other appendages than other cavernicolous or even lucicolous species of the genus. It seems that the theory of modifications "compensatrices de l'impossibilité de voir" cannot be taken into consideration here. This is still more evident when we observe cavernicolous species of the nearly related genus *Rhaphidophora* which preserve in caves exactly the same stout form and relatively short appendages shown by all the species of the genus. The same parallel can be drawn between the European genera *Dolichopoda* Bol. and *Troglophilus* Krauss.

Finally we must point out that the blind *Diestrammena* has been taken in the same cave and very probably in the same place as another species of the same genus, very closely related to it, but with quite well-developed eyes (both species were mixed together in the same tube and

¹ See the first two series in *Mem. As. Soc. Bengal* VI [1919] pp. 339-396, pl. xii-xiv and *Rec. Ind. Mus.* XXII [1921] pp. 511-527, pl. xxi-xxiii.

² It should be noted, however, that this species was found only at the entrance to the cave in broad daylight. [S.K.]

had been confounded by the collector). It seems that we must conclude from this either that two species of common origin have colonized the same cave at periods different enough to explain the fact that only one of them has become strongly modified, or preferably that one of the two forms has proved much more plastic than the other. This second interpretation seems more logical and, owing to the absence of intermediate phases, we are brought to the conclusion that the blind form may have originated from a common ancestor by sudden mutation rather than by slow modifications due to the influence of the surroundings.

ORTHOPTERA.

Family BLATTIDAE.

Subfamily CORYDIINAE.

Genus **Polyphaga**.

Polyphaga sp.

Hsin Dawng Cave, Elephant Hill, Yawngghwe, S. Shan States, 13th March 1922; 1 immature ♂ under stone in complete darkness.

It is quite impossible to describe or recognize this species from this single male specimen in its last larval instar. It is at any rate the first species of the genus found in a cave and it must be quite well acclimatized there. When adult the species must be of a medium or rather small size, very likely to be ascribed to the *africana* group. The colour is rather pale, the eyes far distant from one another (the disposition may change at the last moult); the spines of the tibiae are moderately strong, regularly disposed; intermediate tibiae with 7 superior spines (3+2+2) and 3 inferior (2+1); posterior tibiae with 10 superior (3+3+4) and 6 inferior spines (4+2).

Subfamily PANCHLORINAE.

Genus **Pycnoscelus** Scudder.

Pycnoscelus surinamensis L.

(Pl. IV, fig. 2.)

Siju Cave, Garo Hills, (S. Kemp and B. Chopra, Feb. 1922); 350-400 feet from entrance; 16 ♀ and very numerous young individuals at all stages of development.

All these Blattids present a dark colouration and do not show the least difference from lucicolous specimens of the species. Among the 16 adult ♀, 2 only belong to the long-winged form, the other 14 having the elytra and wings extending scarcely to the apex of the abdomen. As usual, the ♂ seems to be very scarce; in fact among the Siju Cave material, I have not been able to find a single ♂ although I have examined almost the whole material for that purpose.

Pycnoscelus striatus Kirby, which I have previously reported from Malay Caves, is very closely related to the present species; but the ♂ is very easily distinguished, for in *P. striatus* the 8th sternite is square

and the 9th is exposed, longitudinally divided and united with the genitalia, whereas in *P. surinamensis*, the 8th sternite is rounded posteriorly, the 9th completely hidden and bearing one style. The ♀ is much more difficult to characterize, the general aspect being almost the same in both species; the head is more exposed in *P. striatus*, the forehead more flattened and the eyes wider and more distant than in *P. surinamensis*; the ocelli are also much bigger and more approximate to the eye (figs. 1 and 2).

Family PHASGONURIDAE.

Subfamily RHAPHIDOPHORINAE.

Genus *Diestrammena* Brunner.

Diestrammena indica Chopard.

Hsin Dawng Cave, Elephant Hill, Yawngghwe, S. Shan States, 13th March 1922; 2 immature ♀.

Nothing is to be added to the description I gave in these *Records* [1921, p. 519]. The species is still known from the immature female only.

Diestrammena brevifrons frieli, subsp. nov.

(Pl. IV, figs. 3-5.)

1921. *Diestrammena brevifrons*, Chopard, *Rec. Ind. Mus.* XXII, p. 518.

Types.—One male, one female from Lakadong Cave, Jaintia Hills (R. Friel, July 1921).

Very closely allied to typical *D. brevifrons* of which it has the same general shape and colour but from which it differs in the following characters:—

Almost completely glabrous; frontal rostrum shorter, composed of two more widely separated tubercles (fig. 3); subgenital plate of ♀ not so regularly rounded posteriorly, nearly truncated (fig. 4); epiphallus of ♂ with almost straight sides and with less rounded angles (fig. 5). Legs longer; intermediate tibiae with a very small spine on the internal inferior margin; posterior tibiae armed with 35 to 40 spines, supero-internal apical spur equalling metatarsus.

Length of body 13 mm.; ant. fem. 9 mm.; ant. tib. 10.5 mm.; interm. fem. 10 mm.; interm. tib. 10.5 mm.; post. fem. 20 mm.; post. tib. 23 mm.

The *Diestrammena* I recorded (*l. c.*, p. 518) from Rupmath Cave belongs to this subspecies, the typical *brevifrons* being known only from Maosmai Cave.

Diestrammena caeca, sp. nov.

(Pl. IV, figs. 6-11.)

Types.—Two females from Lakadong Cave, Jaintia Hills (R. Friel, July 1921).

Size medium, colouration uniformly of a pale testaceous, without any trace of brown pigment; almost wholly glabrous.

Head long and rather narrow; occiput weakly convex, front declivous, frontal rostrum very short, composed of two rounded, widely

separated tubercles (fig. 8). Antennae yellow (broken off), their bases very approximate, a small tubercle between the sockets; facial shield smooth, glabrous; clypeus rather high, narrowing near the labrum; labrum elongate, ovoid. Mouth parts long, yellowish; galea and lacinia very long and straight, maxillary palpi wanting; labium elongate, labial palpi moderately long (fig. 9). Absolutely no trace of eyes and ocelli (figs. 6 and 7).

Pronotum rather wide, with anterior margin convex, weakly notched in the middle, posterior margin rather strongly convex, lateral lobes moderately high, their inferior margin convex, angles rounded; meso- and metanotum with posterior margin convex, lateral lobes with inferior border almost straight.

Abdomen oval; supra-anal valve triangular, subgenital plate trapezoidal, with posterior margin slightly sinuated (fig. 10). Cerci failing. Ovipositor broken at apex, rather short, gently curved from base; it seems quite smooth up to the apex.

Legs long and slender, pale yellow; anterior femora armed with 1 external movable spine and 1 internal very short one; tibiae with 2 apical spurs, 1 very small spine between the spurs, and 1 spine only on the inferior external margin. Intermediate femora armed with 2 long, movable, apical spurs; tibiae unarmed except the apical spurs. Posterior femora unarmed beneath but with a very small genicular spine inside; tibiae armed with 6 apical spurs, not very long but very slender, the supero-internal one shorter by one-fourth than the metatarsus (fig. 11); superior margins of tibiae armed with 18-20 very short and remote spines. Tarsi long and slender.

Length of body 13 mm.; pronot. 4 mm.; ant. fem. 11 mm.; ant. tib. 11.5 mm.; post. fem. 18.5 mm.; post. tib. 20 mm.; ovipositor 8 mm.

I can only refer the reader to what I said in the introduction about this most interesting species.

Genus **Tachycines** Adelung.

Tachycines adelungi Chopard.

(Pl. IV, figs. 12, 13.)

Hsin Dawng Cave, Elephant Hill, Yawngwhe, S. Shan States, 13th March 1922, 3♂, 1♀, a few young individuals of both sexes.

There is very little to add to the description I gave of this species (*Rec. Ind. Mus.* XXII, p. 520); the subgenital plate of the ♀ is triangular, slightly emarginate at apex (fig. 12); the ovipositor is rather short (10 mm.), as long as the cerci, scarcely curved, very acute at the apex, the inferior valves presenting 6 wide teeth (fig. 13).

Family GRYLLIDAE.

Subfamily NEMOBIINAE.

Genus **Speonemobius**, nov.

Allied to *Nemobius* Serv.; head big, rounded, legs relatively long; anterior tibiae with a large, oval, external foramen; posterior tibiae

armed with 3 external and 2 internal spines, and 5 apical spurs, 2 internal and 3 external. Elytra of ♂ as in *Nemobius*; ♀ unknown.

Genotype : *Speonemobius decoloratus*, sp. nov.

***Speonemobius decoloratus*, sp. nov.**

(Pl. IV, figs. 14–17.)

Type.—One male from Siju Cave, Garo Hills (S. Kemp and B. Chopra Feb. 1922); at entrance.

Size and general aspect of a *Nemobius* (fig. 14). Head relatively big, whitish; front with 4 rows of bristles, 2 of which extend between the antennae; face adorned with two narrow indistinct, brown stripes and a brown spot beneath each eye. Mouth parts yellowish; palpi wholly white, the last joint of the maxillary palpi showing only a small greyish stripe inferiorly, 4th joint shorter than 3rd, 5th large, triangular (fig. 15). Antennae pale testaceous, with a certain number of brown narrow rings. Eyes moderately large, brown; ocelli very small.

Pronotum longer than wide, with anterior margin almost straight, provided with long bristles, posterior margin scarcely sinuated; lateral lobes not very high, their inferior border strongly sinuated, angles rounded; general colour whitish with 2 pyriform, brownish spots on the disk and posterior margin of lateral lobes blackish; disk with long, scarce, bristles.

Abdomen pale testaceous, with sides brownish, very pubescent, supra-anal valve large, lengthened, rounded at apex; subgenital plate short, blackish. Cerci testaceous.

Legs relatively long, mostly whitish, anterior coxae bearing a few long black bristles; anterior femora compressed, slightly greyish at apex, presenting a few bristles on their inferior margins and near the apex of the internal side; tibiae light greyish, darkened at apex, armed with 2 apical spurs, the internal longer than the external one, and bearing a large oval foramen at the external face; tarsi long, base of metatarsus, 2nd joint and apex of 3rd joint blackish. Intermediate legs similar to anterior ones. Posterior femora moderately dilated, light testaceous with a few short brown stripes on external face; tibiae greyish, darkened at apex and at base of each spine, armed with 5 spines and 5 apical spurs; the spines are whitish, 2 internal and 3 external ones, the latter of moderate length, subequal, the former long and slender, inserted between the 2nd and 3rd external and between that one and the apex; 3 external spurs, the inferior very tiny and short, the other 2 rather short but the intermediate longer than the superior one (fig. 16); the 2 internal spurs are long, gently curved, whitish, the superior somewhat the longer (fig. 17); tarsi long, pale testaceous, with apex of metatarsus, 2nd joint and apex of 3rd joint blackish, metatarsus very long, armed with 2 apical spurs.

Elytra (fig. 14) a little shorter than abdomen, rounded at apex, with a blackish ground colour, the whitish veins and posterior margin standing out in relief on the back-ground; discoidal vein somewhat distant from the humeral, to which it is united by a few veinlets; anal vein broken at right angle, diagonal vein rather short, straight; cords

regularly distant, curved, the internal one united to the speculum by a veinlet; speculum rather large, divided into a very large internal cell and 2 small external ones; apical area very short, formed of a few indistinct cells; lateral field black except the whitish humeral band with 3 plain, parallel nerves besides the mediastinal one.

Length of body 9 mm.; pronot. 1.6 mm.; elytra 5 mm.; ant. fem 3 mm.; post. fem. 7.5 mm.; post. tibiae 6 mm.

Although found at the entrance of the cave, this species is remarkably decolourized; the very peculiar armature of the posterior tibiae makes it necessary to create a new genus for it.

Subfamily PHALANGOPSINAE.

Genus *Larandopsis*, nov.

General shape and aspect of a Phalangopsine of the group *Laranda* Walk., but both sexes with elytra and wings developed; pronotum with lateral lobes subtriangular; anterior tibiae with a foramen on their internal face; posterior femora rather short with no apical filiform part; posterior tibiae presenting very small denticles in their basal part and between the spines which are 4 in number on each margin; 6 apical spurs, the external ones very short, the supero-internal longer than the other two.

Genotype: *Larandopsis choprai*, sp. nov.

This genus is closely allied to the different genera of Phalangopsinae with short femora, but it seems to be the only one with elytra and wings developed in both sexes. Unfortunately the types of the species are immature, so that important features, such as the venation of the elytra, are completely unknown. Yet the development of these organs is quite sufficient to assert positively that they exist in the adult ♀ as well as in the ♂.

Larandopsis choprai, sp. nov.

(Pl. IV, figs. 18-21.)

Types.—One young ♂, one young ♀ from the Siju Cave, Garo Hills (S. Kemp and B. Chopra, February 1922), at entrance. 2 other young ♂ at entrance and at 500 feet from entrance.

Size medium (?); colouration rufous testaceous varied with brown. Head a little narrower than pronotum; occiput moderately convex, adorned with 4 narrow brown lines, 1 behind each eye, and 2 near the middle, widening forward up to the base of frontal rostrum; this is about as wide as the first antennal joint, rather elongate, its margins parallel (fig. 18). Eyes rounded, somewhat prominent, ocelli very small, rounded, whitish, anterior one at apex of the rostrum, on its anterior face, posterior ones at base of it. Face declivous, yellowish, with a median brownish band on the top of facial shield, divided in its inferior part, and joining on each side with band of same colour below each eye. Maxillary palpi yellow, somewhat brownish outside, with 5th joint very long. Antennae brown, long.

Pronotum wide, somewhat convex above, anterior margin slightly notched, fringed with bristles, posterior margin straight, disk brownish

with an irregular median whitish band and a large, more or less rounded, yellowish spot on each side (fig. 18); lateral lobes almost triangular (fig. 19), fuscous with a small yellow spot.

Elytra and wings present in both sexes.

Abdomen covered above with a golden pubescence, yellowish in the middle, brownish laterally; supra-anal valve elongate, subtriangular. Cerci very long, as long as the body.

Legs rather long, yellowish with brown bands; anterior femora showing the trace of a foramen inside; anterior and intermediate tibiae with 3 brown rings, armed at apex with 2 small inferior spurs. Posterior femora rather stout and short, gently narrowed apically, showing a few brown spots on the external face; posterior tibiae with 2 basal brown spots, armed with 4 pairs of spines, moderately long, the internal longer than the external ones; a few very small denticles in the basal part of the tibiae and between the spines on the external margin only (3+1+1); external spurs very short, the intermediate about twice as long as the other two (fig. 20), infero-internal spur rather short, the intermediate and superior ones very long, straight, hairy, the superior as long as the metatarsus (fig. 21), metatarsus armed with 2 apical spurs and a few denticles (4 or 5) on the external margin only.

Length of body 10 mm.; cerci 10 mm.; post. fem. 9.5 mm.; post. tibiae 9 mm.

Although we should avoid describing new species from immature specimens, especially when dealing with winged species, I consider that the characters offered by the insect here described are quite sufficient to recognize it in future when the description can be completed by the indication of some features which are wanting, such as the venation of the elytra in the ♂ and the shape of the ovipositor in the ♀.

Genus **Kempiella**¹ nov.

Very closely allied to *Arachnomimus* Sauss., the posterior tibiae having, as in that genus, the supero-internal spur shorter than the intermediate, but elytra present in ♂, short and with very abnormal venation: speculum incompletely closed posteriorly, one cord only well marked united to the internal side of the speculum by 4 veinlets.

Genotype: *Kempiella longipes*, sp. nov.

Kempiella longipes, sp. nov.

(Pl. V, figs. 22-34.)

1921. *Arachnomimus* sp., Chopard, *Rec. Ind. Mus.* XXI, p. 523.

Types.—One male, one female, from Siju Cave, Garo Hills (S. Kemp and B. Chopra, Feb. 1922); 1,600 to 2,000 feet from entrance.

Cotypes.—Same locality: 200 feet from entrance, 2 young ♂, 3 young ♀; 400 feet from entrance, 2 young ♀, 1 young ♂; 450-500 feet from entrance, 2 young ♂, 1 adult ♀, 2 young ♀; 1,200 feet from entrance, 1 ♂, 1 very young ♂, 1 very young ♀ under stone; 1,600 to 2,900 feet

¹ I take much pleasure in naming this new genus in honour of Dr. S. Kemp to whom is due its discovery.

from entrance, 1 ♂, 4 ♀, 3 young ♂, 3 young ♀; 3,000 to 3,600 feet from entrance, 1 adult ♀, 1 young ♂, 2 young ♀.

Male (fig. 22). Size medium, colour testaceous marked with dark brown. Head small, testaceous; occiput and forehead slightly convex, covered with black hairs; frontal rostrum somewhat wider than first joint of antennae, rounded at apex; face yellowish, glabrous, shining; cheeks darkened; facial shield ending in a wide process between the antennae, with a short brown line on each side. Mouth parts whitish, short; maxillary palpi (fig. 23) very long, the 1st and 2nd joints short, white, the three last ones very long and slender, brownish, 5th scarcely widened at apex; labial palpi rather short, whitish. Antennae long, brown. Eyes small, narrow, ocelli absent.

Pronotum much wider than long, its anterior and posterior borders straight, lateral lobes much diverging from the body, with inferior margin rather strongly oblique backwards (fig. 32), anterior angle somewhat rounded; anterior and posterior borders with a row of bristles, surface covered with a fine golden pubescence with long blackish hairs, chiefly near the middle; disk almost flat, with a median furrow and two rounded elevations in the anterior part; colour yellowish above, fuscous laterally. Mesonotum whitish with posterior border thickened and sinuated, presenting 2 rounded tubercles near the middle; metanotum much like the mesonotum but with tubercles and ridge more accentuated and colour more testaceous.

Abdomen yellow with sides and apical margin of the tergites brownish, covered with a golden pubescence, rather strongly narrowed posteriorly; 10th tergite presenting 2 long rounded processes (fig. 24); subgenital plate rather long, subtruncated at apex, with 2 small blackish spots near the base. Cerci extremely long and slender, much longer than the body.

Genitalia (fig. 25) composed of membranous valves and a strongly chitinized pseudepiphallus, subtriangular, formed of a superior part, divided into 3 acute processes, and an inferior bifid part.

Legs long and slender, testaceous, the apex of femora darkened. Anterior tibiae with a small oval tympanum near the base, inside (fig. 26), their apex armed with 2 rather long, inferior spurs; tarsi very long, chiefly the metatarsus, which is almost cylindrical, armed with spinules beneath (fig. 27). Intermediate legs similar to anterior ones. Posterior femora very abruptly narrowed near the middle, unarmed; posterior tibiae very long, armed with 6 apical spurs and 4 spines on each superior margin; these spines are inserted in the second half of the tibia, the external somewhat above the internal ones; there are a few very small denticles between the spines; external apical spurs much shorter than the internal ones, the inferior very short, the 2 superior long and subequal (fig. 28); infero-internal spur short, the 2 supero-internal much longer, chiefly the intermediate one (fig. 29). Tarsi long, the metatarsus much longer than the other two articles, armed above with a few very small denticles and with 2 rather strong apical spurs, the internal of which is longer than the external (fig. 30).

Elytra extending to the apex of the second abdominal tergite, blackish, with the anal field and a band along the external margin testaceous,

lateral field rather high, blackish. Neuration very abnormal (fig. 31 and 32) : mediastinal vein with numerous parallel, almost straight and indistinct branches ; discoidal vein much distant from the median ; diagonal vein very short ; speculum large, triangular, with a few posterior, more or less incompleated areas, mixing themselves with the short apical field ; 3 oblique veins ; cords quite indistinct except the 1st one which is united to the mirror by 4 transverse veinlets. Left elytron translucent, with the same venation.

Female. General shape and colour as in male, but apterous ; meso- and metanotum without tubercles and with posterior margin straight, wholly blackish ; 1st abdominal tergite blackish with a white band along the posterior margin. 2nd and 3rd tergites yellowish laterally, the rest more or less completely brownish ; 10th tergite plain, supra-anal valve rounded ; subgenital plate rather elongate, slightly notched at apex. Ovipositor long, very feebly curved upwards (fig. 33), apical valves very little dilated, their margins smooth, the superior ones finely striated (fig. 34).

Length of body 10.5–12.5 mm. ; pronot. 2.5 mm. ; width of pronot. 4 mm. ; ant. fem. 9–10 mm. ; ant. tib. 9–10 mm. ; interm. fem. 8.5–9.5 mm. ; interm. tib. 8.5–9.5 mm. ; post. fem. 14 mm. ; post. tib. 16 mm. ; cerci 17 mm. ; ovipos. 9.5 mm. ; antennae about 50 mm.

This interesting species shows very constant characters, both in individuals found near the entrance of the cave and in those which have been taken at a great distance from the entrance ; the eyes are as well developed in the latter as in the former. Young individuals do not show any special character ; they never present the least trace of wings. In the ♂ the elytra begin to develop rather late and, in the last stage, they are rounded, slightly overlapping, black ; in young ♂, up to the last moult, the meso- and metanotum are plain and the 10th tergite presents only small tubercles in place of the prominent processes of the adult.

DERMAPTERA.

As stated in my previous report (*Rec. Ind. Mus.* XXI, p. 511), the species of this group which live in caves do not present very conspicuous characters of adaptation to cavernicolous life. But as most of them live in obscurity and are usually hygrophilous insects, they find in caves conditions very favourable for their mode of life and some of them are completely adapted to this special habitat.

Family FORFICULIDAE.

Subfamily LABIDURINAE.

Genus *Forcipula* Bolivar.

Forcipula trispinosa Dohrn.

Bank of Someswari River, near mouth of Siju Cave : 2 ♂, 2 ♀.

This species is not to be included in the list of cavernicolous Dermaptera, as it has never been found inside caves, the specimens I formerly reported (*l. c.*, p. 511) from the Siju Cave belonging to the subsequent species.

Forcipula borellii,¹ sp. nov.

(Pl. V, figs. 35–41.)

1921. *Forcipula trispinosa*, Chopard, *Rec. Ind. Mus.* XXI, p. 511.

Types.—One male, one female, from the Siju Cave, Garo Hills (S. Kemp and B. Chopra, Feb. 1922); 400 to 450 feet from entrance.

Cotypes.—Same locality, 300 to 500 feet from entrance, 5 ♂, 9 ♀, 10 young individuals at different stages of development.

Male (fig. 35). Rather slender, fuscous, legs light yellow, all the femora with a wide brown ring. Pubescence short but abundant on all parts of the body, appendages and elytra. Head depressed, almost quadrangular, occiput and forehead fuscous with a small yellowish spot near each eye; clypeus yellowish; labrum fuscous; palpi yellowish with last joint brown. Antennae dark brown, composed of 31 joints, 2nd very small, 3rd long, 4th shorter than 5th, the following ones becoming long and slender (fig. 36).

Pronotum somewhat longer than wide, deeply impressed in the middle, its anterior part smooth, posterior part feebly shagreened, lateral margins a little raised, yellowish, disk fuscous.

Abdomen rufous brown, very finely punctuated, covered with a short, golden pubescence, each tergite showing a few long bristles along the posterior margin, and two smooth, glabrous, longitudinal stripes on each side; 4th to 8th tergites with a row of very minute tubercles along the posterior margin, 3rd to 5th with a lateral spine, rather stout on the 3rd, long and stout on the 4th and 5th, 6th tergite with a lateral tubercle (figs. 35 and 37); 10th tergite almost smooth, shining, somewhat depressed in the middle, presenting two oblique and very obtuse keels ending in a tubercle. Superior face of the body covered with an abundant, rather long, golden pubescence, subgenital plate subangular. Forceps (figs. 38 and 39) presenting a basal dentiform keel, inner side of the branches minutely spinose, chiefly in the apical third, bearing near the anterior third a strong tooth directed backwards and a short tuberculiform one at a little distance. Pygidium large, triangular, rounded at apex.

Legs yellowish, rather long and slender; front femora swollen, very little darkened inside, intermediate and posterior ones with a wide brownish ring after the middle; tibiae darkened at base; tarsi pale yellow with 1st article a little longer than 3rd.

Elytra fuscous, pubescent, somewhat widened near the apex; keel present at shoulder only, apical margin straight. Wings concealed by the elytra, but attaining, however, half the length of the 1st abdominal tergite, the reduction bearing much more on the posterior part than on the anterior; the latter is as developed as the former which is considerably reduced, thin and with scarcely perceptible veins (fig. 40).

Female. General shape as in ♂, but without lateral spines on the abdomen, 10th tergite very little narrowed posteriorly, furrowed in the middle, with posterior margin straight and presenting 2 small tubercles

¹ Named in honour of Dr. A. Borelli, of Turin, who has had the kindness to examine specimens of this species and to point out the differences between it and the small forms of *F. trispinosa*.

Forceps long, stout, the branches triangular at base, denticulate at the inner side, and presenting a rather long tooth near the apical fourth, curved at apex (fig. 41).

Length of body, ♂ 17 mm., ♀ 18 mm.; pronot. 2.2 mm.; elytra 3 mm.; wings 2 mm.; forceps, ♂ 8 mm., ♀ 5 mm.

Individual Variations. The size is rather variable, from 15.5 to 18 mm.; in the male, the forceps vary from 6.5 to 9 mm. in length, but always preserve the same general shape and denticulation; the spines of the abdomen are rather inconstant, especially the 1st and 4th, the latter being almost always reduced to a tubercle as in the typical specimen, whereas sometimes both of them are almost completely absent.

In some respects this species shows much affinity with *F. trispinosa* and its var. *minor* Burr; it is about the same size and has the short wings of the latter, but the forceps are quite different, more like those of typical *trispinosa*, although showing important differences, such as the presence of a basal crest and of a second internal spine.

Subfamily *CHELISOCHINAE*.

Genus **Chelisoches** Scudder.

Chelisoches morio F.

Siju Cave, Garo Hills (S. Kemp and B. Chopra, Feb. 1922); 400 to 500 feet from entrance, 3 ♂, 4 ♀; at entrance 1 ♀.

A very common species already reported from different caves in India. The cavernicolous specimens are absolutely similar to the lucicolous ones.

Subfamily *FORFICULINAE*.

Genus **Timomenus**, Burr.

Timomenus lugens Bormans.

Siju Cave, Garo Hills (S. Kemp and B. Chopra); at entrance, 1 ♂.

A lucicolous species, not uncommon in India, which had never before been reported from caves.

APPENDIX.

Some of the descriptions I gave in my previous papers on Indian cavernicolous Orthoptera require the following rectifications:—

Phyllodromia nigrocincta Chop., *Mem. As. Soc. Beng.* VI [1919], p. 343. This species is an *Ischnoptera* as is clearly shown by the drawing I gave of the venation of the wing (*l. c.*, fig. ii); it seems rather closely allied to *I. cavernicola* Shelf.

Thanks to Dr. R. Hanitsch, I have had the opportunity to study two female specimens of *Ischnoptera cavernicola* Shelf from Jibong Cave (Sarawak). This species is much nearer to my *I. nigrocincta* than I had thought; the general colour and shape is almost exactly the same but it can be readily distinguished by the shape of supra-anal and sub-genital plates, as follows:

Supra-anal plate regularly rounded at apex, subgenital plate short, with posterior margin weakly convex and presenting two small lateral lobes near the base *I. cavernicola* Shelf.

Supra-anal plate slightly notched in the middle of posterior margin; subgenital plate somewhat elongate with posterior margin sub truncate *I. nigrocincta* Chop.

Spelæoblatta (?) *caeca* Chop., *Rec. Ind. Mus.* XXII [1921], p. 512.

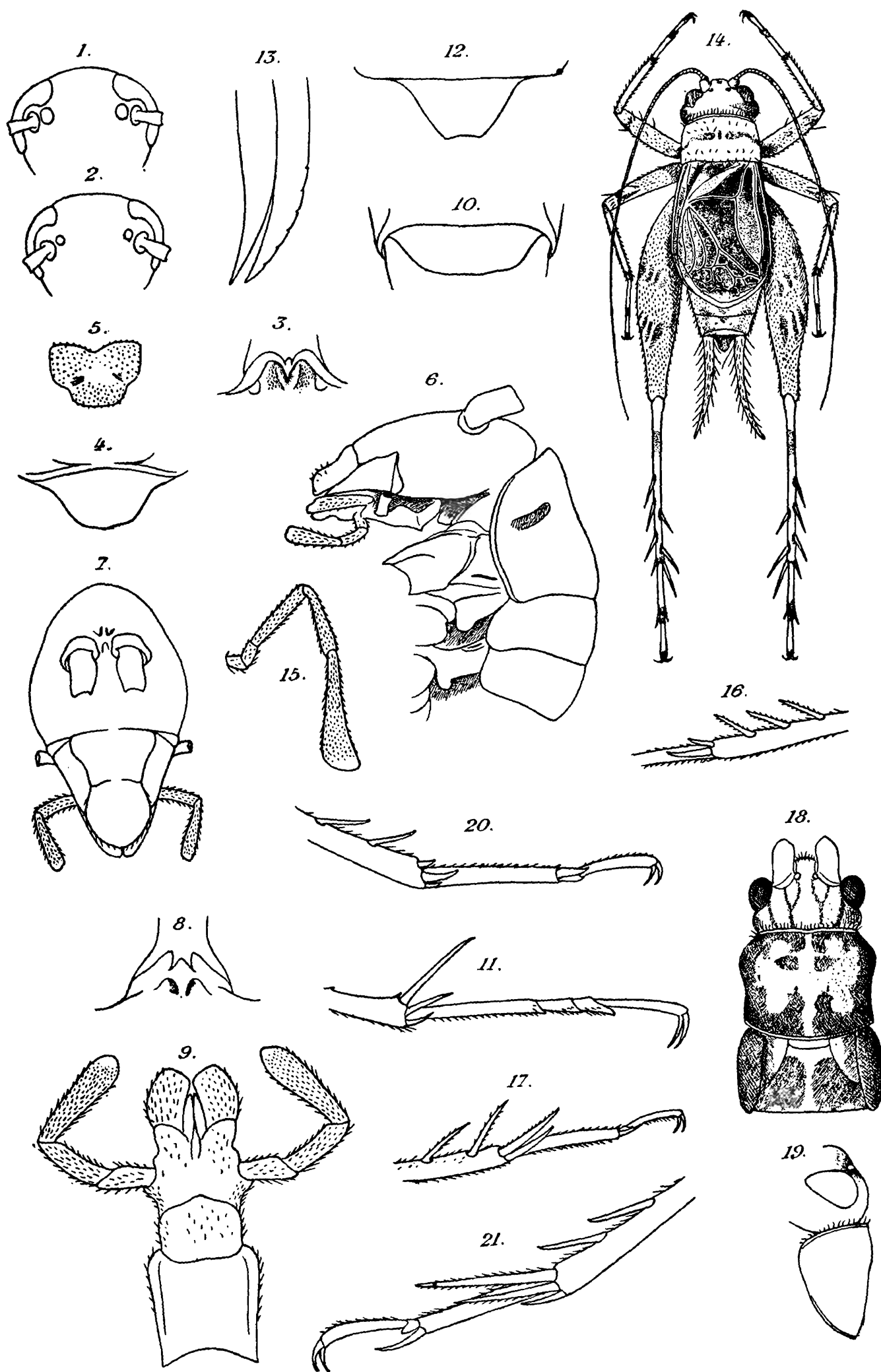
After a careful examination of the characters shown by this remarkable Blattid, it seems evident that it cannot enter the genus *Spelæoblatta* and even that it does not belong to the subfamily Blattinae. Its general shape and, above all, the armature of the anterior femora recalls much more the Pseudomopinae (Phyllodrominae). It must be considered as a new genus of this subfamily, for which I propose the name *Typhloblatta*. This genus may be characterized as follows:—

Apterous, blind. Antennae very long, with 3rd joint much longer than 2nd. Cerci long and slender. Anterior femora armed with a few basal spines, followed by a series of spiniform bristles. No tarsal arolia.

Genotype: *Typhloblatta caeca* Chop.

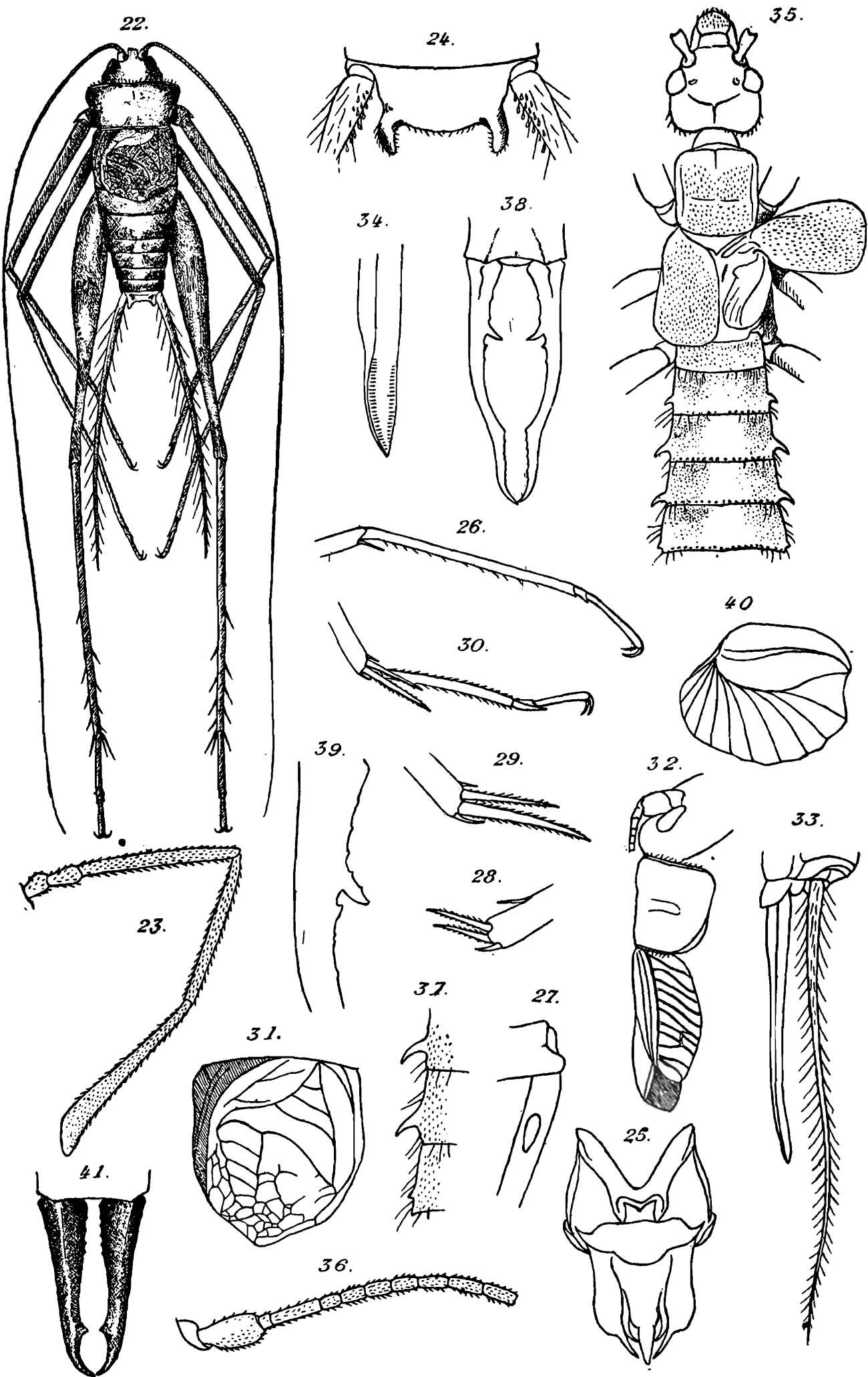
EXPLANATION OF PLATE. IV

- FIG. 1.—*Pycnoscelus striatus* Kirby.—Top of the face, $\times 7$.
 „ 2.—*Pycnoscelus surinamensis* L.—Top of the face, $\times 7$.
 „ 3.—*Diestrammena brevifrons frieli*, subsp. nov.—Frontal rostrum, dorsal view, $\times 12$.
 „ 4.—*Id.* Subgenital plate of female, $\times 12$.
 „ 5.—*Id.* Epiphallus isolated, $\times 12$.
 „ 6.—*Diestrammena caeca*, sp. nov. Head and thorax, lateral view, $\times 10$.
 „ 7.—*Id.* Face, front view, $\times 10$.
 „ 8.—*Id.* Frontal rostrum, dorsal view, $\times 12$.
 „ 9.—*Id.* Labium, $\times 12$.
 „ 10.—*Id.* Subgenital plate of female, $\times 12$.
 „ 11.—*Id.* Posterior tarsus and spurs of tibia, internal view, $\times 7$.
 „ 12.—*Tachycines adelungi* Chop. Subgenital plate of female, $\times 12$.
 „ 13.—*Id.* Apex of ovipositor, $\times 12$.
 „ 14.—*Speonemobius decoloratus*, sp. nov. Dorsal view of male, $\times 5$.
 „ 15.—*Id.* Maxillary palpus, $\times 12$.
 „ 16.—*Id.* External spurs of posterior tibia, $\times 12$.
 „ 17.—*Id.* Internal spurs of posterior tibia, $\times 12$.
 „ 18.—*Larandopsis choprai*, sp. nov. Head and thorax, dorsal view, $\times 7$.
 „ 19.—*Id.* Lateral lobe of pronotum, $\times 7$.
 „ 20.—*Id.* External spurs of posterior tibia, $\times 12$.
 „ 21.—*Id.* Internal spurs of posterior tibia, $\times 12$.



EXPLANATION OF PLATE. V

- FIG. 22.—*Kempiella longipes*, sp. nov. Dorsal view of male, $\times 4$.
 „ 23.—*Id.* Maxillary palpus, $\times 12$.
 „ 24.—*Id.* Apex of abdomen of male, $\times 12$.
 „ 25.—*Id.* Genitalia of male, dorsal view, $\times 12$.
 „ 26.—*Id.* Base of anterior tibia, internal view, $\times 12$.
 „ 27.—*Id.* Anterior tarsus, $\times 7$.
 „ 28.—*Id.* External spurs of posterior tibia, $\times 12$.
 „ 29.—*Id.* Internal spurs of posterior tibia, $\times 12$.
 „ 30.—*Id.* Posterior tarsus and spurs of tibia, internal view, $\times 7$.
 „ 31.—*Id.* Elytra of male dorsal view, $\times 7$.
 „ 32.—*Id.* Pronotum and elytron of male, lateral view, $\times 7$.
 „ 33.—*Id.* Apex of abdomen of female, $\times 3$.
 „ 34.—*Id.* Apex of ovipositor, $\times 17$.
 „ 35.—*Forcipula borellii*, sp. nov. Anterior part of body of male,
 $\times 7$.
 „ 36.—*Id.* Base of right antenna, $\times 12$.
 „ 37.—*Id.* Lateral spines and tubercle of 4th to 6th tergites of
 male, $\times 12$.
 „ 38.—*Id.* Forceps of male, dorsal view, $\times 4$.
 „ 39.—*Id.* Base of left branch of forceps of male, $\times 7$.
 „ 40.—*Id.* Left wing stretched out, $\times 12$.
 „ 41.—*Id.* Forceps of female, $\times 7$.



RHYNCHOTA OF THE SIJU CAVE, GARO HILLS, ASSAM.

By STANLEY KEMP, *Sc.D.*, *Superintendent, Zoological Survey of India*
with

DESCRIPTION OF A NEW SPECIES OF REDUVIID

By W. E. CHINA, *B.A.*, *British Museum, Natural History.*

Only four species of Rhynchota were found in the cave and two of these, both of which are aquatic forms, cannot be regarded as part of the cave-fauna proper. They appear merely to have wandered up the stream which flows through the cave to the positions in which we found them. Both were very scarce and I think it improbable that either of them breeds in the cave.

The other two species are Reduviids with very long legs which inhabit the cavern between 400 and 500 ft. from the mouth. They live and breed freely in the total darkness of this cavern and form a small but very striking part of its fauna.

Family HYDROMETRIDAE.

***Metrocoris nigrofasciatus* Distant.**

1903. *Metrocoris nigrofasciatus*, Distant, *Fascic. Malayenses*, Zool. I, p. 257, pl. xv, fig. 9.
1910. *Metrocoris nigrofasciatus*, Distant, *Faun. Brit. Ind., Rhynch.* V, p. 159, fig. 86.
1918. *Metrocoris nigrofasciatus*, Paiva, *Rec. Ind. Mus.* XIV, p. 25.

This species, which is abundant in the stream leading from the cave-mouth to the Someswari River, occasionally enters the cave itself and swims up-stream for a considerable distance. We obtained specimens at 300, 400 and 2,000 feet from the mouth.

In the cave the species is no doubt able to obtain a limited supply of food in the form of dead prawns and drowned insects and arachnids. It was, however, found only in very small numbers; I do not think it ever breeds in subterranean waters and am inclined to regard it as a mere straggler.

All the specimens in our collection are apterous and agree precisely with Distant's figure (1903) and with specimens determined by him. The species was originally described from Peninsular Siam and has since been recorded from Pahang in the Federated Malay States, from the Dawna Hills and the Southern Shan States in Burma and from Naini Tal in the United Provinces. Its occurrence in Assam, though no hitherto reported, is thus by no means unexpected.

Paiva's *Metrocoropsis femo ata*,¹ described from macropterous specimens from the Garo Hills, bears an exceedingly close resemblance to the

¹ Paiva, *Rec. Ind. Mus.* XVI, p. 365, pl. xxxiv, fig. 5 (1919).

macropterous form of *M. nigrofasciatus* and I believe that the two are specifically identical. *M. femorata* is said to differ from *M. nigrofasciatus* in the presence of teeth on the anterior femora, but this character, to which generic significance is attributed, is, as Paiva remarks, found only in males and in the collection of the Zoological Survey of India there are no macropterous males of *M. nigrofasciatus* for comparison. Judging from the apparent identity of macropterous females of the two forms, it seems evident that *Metrocoropsis femorata* is based merely on macropterous males of *Metrocoris nigrofasciatus*. Whether the species differs sufficiently from other members of the genus to justify generic separation is a point on which I do not feel competent to express an opinion : it is quite possible that Paiva's *Metrocoropsis* is valid.

Family NAUCORIDAE.

Heleocoris sp.

A single specimen of this genus, which I am not able to determine specifically, was found in the stream at a depth of 200 feet from the mouth of the cave in subdued daylight. It had no doubt recently wandered in from the outside and cannot be regarded as a member of the cave-fauna proper.

Family REDUVIIDAE.

Subfamily EMESINAE.

Bagauda cavernicola Paiva.

1919. *Bagauda cavernicola*, Paiva, *Rec. Ind. Mvs.* XVI, p. 366, pl. xxxvi, fig. 3.

This species was described from specimens collected by Mr. R. Friel in the Siju Cave in 1917. It has not been found in any other locality but it may be expected that in due course it will be discovered in open daylight. *B. splendens*, a near ally of *B. cavernicola*, lives among dense vegetation at the edge of water.

At first sight both *B. cavernicola* and *Myiophanes kempi*, with their narrow bodies and enormously long and slender antennae and legs, present every appearance of adaptation to a cavernicolous existence. This appearance is, however, deceptive, for both belong to a subfamily, containing many out-door species, which is characterized by the great length of these appendages.

The fact that increased length of leg and antenna is an adaptation of many truly cavernicolous animals suggests that these two bugs, by reason of their long appendages, found themselves at the time of their immigration well suited to existence in the cave. There is no evidence that they have been modified in response to their environment. Their eyes are well formed and their colouration is normal, *B. cavernicola* being in fact rather brightly pigmented.

Both species were common in the cavern at 400-500 feet from the mouth living in total darkness. They were found on the walls of the

cavern' or on boulders, particularly on the underside of overhanging portions. When moving they walk slowly and sedately with the four posterior legs, holding the body horizontal to the surface and well elevated from it. When at rest they often sway their bodies up and down with a slow rhythmic movement—a feature frequently seen in Tipulids and other long-legged insects. When disturbed they walk briskly away, without any movement that could be called rapid, and though both species have well-formed wings we never saw a specimen fly. They appeared to be quite indifferent to light and would remain motionless, even for as long as five minutes, with a powerful lamp placed close beside them. In *B. cavernicola* the anterior femora are usually held straight out in front, in line with the body; in *M. kempfi* they are generally flexed backwards over the head.

The food of the two species appears to consist mainly of the moths *Tinea antricola* and *Pyralis manihotalis* and of a small spider *Theridion rufipes*, particularly the two last named.

Bugs of the genus *Eugubinus*, also belonging to the subfamily Emesinae, are known to frequent spiders' nests and webs. Gravely,¹ who has studied the habits of a species found near Calcutta in webs of *Cyrtophora ciccatorosa*, suspects that it eats the contents of the spiders' cocoons and records an instance of the spider eating the bug. In the Siju Cave the bugs appear to have the upper hand, for though we found them eating the *Theridion* on more than one occasion, we never found a bug entangled in the ill-formed webs of the spider or being devoured by it.

The larval stages of both species were abundant and are freely eaten by the adults. Cannibalism is probably common among the members of the subfamily Emesinae: Distant² quotes an extreme instance described by Heineken in the genus *Plocaria*.

I am indebted to Mr. W. E. China for drawing my attention to MM. Alluaud and Jeannel's account of the discovery of Emesine bugs belonging to these same two genera, *Myiophanes* and *Bagauda*, in caves at Shimoni and Kulumuzi in tropical Africa. Their occurrence in this situation is extremely interesting, more particularly as neither of the genera had previously been found in Africa. The species are *Myiophanes speluncarum* Jeannel and *Bagauda tenebricola* Horvath. Alluaud and Jeannel remark³ "*B. tenebricola* est extrêmement abondant surtout près de l'entrée de la grotte A (Kulumuzi). Il se tient sur les parois où il déambule lentement; ses longues pattes et sa coloration lui donnent tout à fait l'aspect des Lycoriides que l'on trouve à l'entrée des grottes pyrénéennes. Il chasse d'ailleurs les Lépidoptères ou les Nématocères qui essaient de s'abriter dans la grotte." Of *M. speluncarum* Jeannel says⁴ "il se trouve plus profondément dans la grotte. Lorsqu'on l'effraie il s'enfuit et s'agite en même temps d'un extraordinaire mouvement de

¹ Gravely, *Rec. Ind. Mus.* XI, p. 512 (1915).

² Distant, *Faun. Brit. Ind., Rynch.* II, p. 201 (1904).

³ Alluaud and Jeannel, *Arch. Zool. Expér. Gén.* (5) LIII, p. 375 (1914).

⁴ Jeannel, *Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale, Rés. sci., Hemipt.*, p. 153 (1919).

va-et-vient très rapide, véritable tremblement de grande amplitude à cause de la longueur de ses pattes, qui le rend très difficile à saisir."

I have to thank Mr. W. E. China for the following description of the Siju *Myiophanes*.

Genus *Myiophanes* Reuter.

Myiophanes Reuter, *Act. Soc. Sc. Fenn.* XII, p. 337 (1883); *Revue d'Ent.* 1887, p. 166; Distant, *Faun. Brit. Ind. Rhynch.*, II, p. 204 (1904); Jeannel, *Voyage de Alluaud et Jeannel en Afrique Orientale, Hemipt.* 3, p. 153 (1919)

Type: *M. tipulina* Reut., Japan, China.

Myiophanes kempfi, sp. nov., China.

Male:—Head as long as the anterior lobe of the pronotum, brown with two longitudinal fascia on each side of the anterior lobe and the anterior margin of the posterior lobe, dirty white. Eyes black and prominent. Rostrum brown, third joint subequal to, second a little shorter than, the first which is distinctly incrassated. Antennæ long and slender, brown, the first joint clothed with long hairs, the remainder with shorter hairs. First joint 10 mm. with the extreme apex dirty white, second slightly longer with the extreme base whitish, third 1.3 mm., fourth 2 mm., pale. Pronotum brown; posterior lobe with two dirty white fascia converging anteriorly, almost meeting at the pronotal constriction and then continuing on the anterior lobe as two narrower shortly parallel fascia which diverge to the lateral margins about half way to the head; anterior lateral margins of the posterior lobe dirty white. Hemelytra semitransparent uniformly very pale fuscous with the nervures brown, extending slightly beyond the apex of the abdomen. Anterior coxa equal in length to the pronotum, pale brown with the apex and a medial annulation obscurely paler; anterior femur 7 mm., pale brown with the apex and two more or less obscure medial annulations whitish; anterior tibia 5.5 mm., pale brown with the base whitish. Intermediate femur 12 mm., pale brown, the apical quarter whitish within which is a medial dark brown annulation; intermediate tibia 19.5 mm., pale brown with the base whitish bordered narrowly with dark brown. Posterior legs similar in colouring to the intermediate ones but more longly pilose with the femur 15 mm. and the tibia 26.5 mm. Posterior tarsus less than 1 mm. Abdomen below and connexivum creamy white irregularly speckled and splashed with black, abdomen above black. Genital segment with 3 pale yellow styles strongly curved and almost contiguous at their apices.

The insect is more or less uniformly covered with long silky pale brown hairs especially marked on the posterior femora and tibiae, where the hairs are very long at the apex and base respectively and gradually shorten towards the other extremities. The white annulations on these legs give rise to whitish hairs. The posterior tibiae are slightly curved. Length from base of rostrum to genital styles 18 mm. Pronotum 4 mm., hemelytra 13.5 mm.

Female:—Similar to male but distinctly larger. Length from base of rostrum to apex of abdomen 21 mm. Pronotum 4.5 mm., hemelytra 15.5 mm., post. femur 20 mm., post. tibia 31 mm.

Habitat, Siju Cave, Garo Hills, Assam,¹ 450 to 500 feet from the entrance.

Of the six specimens sent me for determination by Mr. Kemp only one was a male.

This species is very near *M. tipulina* Reut. from China and Japan, but may be distinguished by its greater size and the differently coloured abdomen. It may be distinguished from *M. karenia* Dist. by its much greater size, the white anterior lateral margins of the posterior lobe of the pronotum, by the second joint of the antennæ being slightly longer instead of shorter than the first, greater pilosity, etc. *M. greeni* Dist. may be distinguished at once by the black and white annulated abdomen and the whitish bases of the hemelytra.

¹ The specimen from Tura in the Garo Hills, recorded by the late Mr. C. A. Paiva as *Myiophanes greeni* Dist. (*Rec. Ind. Mus.* XVI, p. 366, 1919) clearly belongs to this species. I have compared it with Siju specimens and can find no difference. The additional record does not add much to the geographical range of the species, but indicates that the form is occasionally found in the open. That it is rare outside the cave is suggested by the fact that only a single specimen was obtained in the course of two and a half months' intensive collecting in the neighbourhood of Tura. There are no caves near Tura. [S.K.]

DIPTERA OF THE SIJU CAVE, GARO HILLS, ASSAM.

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I. TIPULIDAE, TABANIDAE, ANTHOMYIDAE, ACALYPTRATE MUSCIDAE AND PHORIDAE.

By E. BRUNETTI.

The few diptera from the Siju Cave, Garo Hills, Assam, submitted to me for examination by Dr. Annandale comprise species of Tipulidae, Tabanidae, Anthomyidae, Acalyptrate Muscidae and Phoridae. The most interesting are the two tipulid forms and the tabanid *Haematopota annandalei* Ric., a single ♂, this sex not having previously been noted.

It is curious that these three species were captured at a much greater distance from the entrance of the cave than the others. Tipulidae are unusual occupants of caves, yet the two species here noted were taken at approximately half and three-quarters of a mile respectively from the entrance, to which distance of course no light could possibly penetrate. It also seems too far in for accidental occurrences, the natural inference being that they are regular inhabitants of the cave.¹ Prof. Bezzi notes five genera of this family as having been captured in caves, *Pachyrhina*, *Limnobia*, *Dicranomyia*, *Trichocera* and *Ulomorpha*, his records being mostly from localities in Italy and South France, and he states that tipulid larvæ have been found there as well as adults.

Prof. Bezzi's two short papers on cave diptera² may be recommended to students of this subject but it may be noted that many of the species therein recorded are from "grottos."

TIPULIDAE.

Rhamphidia sp.

A single ♀ in indifferent condition very near my *R. inconspicua* and of the same size, but differing in the antennæ not becoming setiform towards the tip. Taken 2,000 feet from the entrance of the cave.

Troglophila,³ sub-gen. nov.

A new subgenus of *Limnophila*. Antennæ very long, filiform, shortly pubescent throughout. Wings with four posterior cells, veins in

¹ This, however, seems to us unlikely, see note on p. 14. [*S.K.* and *B.C.*]

² *Revis. Ital. di Speleologia* I (1903); and *Atti Soc. Ital. Sci. Nat.* XLVI (1907).

³ I have to thank Mr. Edwards for suggesting this name.

apical part of wing each with a row of fine hairs ; subcostal and marginal cross-veins present ; arculus complete (*i.e.*, the small cross-vein forming basal sides of both basal cells), posterior cross-vein some distance before base of discal cell.

***Limnophila (Troglophila) cavernicola*, sp. nov.**

♂. *Head* pale brownish grey ; a short row of long fine hairs on frons towards eye-margins. Antennal scape pale yellowish, 1st joint short, cylindrical, 2nd considerably rounded, almost globular ; flagellum of 12 extremely long and slender joints, blackish, with fine, close grey pubescence ; whole antennæ distinctly longer than whole body ; palpi black, 1st joint yellowish. Back of head yellowish.

Thorax pale brown yellowish, the hinder part of the dorsum forming two large swellings ; scutellum comparatively large, hind margin with short, stiff black hairs ; metanotum with a slight brownish tinge.

Abdomen dull ochraceous brown, a little blackish basally (tip missing) ; pubescence soft, whitish. Belly yellowish.

Legs. Coxæ, trochanters and base of femora pale yellowish, changing to dull brownish, the tibiae, perhaps, rather darker than tarsi. One very minute tibial spur.

Wings. Auxiliary vein ending almost exactly in middle of costa with subcostal cross-vein immediately before its tip : 1st vein ending at three-fourths of the wing, 2nd vein beginning some distance before tip of auxiliary, forking well beyond origin of 3rd vein, the branches nearly parallel ; marginal cross-vein just beyond base of upper branch, joining 1st vein some distance before the tip ; 3rd vein beginning a little beyond half-way between base of prae-furca and forking of 2nd vein, running, after its basal flexure, absolutely straight to wing-tip. Anterior cross-vein almost in a line with basal section of 3rd vein, the three branches of 4th vein practically parallel with 3rd and equidistant from each other. Discal cell rather small, 5-sided. Posterior cross-vein much before discal cell, 5th vein nearly straight, 6th slightly sinuate, ending opposite base of discal cell ; 7th straight, ending opposite base of 2nd vein : hinder angle of wing moderately developed. All the veins with a row of conspicuous, fine long hairs on upper and lower sides of wing : halteres dirty brown.

One ♂ taken 3,600 feet from the entrance of the cave. Long. about 3-3½ mm.

The venation of this species is very much like that of my *Limnophila glabra* except that the upper branch of the 4th vein is not forked, and the posterior cross-vein is situated some distance before the discal cell. The hairy veins are of course also distinctive.

TABANIDAE.

***Haematopota annandalei* Ric.**

One ♂. Antennal 3rd joint dull yellow brown ; the extensive larger front facets of eyes red brown ; frontal triangle whitish-grey dusted ; lower part of frons and upper part of face jet-black ; rest of face whitish, with white pubescence ; palpi pale cream yellow ; proboscis black.

Thorax black, a pair of faint, median greyish stripes on anterior margin; hind margin of dorsum and base of scutellum narrowly and irregularly grey.

Abdomen black, hind margins of segments narrowly orange yellow; 2nd and 3rd segments more or less similarly coloured on extreme side margins. Pubescence of abdomen black on dorsum, intermixed with whitish hairs at sides of segments.

Legs black; the pale rings very weak though obviously present; fore tibiae rather broadly pale at base, two rings on the middle tibiae, the traces of the same on the hind pair much weaker than on middle pair.

Pubescence of legs black, rather coarse and conspicuous, very short on inner side of fore femora, inner and hinder side of fore tibiae, upper side of middle femora and on basal third of upper side of hind femora.

Wings a trifle darker than in ♀, pattern practically exactly similar.

Described from a single ♂ in good condition in the Indian Museum. Taken 1,200 feet from the entrance of the cave. Long. 9 mm.

An uncommon species, of which the ♂ apparently has not been seen before. Its appearance in a cave at such a distance from the entrance is interesting, and must surely have been accidental.

ANTHOMYIDAE.

Pegomyia kempi, sp. nov.

♂ ♀. *Head*. In ♂ eyes absolutely contiguous for several facets, in some specimens just perceptibly separated; vertical triangle very elongate, black above but light grey below ocellar triangle: latter with a pair of long bristles and a few additional stiff hairs; vertex with several long bristles of varying length. Frons triangular, mainly whitish grey, central part yellowish; 4 pairs of fronto-orbital bristles quite obvious though, of course, almost contiguous. Antennæ black, 2nd joint with usual short black bristly hairs and a single long erect bristle; 3rd joint black, dark grey dusted, arista microscopically plumulose. Face moderately light grey dusted; proboscis blackish, nearly bare; labella brownish yellow, with a few pale hairs; palpi of moderate size, black, almost cylindrical but slightly widening to tip, bearing a few stiff hairs. Oral vibrissae strong, about six additional bristles on cheeks. Occiput dark grey, with very short black bristles, slightly concave and not projecting behind eyes in profile on upper half but narrowly so on lower half. A row of short black bristles on upper occipital margin.

In ♀, frons slightly wider below than above, nearly one-third of width of head just above level of antennæ; frons and face wholly whitish-grey dusted, the broad centre of face yellowish, the side-margins dull. One pair of strong and one pair of weak ocellar bristles; two pairs of vertical, inner pair divergent, outer pair convergent; one pair of divergent post-vertical; one pair of weak ones in middle of frons; five pairs of fronto-orbital. Almost all these bristles can be found in the ♂.

Thorax moderately dark whitish grey to yellowish grey, varying in intensity, with four equidistant, narrow longitudinal blackish stripes from anterior to posterior margin, the outer ones placed on side-margins

of dorsum and more or less continued along sides of scutellum. Pleura moderately dark grey, with whitish grey reflections; scutellum concolorous with thorax, with sides and central basal part more or less blackish: metanotum wholly ash-grey dusted. 1 humeral bristle, rather weak, 1 presutural strong, 1 strong supra-alar, 1 strong and 1 weak post-alar; 5 dorso-central (two before and three behind suture); 1 pair of additional comparatively weak bristles between (but slightly in advance of) 2nd pair of dorso-central. One pair¹ of intra-alar, rather long but fine (the 2nd in a line with the 2nd dorso-central behind suture). A row of 4 fine, moderately long pre-scutellar, rather weak but obviously longer than the general pubescence. 2 pronotal, 2 notopleural; a perpendicular row of about 6 strong ones on mesopleura; 1 strong one on anterior upper corner of sternopleura, 2 strong ones (one above the other) on its hind upper corner, with one or two long fine ones below them; lower part of sternopleura with dense long bristles. 1 long, strong scutellar bristle on each side-margin a little beyond base, a strong, decussate, apical pair and a very much weaker, sub-apical reclinate pair. Whole thorax with fine moderately long bristly hairs standing up above the general, somewhat sparse pubescence of short stiff hairs.

Abdomen mainly dark grey, lighter on 2nd segment but apparently more or less blackish towards tip in individuals. Fine, rather long bristly black pubescence; 2 or 3 long bristles about the basal corners of 2nd segment, and a row of several similar ones towards hind margins of each segment. Belly dark grey, with short, black bristly pubescence which is longer on the genital region.

Legs. Coxae ash grey to dark grey, more or less orange towards tips; femora and tibiae all orange; tarsi dull yellowish grey, fore coxae with a row of long black bristles on front side, posterior pairs with similar bristles on outer side. Fore femora with considerable black bristly pubescence varying in length, on outer side. Middle pair with very short black, minute stiff hairs and about three long bristles on basal half of under side; also three on hinder side at tip. Hind pair with several very long bristles above towards tip and about 3 to 6 on outer (almost on upper) side, equidistant, on apical half. Fore tibiae with rows of microscopic bristles, 1 strong one at middle and 1 at tip on outer side: middle pair with a row of 4 or 5 on hinder side, tip with a circlet of several (about 5 or 6): hind pair with 1 below middle on front side; a row of 4 on middle half of outer side, placed a little towards hinder side; 1 at middle and 1 at three-fourths on hinder side; tips with a circlet of 3 moderately strong ones, placed approximately on front, outer and hinder sides.

Wings clear, barely yellowish basally; halteres whitish yellow; squamae very pale yellowish grey with pale orange margins and fine short pale fringes. Long. about 6 mm.

Described from 5 ♂♂ and 2 ♀♀ taken 450 to 800 feet from the entrance to the cave. Types in Indian Museum, cotype ♂ and ♀ in British Museum.

¹ In some specimens three intra-alar bristles are present, in which case it is the 3rd (the hindermost) which is in a line with the 2nd dorso-central behind suture,

MUSCIDAE ACALYPTRATAE.

Limosina ornata de Meijere.

Several specimens taken 450 to 500 feet from the entrance of the cave agree exactly with de Meijere's description, some paler ones being obviously immature.

Limosina notatipennis, sp. nov.

♂ *Head* dull yellowish. Frons rather bright yellow; antennæ dull brownish yellow, 3rd joint rounded, shortly pubescent, arista three times as long as antenna, finely plumose. A pair of ocellar bristles, a pair of convergent vertical ones with a rather diverging pair just behind them. Two fronto-orbital each side at about middle of eyes; four medium sized facial bristles. Oral vibrissae long; lower part of head dull yellowish brown, proboscis black.

Thorax dull nut-brown, with rather sparse, very short pale hairs. One strong post-humeral, placed well backwards and inwards on dorsum; suture not traceable; hinder pair of dorso-central bristles present, also some marginal bristles in neighbourhood of base of wing. Scutellum slightly paler; a pair of apical and of marginal bristles, all well separated.

Abdomen blackish, with fine soft pubescence.

Legs dull brownish yellow; femora with a row of fine stiff, moderate-sized bristles. Middle tibiae with three or four moderately strong bristles on outer side, situated from after the base to beyond the middle; also two strong, diverging preapical ones; a conspicuous row of shorter stiff bristles on about apical half on inner side. Hind tibiae with a row of fine, long bristly hairs on outer side.

Hind tarsi with 1st joint distinctly dilated, rather short; 2nd slightly wider than remainder.

Wings grey, a little darker anteriorly down to 3rd vein; costa with short, fine bristles to tip of 3rd vein. A transverse band composed of three nearly clear spots in a line, separated by 3rd and 4th veins, the lower spot just clear of the abbreviated 5th vein. An outer more distal pale band leaving wing tip broadly grey. A pale spot in costal cell just before tip of 1st vein, which latter ends at one-third of the wing; 2nd vein ending fractionally beyond middle of wing, 3rd ending a little before tip, 4th ending (or becoming suddenly faint) a little beyond half-way from end of discal cell to wing margin; 5th ending (or weakened) a little sooner; 6th weak but nearly reaching wing-margin. Halteres whitish. Long. 1 mm.

Described from a single specimen, apparently a ♂, taken 400 feet from the entrance to the cave. In the Indian Museum.

Limosina tenebrosa, sp. nov.

Sex uncertain. *Head* blackish brown; sides of frons paler dusted about the middle. Antennæ blackish brown, 2nd joint with two or three, very long, fine bristles above and below; arista about $3\frac{1}{2}$ times as long as antennæ, shortly and closely plumulose. Ocellar bristles of moderate size; inner pair of strong vertical ones widely separated, con-

vergent : outer vertical pair nearly on eye-margins ; a post-vertical convergent pair close to and almost just behind latter ; two pairs of fronto-orbital at about middle of eye and nearly on a level with the four pairs of frontal bristles. Oral vibrissa strong, a smaller one below it, one strong genal and several smaller ones in an irregular row behind it. Isolated bristly hairs on face and cheeks.

Thorax cinereous grey, with very short pale yellowish hairs ; pleura whitish-grey dusted. One humeral bristle, one pre-alar, two post-alar ; some stronger bristly hairs or fine, weak bristles along sides of dorsum and above bases of wings. Scutellum very large, nearly half as long as thorax, distinctly paler in colour, practically bare ; a bristle on each side-margin before middle and a wide-apart apical pair, all the bristles long.

Abdomen uniformly blackish brown, pubescence short, inconspicuous ; 2nd segment fully as long as 3rd and 4th together.

Legs mainly rather dark brown ; fore coxæ on inner side, and some parts of all the tarsi considerably yellowish, hind metatarsi slightly widened on inner side, less than half as long as 2nd joint. Middle tibiae with two bristles on outer side ; the first well beyond base, the other well before tip.

Wings pale grey ; costa finely ciliate to tip of 3rd vein ; ambient vein with usual microscopic fringe ; 4th and 5th veins faintly traceable to wing-margin, halteres blackish. Long. $1\frac{1}{2}$ mm.

Three specimens, taken 200 feet from the entrance of the cave. Type and other specimens in Indian Museum.

***Phyllomyza tenebrosa*, sp. nov.**

♀. *Head* black, in certain lights frontal triangle and side margins of frons rather broadly shining : ocelli shining brown. Antennæ black, narrowly orange at base ; 2nd joint subtriangular with very long bristles, above and below ; 3rd joint large, sub-quadrate with rounded angles, orange, but broadly black above and at tip. Proboscis blackish brown, apparently of coarse texture, pointed, as long as height of head ; palpi large, subspatulate, black, pubescent. Face dull yellowish brown ; foveae very broad, moderately deep ; the median partition low. Cheeks in profile extending downwards about one-third to one-fourth height of eyes. Occiput nowhere extending beyond hind margin of eyes, slightly concave, practically bare of conspicuous hairs. One pair of ocellar bristles ; 2 pairs of vertical, well separated (inner pair behind ocellar triangle, outer pair towards sides of vertex), both converging ; 1 pair of post-vertical, diverging ; 3 pairs of fronto-orbital, two lower, smaller converging pairs (? cruciate). Oral vibrissae rather strong, a 2nd bristle less strong and a row of small genal setæ ; 2 or 3 strong bristles each side on hind corners of jowls.

Thorax dull black, microscopically punctate, and with minute yellow pubescence, rather closely beset with minute black bristles. 1 humeral bristle, 2 post-humeral (the lower one near extreme side margin of dorsum) ; 1 pre-sutural ; 2 supra-alar ; 2 post-alar. The last two pairs of dorso-central bristles present and some longer bristles towards hinder part of dorsum. Pleura dark grey-black ; sternopleura with one long bristle

Scutellum blackish, microscopically punctate, a long bristle at middle of each side-margin and a pair of convergent bristles at tip.

Abdomen black with fine short rather sparse pubescence; hind margins of segments almost imperceptibly pale; fine black, very short bristly pubescence and longer bristly hairs towards, but well clear of hind margins of hinder segments. Ovipositor telescopic, moderately elongate, terminal lamellæ dull orange, pubescent. Belly dark grey, with a little black pubescence.

Legs mainly black; knees, fore tibiae narrowly and posterior pairs broadly at tips, also all tarsi wholly yellowish.

Wings nearly clear, microscopically setulose, causing considerable iridescence: several rather strong bristles varying in length at base, including one long one well before humeral cross-vein. Auxiliary and 1st longitudinal veins united; costa finely and shortly setose to tip of 1st vein, beyond this point only microscopically so to tip of costa; 2nd and 3rd veins parallel, latter vein ending exactly at wing-tip, 4th vein practically parallel with 3rd. 2nd basal cell rather small but distinct; anterior cross-vein just before middle of discal cell, latter with its outer side perpendicular; 6th vein indistinct. Halteres blackish. Long. about $2\frac{1}{2}$ mm.

Described from a single specimen taken 450-500 feet from the entrance of the cave. In the Indian Museum.

***Idypaspistomyia latipes* Mg., var.**

♀. *Head*. Frons fully one-third width of head with approximately parallel sides, very dark brown, with vertex, ocellar triangle, broad side-margins and a rather wide median linear space whitish grey. Antennae with 1st joint very small, 2nd sub-triangular, 3rd large, thick, oval; arista dorsal, black, practically bare. Face small, yellowish; mouth-opening much produced; proboscis rather long, somewhat chitinized, cylindrical, tapering, nearly bare; apparently geniculate near base and well before tip. Palpi large, distinctly clavate, yellowish, with some black bristles. Head below eyes moderately produced along its whole width, rather angular in front and behind (in profile) with a row of marginal moderate-sized bristles, which is continued up the lower margin of the face without any definite stronger oral bristle. Occiput moderately produced behind eyes only on its lower half, with a definite marginal fringe of bristles on its outer edge. A pair of small ocellar bristles with a pair of cruciate, rather small vertical ones just behind ocellar triangle; a fairly strong divergent post-vertical bristle at each inner corner of each eye; 4 fronto-orbital bristles.

Thorax yellowish-grey dusted; dorsum wholly uniformly covered with very short black bristly hairs; pleura blackish. 1 humeral, 1 notopleural, 2 post-alar towards hind corners of dorsum. Scutellum concolorous with thoracic dorsum, with a long bristle at each basal corner and an apical pair.

Abdomen conical, darker than thorax, or blackish with a little sparse black pubescence: ovipositor cylindrical, concolorous, moderate-sized; belly blackish.

Legs blackish; posterior tarsi, except tips, dull yellowish.

Wings clear ; humeral cross-vein faint but obvious ; costa weakened but not fractured there and bearing, to this point, a definite row of fine black bristles ; auxiliary and 1st veins united, costa distinctly fractured immediately before tip of 1st vein ; bearing from this point to its tip the usual fringe of minute bristly hairs. 2nd, 3rd and 4th veins practically parallel, all distinct to wing-margin, 4th not obviously less distinct. 2nd basal and discal cells very clearly united, anterior cross-vein just beyond middle of latter ; the two cross-veins slightly nearer together than distance of posterior one to wing margin. Anal cell apparently absent¹ ; halteres whitish.

Described from a single ♀ taken 400 feet from the entrance of the cave. The species is included in the Kertész Palaearctic Catalogue under *Desmometopa*. I have to thank Mr. J. E. Collin for the identification of the species. The specimen differs from the typical form of the species in the unstriped thorax, the rather darker anterior part of the frons and the face, and in the dark front coxae.

PHORIDAE.

Conicera kempī, sp. nov.

♀. *Head* wholly dull black ; mouth-region brownish yellow ; 3rd antennal joint very large, almost pear-shaped, with pointed tip, microscopically setulose ; arista three times as long as joint, apical, absolutely bare. 1 pair ocellar bristles, 1 vertical pair near eye-margins ; an upper frontal row of four bristles, the middle two much larger than the others ; a lower frontal row of middle pair only.

Thorax dull black, with uniform microscopic recumbent dark brown bristly hairs ; side-margins of dorsum with several bristly hairs from humeri to posterior calli. The hinder pair of dorso-central bristles present, long, fine, converging. Scutellum with one pair of apical, converging bristles.

Abdomen dull black, tip of last segment and the (mostly hidden) genitalia pale brownish yellow.

Legs pale brownish yellow. Fore tibiae on front side with a row of fine bristles on apical three-fourths, and a longer one well after the base : middle tibiae with a long strong one on front side after the base, also one pre-apical, one on outer side at first third of the length, a long apical one and a smaller one : hind tibiae with a fairly strong one beyond the base on outer side or almost intermediate between outer and hinder sides ; hinder side with one at first third of the length and another at two-thirds ; one long and one shorter apical bristle. Hind metatarsi about two-thirds as long as tibiae and nearly as long as rest of tarsi.

Wings. Costa with fine short bristly hairs to tip of 3rd vein, extremely inconspicuous ; 1st and 3rd veins very distinct, not parallel with costa ; tip of 1st meeting latter beyond half-way between humeral cross-vein and tip of costa. The four weak veins on disc of wing distinct, approximately equidistant. Halteres black, clubs large. Long. 2 mm.

Six ♀♀. Taken 400 to 500 feet from the entrance of the cave. Type in Indian Museum, cotype in British Museum.

¹ Difficult to ascertain with certainty, both wings being partially folded at this spot.

II. CHIRONOMIDÆ.

By F. W. EDWARDS.

Atrichopogon cavernarum, sp. nov.

♀. *Head* yellow. Eyes quite bare, in contact for a long distance above the antennae. Proboscis nearly as long as the eyes. Palpi with the second segment only slightly enlarged, the two terminal segments together almost as long as the second. Antennae with the scape yellow, sharply contrasted with the black flagellum; segments 1-8 of flagellum almost globular, together scarcely longer than the combined length of segments 9 and 10; hair-whorls rather dense and about twice as long as the short segments; terminal segment with well-marked stylet.

Thorax almost uniformly light brownish yellow, scutellum paler, almost white. Mesonotum scarcely shining. Bristles all yellowish; six long ones, alternating with short ones, on the margin of the scutellum. *Abdomen* with the tergites brownish, pubescence and venter yellowish. *Legs* entirely yellow, tarsi somewhat darkened, but uniformly, the last segment not darker than the rest. First hind tarsal segment about 2.5 times as long as the second. Claws simple. Hind tibiae with 5-7 long bristles. *Wings* with a slight but rather distinct greyish tinge. Macrotrichia numerous on the apical half of the wing, and towards the lower border. Venation almost as in *A. rostratus* (Winn.). Stem of median cell about half as long as the cross-vein. *Cu* forking below the tip of the first radial cell. *Cu1* straight, making an angle of about 100° with *Cu*. *An* almost reaching *Cu2*, then suddenly curved downwards for a short distance. Halteres with yellowish stem and whitish knob. Wing-length 2.8 mm.

♂ Resembles the ♀, with the following exceptions: Flagellar segments 1-9 scarcely darkened, the plumes yellow at the base, dark apically, on each segment; 10 about one-third as long as 11, which is equal in length to 13, and slightly longer than 12. Hypopygium yellowish; ninth tergite broadly rounded apically; claspers gradually tapering, blackened on the apical third; tips simple, rather bluntly pointed. First hind tarsal segment scarcely more than twice as long as the second. Wings much narrower than in the ♀, entirely devoid of macrotrichia. Cross-vein more oblique than in the ♀; *Cu* forking a little more distally; *Cu2* not quite so straight, making an angle of about 120° with *Cu*.

Siju Cave, Garo Hills, Assam, Feb. 1922 (*S. Kemp* and *B. Chopra*). Numerous specimens (♂ ♀) found at distances of 100 to 500 and 1,700 ft. from the entrance. Cotypes in the Indian Museum and the British Museum.

The British Museum also possesses a series of specimens of the same species¹ collected in Batu Cave, 7 miles from Kuala Lumpur, Federated Malay States, Dec. 1896 (*H. N. Ridley*). A note by the collector states that they were from the interior of the cave, about a mile from entrance, living in complete darkness. The flies are mentioned by Mr. Ridley

¹ The tenth flagellar segment of the ♂ antennae is shorter in the Malayan specimens than in those from Assam, being only a quarter as long as the eleventh. No other differences are apparent.

in his paper on the caves of the Malay Peninsula¹ as follows : "Diptera.—A very small fly (family Chironomidae, gen. et sp. nov., closely allied to *Ceratopogon*) was exceedingly abundant in places where bats were plentiful, so much so as to be quite a nuisance. It apparently bred in the bat guano." The bats referred to were mostly fruit-bats of the genus *Cynopterus*.

A. cavernarum is closely allied to, and may perhaps be identical with *A. rhynchops* (Schiner) insufficiently described from Sydney, N. S. W. It is also very nearly related to *A. flavellus* Kieffer,² and *A. jacobsoni* (de Meijere); from the former it differs in its black flagellum and conspicuously darkened abdomen, and from the latter in its larger size and relatively longer second hind tarsal segment, that of *A. jacobsoni* being according to de Meijere only one-third as long as the first. It is noteworthy that both *A. flavellus* and *A. jacobsoni* have been recorded as settling in large numbers on the leaves of trees.

III. DOLICHOPODIDAE.

By C. G. LAMB, M.A., D.Sc.

Hercostomus Loew.

Hercostomus praetentans, sp. nov.

The following description is based on a single male specimen which was captured by Dr. S. Kemp and Mr. B. Chopra in the Siju Cave in the Garo Hills, Assam, about 450 feet from the entrance. Whether it is a true cavernicolous species or not must await further investigation; on the one hand the chitin is well developed though it is of a somewhat abnormal colour, all very dark bluish black, and all the ocular apparatus is fully present; on the other hand the remarkably large, pale ocelli, the excessive size of the chaetotaxic protecting bristles, and the remarkable elongate front tarsi provided with long hairs, are possible developments correlated with cave-dwelling habits, at least for part of the life of the insect.

The systematic position of the species is not very satisfactory. Its main characters lead to *Hercostomus* (*sens. lat.*), and in any case it is a member of the complex near that genus and *Hypophyllus*. It possesses, however, certain structural peculiarities that would fully warrant the erection of a new genus should related forms ever come to hand. The face is very different from that of a normal *Hercostomus* (fig. 1); it is very narrow and almost quite parallel, and is entirely silvery: the frons is also narrow. Aldrich describes a *H. latipes* from St. Vincent, (*Trans. Ent. Soc. London*, 1896, p. 311, see also Becker, *Dipterolog. Studien, Zool. Bot. Gesell. Wien.*, XIII, 1921, p. 33) in which the face is abnormally narrowed, though nothing like so much as in the present species. The frons is also unusual inasmuch as the area from just in front of the median ocellus to just beyond the antennal bases is very deeply sunk, forming a sort of crevasse from the base of which spring

¹ *Rept. Brit. Ass., Bristol 1898*, sec. C, p. 580.

² Dr. S. W. Kemp has kindly sent me specimens of *A. flavellus* for comparison with the new species.

the long flattened first antennal joints. In the present specimen some of this sinking is no doubt due to the somewhat shrivelled condition of the head, an accident so common, unfortunately, in the family. But this can only account for a somewhat exaggerated narrowing of the crevasse, as the general structure of the frons and the exceptional form of antennal joint are only consistent with a deeply furrowed frons. In *Hercostomus* (*Gymnopternus*) *chalybeus* Wied. there is an approach to the curious triangular plate-like first joint, and that species has also a somewhat narrow and silvery frons, though it is not at all depressed. Another remarkable character is the form of the ocelli; these are very large, but almost coplanar with the rest of the surface, not rounded as usual; they are very translucent, and in spite of their size, the hind ones are very difficult to see, they are inserted well over the vertical ridge so that they look more or less backward.

The extraordinarily differentiated front tarsi (fig. 2) are quite exceptional in the genus: they certainly give one the impression of being tactile organs. In Aldrich's *H. latipes* we also find enlarged front tarsal joints, but they are the second, third and fourth. The remarkable front foot might denote relationship to *Hypophyllus*, but the hypopygium is quite of the *Hercostomus* character. It is sessile (fig. 3) and elongate, and has very small terminal lamellae, which agree with the description of those of *H. latipes*: greatly reduced lamellae occur also in *H. germanus* Wied. The adherent 8th segment is here very inconspicuous, being completely fused on to the rest of the hood, and having practically the same texture. The most aberrant character of the abdomen is the excessive elongation of the last terminal segment, which forms a projecting tail; this feature is almost, if not quite, unique in the family.

DESCRIPTION.

Head.—In top view the eyes are rounded in profile and are clothed

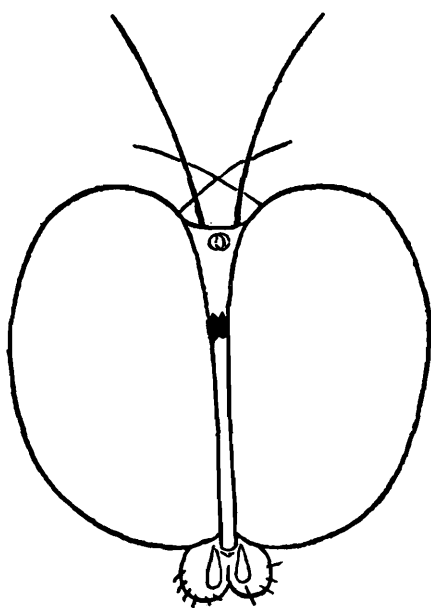


FIG. 1.—*Hercostomus praetentans*,
sp. nov. Head.

with dense pale stubbly hairs. The frons is parallel-sided from the level of the front ocellus to that of the antennæ, and the whole, including the eye-margins, is covered with brilliant silvery dust; that portion of the frons has its base deeply sunk, thus forming a longitudinal crevasse from the base of which arise the antennæ. The vertical ridge is more blackish silvery: the ocellar bristles are very stout and long, and are inserted almost on the vertical ridge itself. The single pair of vertical bristles is strongly crossed, inserted a little down the back of the head, and very close to the eye-margins. The front ocellus is very large, nearly flat, and of a pale glassy brown colour; it occupies nearly half the breadth of the frons. The hind ocelli are also large and flat, but are singularly inconspicuous;

they lie very near the eye-margins between the bases of the oceller and vertical bristles. The antennae are best seen in this top view;

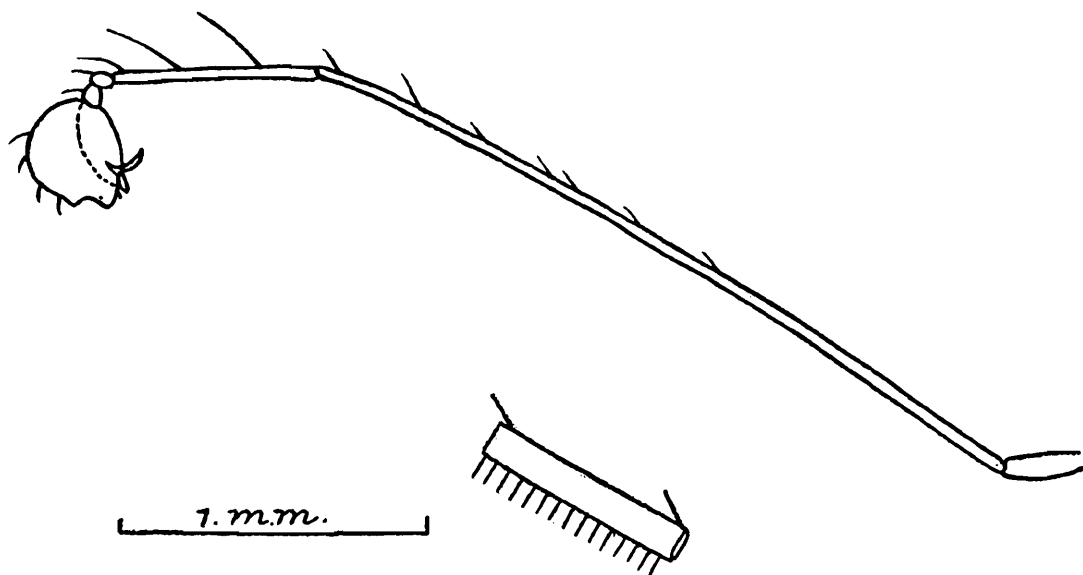


FIG. 2. *Hercostomus praetentans*, sp. nov. Front tarsus.

the first joint (as usual, bristled above) is long and much flattened, about one-third of it is hidden in the crevasse; it is black except for the upper surface adjacent to the second joint, and the small and narrow thumb; these are orange. The second joint is of normal form and bristling, it clasps the third joint, the inner lobe being much larger than the outer; in colour it is blackish orange, the inner clasp being more orange. The third joint is as figured, it is blackened and covered with pale pollen, and is densely though shortly pubescent at the tip. The arista has a stout black basal joint, and a dark orange flagellum, which tapers quite uniformly from base to tip; it is pubescent, and the pubescence is much more conspicuous on the tapered distal portion. The front view of the head is shown in a somewhat diagrammatic manner in fig. 1, the exact outline cannot be given owing to shrinkage, which has caused the eye-margins to curl over and closely fit on to the thorax, so that in side-view the post-ocular fringe is quite invisible. The palpi are bright orange with several black terminal bristles; the proboscis is also yellow, but its edge is bordered with a dark band on which is a uniform belt of stout dark bristles.

Thorax.—The dorsum is entirely bluish black but is lightly dusted; this dust is absent on a well defined narrow line between the acrostichal bristles, which line is very conspicuous in front. The acrostichal bristles are in five well marked pairs, with two smaller more hair-like pairs in front. Including the prescutellars there are six pairs of dorso-centrals which are all collinear, lying on two somewhat divergent straight lines. The pleuron is coloured like the dorsum, but is duller and more dusted, it is also narrowly splashed with orange along the sutures, while the actual humerus and the spiracle are all orange. Similar ill-defined orange patches occur on the thorax at the wing insertions. The smooth matt scutellum is the same in colour as the dorsum; its margin follows a curve nearly parallel to the thoracic boundary, and it bears the usual large bristle-pair at the outer angles,

together with a small hair between each bristle and the base. The thoracic chaetotaxy is normal, but all the bristles are very strongly developed.

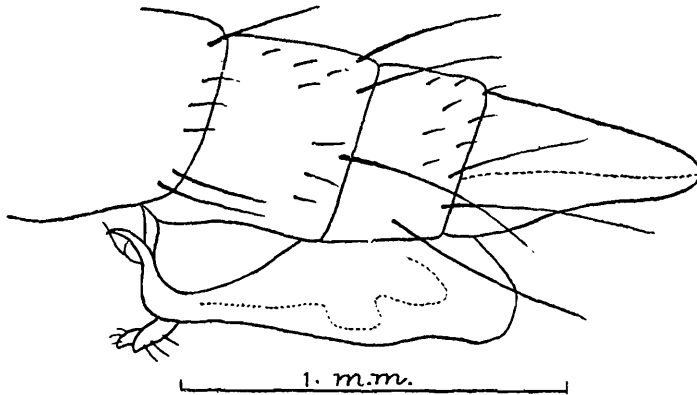


FIG. 3.—*Hercostomus praetentans*, sp. nov. Terminal segments of abdomen.

The *wings* (fig. 5) are quite glassy with pale brown veins; there is a distinct costal swelling, and a knob at the beginning of the third vein; the costa has black bristles, and the hind margin of the wing is provided with unusually long ciliation. The squama is bright yellow with long dark brown fringes and a few extra shorter hairs: the fringes are not spread out fan-wise, but form brushes of nearly parallel hairs. The haltere is entirely pale yellow.

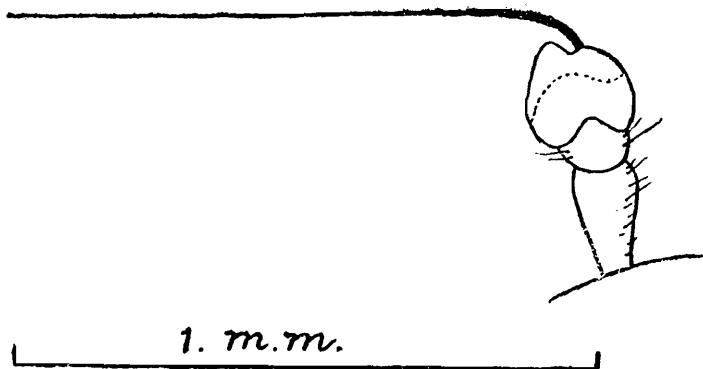


FIG. 4.—*Hercostomus praetentans*, sp. nov. Antenna.

The *legs*, including the front coxa, are entirely yellow except as follows; mid and hind coxa slightly suffused with the pleural colour; last four joints of mid tarsus browned; the hind femur with a conspicuous blacked spot on the tip; the end third of hind tibia and the whole of the tarsus blackened. The chaetotaxy is not very strong; the front tarsus is shown in fig. 2, it is provided with a perfectly even inferior pectination as shown in the small figure; the front coxa has about six terminal bristles; the tibia and femur are about equal in length, each being about two-thirds of the length of the first tarsal joint, while the coxa is about two-thirds the length of the femur. In the middle legs, the coxa has a single outside bristle; the femur has a hind pre-apical remote from the tip the tibia has three anterior-superior and two posterior-superior bristles, and a very strongly developed terminal crown; the first tarsal joint is about as long as all the others taken together, and the whole

tarsus carries a long regular bristly pectination beneath. In the hind legs the coxa has one outer bristle; the femur carries a stout anterior pre-apical, inserted about one-fifth of the total length from the tip; the tibia has three anterior-superior bristles on its upper half, and four equally spaced posterior superior bristles, the last bristle being the sole representative of the terminal crown; the first tarsal joint is about half the length of the second, which is somewhat longer than the remaining three taken together.

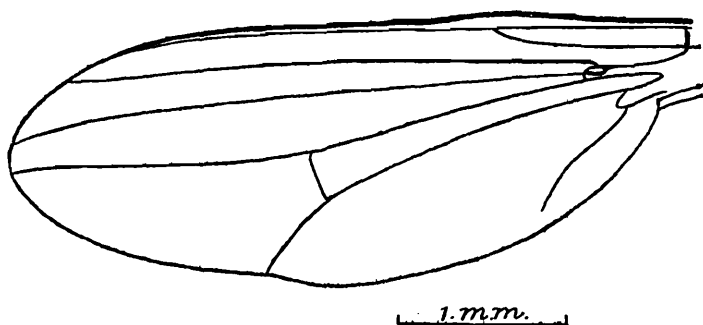


FIG. 5.—*Hercostomus praetentans*, sp. nov. Wing.

The *abdomen* is bluish black like the thorax and is also lightly polinated with silvery dust. The marginal bristles are very long, completely overlapping to the next segment; the sides of the basal segment carry conspicuous outstanding bristles. The remarkable terminal segment is shown in fig. 3. The sessile hypopygium is not very highly chitinised; it is brownish in colour, more yellow distally. The tiny terminal lamellae are yellow with a few black bristly hairs; the hooked inner appendages are also yellow.

Size $5\frac{1}{2}$ mm. Wing $3\frac{1}{2}$ mm.

Type in the Indian Museum.

IV NYCTERIBIIDAE.

By Major W S. PATTON, I.M.S.

Nycteribia (Acrocholidia) euxesta (Speiser).

Specimens of this species were found on all the bats obtained in the cave: on *Cynopterus sphinx gangeticus* at 400-500 feet from the entrance, on *Rhinolophus subbadius*, shot at the entrance, and on *Hipposideros lankadiva*, which ranges from 800 to 3,600 feet from the entrance. The species has been recorded from Burma and Ceylon on *Hipposideros armiger* and *H. lankadiva*.

Eucampsipoda hyrtli Kolenati.

Many specimens from *Cynopterus sphinx gangeticus* at 400-500 feet from the entrance. This is a widely distributed species and has been recorded from Africa, the Comoro Islands, Sumatra, Burma and Ceylon, from *Tylonycteris pachypus*, *Rousettus seminiidus* and *R. aegyptiacus*.

A Streblid also found on the *Cynopterus* has not been identified.

LEPIDOPTERA OF THE SIJU CAVE.

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I. PYRALIDAE.

By T. BAINBRIGGE FLETCHER, *Imperial Entomologist.*

Pyralis manihotalis Guénée.

- Pyralis manihotalis* Guén., *Delt. and Pyr.*, p. 121 (1854) ♀ [Cayenne].
Pyralis vetusalis Wlk., *Cat.*, XIX, pp. 891-892 (1859) ♀ [St. Domingo].
Pyralis gerontesalis Wlk., *Cat.*, XIX, pp. 896-897 (1859) ♀ [Ceylon].
Pyralis gerontesalis Moore, *Lep. Ceylon*, III, p. 178, f. 6 (1887) [redescri.] [Ceylon].
Sacatia landatella Wlk., *Cat.*, XXVII, p. 124 (1863) ♂ [Ceylon].
Pyralis despectalis Wlk., *Cat.*, XXXIV, p. 1243 (1865) ♀ [Moreton Bay].
Pyralis ? miseralis Wlk., *Cat.*, XXXIV, p. 1244 (1865) ♂ [Moreton Bay].
Pyralis achatina Butl., *Ent. Mo. Mag.*, XIV, p. 49 (1877) [Hawaii].
Pyralis manihotalis Hmp., *Faun. Brit. Ind., Moths*, IV, p. 151, f. 87 (1896) ♂ [Neotropical, Oriental and Australian Regions].
Pyralis manihotalis Deventer, *Tijds. Ent.*, XLVI, pp. 79-80, t. 9 ff. 1a, 1b (1903) [early stages].
Pyralis manihotalis Fletcher, *Trans. Linn. Soc.* (2) XIII, p. 300 (1910) [S. America; W. and S. Africa; Seychelles; India; Ceylon; Nicobars; Cocos-Keeling; Java Singapore; W. China; Formosa; New Guinea; Queensland; N. S. Wales; Hawaii].

In the collection of the Agricultural Research Institute at Pusa, we have specimens of *P. manihotalis* bred, together with *P. pictalis* Curtis, from similar, and in some cases identical, lots of stored grain. *P. pictalis* was described by Curtis from a specimen taken at Poplar (East London); but it is not a British species and Curtis' specimen was almost certainly imported, probably from India. The form found in the Siju Cave is quite distinct from typical *P. pictalis*, but in a long series the two tend to merge together. It appears probable that *P. pictalis* and *P. manihotalis* are synonymous; this, however, can only be proved by breeding and pending further evidence they may be kept separate.

P. manihotalis was very common in the Siju Cave in the cavern between 400-500 feet from the mouth. It was always found at rest on the walls or on the roof and was never seen to fly. No observations on its breeding habits were made but it is freely eaten by the Reduviid bugs *Bagauda cavernicola* Paiva and *Myiophanes kempi* China. On one occasion a specimen was noticed being devoured by the earwig *Chelisoches morio* Fabr.

This is not the first time that species of *Pyralis* have been found in caves. *P. pictalis* is known to inhabit the Farm caves near Moulmein¹ and the allied *P. fumipennis* has been recorded from the caves near Biserat in Jalor.² In both localities the moths were observed resting on the walls as in the Siju Cave.³

¹ *Journ. Asiat. Soc., Bengal* (n. s.) IX, p. 406 (1914).

² Swinhoe, *Fasciculi Malayenses, Zool.* I, p. 99 (1903).

³ The larva probably feed on vegetable debris.

II. TINEIDAE.

By E. MEYRICK.

***Tinea pyrosoma*, sp. nov.**

11-15 mm. Head, palpi, and antennae dark fuscous. Thorax purple blackish, a white spot at posterior extremity. Abdomen orange, base dark fuscous. Posterior tibiae with appressed scales. Forewings narrow, costa slightly arched, apex obtuse-pointed, termen extremely obliquely rounded; bronzy-black; markings snow-white; a small spot on fold at $1/4$, a transverse mark from dorsum at $3/5$ of wing, a slightly oblique mark from costa at $1/3$, smaller transverse costal marks at middle and $2/3$, and an angular spot in disc towards apex: cilia grey, basal half blackish. Hindwings ovate-lanceolate; grey, costal area covered by forewings snow-white, apical $2/5$ blackish, extending on dorsum to before middle; a small blackish spot at base, beneath this a pecten of white hairs; cilia dark grey.

Only in a large cavern about 500 feet from the entrance of the Siju Cave; 5 specimens. The species was not common; it was found flying or running on the walls and appeared to be attracted by light. I have also examined a specimen, sent me by Mr. T. Bainbrigge Fletcher, which was obtained by a native collector at Cherrapunji, Assam.

***Tinea antricola*, sp. nov.**

10-14 mm. Head brownish-ochreous or brownish. Palpi greyish. Antennae underly greyish, thorax light brownish or fuscous. Forewings rather narrow, costa gently arched, apex obtuse, termen very obliquely rounded; brownish or fuscous; cilia grey. Hindwings and cilia light grey.

Ten specimens examined. The species occurs throughout the Siju cave, even at the extreme end, nearly three-quarters of a mile from the entrance. It was, however, only seen in places where deposits of bat-guano, on which the larvae feed, were to be found. In the cavern at about 500 feet from the mouth the species was extremely abundant; the surface of the limestone boulder seen in the foreground of Plate II fig. 3 was covered with a thin deposit of guano and was literally alive with larvae and adults. The species affords one of the chief sources of food-supply of the predaceous cave insects.

In the Moulmein caves in company with *Crypsithyris spelaea*, Mr. Fletcher took an example of a *Tinea* which I found too poor for determination; it was similar to this species, and might prove to be identical.

COLEOPTERA OF THE SIJU CAVE, GARO HILLS, ASSAM.

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I. CARABIDAE.

By H. E. ANDREWES.

It is many years now since the caves and grottoes of Europe, and especially those of the Alps, were subjected to a more or less exhaustive zoological exploration, resulting in the discovery of a number of species of Carabidae, many of them without or with only rudimentary eyes, chiefly belonging to the genera *Pristonychus* and *Trechus*, or their close allies. We should have looked therefore for species of these genera in the caverns of the Himalayas, and when these are examined systematically such species will possibly be discovered. The small collection, however from the Siju cave, which I have been asked to examine, contains no representative of these genera, but consists of twenty-eight examples, belonging to four different genera, none of which has hitherto been recognized as cavernicolous. All the specimens have well developed eyes, and three of the species are certainly found in other habitats, so that they would appear to be intruders, which have found a convenient home in the cavern, rather than true cave-dwellers. It may be noted that with a single exception all the specimens were found within 500 feet of the entrance.

The genera in question are *Tachys*, *Abacetus*, *Anchista*, and *Anaulacus*. Of these *Tachys* is a cosmopolitan genus, living on the banks of lakes and streams, and *Abacetus* is widely spread in the more southerly portions of the old world: both the species are new and are described below, but, while the *Tachys* occurs commonly elsewhere in the Himalayan region, the *Abacetus* is not known at present from any other locality. The other two genera are confined to the oriental region, and, as nothing is yet known of their life-history, it is interesting to put on record this unusual habitat.

All the specimens were taken by Dr. S. W. Kemp and Mr. B. Chopra.

***Tachys micraulax*, sp. nov.**

Length: 2.7-3.2 mm.

Black, shiny, and slightly iridescent, underside more or less piceous; joints 1-4 of antennae (rest fuscous), palpi, neck, legs, apical border of elytra and two spots on each testaceous, the spots covering intervals 3-8, the front one extending obliquely inwards from shoulder, hind one rounded.

Head with duplicated rather shallow furrows, inner ones extending more or less on to clypeus and diverging a little behind, mentum without pores, eyes moderately prominent, antennae distinctly thickened towards apex, joint 2 a little shorter than 3. *Prothorax* wider than head, but much narrower than elytra, transverse, cordate, and moderately convex, base truncate, sides gently rounded in front and slightly sinuate behind, the angles very sharp and a little acute, with a slight carina; median line and basal sulcus moderately deep, latter finely crenulate, interrupted in middle, where the end of the median line widens to form a slight elongate pore. *Elytra* ovate, convex, border simple, rounding shoulder sharply and ending at base of stria 5, opposite hind angles of prothorax; fully striate, striae moderately deep and all (including 9) finely punctate, outer ones not quite reaching base, 2-7 disappearing behind at about apical fourth, striae of medium length, curved, ending on middle of elytron, the pore half way along it; dorsal pores on stria 3 at a little before a third and two thirds respectively. Microsculpture very clear, elytra with fine transverse lines, disk of prothorax and head with nearly isodiametric reticulation. Prosternum slightly channelled, metasternal process widely bordered, the surface depressed behind border, ventral surface minutely punctulate, last ventral segment of ♀ with the four pores nearly in line and not far from margin, ♂ protarsi with two slightly dilated joints.

In some respects not unlike *T. tetraspilus* Solsky, and coloured in nearly the same way. The head and prothorax nearly similar and about the same size, frontal furrows more divergent, hind angles of prothorax sharper, basal sulcus distinctly interrupted at middle; elytra much wider and larger, more convex, and a little more pointed at apex, fully striate, with the border terminating opposite hind angles of prothorax. The microsculpture is also very clearly visible.

ASSAM: Garo Hills, Siju Cave, 300-400 feet from entrance (*S. W. Kemp* and *B. Chopra*,—*Ind. Mus.*, 15 ex. SIKKIM: Gopaïdhara (*H. Stevens*), many ex. KUMAON: Chakrata Dist., Chulli Khud, 6500 feet (*S. N. Chatterjee*—*Forest Res. Ins.*), 1 ex. The type is in my collection.

***Abacetus lucifugus*, sp. nov.**

Length: 6.0-6.5 mm. Width: 2.4-2.6 mm.

Colour black, shiny: palpi, joints 1-3 of antennae, and legs testaceous, labrum, margin of prothorax and ventral surface dark red, joints 4-11 of antennae brown.

Head convex, smooth and highly polished, frontal grooves short and oblique, but not curved, a second short, deep groove on each side between the frontal groove and the narrow channel bounding the side border; eyes prominent, antennae reaching basal third of elytra. *Prothorax* cordate, moderately convex, smooth and polished, though with some very faint cross-striation, half as wide again as head, about a fourth as wide again as long, sides finely bordered, moderately rounded in front, sinuate rather before base, margin moderately explanate, rather more widely behind, front seta well within the border at a third from apex, hind one on the border just in front of hind angles, which are right

and sharply defined, where the pore from which it springs forms a distinct though slight emargination; median line clear, but not deeply impressed, basal grooves elongate and fairly deep, converging in front, basal border entirely wanting. *Elytra* convex, sides parallel, distinctly pointed at apex, shoulders square, not quite half as wide again as prothorax, and not quite two-thirds as long again as wide; the striae deep, impunctate, intervals convex and smooth, the puncture on 3 at about two-fifths from apex. Underside smooth, metepisterna twice as long as wide. *Legs*: front femora ♂ without tooth, front tibial spurs simple, meso- and metatarsi sulcate on outer surface only.

In the striation of the elytra similar to *A. quadrinotatus* Chaud., but a little larger, and without spots. Head with frontal grooves oblique but nearly straight, not curving abruptly to eye, a depression on each side near front angles; prothorax wider, the margins explanate, basal grooves longer, the space between them smooth, the base unbordered, a notch before hind angles; elytral striae slightly deeper.

4 examples taken at 100-350 feet from entrance under stones in moist places or at the edge of the stream that runs through the cave: one example, however, was taken at 3,550 feet from the entrance. The type is in the Indian Museum.

Anaulacus fasciatus Schm. Goeb.

Anaulacus fasciatus, Schm. Goeb., *Faun. Col. Birm.* 1846, 89; Schaum, *Berl. Ent. Zeitschr.* 1863, 78; Chaud., *Etude monographique des Mesoréides*, etc. *Bull. Mosc.* 1876, iii, 25; Bates, *Ann. Mus. Civ. Gen.* 1892, 405; Andr., *Trans. Ent. Soc. Lond.* 1919, 159.

1 example at 500 feet from entrance, "under stone in earth heavily manured with bat-guano."

I happen to have the type of the species before me, and have therefore been able to compare this example with it. I have records from India, Ceylon, Burma, Andaman Islands and Indo-China. Mr. H. L. Andrewes took the species in the Nilgiri Hills at about 3,500 feet "in heavy jungle in dead tree-trunks."

Anchista binotata Dejean.

Anchista binotata, Dejean, *Spec. Gen.* i, 1825, 252; Chaud., *Bull. Mosc.* 1877, ii, 236; Bates, *Trans. Ent. Soc. Lond.* 1883, 208; *id.*, *Ann. Soc. Ent. Fr.* 1889, 284; *id.*, *Ann. Mus. Civ. Gen.* 1889, 111; *id.*, *Ann. Mus. Civ. Gen.* 1892, 423; Lesne, *Mission Pavie, Hist. Nat.*, 1904, 81.
Callida discophora, Chaud. *Bull. Mosc.* 1852, i, 48.
Paraphaea signifera, Bates., *Trans. Ent. Soc. Lond.* 1873, 312; *id.*, *Trans. Ent. Soc. Lond.* 1876, t. i, f. 5.

8 examples at 400-500 feet from entrance, "in crevices on the walls and on boulders, or under stones in earth heavily manured with bat-guano."

I have seen all the three types. That of Dejean came from the Marianne Is., Chaudoir's from North India, Bates' from Japan, and the species seems to be spread all over S.E. Asia, including the Malay Archipelago.

II. NEW SPECIES OF STAPHYLINIDAE.

By MALCOLM CAMERON, M.B., R.N., F.E.S.

Philonthus annandalei, sp. nov.

Black, shining, the elytra shining bronze-green. Thorax with dorsal row of 4 moderate punctures on either side. Femora yellow, the extreme apex, coxae, tibiae and tarsi black. Length 6.5 to 10 mm.

Var. Antennae with 11th or 10th and 11th joints ferruginous.

Very closely allied to *P. bengalensis* Bernh. from which it differs in the 1st joint of the antennae, the knees, tibiae and tarsi being entirely black, the larger head and longer antennae; the puncturation scarcely differs from that of *P. bengalensis*.

Head large, suborbicular; in the male broader than in the female, as broad as the thorax; median intraocular punctures widely separated; mandibles prominent, the apices reddish; maxillary palpi brown. Antennae passing the posterior angles of the thorax, the 1st joint elongate, black, 2nd distinctly shorter than 3rd, 4th to 11th all longer than broad, but gradually decreasing in length, the last one or two often ferruginous, this coloration being sometimes asymmetrical, one antenna being entirely black, the other with terminal ferruginous joint or joints¹.

Thorax (viewed from above) longer than broad, the sides parallel, the disc on either side with 4 moderate punctures, externally with 3 others and with 2 or 3 more behind the anterior angles.

Elytra as long as, but broader than the thorax, a little broader than long, finely and rather thickly punctured, finely pubescent; scutellum black, very finely and very closely punctured. Abdomen finely and closely punctured at the bases of the segments, much more finely and sparingly elsewhere, especially behind; basal lines not angulate.

♂: head larger, antennae longer: 6th ventral segment triangularly excised, the margins of the incision narrowly impressed. Anterior tarsi moderately dilated.

Habitat: Stream debris and moss, Mussoorie. Dehra Dun (type). Siwaliks. Garo Hills, Assam (Siju Cave).

Type in my collection.

Philonthus kempi, sp. nov.

Black, shining; the elytra shining bronze-black. Antennae, tibiae and tarsi black, femora brown. Thorax with dorsal row of 4 moderate punctures. Length 7.5 to 8.5 mm.

In build and antennal structure very similar to the preceding and allied thereto.

Head large, subquadrate, as broad as the thorax (♀), the median intraocular punctures well separated: antennae rather slender, the 2nd joint shorter than the 3rd, 3rd to 11th all longer than broad, gradually decreasing in length, the penultimate only slightly longer than broad, the 11th a little longer than the 10th; mandibles prominent, the apices reddish; maxillary palpi brown.

¹ The same condition I find in a long series of *P. bengalensis*, so that the character is scarcely of value as a specific distinction.

Thorax longer than broad, viewed from above parallel-sided, the disc with 4 moderate punctures on either side, 3 externally and 2 or 3 behind the anterior angles. Elytra as long as but broader than the thorax, scarcely broader than long, finely and rather closely punctured, finely pubescent. Scutellum black, very finely and densely punctured. Abdomen finely and closely punctured at the bases of the first three segments, much more finely and sparingly elsewhere, especially posteriorly; basal lines not angulate.

♂ unknown.

Habitat: Garo Hills, Assam (Siju Cave).

Type in the Indian Museum, co-type in my collection.

III. ELATERIDAE.

By E. FLEUTIAUX.

Megapenthes vespertilionis, sp. nov.

Long. 8 à 8.5 millim.—Allongé, peu convexe. Dessus noir, pronotum largement jaunâtre sur les côtés et transversalement près de la base; pubescence obscure. Tête brillante, subtricarinée, finement ponctuée; bord antérieur presque droit, peu saillant au milieu; épistome assez large. Yeux normaux, engagés sous le pronotum. Antennes noires, sauf les trois premières articles jaunâtres, atteignant à peu près l'extrémité des angles postérieurs du pronotum: premier article subglobuleux, pas plus long que le 4^e; 2^e et 3^e moins gros, courts, subégaux; suivants plus longs, comprimés et serriformes; dernier anguleusement atténué au sommet. Pronotum brillant, plus long que large, peu rétréci en avant, sinué sur les côtés, convexe, fortement déprimé à la base, sillonné au milieu en arrière sur la partie déclive, finement et éparsément ponctué; angles postérieurs aigus, non divergents, unicarénés. Ecusson presque vertical, triangulaire, rugueux. Elytres, légèrement atténués en arrière, ternes, rugueux, ponctués-striés, échancrés au sommet. Dessous noir, propleures jaunes; pubescence jaune clair. Prosternum étroit, parallèle, ponctuation fine et écartée; pointe terminale longue et effilée; sutures simples. Propleures à ponctuation fine, très espacée. Méta sternum finement et densément ponctué. Episternes parallèles. Hanches postérieures modérément et anguleusement élargies en dedans, plus larges en dehors que les épisternes. Abdomen finement et densément ponctué. Pattes très grêles, noirâtres avec les articulations jaunâtres; tarses plus minces et plus longs que les tibias.

♀. Long., 10 millim.—Taille plus grande; forme plus parallèle.

Bien conforme à *M. tibialis* Lacordaire. Son pronotum est rougeâtre sur les côtés et en arrière, sauf à l'extrême base; ses élytres sont plus rougueux; ses pattes plus fines; ses antennes plus comprimées et nettement serriformes.

Cette espèce a été recueillie dans une grotte à Siju, dans les collines du Garo (Assam), à 400 pieds de l'entrée, en pleine obscurité, sous une pierre, dans un terrain composé en grande partie de guano de chauve-souris.

IV HISTERIDAE, HYDROPHILIDAE, EROTYLIDAE, LATHRIDIIDAE, TENEBRIONIDAE, AND HYLOPHILIDAE.

By K. G. BLAIR.

HISTERIDAE.

Carcinops 14-striatus Steph.

This species was abundant in the cavern at about 400 feet from the entrance, living under stones in soil heavily manured with bat-guano. The specimens differ slightly from the usual form, which is mainly European in distribution but occurs also in Hawaii and N. America, in having the posterior and middle tibiae a little broader, with the spines along the outer side smaller, etc. It is possibly a different species, though I should hesitate to describe it as new.

HYDROPHILIDAE.

Cercyon sp.

A single specimen of this genus, found in the same situation as *Carcinops*, possibly represents a new species. It is allied to *C. haemorrhoidalis* F. (= *flavipes* F.) of the European fauna and to *C. placidus* Shp. of Japan.

EROTYLIDAE.

Euxestus parki Woll.

This species, kindly determined by Mr. G. J. Arrow, is one of wide distribution and was not uncommon under stones in damp earth heavily manured with bat-guano at about 500 ft. from the entrance.

In its original locality, Madeira, it was found abundantly in gardens, under dry vegetable refuse, and also occasionally in the nests of ants.

LATHRIDIIDAE.

Holoparamaecus sp.

A single specimen belonging to this genus was caught flying at about 400 feet from the mouth of the cave. It probably represents a new species, allied to *H. caularum* Aub., but more convex, with thorax more strongly constricted at base, elytra more ovate, etc.

TENEBRIONIDAE.

Palorus exilis Mars.

This species, of which Waterhouse's *P. minor* is a synonym, is represented by a number of specimens found under stones at a distance of 550 feet from the mouth of the cave in very light dusty soil. The series seems to agree absolutely with Marseul's type from Japan. The species has also been recorded from Java and, as *P. minor*, from Damma I.

Diaclina rufotincta Fairm.

Numerous specimens found under stones in damp soil heavily manured with bat-guano at a distance of 400 feet from the mouth of the cave. The species was described from Indo-China.

HYLOPHILIDAE.

Hylophilus kempi, sp. nov.

Elongate, grayish black with the apical joints of the tarsi, and the underside of the basal joints testaceous; clothed throughout with a short moderately dense decumbent pubescence, giving the insect a pruinose appearance. Head across the eyes slightly wider than the thorax, the vertex somewhat gibbous, the back of the head concave; eyes large, the genae behind them evident; antennae slender, hairy, 3rd joint rather shorter than 4th and this than 5th, 5th to 8th equal, cylindrical, 9th and 10th slightly shorter, 11th thickest near middle, thence tapering sharply to apex; last joint of maxillary palpi large and transverse, inner side only half as long as outer, and more strongly arcuate. Thorax about as long as broad, sides subparallel in basal half, strongly narrowed in front, base rounded in middle, the posterior angles blunt, but slightly prominent above base of elytra, surface distinctly though rather finely punctate, the interspaces opaque and strongly alutaceous. Scutellum feebly elongate, apex truncate or slightly emarginate. Elytra nearly twice as wide as base of thorax, convex, subparallel for 2/3 of their length, disc irregularly punctate, rather more sparsely and coarsely than the thorax, the interspaces alutaceous, but more nitid than on the thorax. Legs long and slender, tarsi, except of posterior pair, about as long as their tibiae, posterior femora slightly thickened beyond middle; anterior pair showing sexual dimorphism.

♂ More slender than ♀, anterior femora shorter and incrassate, straight beneath but upper side strongly arcuate; anterior tibiae short and thickened on inner side about middle; apex of elytra bluntly rounded; antennae nearly as long as body. Length 3 mm.

♀ Elytra with a shallow post-basal depression, and another, parallel with the suture, beyond the middle, apex divaricate, each ending in a blunt point; antennae 3/4 of length of body. Length 3½ mm.

Very close to *H. troglodytes* Champ. from Selangor, a species also cavernicolous in habit, but the new species is larger; has the vertex of the head more prominent, and the sexual characters different in both sexes.

This species was by no means rare in the Siju cave and was always caught flying to light. It was common at 400-500 feet from the mouth and a few specimens were found at greater depths, up to 2,000 feet.

Hylophilus speluncarum Pic¹ has been found in great numbers in a cave at Kulumuzi, near Tanga in E. Africa, and is also attracted by light.

¹ Pic, *Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale, Coleopt.*, p. 159 (1914) and Alluaud et Jeannel, *Arch. Zool. Expér. Gén.* (5) LIII, p. 374 (1914).

With the exception of the *Hylophilus*, it is noteworthy that none of the species in this section are essentially cavernicolous in habit, most of them indeed being commonly found feeding on dried or decaying organic matter in the open. The presence of the elaterid in this *coterie* is perhaps remarkable since its immediate relatives appear to have mainly wood-feeding larvae, though in some cases they are predaceous upon other larvae living in such situations. In this way it may be that the *Megapenthes* larvae prey upon the saprophagous larvae living in the guano-impregnated floor of the cave, or they may themselves be saprophagous, and feed on this material instead of in rotten wood.

HYMENOPTERA OF THE SIJU CAVE, GARO HILLS, ASSAM.

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I. TRIGLYPHOTHRIX STRIATIDENS EMERY AS A CAVE ANT.

By WILLIAM MORTON WHEELER.

Dr. S. Kemp has sent me for identification several workers and a winged female of a small ant taken by the Zoological Survey of India in the Siju Cave, Garo Hills, Assam. The insects were nesting in complete darkness, 400 feet from the entrance of the cave, under stones in ground heavily manured with bat-guano. Dr. Kemp surmises that the ant is not a regular cavernicolous species and this proves to be true, for it is *Triglyphothrix striatidens* Emery, a highly adaptable Indian species which for some years has been extending its range, not only in the Old but also to the New World. In a paper entitled "An Indian Ant Introduced into the United States" (*Journ. Econ. Ent.* 9, 1916, pp. 566-569, 1 fig.) I cited the known distribution of *T. striatidens* in 1916. It had spread from India to the Bismarck Archipelago, Queensland, Formosa, Ceram, Sumatra, Borneo, Guam, Tunis and Sierra Leone. In America it had been taken in Barbados, Mexico and Audubon Park, Louisiana. As early as 1906 Bingham found it in the propagating pits of the Kew Botanic Garden, and in 1905 and 1908 Donisthorpe recorded it as common in the palm house of the same institution.

In this connection I would note that Mr. F. W. Urich recently sent me from Trinidad two species of ants which he took in the cave inhabited by the singular "guacharo," or fat-bird (*Steatornis caripensis* Humboldt). One of the species, which was living in the nests of the birds, is *Wasmannia auropunctata* Roger, a well-known and widely distributed neotropical ant, which usually nests under stones or bark. The other, which was living in the guano of the guacharo, belongs to a new genus and will be described as *Spelaeomyrmex urichi*, gen. et sp. nov. It is evidently a true cavernicolous ant, blind, pale-coloured and covered with long, sparse sense-hairs.

Santschi [Formicidæ. Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911-12), 1914] has recorded the following ants as having been taken by Alluaud and Jeannel in the caves at Tanga and Shimoni, East Africa: *Ponera dulcis* Forel, *Leptogenys jeanneli* San., *Odontomachus haematoda* L. var. *troglydytes* San., *Dorylus* (*Rhogmus*) *fimbriatus* Shuck., *Monomorium rhopalocerum* Emery subsp. *speluncarum* San., *Strumigenys stygia* San., *Epitritus marginatus* San. and *Prenolepis* (*Nylanderia*) *jaegerskioeldi* Mayr. Probably none of these can be regarded as a true cavernicolous species. Of course, ants that nest in the

ground or under stones are really cave-dwellers, and many of them would probably adapt themselves to living in the large cavities, to which we restrict the terms "cave" or "cavern," were it not that their food supply is usually too meagre to sustain whole colonies of social insects.

II. DESCRIPTION OF A NEW BRACONID.

By S. A. ROHWER, U. S. Bureau of Entomology, Washington, D. C.

The specimens of this new genus and species of Braconid were recently forwarded to the author with the request that the species be named. The form is a very interesting one and although the sender stated that they were living in total darkness they show none of the usual characteristics which accompany this mode of life. From their systematic relationship and general habitus it may be expected that this species will be found to be a parasite of some internally feeding insect and perhaps one belonging to the order Coleoptera.

Neontsira, new genus.

The second intercubitus is obsolet, although its position is clearly indicated, and because of this one might be justified in saying that this new genus would fall in the subfamily Hecabolinae as defined by Szepliget¹. It does not agree entirely with the characterization of this group because the head is not cubical, nor does it agree with any of the genera placed in the subfamily. Considering that the fore wings have three cubital cells, and I think we should, the genus will fall more exactly in the subfamily Hormiinae as defined by Szepliget¹. It does not agree with any genus in this group, however, and it seems necessary to consider the head cubical and place the genus in the subfamily Doryctinae. In the key to the genera of this subfamily the new genus runs fairly satisfactorily to *Ontsira* Cameron, and when compared with the description of Cameron's genus seems to have a number of significant characters in common with it. From *Ontsira* it may, however, be distinguished by the strongly postfurcal nervulus, the different first tergite, the simple hind coxae and the absence of an impressed line on the prescutum.

Genotype.—*Neontsira typica*, new species.

Head when seen from above subcubical, narrowing behind the eyes, and broadly projecting between eyes; when seen from below the head is more nearly cubical because the projection between the eyes is not separable; ocelli arranged in an acute triangle; eyes oval, prominent; malar space long; flagellar joints nearly of uniform length; notauli nearly complete; scutellum margined laterally; propodeum with the dorsal surface separated from the lateral and posterior aspects by a carina, the posterior aspect with two median carinae; prepectal carina strong; sternauli and episternauli present; legs rather long, slender; hind coxae elongate; trochanters long; radius leaving stigma a short

¹ Genera Insectorum, Braconidae, fas. 22, 1904.

distance beyond middle ; first abscissa of radius about half as long as the first intercubitus ; radial cell completely closed ; recurrent interstitial ; nervulus postfurcal by at least its length ; subdiscoideus nearly interstitial, slightly curved at base ; radiella obsolescent, indicated by a faint line ; cubitella interstitial and extending to near apex of wing ; first tergite elongate ; no accessory sutures on tergites and all sutures feeble, so the second and third tergites are nearly fused ; only four tergites visible.

Neontsira typica, new species.

Female.—Length, 3.5 mm. ; length of antenna, 3 mm. ; length of ovipositor 1.5 mm. Face finely tessellate ; frons, vertex and orbits shining ; antenna 22-jointed, the apical joint longer than the preceding and acute apically ; scutum and scutellum opaque, finely granular ; notauli foveolate ; mesepisternum polished, the sutures foveolate ; dorsal aspect of propodeum reticulate, with an indication of a median carina which divides posteriorly ; first tergite about twice as long as apical width, finely and evenly striate ; second tergite with fine, even, longitudinal striae ; third tergite with fine transverse aciculation, but shining ; fourth tergite polished. Piceous ; head, antenna (except apical joint), propodeum and first tergite rufo-ferruginous ; basal part of venter whitish ; legs piceous black, four anterior femora and tibiae beneath and all coxae beneath sordid whitish ; tarsi brownish ; wings hyaline, fore wing with the area from basal to end of stigma and occupying width of wing infuscated ; venation dark brown.

Male.—Length, 2.75 mm. ; length of antenna, 3.75 mm. The male agrees very well with the above description of the female but differs in the much longer antenna which is 29-jointed.

Type-locality.—Siju Cave, Garo Hills, Assam.

Described from seven (one type) females and one male received from the Director of the Zoological Survey of India. All of these were collected in February 1922 and seven were collected 450 feet from the entrance of the cave. The other paratype was collected 200 feet from the entrance of the cave.

Type, allotype and two paratypes.—Cat. No. 14366, U. S. Nat. Mus.

Four paratypes returned to the Director of the Zoological Survey of India, Indian Museum.

OLIGOCHAETA OF THE SIJU CAVE, GARO HILLS, ASSAM.

By J. STEPHENSON, M.B., D.Sc., Lieutenant-Colonel I.M.S. (retired),
Lecturer in Zoology, the University of Edinburgh.

(Plate VI.)

The small collection of worms from the Siju Cave comprises only five identifiable species. These are, however, of considerable interest, since four out of the five are new; none of the few worms previously recorded from the Garo Hills (2) were found in the cave.

It cannot be said that the distinctive characters of the several species are in any way related to their peculiar habitat. This is of course scarcely to be expected, since earthworms live in general in conditions which resemble in a great degree those of a cave. All the species were pale in colour, unpigmented, with no difference between the dorsal and ventral surfaces.

Family ENCHYTRAEIDAE.

Genus **Enchytraeus**.

Enchytraeus cavicola, sp. nov.

(Plate VI, figs. 1—4.)

Siju Cave, Garo Hills, Assam; 500 feet from entrance. S. Kemp and B. Chopra, February, 1922. A number of specimens, found in damp bat-guano, of which a fair proportion are mature.

External Characters.—Length of the sexual animals 7–9 mm.; diameter 0.3 mm. Segments 36 in each of two specimens examined. Colour white, without pigmentation; the clitellum more opaque.

Prostomium rounded, hemispherical.

No dorsal pores or head pore.

Setae two per bundle in both dorsal and ventral bundles throughout the body. The setae are of the Enchytraeinae type, the shaft being straight (there may be a suspicion of a slight distal curvature in some cases), and the tip bluntly pointed; those in the posterior part of the body are longer and stouter than those of the anterior bundles; thus while the setae in one of the anterior bundles measured 38μ in length and 4μ in thickness, those near the hinder end were 70μ long and 7μ thick.

The clitellum extends over segms. xii– $\frac{1}{2}$ xiii ($=1\frac{1}{2}$).

Internal Anatomy.—What I have called postpharyngeal bulbs (4) are present as a pair of rounded knob-like masses of cells behind the pharynx on the dorsal side, with a solid stalk connecting them with the pharyngeal epithelium (figs. 2, 4).

Salivary glands are also present, and in a rather curious form. These structures usually have the form of twisting tubules, the lumen of which discharges into the hinder part of the pharynx. In the present species the tubules (*sal.*, figs. 1, 4) are 20μ in thickness, and twist and curl in segm. iv; a lumen may or may not be visible; these enter in front a median chamber of irregular shape, 36 – 64μ in height and up to 76μ

in transverse diameter, with walls of varying and sometimes irregular thickness (*ch.*, figs. 1, 2) ; this chamber, situated immediately dorsal to the beginning of the oesophagus, is connected by a solid tract of tissue with an upwardly and backwardly directed recess (*r*) in the hinder part of the dorsal pharyngeal wall.

The septal glands (*s. gl.*, figs. 1, 4) are three pairs, in segms. iv, v and vi ; they are not very bulky.

Some of the coelomic corpuscles (*corp.*, fig. 1) are broadly elliptical, others fusiform in shape. In length they are $24-27\mu$; the body is granular, and there is a small dot-like nucleus. They are numerous in the anterior segments as far back as segm. viii, and sometimes are closely packed together in the hindmost segments of the body.

The dorsal vessel arises in segm. xiii.

The nephridia have a relatively large anteseptal portion in which the tube undergoes a few turnings ; the organ is somewhat constricted at the septum, and the postseptal portion is ovoid in shape ; the duct is short and relatively thin, and leaves the end of the postseptal portion at a right angle. The appearance of the nephridia differs, however, even in the same specimen, according to the plane of the section, and perhaps according to the degree of contraction of the particular part of the animal.

The cerebral ganglion in a well extended specimen is shown in fig. 3 ; it is about one and a half times as long as broad, is somewhat indented in front and behind, and its sides are almost parallel.

The testes were no longer visible in the specimens sectioned ; there were sperm morulae and spermatozoa floating freely in segm. xi. The funnels are small and thin,—only 40μ in diameter,—relatively much smaller than in many other Enchytraeids ; they take up a comparatively small part of segment xi, and are 5–6 times as long as broad.

The vas deferens is long, thin (7μ), and thrown into numerous coils in segm. xii. There is a small compact spherical penial bulb, with definite outline, 50μ in diameter, from the neighbourhood of which muscular fibres radiate upwards to the body-wall.

The ovaries have the usual situation. Ova may be seen extending back to the level of segm. xvi.

The spermathecae are perhaps the most interesting part of the anatomy. These organs are in the Enchytraeidae in general contained in segm. v, and their ducts reach the surface in the intersegmental groove 4/5. In the present species the spermathecal ampullae are situated either in segm. vi or vii, or in vi on one side and vii on the other, and the duct is a long thin tube which passes forwards to reach the surface in the usual position.

The ampulla (*amp.*, fig. 4) is a rather small sac, variable in size, $70-110\mu$ long by $40-78\mu$ in diameter ; its lumen contains, but is not filled by, a round ball of spermatozoa (*spz.*) cemented together by a considerable quantity of colourless and non-staining material ; the wall is thin, the epithelium low and flat, scarcely distinguishable as a separate layer, with nuclei here and there which cause slight projections ; there are a number of much flattened peritoneal nuclei in the outer part of the wall. The ampulla does not communicate with the oesophagus.

The duct (*duct*) is long, thin, cylindrical, 20μ in diameter; it runs forwards, sometimes with an irregular or undulating course, passing close by the side of the oesophagus, through segms. vi and v, and reaches the surface at furrow 4/5. There are no gland cells round the end of the duct.

All the ducts show a dilatation (*dil.*) on their course in segm. vi; each dilatation is about 36μ in diameter, and contains a wisp of spermatozoa. The epithelium of this dilatation is very irregular in height, and the lumen in section is thus somewhat star-shaped. Where the duct leaves the dilatation it is slightly invaginated backwards into the cavity of the dilatation; possibly all the organ ental to and including the dilatation should be considered as ampulla.

Remarks.—The peculiar form of the spermathecae, taken in conjunction with the small and slender male funnels, and the numbers of the setae (two per bundle throughout the body) form a distinctive group of features which will serve to characterize the species.

Family MONILIGASTRIDAE.

Genus *Drawida*.

Drawida troglodytes, sp. nov.

Siju Cave, Garo Hills, Assam; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. Two fragments, apparently belonging to a single animal which had undergone autotomy.

External Characters.—Length $70+25$ mm.; diameter 4 mm. Segments 81+54. Colour a dirty grey, with no difference between the dorsal and ventral surfaces; the genital region (segms. ix to xiii or thereabouts) yellow, the genital organs showing through the body-wall. Secondary annulation begins from segm. xiv; the segments for some distance behind this are 4-annular, and then 3-annular as far as into the posterior fragment.

A prostomium is absent, but is simulated by a bulging forwards of the buccal cavity.

There are no dorsal pores.

The nephridiopores are in line with the setae *cd*.

The setae are small and closely paired; the interval *aa* is equal to *bc*, and *dd* is a little less than half the circumference.

The clitellum extends over segms. x-xiii or, at any rate ventrally, $x-\frac{1}{8}$ xiv; but it is not very marked, and its anterior limit is indistinct.

The male pores are situated in groove 10/11 on transversely oval papillae which take up a space equal to the setal interval *bc*, and are bounded in front and behind by well-marked grooves. The pores are to the inner side of the centres of the papillae, and hence are nearer the line *b* than *c*.

The female pores are in groove 11/12, in line with *b*.

The spermathecal pores are in groove 7/8, a little below the line of setae *c*.

There are no other genital markings.

Internal Anatomy.—Septa 5/6–8/9 are thickened, the first three considerably, the last a little less.

There are two well developed gizzards, in segms. xiv and xv ; there is perhaps in addition some strengthening of the muscular coat of the gut in segms. xiii and xvi.

The last heart is in segm. ix.

The excretory system is meganephric.

The testis sacs are contained entirely in segm. x ; they are of moderate size, and somewhat irregularly quadratic in shape. The vas deferens consists of a number of closely apposed loops on the outer side of and below the testis sac, entirely in segm. x ; the ectal portion of the vas runs upwards along the elongated prostate, which it enters at its dorsal (ental) end.

The prostate is of a light brown colour, and of an elongated cylindrical shape ; it is slightly curved round the gut, and joins the body-wall not far from the line of the ventral setae. Its surface is not shaggy or papillose, but still less is it smooth and shining,—it is “glandular” rather than muscular.

A complete ovarian chamber is present. The ovisacs are stoutly cylindrical, and extend backwards through segms. xii and xiii (right), or xii–xiv (by bulging back septum 13/14 on the left side).

The spermathecal ampulla is circular in shape (empty in the single specimen) ; the duct is somewhat, but not very markedly, sinuous, thin and rather difficult to follow towards its end ; it keeps on the posterior side of the septum ; there is no trace of an atrium, and the duct enters the body-wall just below the line of setae *c*.

Remarks.—The worm presents no very remarkable features ; it bears a general resemblance to *D. pellucida* and its varieties. *D. pellucida* is a peregrine species, and it and its varieties have been found in Southern India, Ceylon, and the Abor country. The distinctive characters of the present form are the small number of gizzards and the elongated prostates.

The dissection of the worm is here sufficient to demonstrate, what I have elsewhere shown by microscopical sections (3),—that the prostate is not an independent appendage of the male duct, but is simply the ectal portion of the duct itself, thickened by the growth of muscular and glandular elements.

Family MEGASCOLECIDAE.

Subfamily MEGASCOLECINAE.

Genus *Megascolides*.

Megascolides antrophyes, sp. nov.

(PLATE VI, FIGS. 5, 6)

Siju Cave, Garo Hills, Assam ; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. A single specimen.

The specimen was so small that dissection seemed likely to prove a difficult matter, and I had to consider whether it would not be better to section it. However the certainty that penial setae, if present, would be destroyed by sectioning, and the possibility that earth in the alimen-

tary canal might ruin the series, decided me to do my best with dissection.

External Characters.—Length 35 mm. ; diameter 1 mm. Segms. 112 mostly triannular. Colour pale, unpigmented, dorsal and ventral surfaces the same.

Dorsal pores begin in groove 10/11.

The setae are extremely small and difficult to see ; they are largest at the hinder end of the body, where $ab = \frac{2}{5}aa = \frac{1}{2}bc = \frac{4}{5}cd$; at this end of the body dd is small, only a quarter of the circumference.

The clitellum extends over $\frac{2}{3}$ xiii—xvii ($= 4\frac{2}{3}$) ; it is smooth, and without indication of the limits of the segment.

The male area (fig. 5) is cup-like, circular in shape with a strongly marked rim, the inner and outer sides of the rim being vertical. The area takes up the whole breadth of the ventral surface of segms. xviii and xix ; anteriorly it is bounded by the hinder margin of the clitellum, and here the rim is wanting ; within, on the floor, are two low transversely oval papillae filling up nearly the whole of the area.

The male pores (σ) appear to be on the anterior part of segm. xviii, near the margin of the clitellum. There is also an appearance of a pair of pores (p .) on xix, slightly further apart than the former, with which they seem to be connected by a pair of faintly marked grooves (g), somewhat convex towards the middle line. These appearances of pores and grooves must be considered doubtful ; I should have liked to confirm them by sections, but, as I have said, it was scarcely justifiable to section a unique specimen.

The female pore (ϕ) was indicated by a small faint whitish papilla midventrally situated on the anterior part of segm. xiv.

The spermathecal apertures were indistinct, but appeared to be not far from the middle line in grooves 7/8 and 8/9.

There were no other genital markings.

Internal Anatomy.—The septa from 6/7 to 11/12 are somewhat thickened.

The gizzard, in segm. vi, is relatively large, elongated, cylindrical, with parallel sides. There are two pairs of calciferous glands in segms. xii and xiii ; both are small, with slightly lobulated margins ; those in xiii are stalked, those in xii have a broader base. The intestine begins in xiv.

The last hearts are in segm. xiii.

The excretory system is micronephridial. The organs are small coiled tubes, and are not very numerous ; there are small masses of tubes on each side of the anterior end of the gizzard ; between this and the clitellum there are a few coils, and in some of the clitellar segments there are a few nephridia on each side in a transverse line ; behind the clitellum only one nephridium can be distinguished on each side in each segment,—a small twisted tube in line with the setae c ; in the last dozen segments the organs are rather larger, but they are still one pair per segment.

Male funnels were identified as glistening masses in segms. x and xi ; there are no testis sacs. Seminal vesicles appear to be altogether absent.

The prostates are tubular, of relatively great length, extending with a wavy course back to xxix or xxx ; the duct leaves the anterior end of the gland and passes obliquely forwards and inwards through segm. xix to end near the side of the ventral nerve cord in xviii ; the duct is thin, but slightly wider and more shiny near its ectal end.

In the segment behind that in which the prostatic ducts end are a pair of round flat white cushions, close to the middle line and close behind the ends of the prostatic ducts ; these cushions are slightly darker in their centres. They apparently correspond to the posterior of the two flat papillae within the male area, and the darker centres are represented on the surface by the pore-like dots previously described ; but whether there really are any apertures is, I think, doubtful. The vasa deferentia I think I can trace backwards to join the prostates at their ends in segm. xviii.

I could discover no penial setae.

There are two pairs of spermathecae, which lie in segms. vii and viii. The ampulla is a relatively large ovoid sac ; the duct is half as long and at its upper part one-third as thick as the ampulla, but it diminishes in diameter towards its outlet ; a single diverticulum is given off from the upper part or from the middle of the duct,—a long, narrow, cylindrical tube, somewhat wavy, reaching when straightened out as far as the ental end of the ampulla (fig. 6).

Remarks.—The present species does not appear to be closely related to any other Indian form. The genus is not common in India, but it is widely spread ; geographically, the nearest record to the present is British Sikkim (E. Himalayas).

Subfamily *DIPLOCARDIINAE*.

Genus *Dichogaster*.

Dichogaster bolau (Mich.)

Siju Cave, Garo Hills, Assam ; 450-500 feet from entrance. S. Kemp and B. Chopra, February, 1922. A number of specimens.

The same, 500 feet from entrance. Six specimens, four of them small and immature.

The same, 350 feet from entrance. Three specimens.

A number of mature and well preserved specimens gave me the opportunity of examining the anatomy of this species both by dissections and microscopic sections.

One batch (the first) consisted of worms of an average length of 50 mm. and of a diameter of $1\frac{1}{4}$ —2 mm. They were thus considerably larger than the usual run of the species (Michaelsen in the Tierreich (1) gives the dimensions as 20-40 mm. in length and $1\frac{1}{3}$ — $1\frac{1}{2}$ mm. in diameter).

In two dissections I placed the gizzards, once in segms. vi and vii, and once in segms. vii and viii. But two series of longitudinal sections showed that they are really in vi and vii ; certain of the septa—7/8, 8/9 and 9/10—are very close together, and very thin, and this, joined to the very small size of the worms, renders it impossible to be certain

of the disposition from dissection alone. Indeed the condition may not be immediately clear even from sections; septum 9/10 is inserted into the body-wall, over a considerable part of its periphery, along with 10/11, which is liable to cause confusion; again, in one series one of the septa was missing on the dorsal side, so that in a dissection it would have been possible—counting from behind, where (in the genital region) the numbering of the segments is easily determinable—to interpret the gizzards as being in vii and viii.

In one of the dissections the gizzards seemed scarcely separate, being demarcated neither by a softer intervening ring nor by a constriction; nor was there a septum between the two. In the sections, however, a thinner ring could be distinguished; and, while there was no complete septum 6/7, there appeared to be a few remnants of it attached to the interval between the two gizzards.

The seminal vesicles are very variable, but always small. In one specimen I found them on both sides in both xi and xii; while in another (sectioned) specimen they were quite rudimentary in x (attached to the anterior face of septum 10/11) and xii, and somewhat larger in xi (on the posterior face of 10/11); those in x and xii would certainly not have been visible in a dissection.

Family LUMBRICIDAE.

Subfamily MICROCHAETINAE.

Genus *Glyphidrilus*.

Glyphidrilus spelaeotes, sp. nov.

Siju Cave, Garo Hills, Assam; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. Seven complete or fairly complete specimens and a few fragments; only one specimen with signs of maturity.

The same; 3,000 feet from entrance. Two specimens, one mature, both incomplete posteriorly.

From the condition of the specimens the animals would appear to undergo autotomy on handling or preservation.

External Characters.—Length 175 mm.; diameter 2–3 mm.; they are thus long thin worms. Segments of a complete but non-sexual worm 310, the last score or two very short. Colour pale, or light brownish grey, the same on both dorsal and ventral surfaces. Secondary annulation in the preclitellar segments; there may be as many as six secondary annuli per segment, and even eight may be indicated. The body is four-sided behind the wings; the dorsal surface is grooved, the groove becoming more marked towards the hinder end of the body; the ventral or the lateral surfaces may also be grooved. The anus is dorsal, a pear-shaped opening with the narrow pointed end anterior and the hinder margin rounded.

The prostomium is prominent, zygalobous and bluntly triangular.

There are no dorsal pores.

The setae are paired, but rather widely so, especially the lateral. In front of the wings $ab = \frac{1}{2} aa = \frac{2}{5} bc = \frac{4}{5} cd$, and $dda = 1\frac{1}{3} a$; a little

behind the wings $ab = \frac{2}{5} aa = \frac{1}{3} bc = \frac{4}{5} cd$, while dd is greater than aa and about equal to $3cd$; towards the hinder end the ratios are the same except that dd is relatively greater and aa is equal to or even greater than bc , while there may be no perceptible difference between ab and cd . The setal couples behind the wings are situated along the angles of the body. The setae are prominent in the hinder part of the body,—indeed they are so everywhere except in the anterior 20 or 30 segments; examined microscopically they are seen to be ornamented with a few fine transverse lines near the tip.

The clitellum, in the only specimen in which it is distinguishable, extends over segms. xvi–xxx, and in addition xiv and xv are slightly altered; but the modification is nowhere very great, and is mainly evidenced by the loss of the secondary annulation.

The wings are attached between the line of the dorsal and that of the ventral setal couples, and extend from xviii or xix to xxiv or $\frac{1}{2}$ xxv; they are bent downwards and inwards, and on segm. xviii they are, if present, less prominent than in the rest of their extent. This portion,—i.e., that on xviii,—is discontinuous from the rest, being cut off by an incision.

There are several series of circular papillae, each with a central depression from which rises a small round mamillary projection. The papillae are placed on the hinder part of the segments on which they occur; their diameter is equal to two-thirds of the length of the segment, so that the anterior quarter or third of the segment is not encroached on by the papillae. In the only two specimens that show them, their distribution varies so much that it is necessary to describe them separately in each.

In the first of the two specimens there are (a) a midventral papilla on segm. xi; (b) a submedian series, with their centres internal to the line of setae *a*, paired and touching in the middle line in segms. xix and xxvii, single and on the right side only on xxviii; (c) a pair with their centres immediately outside the line of setae *b*, on segm. xxv; (d) a dorso-lateral series, between the lines of *c* and *d*, paired on xiv and xvi, single, small and on the left side on xv.

In the second specimen there were (a) midventral papillae on segms. xvii and xviii; (b) a pair a little above the line of setae *b* on segm. xxv; (c) a pair midway between the lines of *b* and *c* on segm. xvii.

In addition there was, in the first specimen, a median dorsal series of a different kind; these were circular, slightly raised, without depression or mamillary projection in the centre, situated over the middle of the segment (not over its hinder part), and taking up nearly the whole length of the segment; these occur on segms. xviii to xxviii and perhaps slightly on xxix. They are not to be seen in the second specimen.

I could not discover the genital apertures.

Internal Anatomy.—No septa are notably thickened; mostly they are very tenuous, and indeed are scarcely perceptible behind 12/13; 8/9 is perhaps the most thickened, and all from 5/6 to 12/13 seem a little stronger than those behind,—they are at any rate visible without difficulty.

The gizzard occupies segm. viii and the hinder part of vii ; it is rather soft, in shape square in front, cylindrical but narrowing a little at the hinder end. The intestine begins suddenly in segm. xv.

There are four pairs of hearts, in viii-xi.

The excretory system is meganephric. No nephridia are distinguishable in the first eleven segments, and they are very small in xii and small in xiii ; thenceforward they appear as considerable twisted tubes as far as segm. xxx, after which they become larger and form flattish opaque lobed masses which cover nearly all the body-wall except a middorsal streak and the midventral region between the lines of the setae *a* ; i.e., they cover the inside of the body-wall from the line *a* to above *d*.

The male funnels are free in segms. x and xi. There are four pairs of seminal vesicles, in segms. ix-xii, of moderate size, those in xii being the largest ; they are all slightly lobed, those in xii most so.

The ovaries are in segms. xiii. There are perhaps ovisacs in xiv.

The spermathecae are small ovoid sacs disposed with their long axes longitudinal, without distinguishable duct and therefore sessile on the body-wall. They are arranged in three transverse rows on each side, with five (once four) in each row, over grooves 13/14, 14/15 and 15/16 ; in each row the organs are placed in line with the setae *a*, *b*, *c*, and *d*, and one of the five is between the lines *b* and *c*.

No prostates were seen.

Remarks.—The present species is related, as shown by the extent of the clitellum and of the wings, to the species already known from Burma and from Bengal and Orissa (*G. papillatus* and *tuberosus*) ; in *G. annandalei* from S. India both clitellum and wings extend considerably further back.

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EXPLANATION OF PLATE VI.

- FIG. 1.—Longitudinal section through part of anterior region of *Enchytraeus cavicola*; *b. w.*, body-wall; *ch.*, chamber which receives the salivary glands (*sal.*), connected to recess (*r.*) of hinder part of pharynx by a solid stalk; *c.g.*, cerebral ganglion; *corp.*, coelomic corpuscles; *oes.*, oesophagus; *ph. ep.*, pharyngeal epithelium; *ph. m.*, pharyngeal muscles; *r.*, recess (v. sup.); *sal.*, salivary gland; *s. gl.* a few cells of one of the septal glands; *v. n. c.*, ventral nerve cord; 4/5, septum 4/5. $\times 230$.
- FIG. 2.—Transverse section through beginning of oesophagus of the same; *bulb*, postpharyngeal bulb (apparently double on each side); *ch.*, chamber into which salivary glands open; *c. m.*, circular muscular layer; *cu.*, cuticle; *d. v.*, dorsal vessel; *ep.*, superficial epithelium; *l. m.*, longitudinal muscular layer; *oes.*, oesophagus; *ph. m.*, pharyngeal muscles; *v. n. c.*, ventral nerve cord. $\times 190$.
- FIG. 3.—Outline of cerebral ganglion of the same.
- FIG. 4.—Longitudinal section of part of the anterior region of the same, constructed from several consecutive sections, semidiagrammatic; *amp.*, spermathecal ampulla; *bulb*, postpharyngeal bulb; *b. w.*, body-wall; *dil.*, dilatation in course of spermathecal duct, containing spermatozoa; *duct*, spermathecal duct; *oes.*, oesophagus; *ph. m.*, pharyngeal musculature; *r.*, recess in hinder part of dorsal pharyngeal wall; *sal.*, salivary gland, variously cut; *s. gl.*, septal glands; *spz.*, ball of spermatozoa in spermathecal ampulla; 4/5, 5/6, 6/7, the corresponding septa. $\times 210$.
- FIG. 5.—*Megascolides antrophyes*, external characters of genital region; *clit.*, clitellum; *gr.*, a faintly visible groove between *p.*, a doubtful glandular pore and ♂, the male aperture; ♀, female papilla.
- FIG. 6.—The same; a spermatheca.

