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NOTE ON THE OCCURRENCE OF THE LEECH *LIMNATIS NILOTICA* IN SEISTAN AND THE AFGHAN-BALUCH DESERT

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Blanchard [1] has given numerous instances of the leech *Limnatis nilotica* causing haemorrhage in the throat of men and beasts when swallowed, while Masterman [2] supplies details of cases in Palestine. The oldest reference, however, is probably to be found in the story of how Gideon [3] chose out his picked men, careful and fitted for a sudden night-attack on the enemy. This he did by selecting those who lifted up water from a stream in their hands before drinking it, instead of lapping like a dog direct from the stream. The precaution is still a necessity for all who drink from streams and springs in Palestine (where the danger of swallowing a leech is real), and might still be used in separating careful from careless persons. In all cases investigated in Palestine the leech swallowed has been *L. nilotica* (*cf.* Masterman, *op. cit.*).

It is, therefore, of particular interest to put on record the occurrence of this leech on the borders and even within the boundaries of the Indian Empire. While travelling to Seistan in November 1918, Dr. Annandale and Dr. Kemp saw a member of an Indian labour corps carefully skimming water from the top of a spring at Makki in Western Baluchistan, close to the Afghan border. When asked why he did this, the man said that he was afraid of leeches. No leech was seen in this spring, but many were observed at Robat close to the point at which the Afghan, Baluch and Persian frontiers meet, and also at Hurmuk across the last. Specimens were not obtained at any of these places, but there can be little doubt from the observations made that they belong to the same species as one captured at Nawarchah, a place some distance north of Hurmuk and well within the district of Seistan, on the tongue of a horse.

The specimen is small, being only 2·5 cm. long and ·5 cm. broad as preserved in 90% alcohol, but it agrees in all essentials with small specimens of *L. nilotica* (Savigny) from Palestine. It belongs to the colour-form in which the dark markings are obscure or obsolete. The posterior sucker is of a characteristic size, the

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[1] *Boll. Mus. Zool. Torino* IX, No. 189, p. 43 (1894).

[2] *Parasitology* I, p. 282 (1908).

[3] *Judges* VII, 6. Frazer in his *Folk-lore in the Old Testament* adopts a ritualistic explanation.

diameter being about 5 mm. and that of the anterior sucker only 2 mm.

L. nilotica is easily distinguished from the common Indian species, *Limnatis* (*Poecilobdella*) *granulosa* (Savigny), by the absence of the colour-pattern characteristic[1] of the sub-genus *Poecilobdella* and by its smaller size.

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[1] See Blanchard in Weber's *Zool. Ergeb. Niederland. Ost.-Ind.* IV, p. 346, fig. 3.

NOTES ON SOME ASIATIC SPECIES OF *PALINGENIA* (ORDER EPHEMEROPTERA).

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(With Plates XVIII—XX.)

The Ephemerid genus *Palingenia* has attracted the attention of many naturalists on account of the way in which immense swarms of adults hatch and die annually during the evenings of a few consecutive days only.[1]

The larvae are fossorial. They have six pairs of double gill-plumes arched upwards over the back and protected by five pairs of lamellae which are covered on the outer side by long hairs. According to Swammerdam (1758, p. 109), these lamellae are "oars that serve the creature for swimming." Male larvae may be distinguished from females by their larger eyes and, in the later stages, by their longer caudal appendages and developing forceps.

The genus has been provisionally divided by Eaton (1883, p. 23) into three subgenera as follows:—"*Palingenia* (typical), Burmeister, containing European and Western Asiatic species; *Anagenesia* containing Indo-Malay and a Siberian species; and a nameless subgenus containing Brazilian species," concerning the adults of which scarcely anything appears to be known.[2]

Eaton's system of reference to the venation of the wings[3] has been adopted throughout the following notes in order to facilitate comparison with his monograph. In the figures this system is supplemented by that used in Comstock's book "The Wings of Insects" (New York, 1918).

Subgenus **Palingenia**, Burmeister, *s. str.*

Adult with the fore-tarsus of the male about 2½ times as long as the femur; the praebrachial nervure (6) of the forewing forked beyond the middle; two conspicuous couples of longitudinal nervures (midway between 4 and 5, and 5-6) proceeding to the terminal margin of the fore-wing (pl. xx, fig. 21); the forceps with a long slender basal joint grooved on the inner side and (? always) at least five shorter terminal ones (pl. xx, figs. 22-3).

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[1] For references see Eaton, 1883, pp. 24-28; also Swammerdam, 1758, p. 104, concerning references by more ancient writers.

[2] The larva is figured by Eaton, 1883, pl. xxv, figs. 20-24.

[3] Eaton, 1883, p. 4.

Larva with the dorsal margin of the fore-tibia (? always) strongly toothed (pl. xviii, fig. 4).

Palingenia (*s. str.*) ? longicauda, Olivier.[1]

Palingenia sp. (*? robusta*), Needham, 1909, p. 191, pl. xx, fig. 8.[2]

Adult (pl. xx, figs. 21-23).—Nine pinned specimens from Seistan, all in bad condition. One of these was erroneously referred by Needham to the subgenus *Anagenesia*, to which *P. robusta*, Eaton, belongs, with the remark :—"The species will be recognized by the male forceps. which is different from the forceps of any species that has been figured hitherto." His figure (1909, pl. xx, fig. 8) differs from Eaton's figure (see 1883-8, pl. i. 1*a* ♂) of the male genitalia of *P. longicauda* in having five instead of six terminal joints to the forceps. But Cornelius (1848, pp. 28-29) states that *P. longicauda* has only three such joints and shows only three in his figure (1848, fig. 4K), though the terminal one could be almost better interpreted as two joints than as one but for the accompanying statement, and might even be composed of three. The probability, it seems to me, is therefore that normally the forceps of *P. longicauda* consists of at least five terminal joints and one long basal one. In the specimens now under consideration most of the forceps are broken. In one the terminal joints appear to be six in number, the last being very small and imperfectly separated, in another they appear to be seven, the terminal one again being very small. Unfortunately no European specimens are available for comparison. The colour of the Seistan specimens appears to be duller and more uniform than in European specimens, but this may be due to their poor state of preservation.

The species probably occurs also in Mesopotamia, as Major Connor writes that he "saw millions of the large Mayflies on the Euphrates at about the beginning of April. They were being eaten up by the ordinary Caspian river tortoise as they lay in heaps in eddies and slack water. They swarm in the river even as far down as Basra."

Larva (pl. xviii, figs. 1-4).—Six males and eight females, none full-grown (length, excluding mandibles and caudal appendages, 21-25 mm.), from thick mud of pools in the bed of the Randa stream (otherwise dry) four miles northwest of Jellalabad, Seistan. 2.xi.18.

Dr. Annandale has supplied the following note on the finding of these larvae :—

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[1] For *P. longicauda*, see Eaton, 1883, p. 24, pl. i, fig. 1*a* ; and Cornelius, 1848, pp. 22-29, figs. 4-4K.

[2] The nymphs referred by Needham (*loc. cit.*) to this genus belong, in all probability, to the genus *Ephemera*. (See Vayssière, 1882, pp. 38-42, pl. i, figs. 3-7; Eaton, 1883-8, pp. 58-59, pl. xxx, figs. 1-19; and Klapálek, 1909, pp. 29-30). They are very different from those of *Palingenia*.

"The larvae of *Palingenia* were collected about the end of November at the edge of small pools of very foul water left by the retreat of the annual floods in the bed of the Randa stream near the ruined city of Jellalabad, some twelve miles north of Nasratabad, the capital of Seistan. This stream is filled with water only in flood-time. For some considerable distance south the country consists of a flat barren plain the surface of which in winter is formed of bare and extremely hard grey clay. It is in fact one of those shallow basins, so common in Seistan, which are flooded every normal year by the rise of the Helmand. Towards the edge of this basin we noticed that the whole ground was pitted with little holes as though a rather narrow pen-holder had been repeatedly thrust into it. We were unable to account for this phenomenon until we examined the edge of the pools, where each hole was occupied by a *Palingenia* larvae. The mud was here fairly soft but was caking rapidly and the larvae, the gills of which were pressed tightly against the sides of their abdomens, were, though still living, apparently being gradually asphyxiated. The foulness of the water was due partly to the presence of large numbers of dead fish and partly to the fact that the several tribes of the district watered their flocks of sheep and goats at the pools. Doubtless the Mayflies of the same genus collected in large numbers in Seistan by the officers of Sir Henry MacMahon's Commission were captured in spring or su nmer."

The identity of Dr. Annandale's larvae with these adults from Seistan is extremely probable, but has not been definitely proved. The larvae appear to be identical with those of *P. longicauda* described by Swammerdam (1758) and Cornelius (1848). The caudal appendages are not very well preserved; they seem to be of almost equal length in both sexes, but this is probably due to their not being fully developed. These larvae differ from all other *Palingenia* larvae yet known in having the dorsal (outer) margin of both the mandibles and fore-tibiae very strongly toothed.

I have not been able to distinguish the second spine figured by Cornelius on the blade of the maxilla; but this may be a variable character (see below, p. 142). The labial palps bear hairs and spines like those of *P. robusta*.

The front legs closely resemble those of *P. robusta*. The group of spines on the inner side of the lower distal angle of the tibia is, however, composed entirely of simple spines somewhat longer and slenderer than the very stout simple spines of the outer half of the group in that species. The serrate spines on the tarsus, on the contrary, are somewhat coarser; they are also more numerous. The middle legs differ from those of *P. robusta* chiefly in the presence of a large conical tooth on the dorsal surface of the distal end of the tibia. The hind legs differ chiefly in having the outer distal angle of the tibia less produced. In both middle and hind legs the spines on this angle resemble those found in the same position on the front legs; they are much thinner than in *P. robusta*.

The gills and their protective lamellae have been somewhat crushed together, but appear to resemble those of *P. robusta.*

Subgenus **Anagenesia,** Eaton.

Adult with the fore-tarsus of the male shorter than the femur; the praebrachial nervure (6) of the fore-wing forked before the middle; three conspicuous couples of longitudinal nervures (midway between 4 and 5, 5-6, and midway between 6 and 7) proceeding to the terminal margin of the fore-wing (pl. xx, fig. 24); the forceps with a long flattened basal joint and two shorter terminal ones, the latter sometimes with a small and imperfect third joint between them (pl. xx, figs. 17-20 and 25).

Larva with the dorsal margin of the fore-tibia (? always) without conspicuous teeth (pl. xviii, fig. 8).

Palingenia (Anagenesia) lata, Walker.

Adult (pl. xx, fig. 17).—The Indian Museum collection contains pinned males from Sibsagar. See Eaton, 1892, p. 407.

Palingenia (Anagenesia) picta, n. sp.

Adult (pl. xx, figs. 24-25).—Two pinned males each about 22 mm. long, from Kapit, Sarawak, 24.vii.10. This species differs from *P. lata* in its slightly larger size and in having the terminal joint of the forceps distinctly smaller than the penultimate. The most striking difference, however, is in colour, *P. lata* being of an almost uniformly dull brown colour, whereas in *P. picta* the general colouration is bright reddish or yellowish brown, while the head is more or less black between the eyes, except for a strongly marked median brown line on the vertex; the mesonotum is almost equally dark; the wings are whitish with yellowish veins, the anterior pair having infuscate margins, especially in front and at the tips; the dorsal plates of the abdomen are somewhat dark, except for a narrow posterior border. The relatively pale pronotum stands out in marked contrast to the dark head and mesonotum.

Palingenia (Anagenesia) robusta, Eaton.

Palingenia robusta, Eaton, 1892, pp. 407-408.

Adult (pl. xx, figs. 19-20).—The imperfect type male from Cachar, two dry and six spirit males and three spirit females from the Dikko River, Nazira, Assam. The Dikko specimens were sent by Mrs. Maxwell, with the following information. They emerge annually at about the end of October, and for three or four days float down the river in countless millions. The natives say that they also appear on other rivers, such as the Desoi, Desang and Dihing, and that they come out at and under the edge of the water in the shallows after the rivers have left the hills and where they run through silt only; but Mrs. Maxwell says that so far as

she knows they do not occur on rivers actually rising in flat districts. The natives believe that until they have appeared there is always a chance of further floods and that consequently it is no use building the temporary bamboo bridges which they put up every cold weather until these "pani-pooka" (water insects) have gone. The caudal appendages of the males were 3 inches long and semi-transparent when fresh. The insects are so light and hollow that they cannot be kept under water; when just out they are white or creamy and look like foam when blown together by the wind. All the specimens collected as adults were males; the females were caught as nymphs and hatched in captivity.

This species is of about the same size as the last, but lacks its rich warm colour. The general colour of the male is whitish, with the upper surface of the head, mesothorax and posterior end of abdomen tinged with dull brown. The margins of the fore-wings are narrowly tinged with the same colour. The second joint of the foretarsus is more distinctly longer than the first and third than in either of the two preceding species. The forceps seems normally to consist of the one long basal and two terminal joints characteristic of the subgenus; but the second of the latter joints, which is fully as long as or even a little longer than the first, is often divided quite definitely into two near the base, at least on the outer side.

The legs and caudal appendages of the female are smaller and feebler than those of the male, especially the caudal appendages, and the dorsal surface of the body is much darker in colour, being of a dull brown tint. The wings are whitish as in the male.

Larva (pl. xviii, figs. 5-8, pl xix, figs 9-16).—One male and two female cast skins, found floating in the surface water of the Dikko River, Nazira, Assam when adults were emerging, Oct. 26-30, 1918; three males and one female insect from the same locality, Oct. 1919.[1]

The total length (excluding the mandibles but including the caudal appendages) is 45-47 mm. in both sexes. The caudal appendages are 13 mm. long in the male and only 9 in the female, the body being therefore 4 mm. longer in the female than in the male.

The teeth on the anterior margin of the head are somewhat more scattered than in *P. longicauda*.

The mandibles (pl. xviii, fig. 7) are very hairy, long and slender and are upturned distally; they have a number of small teeth, much smaller than those of *P. longicauda*, scattered along the basal ⅔ of the upper margin. They are intermediate in form between those of *Palingenia* (*s. str.*) *longicauda* (see Cornelius, 1848, fig. 3B) and those of *Ephemera vulgata* (see Eaton, 1883-8, pl. xxx, figs. 7-8). They are very different from the mandibles of the *Palingenia* (*Anagenesia*) larva from Ceylon[2] figured by Eaton (1883 8, pl. xxv,

[1] The description is taken from the cast skins, as the larvae were not received till it had been completed.

[2] No adult from Ceylon was known to Eaton. Banks (1914, pp. 612-613) has since described *Palingenia* (*Anagenesia*) *greeni* from there.

figs. 8-9), which are much shorter and stouter, are distally somewhat wedge-shaped and irregularly dentate instead of slender and pointed, and appear to be without the two small laminar teeth found below the molar tooth in the present species and in *P. longicauda* and *E. vulgata*. There is little or no difference between the teeth on the right and left mandibles.

The maxillae (pl. xix, fig. 9) and labium closely resemble those of Eaton's Ceylonese larva but are less pointed, especially the maxillary palps. The blade of the maxilla bears two spines distally as in Cornelius's figure of *P. longicauda*, but the lower one is more transparent than the terminal one, and is sometimes very hard to distinguish and possibly absent.

The labial palps (pl. xix, fig. 10) bear a number of transparent stout curved spines at the distal extremity and a tuft of spines on a tubercle at the base of the penultimate segment.

The front legs (pl. xviii-xix, figs. 8 and 11) are clothed with hairs and spines arranged in very definite series. The transverse line of hairs at the base of the femur and the two transverse lines at the base of the tibia are finely pectinate (pl. xix, fig. 14). The lateral filaments on these hairs are extremely minute, but probably form two series more nearly at right angles to each other than in one plane. The ventral aspect of the outer distal angle of the tibia bears a group of strong spines of which the outermost half are somewhat less stout than the innermost, and are coarsely biserrate Owing, however, to the angle which the two rows of serrations bear to one another not more than one of them can be clearly seen from any one point of view (pl. xix, fig. 12). The tarsus bears a number of more slender biserrate spines below its outer margin. Their serrations are more nearly in one plane (pl. xix, fig. 13). The remaining hairs and spines are simple.

On the last two pairs of legs the lines of pectinate hairs are absent, and there are no serrate spines, simple spines and hairs being more extensively distributed in place of them. The spines are strongest and most numerous on the third pair of legs. Except for a group of very stout curved spines of moderate length on the ventral aspect of the outer distal angle of the tibia, the spines are confined to the dorsal surface (pl. xix, figs. 15-16).

The first abdominal segment bears a pair of gills but no protective lamella. The five following segments bear both gills and lamellae. The three remaining segments are without appendages. The first two of these bear spines and hairs laterally. The last has hairs distributed over almost the whole of its dorsal surface; these hairs are thick behind, but there are no spines at all comparable in strength with those on the two preceding segments.

Each gill consists of two plumes, one situated behind and to the inner side of the other. The former is of about equal size on all segments, and being directed backwards it conceals the latter, which is considerably smaller—more so in the anterior than in the posterior segments.

All five protective lamellae are of about equal size. Each

consists of a finger-like process of the body-wall, bare on the inner side but fringed and entirely covered on the outer side with very long hairs.

Palingenia (Anagenesia) minor, Eaton.

Palingenia minor, Eaton, 1882, p. 408.

Adult (pl. xx, fig. 18).—Two specimens labelled "Karachi Museum" and one from Nattor, which is in the Rajshahi Division of Bengal, were described by Eaton from the Indian Museum collection. A specimen from Sara Ghat in Bengal, and one from Pakokku in the oil-fields of Upper Burma, have since been added. The species would seem, therefore, to be very widely distributed over the Indian Empire.

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1909. Needham, J G. "Notes on the Neuroptera in the Collection of the Indian Museum." *Rec. Ind. Mus.* III, 1909, pp. 185-210, pl. xix-xxi.

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EXPLANATION OF PLATE XVIII.

Palingenia larva from Seistan.

FIG. 1.—Head of male.

„ 2.—Head of female.

„ 3.—Right mandible.

„ 4.—Left front tibia and tarsus from above.

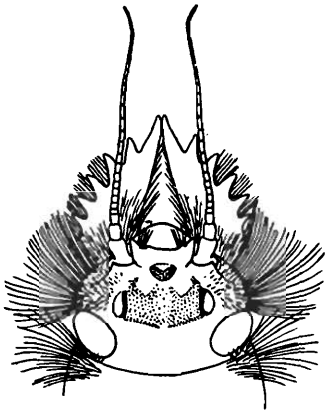
Palingenia robusta, larva.

„ 5.—Caudal appendages of female.

„ 6.—Cast skin of male.

„ 7.—Right mandible.

„ 8.—Left front tibia and tarsus from above.



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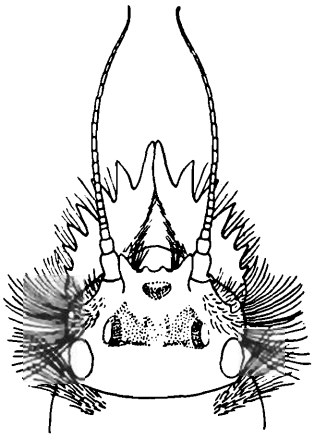

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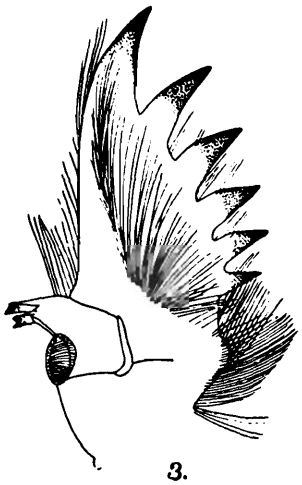

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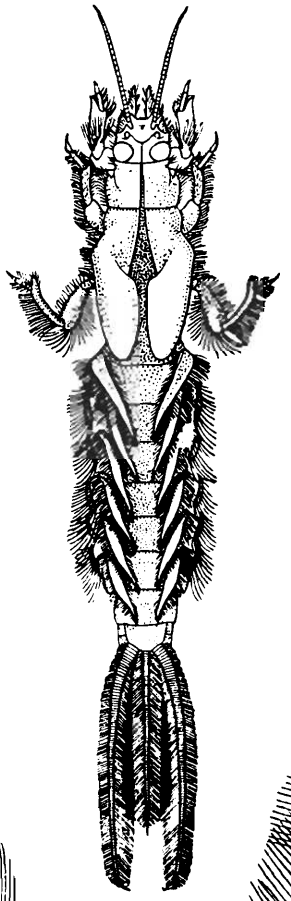

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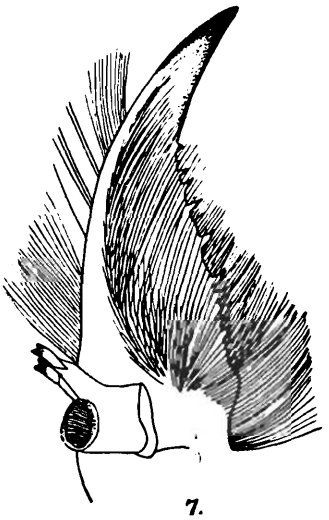

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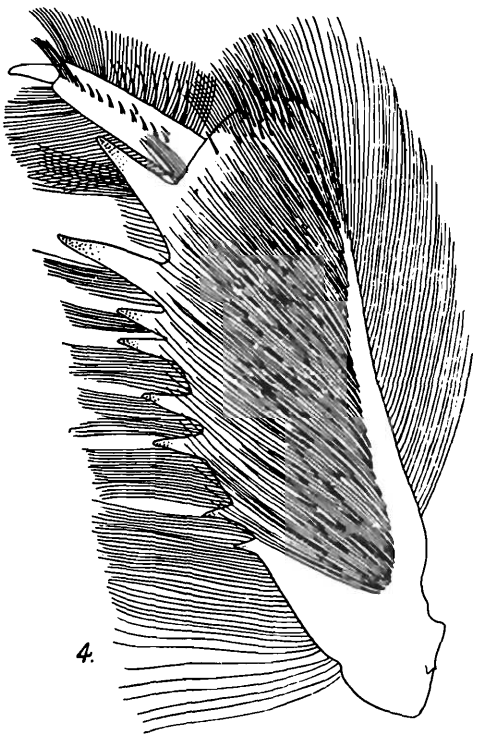

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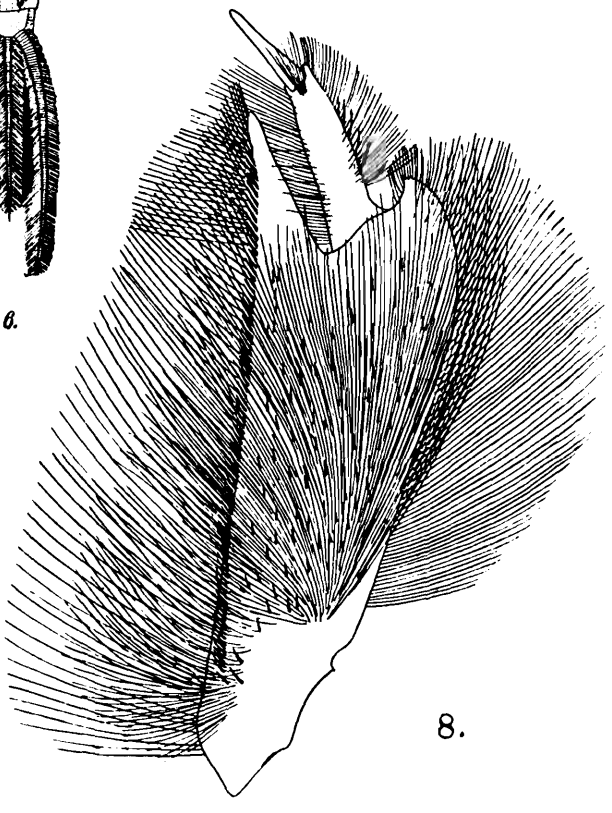

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PALINGENIA LARVAE.

EXPLANATION OF PLATE XIX.

Palingenia robusta, larva.

FIG. 9.—Right maxilla from below.

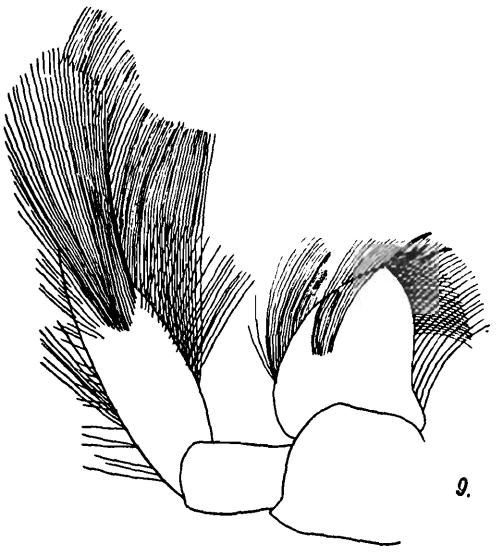
,, 10.—Right labial palp from below.

,, 11.—Left fore leg from below.

,, 12.
,, 13. } Spines and hairs from fore leg.
,, 14.

,, 15.—Left middle tibia and tarsus from above.

,, 16.—Left hind tibia and tarsus from above.



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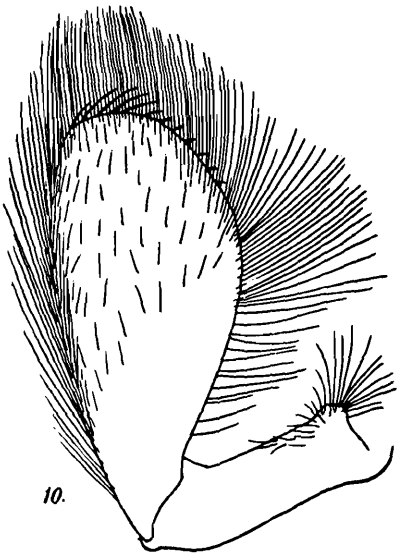

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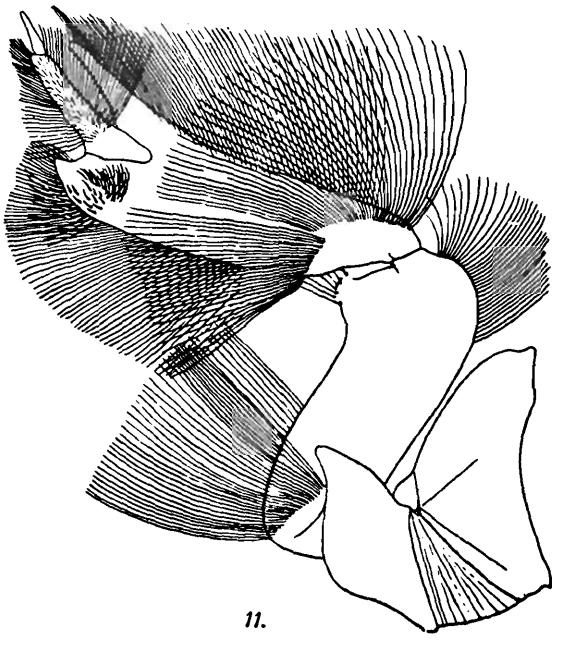

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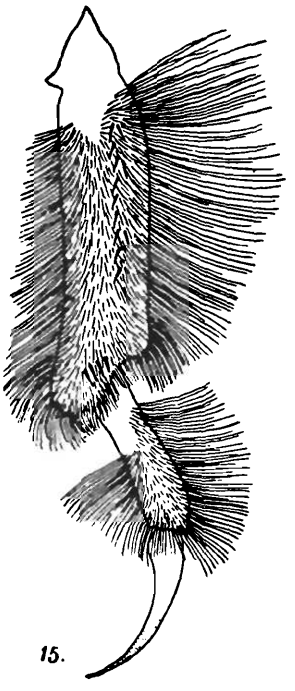

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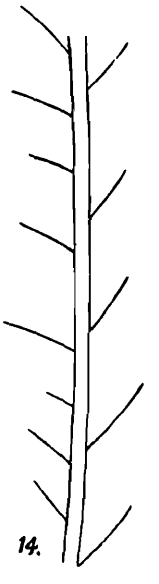

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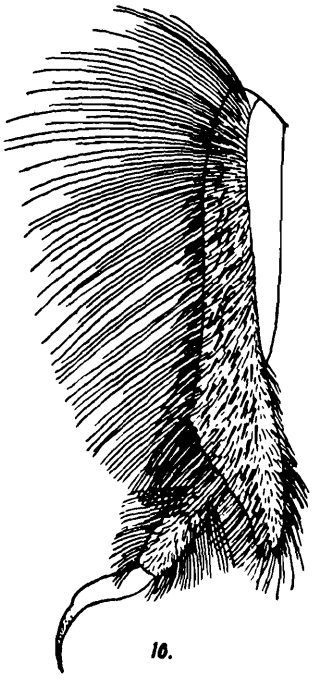

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PALINGENIA LARVAE.

EXPLANATION OF PLATE XX.

FIG. 17.—*Palingenia lata*, terminal joints of forceps of male.

,, 18.—*Palingenia minor* ,, ,, ,,

,, 19.—*Palingenia robusta* ,, ,, ,,

,, 20.—*Palingenia robusta* ,, ,, ,,

,, 21.—*Palingenia* from Seistan, right fore wing.[1]

,, 22.—*Palingenia* ,, , forceps of male.

,, 23.—*Palingenia* ,, , terminal joints of forceps of male.

,, 24.—*Palingenia picta*, male from above.[1]

,, 25.—*Palingenia picta*, terminal joints of forceps of male.

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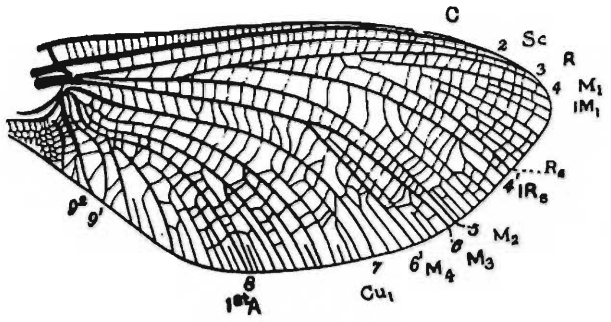
[1] The numbers at the ends of the veins are the symbols used by Eaton in his monograph. The letters are those used by Comstock in his book on "The Wings of Insects" (see above p. 137).



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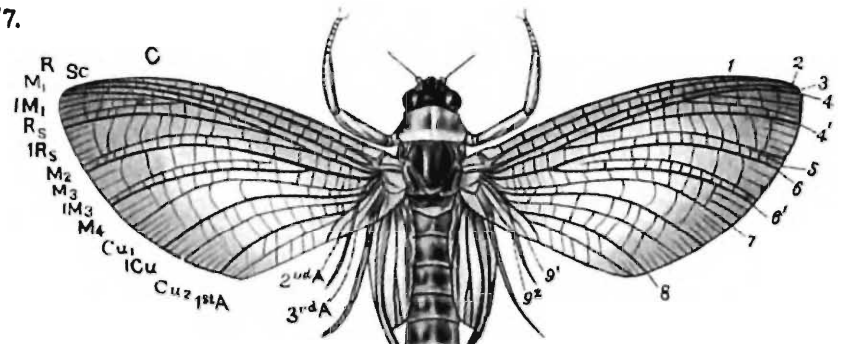

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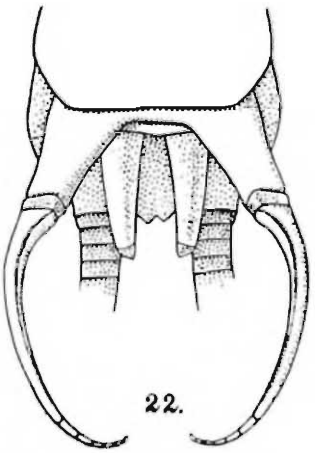

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PALINGENIA.

LIST OF ENTOMOSTRACA COLLECTED IN SEISTAN AND THE BALUCH DESERT

By ROBERT GURNEY, *M.A.*, *F.Z.S.*

[The few Entomostraca mentioned in Mr. Gurney's list are the only fresh-water Crustacea we saw in Seistan except the crab *Potamon* (*Potamon*) *Potamios gedrosianum*, Alcock, and certain small Ostracods abundant in springs in the desert. Owing to some accident no specimens of the latter were collected. The crab was found in considerable numbers buried in the mud at the bottom of pools of foul water in the bed of the Randa stream near Jellalabad. No trace of it was, however, observed in the Hamun-i-Helmand. Mr. S. W. Kemp has compared a series of specimens from Seistan and from Quetta, where it was seen in an active condition in winter, and can find no local difference. In the hill-country of Baluchistan, which is not represented in the collection examined by Mr. Gurney, at least two species of Amphipods are common in springs.—*N. Annandale.*]

(1) NASRATABAD, SEISTAN. Pools on Parade ground. 27-xi-18.

These pools were pits from which clay had been dug for bricks. There was a luxuriant growth of *Zannichellia*, but the water was very foul, being visited by large numbers of donkeys and camels.

Daphnia magna Straus. Abundant.
Simocephalus vetulus O.F.M. Abundant.
Cyclops strenuus Fischer-Sars.
,, *leuckarti* Claus.
Eucypris clavata Baird. Common.
Ilyocypris bradyi Sars.
Potamocypris villosa Jur. Common.

(2) NASRATABAD, SEISTAN. Irrigation channel. 19-xii-18.

Leptestheria tenuis Sars. A single male specimen.

I do not feel at liberty to dissect this specimen, but it agrees so closely in external appearance with *L. tenuis* that I have no hesitation in so naming it.

(3) LAB-I-BARING, SEISTAN. Channels in reed-beds in Hamun. 10-xii-18.

The collection was made in small pools about 8 feet deep, blocked with *Potamogeton pectinatus*.

Daphnia longispina var. *rosea* Sars. Rare.
Ceriodaphnia pulchella Sars. Common. Ephippial females seen.
,, *reticulata* Jur. A few.
Simocephalus vetulus O.F.M.
Bosmina longirostris O.F.M. Two seen.
Cyclops viridis Jur. One female only.
Herpetocypris reptans Baird. One only.
Free ephippia of *Daphnia magna*.

(4) YAKMATCH, W BALUCHISTAN. 13-xi-18.

Yakmatch is a station on the Baluchistan-Persia Railway in the middle of the desert. The specimens are from a small artificial pool lined with cement into which water is pumped from a spring. The only vegetation was a spongy grey alga.

The bottle contained a number of shells of Ostracods, but no complete animals. The shells of *Cyprinotus incongruens* Ramd. and of *Ilyocypris bradyi* Sars were identified.

(5) ZANGI NAWAR, 20 MILES FROM NUSHKI, BALUCHISTAN. 29-xi-18.

From small lakes of practically fresh water into which the Peshin-Lora river drains in the Baluchistan desert. The pools were full of submerged weeds.

Diaphanosoma brachyurum Liévin. Common. Males and females with resting eggs present.

Simocephalus exspinosus Koch. Abundant.

Ceriodaphnia reticulata Jur. Common.

Diaptomus salinus Daday. Common.

Eurycypris pubera O.F.M. Young only.

Cypridopsis dentatomarginatus Daday? One specimen only.

Limnicythere inopinata Baird? One young specimen.

Potamocypris villosa Jur. Shells only.

Ephippia of *Daphnia magna* found.

REPORT ON THE FRESHWATER GASTROPOD MOLLUSCS OF LOWER MESOPOTAMIA

PART II.—THE FAMILY PLANORBIDAE.

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

I have examined shells of four species of this family from Lower Mesopotamia, three belonging to the genus *Gyraulus*, one to *Bullinus*. As all but one of these have recently been discussed in these "Records" and as the one species not hitherto considered is represented in the collections before me merely by empty shells, there is not much that can be profitably said here. I think, however, that it will now be convenient to treat *Bullinus* as the type-genus of a distinct subfamily, in which *Physopsis*, Krauss, may be provisionally included. At least one recent writer has talked of the family Bullinidae, but in view of the close resemblance between the young shell of certain species of *Planorbis* (*s.s.*) and the adult shell of *Bullinus*, this course seems to me to go too far.

Family PLANORBIDAE.

Subfamily *PLANORBINAE*.

Genus **Gyraulus**, Agassiz.

Of the three species found in Lower Mesopotamia, two have been discussed already in this volume. I have unfortunately no information about the anatomy of the third.

Key to the species of Gyraulus *of Lower Mesopotamia.*

1. Shell surrounded by a strong median keel; mouth of shell sharply pointed externally ... *G. euphraticus.*
2. Median keel absent or poorly-developed; mouth rounded or bluntly-pointed externally ... *G. convexiusculus.*
3. Mouth of shell relatively small, bluntly pointed externally; a fairly strong basal keel on periphery of shell ... ... *G. intermixtus.*

Gyraulus euphraticus (Mousson).

1919. *Gyraulus euphraticus*, Annandale and Prashad, *Rec. Ind. Mus.*, XVIII, pp. 40, 53, 55, figs. 5c, 7a, 8a.

I have nothing to add to our recent observations on this species except to say that shells occur mixed with those of *G.*

convexiusculus, which is the more abundant of the two, at the edge of the lower Euphrates at all points at which deposits are formed by floods. Probably Mousson included both species under the name *Planorbis* (*Gyraulus*) *devians* var. *euphratica*. There are no fresh specimens in the collections examined.

Gyraulus convexiusculus (Hutton).

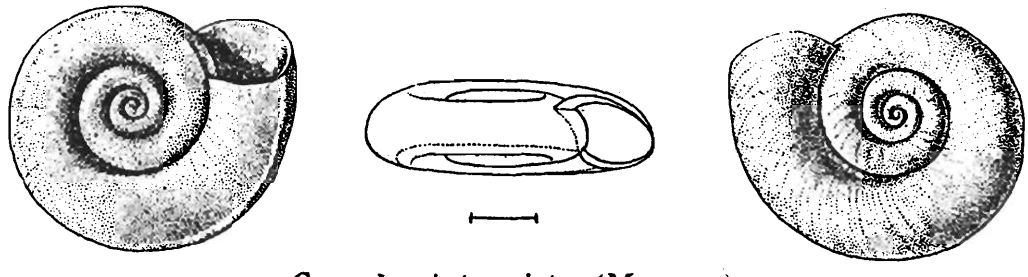
1919. *Gyraulus convexiusculus*, *idem*, *op. cit.*, pp. 40, 53, figs. 5*e*, 7*b*, 8*b*.

This is by far the most abundant species of the family in all the flood-deposits from Lower Mesopotamia from which I have examined shells. Capt. Boulenger obtained living specimens on mud-flats of the River Euphrates at Gurmut Ali, N. of Basra. As usual, the shell exhibits great individual variability and some examples come much nearer *G. euphraticus* than others. I can, however, detect no constant difference from series from India, Burma and China.

Gyraulus intermixtus (Mousson).

1874. *Planorbis* (*Gyraulus*) *intermixtus*, Mousson, *Journ. de Conchyl.* (3) XIV, p. 45.

This species is scarcer in the river-deposits of Lower Mesopotamia than either of the other two and I have only seen empty bleached shells. It is, however, widely distributed in this area.



Gyraulus intermixtus (Mousson).

It is closely related, as Mousson points out, to *G. euphraticus*, though that author did not recognize the identity of the latter species with the *P. compressus* of Benson and Hutton; but it differs in that the spiral is more transverse and deviates less below and in that the keel is situated at the base of the last whorl instead of round its middle. This is a very characteristic feature. Mousson refers to the sculpture as "*transverse tenuiter striata.*" In the specimens before me I can detect no transverse striae, but they are perhaps slightly water-worn. They agree well in other respects with the original description.

Subfamily *BULLININAE*.

Genus **Bullinus**, Adanson.

1918. *Bullinus*, Annandale, *Rec. Ind. Mus.*, XV, p. 167.

Mousson recognizes two species of this genus from flood-deposits in Lower Mesopotamia. He calls them *Physa* (*Isidora*)

Brocchii, Ehrenberg, and *Physa* (*Isodora*) *lirata*, Mousson, and distinguishes the latter by its more elongate body-whorl, regular spire, less distinct and less scalariform whorls, by the mouth of the shell being obtuse both above and below, and by the sculpture, which he describes as consisting of fine, sharp costae, which are somewhat distinct and represent lines of growth. The spiral and the form of the mouth in *B. contortus* (of which *Isidora brocchii*, Ehrenberg, is a synonym) are so variable and the sculpture so liable to be less or more distinct in different phases and individuals that I am inclined to regard these two forms as specifically identical, especially as I do not find that strong sculpture of the surface is always correlated with a more tightly wound shell or with any particular outline of the mouth.

Bullinus contortus (Michaud).

1874. *Physa* (*Isidora*) *Brocchii*, var. *approximans*, and *P.* (*I*) *lirata* (?), Mousson, *op. cit.*, pp. 42, 43.
1918. *Bullinus contortus*, Annandale, *op. cit.*, p. 168, pl. xx, figs. 6-11.
1919. *Bullinus contortus*, Boulenger, *Ind. Journ. Med. Res.*, VII, p. 19.
1919. *Bullinus contortus*, Kemp and Gravely, *tom. cit.*, p. 255.

The varietal or subspecific name *approximans*, Mousson, may perhaps be retained provisionally, but it seems probable that it represents a mere phase the peculiarities of which are due to life in water of abnormal chemical composition or to some other circumstance of the environment. The most marked feature of this phase is the extreme variability of the shell, but a precisely similar variability occurs in a series of shells collected in Lake Ashangi in Abyssinia by the late Dr. W. T. Blanford. These shells are considerably larger than the majority of those from river-deposits in Lower Mesopotamia, but Capt. Boulenger obtained fresh shells almost as big in a drying marsh 5 miles S. of Amara and in a recently dried irrigation channel close to the River Tigris at the same place. The largest specimens in these series are 12 mm. long.

It is curious that the species has not been found alive in Mesopotamia, but Capt. Boulenger's specimens from Amara are entirely recent. Some of them even contain remains of the soft parts. *B. contortus* is a bottom-loving mollusc and perhaps in Mesopotamia, like *Melanoides tuberculatus* in the Lake of Tiberias,[1] it only lives in comparatively deep water.

Capt. R. B. Seymour Sewell, I.M.S., recently obtained a large shell of *B. contortus* (empty) near Gaza in southern Palestine, while I have no doubt that Preston's *Physa tiberidensis* from the Jordan just north of the Lake of Tiberias is identical with the closely allied species or variety *B. dybowskii*.

[1] Annandale, *Journ. As. Soc. Bengal* (n.s.) XI, p. 466 (1915).