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SPONGES, HYDROZOA AND POLYZOA OF SEISTAN

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(Plate XII).

Specimens of eight species of the groups discussed in this paper were collected in Seistan—three sponges, one Hydrozoon, and four Polyzoa. While the sponges and the Hydrozoon are widely-distributed species, all of which also occur within the limits of the Indian Empire, two of the four Polyzoa are new to science, though related to Indian species; one of the other two is characteristically Indian and Eastern Asiatic, the other cosmopolitan as a species.

The three sponges are *Spongilla alba*, *Spongilla carteri* and *Ephydatia fluviatilis*. The range of the first extends from Egypt to Bengal, of the second from Hungary to Mauritius and the Malay Archipelago, while the third is cosmopolitan in non-tropical countries. The specimens of *S. alba* are sufficiently distinct to be made the types of a new variety; of *S. carteri* only gemmules, which do not differ from those of Indian sponges, were obtained; but the *Ephydatia*, while differing in certain respects from European forms, is not definitely enough different for nominal distinction. It is, however, quite distinct from the two Indian varieties or races, *himalayensis* from the Western Himalayas (which should perhaps be united with *syriaca*, Topsent) and *intha* from the Shan States of Burma.

The Hydrozoon is *Hydra vulgaris*, a cosmopolitan species not uncommon in India.

The four Polyzoa are somewhat remarkable forms. They are *Fredericella sultana* var. *jordanica*, *Plumatella* (*Afrindella*) *persica*, sp. nov., *Plumatella* (*Hyalinella*) *bigemmis*, sp. nov. and *Lophopodella carteri*. The *Fredericella* is a race of a cosmopolitan species the known range of which includes the Volga and Jordan systems; one *Plumatella* is closely related to a Gangetic species (*P. testudinicola*) associated, unlike its Persian relative, with freshwater tortoises; the other differs from the cosmopolitan *P. punctata* in one important structural and physiological character, while the *Lophopodella* is a characteristic Indian species with a local race in China and Japan and related to Tropical African forms.

The representatives in Seistan of the three groups have, therefore, mixed geographical relationships, partly Indian, partly

southern Palaearctic, partly cosmopolitan. The Indian element is strongest, or at any rate most conspicuous, in the Polyzoa.

It is remarkable to find these groups (or at any rate the sponges and Polyzoa) so well represented in a country that seems in almost every respect unsuitable for them. In the Inlé lake-system in the Shan States,[1] a district apparently in all respects favourable to such organisms, only three sponges and two Polyzoa, both of which belonged to the same genus, were found; whereas in the Hamun system, in which the water is of extremely variable composition and amount, in which extremes of climate occur in regular succession, the same number of sponges and twice as many Polyzoa (which belonged, moreover, to three genera) were obtained. It might seem at first sight that it was necessary for gemmules and statoblasts to undergo desiccation, of which there is the greatest possible chance in Seistan, just as it is necessary for the eggs of many "Phyllopod" Crustacea; but against this theory must be placed the richness of the fauna of these groups in the comparatively equable conditions of Lower Bengal. We are still far from understanding the factors that encourage growth and reproduction in the lower aquatic invertebrates, and the only possible way to gain light is to keep careful records of the modes of occurrence of the living animals and of the *provenance* of specimens. The Hamun is the seventh large Asiatic lake that I have had an opportunity of examining in the last seven years (as well as innumerable smaller bodies of water), and in each place I have paid particular attention to the sponges and Polyzoa; but I must confess myself still as far as ever from understanding many of the fundamental factors in the biology of these groups. The lakes have been of diverse kinds and situated in diverse countries—Lake Biwa in Japan, the Tai Hu in China, the Talé Sap in Siam, the Inlé Lake in Burma, the Chilka Lake in India, the Hamun in Persia and the Lake of Tiberias in Palestine. But they are not sufficient.

PORIFERA.

Of three sponges collected in Seistan in winter, one (*Ephydatia fluviatilis*) was found in an active state; of one of the others only dried specimens were found, and of the third only gemmules. The *Ephydatia* is interesting because it occurred in the Hamun-i-Helmand in two phases each correlated with a different type of environment.

I take this opportunity to describe a new variety of *Spongilla lacustris* from Mesopotamia.

Spongilla alba, Carter.

1915. *Spongilla alba*, Annandale, *Mem. Ind. Mus.* V, pp. 25-32, figs. 1, 2 pl. iii; pl. iv, figs. 1, 2; pl. v, fig. 1.

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[1] Annandale, *Rec. Ind. Mus.* XIV, p. 75 (1918).

var. **rhadinaea,** nov.

The chief diagnostic character of this variety lies in the shape of the skeleton-spicules, a large proportion of which are bluntly pointed. This I have not seen in any Indian specimen. The flesh-spicules, which are scattered singly among the interstices of the skeleton, are very thin and vary in length; they taper to the extremities and have their spines, which are extremely minute, congregated in the central region. The gemmule-spicules have all their spines straight. The sponge is compact but friable, containing little chitinoid substance. The external membrane

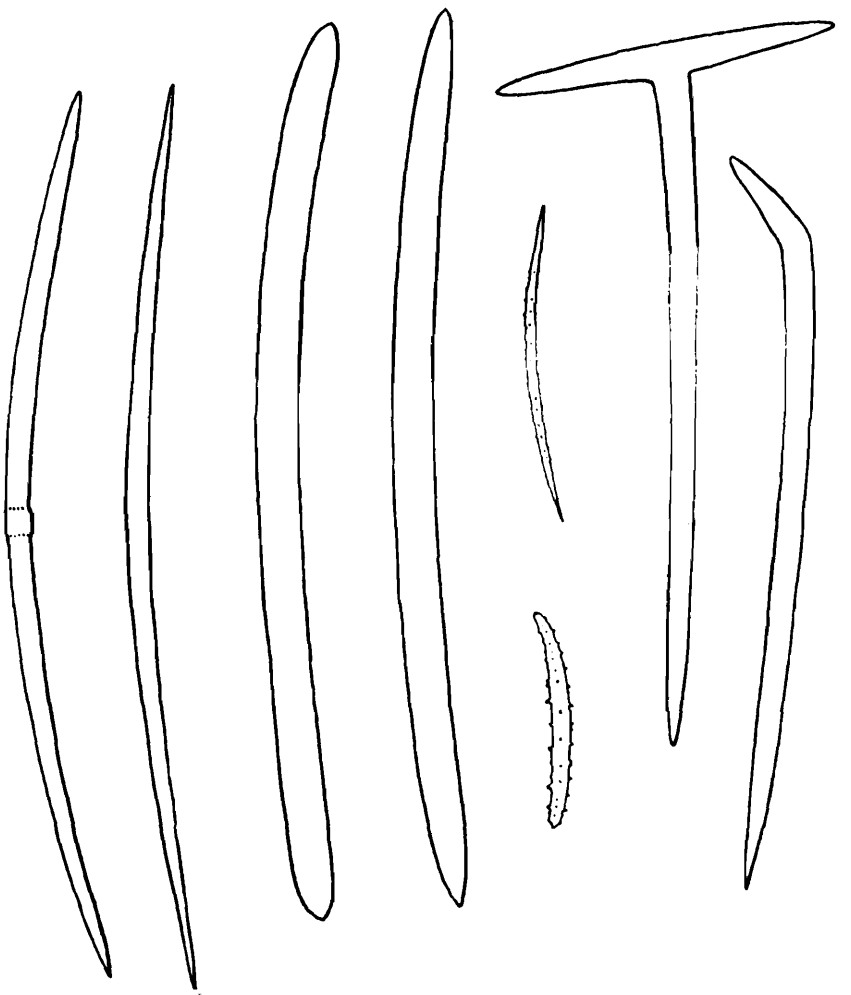


FIG. 1.—Spicules of *Spongilla alba* var. *rhadinaea*, nov., × 250.

has disappeared from my specimens, which coated the stems of reeds in a layer not more than 1 cm. thick. They contain abundant gemmules of a perfectly normal character, but rather small and bleached white.

Measurements of spicules, etc.

Length of skeleton-spicules	0·402-0·414	mm.
Greatest diameter of skeleton-spicules	0·0123-0·025	mm.
Length of flesh-spicules	0·0826-0·135	mm.
Length of gemmule-spicules	0·082-0·094	mm.
Diameter of gemmules	0·425-0·51	mm.

Type-specimen.—P. $\frac{94}{1}$, Z.S.I. (*Ind. Mus.*).

Locality, etc.—This sponge was found in abundance in the dry Naizar or reed-country round the Hamun-i-Helmand in December, 1918. Gemmules were also observed in drift near Nasratabad with those of *S. carteri*. The sponge grows on the stems and roots of reeds in country desiccated for a considerable part of each year. No living examples were observed in winter.

[Spongilla lacustris var. ineptorum, nov.]

Fragments of sponge from the edge of a creek running into the Tigris at Baghdad must be assigned, on account of their yellowish colour in a dry condition, to *S. lacustris* rather than *S. alba*, but they represent a very distinct new variety, for which I propose the name *ineptorum*. When fresh they were evidently green. Their skeletal support is fragile and all the elements in the skeleton feebly developed. The skeleton-spicules are very thin, resembling those of the var. *montana*, Potts,[1] a variety which

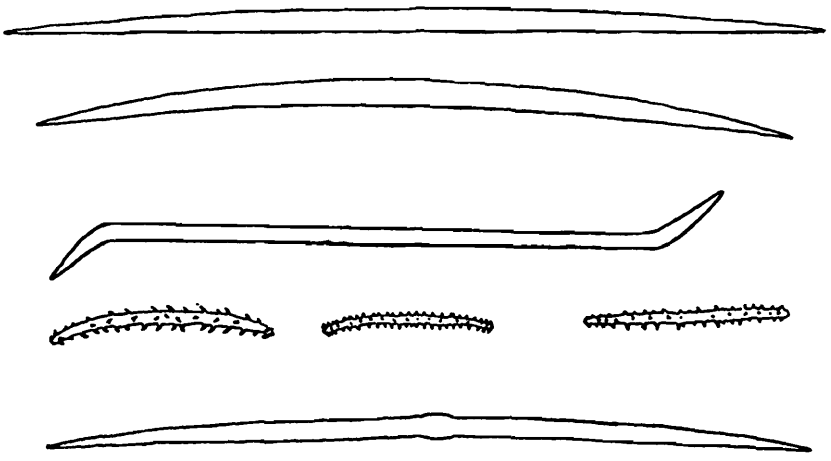


FIG. 2.—Spicules of *Spongilla lacustris* var. *ineptorum*, nov. × 250.

lives at high altitudes. At the nodes of the skeleton, however, there are dense masses of microscleres, most of which are covered somewhat sparsely with rather stout spines. The spines at the extremities are retroverted. These microscleres are indistinguishable from those of the gemmules. Others also occur, however, more sparingly in which the spines are all quite straight and the ends more pointed. The two types of flesh-spicules are found together. The gemmules are normal, with the pneumatic wall well developed and the spicules abundant and arranged in the usual manner.

Measurements of spicules, etc.

Length of skeleton-spicules .	0·348-0·373	mm.
Greatest diameter of skeleton-spicules	0·0082-0·0123	mm.
Length of flesh and gemmule-spicules	0·082-0·095	mm.
Diameter of gemmules	0·394-0·476	mm.

[1] Potts, *Proc. Nat. Sci. Philadelphia*, 1887, p. 192, pl. 6.

Type-specimen. P. $\frac{93}{1}$ Z.S.I. (*Ind. Mus.*).

These specimens were collected in December, 1918 by Bombadier R. Hodgart of the Anglo-Indian Battery (Zoological Collector in the Z.S.I.) and presented by him to the Zoological Survey of India.

Spongilla (Eunapius) carteri, Carter.

1911. *Spongilla carteri*, Annandale, *Faun. Brit. Ind., Freshw. Sponges*, etc., p. 87, fig. 14.

Gemmules, which do not differ from those of Indian specimens, were found among drift at the edge of a pool in the desert near Nasratabad, Seistan, in December, 1918. The pool in flood-time is connected with an effluent of the Helmand.

This sponge is by far the commonest species in the plains of India. It has also been found in Hungary, Mauritius and several of the Malay islands. Its occurrence so far west in Asia as Eastern Persia is interesting in view of the fact that it has been found in Eastern Europe. Specimens from Lake Balaton in Hungary differ somewhat in structure from any Indian form, but their gemmules are closely similar.

Ephydatia fluviatilis, auct.

1911. *Ephydatia fluviatilis*, Weltner, *Trans. Soc. Nat. St. Pétersbourg* XLII, p. 59, pl. i.

1916. *Ephydatia fluviatilis*, Annandale, *Journ. As. Soc. Bengal* (n.s.) XI, p. 445.

Sponges of this species were found in the Hamun-i-Helmand in two different types of environment, on the lower surface of blocks of hard clay at the edge of the lake and on the stems of bulrushes in the reed-beds. Specimens from these two habitats differ considerably, but neither affords any very definite diagnostic character whereby it might be distinguished nominally from the *forma typica* of the species. Both phases differ from the Himalayan var. *himalayensis* (which is so near the Syrian var. *syriaca* that it is hardly worth while to distinguish them) in the almost complete absence of spines or tubercles, however minute, on the skeleton-spicules.

Sponges on the stems of bulrushes form a layer 2 to 3, rarely 5 mm. thick. The outline of each mass is oval, following the long axis of the reed, which it rarely, if ever, completely encircles. Few are more than about 70 mm. long. Their colour is dirty white. The external surface is smooth and rounded with but moderately conspicuous exhalent orifices and radiating superficial channels. The consistency is very soft and friable. The skeleton contains little binding substance and is not particularly regular in structure. There are no bubble-cells. The skeleton-spicules are short and slender, sharply but abruptly pointed, often a little irregular in outline and sometimes bearing a few widely scattered extremely minute tubercles, as a rule gently curved but sometimes bent in the middle or elsewhere almost abruptly. In some parts of the sponge there are groups of very small and slender spicules. Measurements of these are not included in the table given below. The gemmule-

spicules are well-developed and normal in appearance. A few are scattered in the parenchyma. The shafts are stout and as a rule considerably longer than a single rotule, with the spines upon them by no means strongly developed. The rotules are deeply but irregularly divided, their denticulations having the form of flattened spines more or less welded together at the base but without any trace of webbing. The gemmules are small and somewhat depressed. Their pneumatic layer is thin and they bear a single layer of spicules. These specimens are from station 21 of our expedition. I give with their measurements those of specimens from station 20, which I will describe, for comparison.

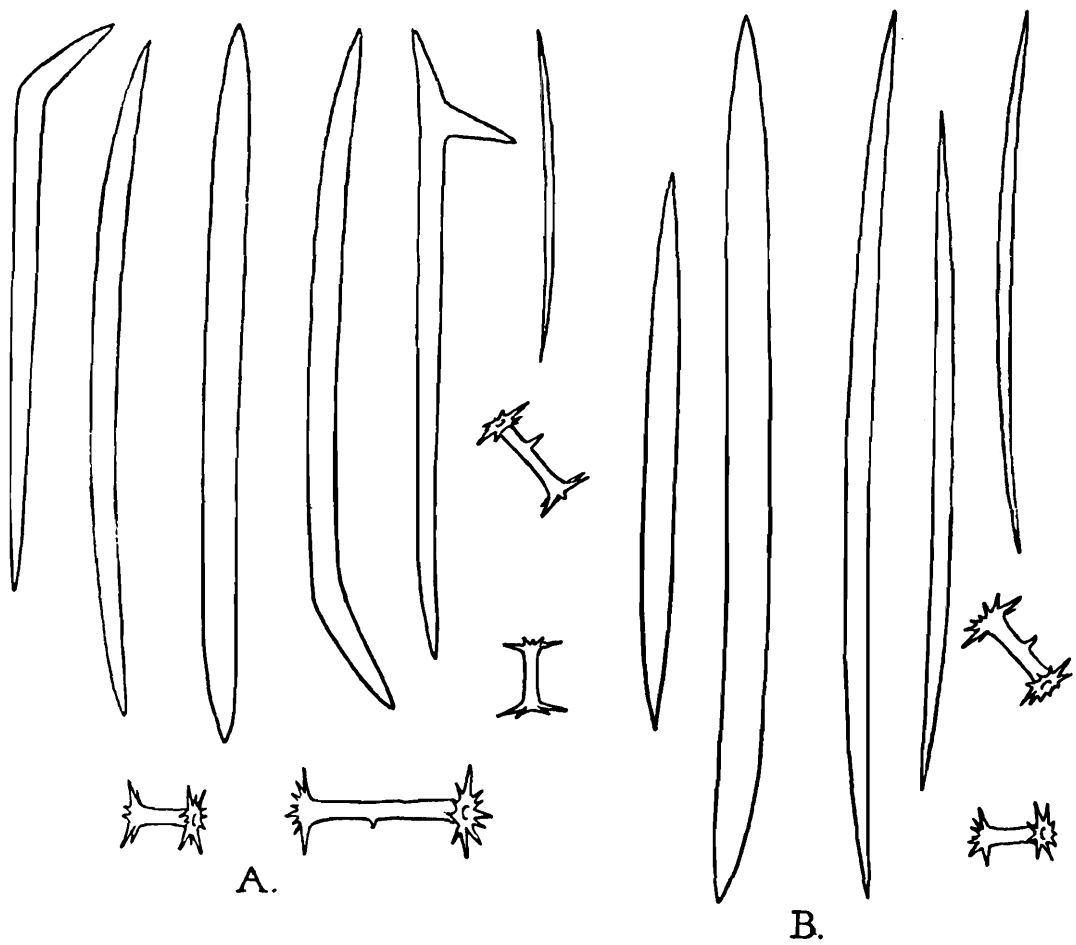
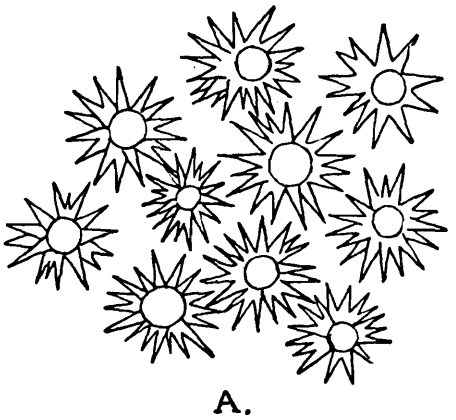


Fig. 3.—Spicules of *Ephydatia fluviatilis* from the Hamun-i-Helmand, × 250. A = spicules of specimens from the lower surface of a block of clay at the edge of the lake. B = spicules of a specimen from the stem of a bulrush in a reed-bed.

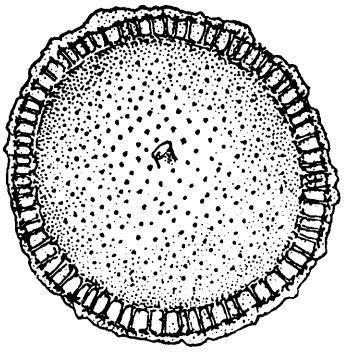
Measurements of spicules, etc.

	Sta. 20.	Sta. 21.
Length of normal skeleton-spicules ..	0·246-0·328 mm.	0·2624-3075 mm.
Maximum breadth of normal skeleton-spicules	0·006-0·025 ,,	0·0123-0·01435 ,,
Length of normal gemmule-spicule	0·020-0·0369 ,,	0·0287-0·0369 ,,
Diameter of rotule	0·016-0·0246 ,,	0·0246-0·0328 ,,
Diameter of gemmule	0·340-0·375 ,,	0·345-0·359 ,,

The specimens from sta. 20 are from the lower surface of blocks of hard clay which had fallen into the lake from cliffs of that substance. Their skeleton-spicules exhibit less variation and are as a rule shorter and relatively stouter than those from the stems of bulrushes. Their normal gemmule-spicules are also usually stouter and shorter with relatively larger rotules, but very long spicules of the same type occur occasionally. The whole sponge is so full of particles of clay that it is almost impossible to study the structure of the skeleton in detail, but it is certainly (doubtless for this



A.



B.

FIG. 4.—Gemmules and gemmule-spicules of *Ephydatia fluviatilis* from the Hamun-i-Helmand. A = outer rotules of a specimen from a block of clay at the edge of the lake: highly magnified. B = a gemmule of a specimen from the stem of a bulrush as seen from above: × 20.

reason) very lax and amorphous and the groups of small spicules characteristic of the other phase seem to be absent, though small amphioxi occur scattered in the parenchyma. The colour is that of the clay. The gemmules are normal except that in some single birotulate spicules are, as it were, plastered on outside the normal single row in a vertical or slanting position. They are held in position by an extension of the outer horny coat, which covers them completely.

It is probable that there was a difference in the chemical composition of the water from which these two sets of sponges came

(see p. 97 *antea*), and they were growing in very different types of environment, though in the same lake at a distance of less than five miles apart. The sponges from sta. 21 were living in most unfavourable conditions on the lower surface of blocks of clay partly embedded in soft mud, which permeated their whole substance, and in a situation liable to desiccation with a change of wind, and also to the effects of nightly frost. Those from sta. 20 on the other hand were living in much deeper water, protected from frost and wind and not in any danger of being choked by mud (*v.* p. 91). The sponges from the blocks of clay were in a somewhat similar situation to those of the var. *syriaca* I collected in the Lake of Tiberias,[1] except that the latter were attached to solid stone. In the other instance the method of growth is similar to that of *Spongilla fragilis* in Japan.[2]

The specimens from the edge of the Persian lake are so enveloped in and permeated by mud that their whole structure is distorted, whereas those of the Lake of Tiberias were normal in structure but small. Moreover, there is no trace of green corpuscles in the Persian specimens, though minute extracellular algae of various kinds are found in their parenchyma.

The specimens from both types of environment in the Hamun-i-Helmand were in an active vegetative condition in December, but both contained numerous gemmules. I can find no trace of embryos.

No specimens of *E. fluviatilis* from the Hamun bear any particular resemblance to those of the same species described from lakes in Central Asia by Weltner (*op. cit.*), except that the skeleton-spicules of those growing on reeds have a somewhat similar outline to those from Issyk Kul figured by him in figs. 8-14 on p. 65 of the work cited. In the occurrence in the sponges from the margin of the lake of occasional abnormally large birotulate spicules they resemble the Australian *E. multiformis*,[3] but that species (? or variety of *E. mülleri*) possesses bubble-cells in its parenchyma. I have examined a cotype or schizotype sent me before the war by Dr. Weltner and have found in it a spicule of this type, but neither in Persian nor in Australian specimens have I discovered such spicules *in situ* on the gemmule. I see no reason to regard them as adventitious but believe that they are produced free in the parenchyma, perhaps as a result of abnormal environment.

HYDROZOA.

Hydra vulgaris, Pallas.

1911. *Hydra vulgaris*, Annandale, *Faun. Brit. Ind., Freshw. Sponges, etc.*, p. 148, fig. 29, p. 131, fig. 27A.

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[1] Annandale, *Journ. As. Soc. Bengal* (n. s.) IX, p. 59 (1913) and XI. p. 455 (1916).

[2] Annandale and Kawamura, *Journ. Coll. Sci. Univ. Tokyo* XXXIX, p. 13 (1916).

[3] Weltner in Michaelsen and Hartmeyer's *Faun. Südw. Australiens* III, p. 138 (1910).

A single small specimen of a pale brownish colour and without buds or reproductive organs was taken amongst green filamentous alga in an irrigation-channel at Nasratabad, Seistan, in December.

POLYZOA.

The four species of Polyzoa collected in Seistan all belong to the Phylactolaemata and all but one are sessile, branching species. Otherwise they have little in common. The two Plumatellinae are remarkable for the differentiation exhibited between the zooecia that produce free and those that produce fixed statoblasts. All the species were found in full activity in December, except the *Afrindella*, which was taken in foul water and was in a degenerate condition, densely packed with statoblasts of both kinds. *Lophopodella carteri*, which elsewhere has been found associated with algae,[1] was only observed in an active state in Seistan attached to tubes inhabited by a small Oligochaete worm, but perhaps stolen by the worm from a Dipterous larva.

Fredericella sultana subsp. **jordanica**, Annand.

1913. *Fredericella sultana jordanica*, Annandale, *Journ. As. Soc. Bengal* (n.s.), p. 223, pl. vii, figs. 1, 1*a*, 1*b*, 1*c*.
1915. *Fredericella sultana* subsp. *jordanica*, *id.*, *Trav. Sta. Biol. Volga* (Saratow) V, p. 74.

Specimens that may be assigned to this race were abundant in December both on the stems of bulrushes in the reed-beds of the Hamun-i-Helmand near Lab-i-Baring and on the lower surface of blocks of clay at the edge of the lake near the same place. It was also found on empty Unionid shells in the open lake. Though many of the colonies were degenerate they contained few statoblasts and the peculiar thickening of the ectocyst noted in association with the formation of gemmules in the Lake of Tiberias was not observed. The zooecia were narrow and still more strongly keeled and emarginate than in specimens from Palestine or the Volga.

F. sultana is apparently cosmopolitan as a species. The Palestinian race has hitherto been found only in and near the Lake of Tiberias and in the lower Volga system in eastern European Russia. In the plains of India it is replaced by the race *indica*, while the typical form occurs in the lakes of Kumaon in the Western Himalayas.

Fam. PLUMATELLIIDAE.

Genus **Plumatella**, Lamarck.

Subgenus **Afrindella**, Annandale.

1912. *Afrindella*, Annandale, *Rec. Ind. Mus.* VII, p. 140.

This subgenus has hitherto been found only in tropical Africa, India, Siam[2] and the Philippines. Its occurrence in Seistan is,

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[1] West and Annandale, *Journ. As. Soc. Bengal* (n.s.) VII, p. 83 (1911).
[2] *Plumatella* (*Afrindella*) *tanganyikae* occurs in the inner lake of the Talé Sap in the Siamese province of Singgora or Sunkla.

therefore, evidence for the existence of a tropical element in the aquatic invertebrate fauna of that country.

Key to the species of the subgenus Afrindella.

A. Zoaria forming a single layer.
  1. Ectocyst smooth; zooecia regular in growth, with a strong continuous keel; statoblasts (free) elongate .. *Plumatella philippinensis.*
  2. Ectocyst obscurely annulate, densely covered with minute sand-grains; zooecia without keel; statoblasts (fixed) broad, variable in shape ... ... *P. testudinicola.*
  3. Ectocyst rough, irregularly annulate on the distal region; proximal region of zooecium strongly keeled; statoblasts (free and fixed) moderately elongate ... *P. tanganyikae.*

B. Zoarium in two layers, in the lower of which fixed, in the upper free statoblasts are produced.
  Ectocyst more or less irregular; zooecia without keel; statoblasts (free and fixed) elongate ... ... *P. persica.*

Plumatella (Afrindella) persica, sp. nov.

This species closely resembles the Gangetic *Plumatella testudinicola*[1] in structure, but is differentiated (apart from the method of growth) by the possession of free as well as fixed statoblasts and by the more elongate form of the latter.

The specimens examined consist of rather dense growths on the woody roots and stems of water-plants which were in a condition of rest in winter. Each growth is separated quite definitely into two layers. Most of the zooecia of the outer layer are degenerate but some still contain polypides, while all except the youngest are packed with free gemmules. Those of the lower layer are filled with fixed statoblasts arranged in single longitudinal rows. The zoarium is everywhere too congested to reveal its precise method of growth, but even round the margins of the colony, where the youngest zooecia occur, the two layers are distinct and the lower zooecia contain fixed statoblasts. In this part of the zoarium the zooecia are arranged roughly in parallel lines and it is clear that the system of budding was that of a terminal and a latero-terminal bud being given off almost simultaneously by each terminal zooecium, and that owing to the congested state of the colony the latero-terminal buds have been closly adpressed to the terminal ones. The zooecia lie practically flat, all orientated in one direction and each with its orifice opening almost horizontally. The base of the buds being somewhat flattened and issuing from the lower part of the parent zooecium permits the latter to open in this way. When the polypides expand they doubtless bend upwards, which the softness and laxness of the distal part of the zooecia would readily permit them to do. The zooecia are nearly cylindrical but flattened on the attached surface. They are about

[1] Annandale, *Rec. Ind. Mus.* VII, p. 148, pl. xiii (1912).

0·7 mm. in diameter and not longer than 2·5 mm. In the denser parts of the colony they are often bent or twisted in their long axis. The proximal region of each zooecium is brownish, smooth or irregularly annulated and translucent, the softer distal region colourless, transversely wrinkled when the polypide is retracted and transparent in fresh specimens. In degenerate colonies this region disappears with the polypides, but in living areas it is of relatively large extent.

The polypides are nearly colourless throughout. I have not been able to detect any distinctive feature in their anatomy.

The statoblasts are of the elongate type. Those of the free kind are from 1½ times to over twice as long as broad. They have the sides nearly parallel and the ends broadly rounded. The ring of air cells is narrow and not much broader at the ends than at the sides. It encroaches little on either surface. These statoblasts are somewhat curved in their long axis. The fixed statoblasts resemble the free ones in shape, but are larger and usually broader and more variable in outline. They are very flat but slightly convex on the dorsal surface, black, smooth and polished. Each is surrounded by a delicate peripheral crenulate carina separated from the body of the statoblast by a deep but narrow groove. Both kinds of statoblast are large compared with the calibre of the zooecium.

Measurements of statoblasts (in millimetres).

	Free.	Fixed.
Length	0·289-0·374	0·34-0·544
Breadth	0·17-0·204	0·255-0·272

Type-specimen. P. $\frac{91}{1}$ Z.S.I. (*Ind. Mus.*).

Locality, etc.—Our specimens were found at the bottom of a pool of very foul water in the nearly dry bed of the Randa stream near Jellalabad, Seistan. They coated the peculiar nodular roots and the stems of some plant which grew in the mud but had died down completely in winter.

Subgenus **Hyalinella**, Jullien.

1885. *Hyalinella*, Jullien, *Bull. Soc. zool. France* V, p. 133.
1910. *Hyalinella*, Loppens, *Ann. Biol. Lacustre*, IV, p. 147.
1911. *Australella*, Annandale, *Faun. Brit. Ind., Freshw. Sponges, etc.*, p. 212.
1911. *Plumatella* (in part), *id., ibid.*, p. 212.
1914. *Australella*, Kraepelin in Michaelsen's, *Laud-u. Süsswass. Fauna Deutsch-Sudwestafrikas*, XI, p. 61.
1916. *Australella*, Annandale, *Rec. Ind. Mus.* XI, p. 163.

The one diagnostic feature of this subgenus is that the true ectocyst is transformed into a gelatinous layer, which may be so thick as to produce a synoecium analogous to that of the Lophopodinae. The growth, however, is always dendritic, and the tentacles never of great length. Until now no fixed statoblasts have

been observed, but they are highly developed and specialized in the species to be described here. Some species of the genus bear a close external resemblance to those of the group of *Plumatellae* that has been named *Alcyonella*, but in *Alcyonella* a horny ectocyst is present as well as the gummy substance by means of which the zooecia are agglutinated together. In preserved specimens of *Hyalinella* the ectocyst is apt to shrink and lose its gelatinous character, but in the natural condition its structure and appearance are most characteristic. It is usually much harder than the zooecium of the Lophopodinae. Six species may now be assigned to the subgenus:—*Plumatella punctata*, Hancock, the type-species; *P. bigemmis*, sp. nov.; *P. indica*, and *P. longigemmis* (Annandale); *P. jheringi* (Meissner), and *P. lendenfeldi* (Ridley). The first of these is widely distributed in Europe and North America and occurs also in tropical Africa and in India; the second is here described from E. Persia; *P. indica* and *P longigemmis* are Indian; *P. jheringi* comes from Brazil, and *P. lendenfeldi* from Australia.

These species may be distinguished by the following key:—

I. Ectocyst not greatly swollen, fairly soft, not concealing the identity of the zooecia.
  A. Statoblasts of one type only, all free.
    1. Statoblasts not much longer than broad, very variable ... ... *P. punctata.*
    2. Statoblasts nearly 1½ times as long as broad, not particularly variable ... ... *P. longigemmis.*
  B. Fixed statoblasts present as well as free ... *P. bigemmis.*

II. Ectocyst stiff, not greatly swollen but compacting the zooecia together into a solid mass.
  Statoblasts oval, rounded at the ends ... *P. indica.*

III. Ectocyst very copious, soft; the distinction between zooecia entirely obliterated.
  A. Statoblasts oval, subtruncate at the ends ... *H. lendenfeldi.*
  B. Statoblasts subcircular or polygonal ... *H. jheringi.*

As is shown in this key the distinction between my *Australella* and Jullien's *Hyalinella* is merely a matter of degree. Some specimens of the species now to be described might be assigned with equal propriety to either. Nor does the one differential character, considered in this light, seem sufficient for generic separation from *Plumatella*.

Plumatella (Hyalinella) bigemmis, sp. nov.

The zoaria grow prone on the stems of plants and have much the appearance of those of *H. punctata*, except that the ectocyst is still more transparent and swollen and quite smooth on the external surface. Young zoaria have an almost linear growth, slightly zig-zag owing to the subterminal buds being produced on opposite sides of alternate zooecia. Though these buds are lateral in origin they are directed almost straight ahead, so that the deviation from a straight line is not great. As the colony develops, the zooecia are pressed together into a compact layer. This is brought about by the production of lateral branches which form an acute angle with the main axis of the colony. A radiating

zoarium may also be produced and in the mature colony the orientation of the zooecia is often radial, mainly in four directions. In any case a large number of the zooecia always point in the same direction. The colony as a whole is quite flat, the gelatinous ectocyst filling in the interstices between the zooecia.

The individual zooecia maintain their identity distinct, but their ectocyst is so thick that their openings have in more congested parts of the colony a honeycomb-like appearance. The ectocyst is, as already stated, usually quite hyaline and colourless, but it is sometimes darkened towards the distal extremity of the zooecia It is hard and almost cartilaginous for the greater part of its length, but the harder region ends abruptly near the aperture, which is surrounded by a thin, soft, mainly retractile membrane. The margin of the former region is well-defined, of an oval form and somewhat oblique in its long axis, which is mainly vertical in direction. Sometimes the external surface is covered with minute algae. The zooecia are long, but somewhat variable in length, sometimes bent or curved in their long axis. They are distinctly flattened. Their transverse diameter (internal) is about 0·5 mm. and even when quite young they are of almost equal calibre throughout their length. Their long axis is parallel to the surface to which they are attached.

This description applies to the normal zooecia which constitute the greater part of the colony, but in old zoaria zooecia of another type are produced at or near the terminal points of the branches. These are variable in shape and sometimes shorter, occasionally longer, than the normal zooecia. Zooecia of this type (which are only produced when the vegetative period of growth nears its end) never contain a fully developed polypide but only one or more statoblasts partly embedded in a strand of undifferentiated tissue, which broadens out towards the distal extremity of the zooecium.

The polypide is much like that of *H. punctata* and offers no particular diagnostic characters. The tentacles are moderately short and not very numerous and the whole body is almost colourless.

The free statoblasts are very like those of *H. punctata*, but not so variable in shape, a little more rhomboidal, and with a broader ring of air-cells at the extremities. The fixed statoblasts are large, broadly oval, of a dark brown colour and densely punctured on the surface. Each is, however, surrounded by an amorphous mass of dark horny material that obscures its true shape and ornamentation. The statoblasts are not very numerous.

Measurements of statoblasts (in millimetres).

	Free.	Fixed.
Length	0·357–0·374	0·459–0·561
Breadth	0·255–0·272	0·425–0·459

Type-specimen. P. $\frac{92}{1}$, Z.S.I. (*Ind. Mus.*).

Locality.—Our specimens were found on the stems of bulrushes in the reed-beds of the Hamun-i-Helmand near Lab-i-Baring in December, 1918, with *Fredericella sultana* and *Ephydatia fluviatilis.*

Genus **Lophopodella,** Rousselet.

1904. *Lophopodella,* Rousselet, *Journ. Quek. Micr. Club* (2) IX, p. 45.
1911. *Lophopodella,* Annandale, *Faun. Brit. Ind., Freshw. Sponges,* etc., p. 231.
1914. *Lophopodella,* Kraepelin in Michaelsen's *Land-u. Süsswasserfauna Deutsch-Sudwestafrikas* I, p. 64.

Kraepelin gives in the work cited a useful key to the species and figures the statoblasts. He points out that the African species hitherto confused with *L carteri* is distinct, and describes it under the name *L. stuhlmanni.* He also describes a new variety of *L. capensis* (Sollas) under the name var. *michaelseni.* The forms that must now be referred to the genus are *L. carteri* (Hyatt), *L carteri* subsp. *davenporti* (Oka), *L. thomasi,* Rousselet, *L. capensis* (Sollas), *L. capensis* var. *michaelseni,* Kraepelin and *L. stuhlmanni,* Kraepelin. The range of the genus extends from Eastern Persia to Japan, Brazil and South Africa, but is mainly tropical. The following key, though not actually based on Kraepelin's, owes much to it.

Key to the species of Lophopodella.

1. Each extremity of the statoblast produced into a long slender process bearing books along each margin ... *L. capensis.*
2. Extremities of statoblast truncate or subtruncate, with a single row of hooked processes.
   - A. Extremities of statoblast broadly truncate, little narrower than the greatest transverse diameter ... *L. stuhlmanni.*
   - B. Extremities of the statoblast broadly rounded, much narrower than the greatest transverse diameter ... *L. carteri.*
   - C. Extremities of the statoblast very narrow, concave *L. thomasi.*

All of these species except *L. carteri* are African.

Lophopodella carteri (Hyatt).

1911. *Lophopodella carteri,* Annandale, *Faun. Brit. Ind. Freshw. Sponges,* etc., p. 233, fig. 46, pl. iii, figs. 4, 4*a.*
1912. *Lophopodella carteri, id., Rec. Ind. Mus.* VII, p. 143.

Specimens from an irrigation channel in the Consulate garden at Nasratabad, Seistan agree well with Indian specimens. Statoblasts were also taken, with gemmules of *Spongilla carteri* and *S. alba,* amongst drift at the edge of a pool in the desert in the same district. The statoblasts did not differ in any respect from those of Indian colonies.

Statoblasts were found in active colonies in all stages of development in December. The animal was living among green filamentous algae. The most interesting feature of these colonies was, however, that each was attached to a fine mucilaginous tube and that each tube was inhabited by a small Oligochaete worm

identified by Lt.-Col. J Stephenson, I.M.S., as *Nais communis* var. *punjabensis*. This worm does not ordinarily construct tubes, and was found free in the reed-beds of the Hamun, but Col. Stephenson has seen it in tubes made by insect larvae (probably those of Diptera) in the Punjab. It is possible that in Seistan also it occupied the dwellings of larvae which it had dispossessed or succeeded after their departure, but as to the association between it and *Lophopodella* there can be no doubt, for it was noted repeatedly on more than one occasion. *L. carteri* has been observed in association with certain algae,[1] and it is not uncommon for Chironomid larvae to construct their tubes at the base of its colonies; but I have not hitherto found it associated with Oligochaete worms.

The known geographical range of *L. carteri* now extends from Eastern Persia to Japan. The Japanese and Chinese race (*davenporti*, Oka [2]) is distinguished from the *forma typica* by the greater development of the terminal processes of the gemmule, but nothing is known of the species in the countries intermediate between India and China.[3] A form (var *himalayana*, mihi) with the process of the gemmules absent or imperfectly developed occurs occasionally in the Kumaon Lakes in the Western Himalayas, but normal colonies have been found at the same places at other times. In the plains of India the distribution is apparently sporadic, but the species is common in parts of the Bombay Presidency and the Central Provinces. I have never found it in the Punjab, Bengal or Madras.

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[1] See Annandale and West, *Journ. As. Soc. Bengal* (n. s.) VII, p. 81, pl. iii (1911).

[2] *Pectinatella davenporti*, Oka, *Zool. Anz.* XXXI, pp. 7, 6 and *Annot. Zool. Japan.* VI, p. 117 (1907).

[3] The Rev. Gist Gee has recently sent me specimens of the Japanese race from Soochow in the Kiangsu province of China.

EXPLANATION OF PLATE XII.

POLYZOA OF SEISTAN.

Plumatella (Hyalinella) bigemmis, sp. nov.

FIG. 1.—A part of the peripheral region of a mature but growing colony on the stem of a bulrush, showing the resting statoblasts, × $5\frac{2}{3}$.

,, 2.—A part of the peripheral region of a more compact and vigorous colony, × $5\frac{2}{3}$.

The white substance in the interstices between the zooecia is composed of microscopic algae.

FIG. 3.—Three zooecia containing statoblasts, × 40.

On the right a zooecium in which the polypide has completely degenerated and a single free statoblast has been produced, is shown growing over a terminal zooecium in which a single fixed statoblast has been formed. The degenerated polypide of the latter is also shown. Its roof has largely disappeared. On the left a zooecium with a single statoblast is figured.

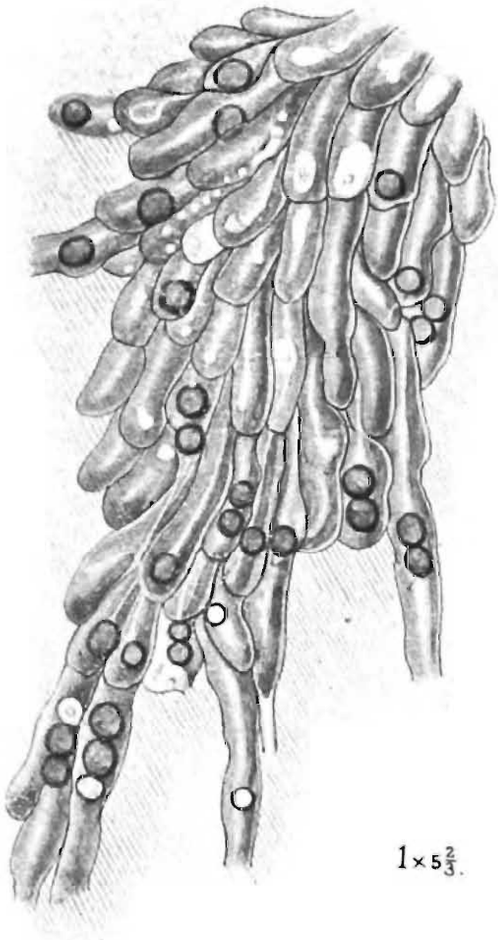
Plumatella (Afrindella) persica, sp. nov.

FIG. 4.—Fixed statoblasts, × 40.

,, 5.—A part of a still vigorous colony growing on a rootlet, × $5\frac{2}{3}$.

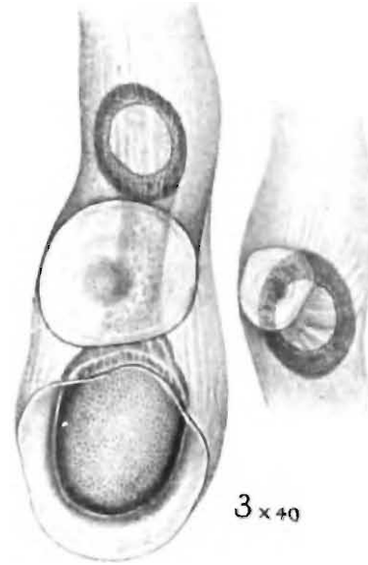
„ 6.—A part of a colony in which most of the zooecia of the upper layer have degenerated and disappeared, leaving those of the lower layer exposed. The roof of the latter has also degenerated, exposing the fixed statoblasts, × $5\frac{2}{3}$.

,, 7.—Free statoblasts, × 40.

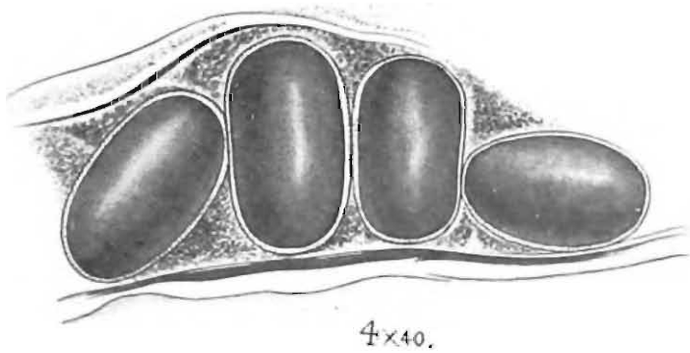


1×5⅔.

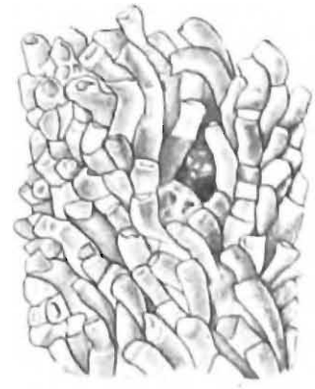
2×5⅔.



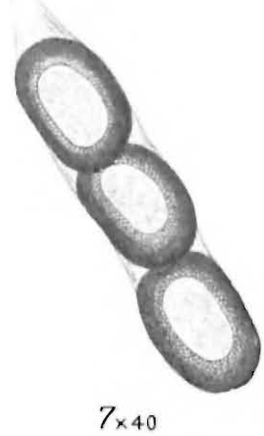
3×40



4×40.



5×5⅔.



7×40

6×5⅔.

A. C. Chowdhary del.

POLYZOA OF SEISTAN.

CARABIDAE FROM SEISTAN.

By H. E. ANDREWES.

[The Carabid beetles on which Mr. Andrewes has been kind enough to report were collected, mostly by Mr. S. W. Kemp, in the depth of winter. With the exception of *Metabletus fuscomaculatus* and *Microlestes corticalis*, which come from the desert, they were found at the edge of water-channels, streams or pools, or at that of Hamun-i-Helmand or lake of Seistan. On the shore of this lake there is in winter a drift-line, marking flood-level and consisting mainly of fragments of reeds. Under these fragments a fairly large fauna (consisting mainly of beetles and Heteroptera, but also including earwigs, a toad, etc.) finds shelter, and here we took no less than seven of the sixteen Carabidae found in Seistan.—*N. Annandale.*]

The species of Carabidae taken in Seistan number sixteen only. These show little relationship to the Indian fauna, though there are two species of which I have records from Karachi and the United Provinces respectively. A third species has not yet been recorded as coming from India, but I have examples of it in my collection from the Himalayas as mentioned below. Seistan—judging by the Carabidae—seems to be near the boundary (in so far as it exists) separating the fauna of Central Asia from that of the long sandy tract which stretches from Morocco to Sind. I have been able to determine most of the species, but have had to leave one or two unidentified.

Distichus planus, Bon.

1 Ex. No. 8782. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

Common in S.E. Europe, S.W Asia, Egypt, etc.

Dyschirius sp.

3 Ex. No. 8795. Edge of stream of saline water near Lab-i-Baring, Seistan, 11-xii-18.

I have not been able at present to identify this species.

Pogonus micans, Chaud.

11 Ex. No. 8791-3. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

N. Persia : Astrabad. Kopet-Dagh : Germab.

Bembidium sp.

1 Ex. No. 8779. Nasratabad, Seistan, *ca.* 2,000 ft., 26-xi-18.

I cannot identify this species, but a large number have been described from Central Asia, and this may be among them.

Bembidium niloticum, Dej.

1 Ex. No. 8799. Water-channels near Nasratabad, Seistan, xi-18.

Described by Dejean from Egypt, whence it extends eastwards as far as Japan, and south to the Malay Peninsula; I have seen Indian specimens from the Himalayas, but not further south.

Bembidium varium, Oliv.

11 Ex. Nos. 8798-9, 8802. Near Jellalabad, Seistan, 2-xii-18. Channel 8 miles E. of Lab-i-Baring, Seistan, 16-xii-18.

Extends apparently over the whole of Europe, and the greater part of temperate Asia.

Bembidium latiplaga, Chaud.

5 Ex. Nos. 8794, 8797, and 8800. Channel 8 miles E. of Lab-i-Baring, Seistan, 16-xii-18. Water channels near Nasratabad, Seistan, xi-18. Edge of stream of saline water near Lab-i-Baring, Seistan, 11-xii-18.

Mediterranean basin and S. Russia. I am not aware that the species has been recorded yet from a locality so far east as Seistan.

Siagona europaea, Dej.

1 Ex. No. 8789. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

This is the furthest point east from which I have seen an example of this species, which is commonly found in the Mediterranean basin. I have quite recently (*Ann. and Mag. Nat. Hist.*, (9) iii, 1919, p. 470) given my reasons for considering it distinct from the Indian *S. depressa*, F.

Chlaenius semicyaneus, Solsky ?

1 Ex. No. 8777. Hurmuk, Perso-Baluch-Afghan frontier, *ca.* 3,000 ft., 22-xi-18.

A single ♀ example agreeing fairly well with Solsky's description, but I have no specimen available for comparison.

Chlaenius spoliatus, Rossi.

3 Ex. Nos. 8780, 8783-4. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

This species has a very wide range, from S. Europe and N. Africa to Japan; it does not extend to Southern Asia.

Diplocheila transcaspica, Sem.

2 Ex Nos. 8781 and 8785. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

Hitherto known only from the transcaspian provinces of Russia.

Pterostichus sp

3 Ex. ♀ ♀ Nos. 8786-8. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

Possibly one of the numerous species described from Central Asia.

Brachinus sp.

1 Ex. No. 8790. Lab-i-Baring, Seistan, 7-xii-18, under drift at edge of Hamun.

Unknown to me. Chaudoir's Monograph of this genus unfortunately does not embrace the palaearctic species.

Glycia ornata, Klug.

1 Ex. No. 8778. Nasratabad, Seistan, *ca.* 2,000 ft., 26-xi-18.

Ranges from the Mediterranean basin through the desert regions of Egypt and Arabia as far as Sind.

Metabletus fuscomaculatus, Motch.

1 Ex. No. 8796. Lab-i-Baring, Seistan, 15-xii-18, at base of desert plants.

South Russia, Mongolia, Caucasus, Syria; I have specimens in my collection from Chamba, Himalayas, but the species has not previously been recorded from the Indian region.

Microlestes corticalis, Dufour.

2 Ex. ♂ ♂ No. 1401. Lab-i-Baring, Seistan, 15-xii-18, at base of desert plants.

Extends from the Mediterranean basin to Central Asia.

REPORT ON THE FRESHWATER GASTROPOD MOLLUSCS OF LOWER MESOPOTAMIA.

PART I. THE GENUS *LIMNAEA*.

By N. ANNANDALE, *D.Sc., F.A.S.B., Director, Zoological Survey of India, and* BAINI PRASHAD, *D.Sc., Offg. Director of Fisheries, Bengal, Bihar and Orissa.*

(With Plates XIII, XIV.)

In the report of which the first part is now published we propose to discuss the freshwater Gastropod molluscs of the delta of the Tigris and Euphrates and of the lower reaches of the two rivers. Stress of other work and official duties have already greatly delayed its preparation, and as the medical authorities are anxious for any information about the freshwater molluscs as soon as possible, we have decided to issue it in parts dealing with separate genera or larger groups. It will be convenient to include this report in the same volume as that on the molluscs of Seistan, as the two faunas are related.

The material from Mesopotamia that we now have in our hands consists of three collections, all presented by the generosity of their collectors to the Zoological Survey of India. Two of these have already been discussed.[1] They were made by Lt. Col. W. H. Lane and Bombadier R. Hodgart and consist of empty shells, most of which were probably subfossil. The third collection, made by Capt. C. L. Boulenger, adds greatly to our knowledge as it includes specimens preserved in spirit. It has been possible with its aid to correct and expand the results based on shells previously examined.

We have, so far as possible, consulted the literature on the Persian, Central and Western Asiatic molluscs, as well as that on those of India and Europe, but it is possible that some Russian works, or memoirs published in Europe during the war, may have escaped our notice. The only paper dealing specifically with Lower Mesopotamia that we have found is Mousson's, "Coquilles ters. et fluv. rec. Dr. A. Schlæfli en Orient" in the *Journ. de Conchyl.* XXII (1874). The descriptions in this paper are fairly full and it has not been difficult with specimens before us to discriminate the species. The paper, however, is not illustrated, and without figures or specimens verbal descriptions of freshwater molluscs have little value. We are strongly of the opinion that

[1] Annandale, *Rec. Ind. Mus.* XV, pp. 159-170, pl. xx (1918).

among the Pulmonata at any rate no description unaccompanied by a recognizable figure should be considered valid.

Genus **Limnaea**, Lamarck.

The species that occur in Lower Mesopotamia are of considerable interest. They fall into two of the main groups of the genus, namely those that may be called, in quite a general sense, those of *L. auricularia* and *L. truncatula*. Most of them we assign to the former group. These species are all variable and at first sight it might seem that most of those of southern Persia and the lower valley of the Tigris and Euphrates were conspecific, merely separable into numerous races and varieties. A careful study of a large amount of material has, however, convinced us that this is not the case, and that a number of species actually exist which can be separated by anatomical as well as merely conchological characters. The examination of young shells is most important for this reason, and we find that adults which resemble one another rather closely can often be traced back to young forms that differ considerably. In conditions such as those found in Lower Mesopotamia, and also in most parts of Persia, convergence seems to have taken place between different species of the genus on a fairly extensive scale, and forms which are perhaps not closely related genetically have come to resemble one another owing to the plastic influence of environment.

In Seistan we know of two species of the *L. auricularia* group (*L. gedrosiana* and *L. bactriana*) which at first sight appear almost identical, but on a detailed investigation have proved quite distinct. We are of the opinion that these species each had a different line of ancestry, but have thought it best in the present state of our knowledge not to discuss these lines of ancestry in detail.

Similarly in collections from Lower Mesopotamia we have found five forms that seemed to us on a superficial examination to grade the one into the other. Two of these (*L. gedrosiana* and *L. bactriana*) are the same as the two Seistan species. The others are *L. peregra canalifera*, *L. tenera euphratica* and *L. cor*.

It is important, therefore, to consider what common features are to be found in the forms of each country, and to what extent these features can be correlated with peculiarities of environment. Both Lower Mesopotamia and Seistan are countries that have a prolonged dry season, when the temperature is high, and are nevertheless liable to floods. In Seistan the water always contains a high percentage of mineral salts, while the delta of the Tigris and Euphrates is an estuarine tract in which even water that is practically fresh is probably liable to be contaminated with water of comparatively high salinity. Moreover, this tract has been gradually extending southwards and receding from the north for a considerable period, and many of our specimens are from old deposits that must have been laid down in conditions far more estuarine than

those that now prevail in the districts where the specimens were collected.

Both the species of *Limnaea* from Seistan and those from Mesopotamia have in most instances small and very thin and fragile shells, which are sculptured with more or less prominent longitudinal ribs, but the ribs on those from Mesopotamia are much more pronounced than on Seistan shells. This is so even in identical species. The shape of the shell in most forms exhibits slightly different modifications in the two countries. The two Seistan species are both rather narrow but have relatively large and patent mouths and short, pointed spires. The three distinct Mesopotamian forms exhibit a tendency, on the other hand, to grow broad in proportion to their height, while their spires are still shorter. Their mouths, in the broader forms, are relatively narrow but on the whole resemble those of *L. gedrosiana* and *L. bactriana*. An entirely new character appears in Mesopotamia in the canalization of the suture above the body-whorl found in all the endemic species and well-defined races.

How far can these differences and resemblances be correlated with similar peculiarities of the shell from different or identical types of environment in other countries ? Baker,[1] in his fine monograph of the North American Limnaeidae, states that shells from saline districts in that country are prominently ribbed, but whether this ribbing is associated with the presence of any particular salt we are not informed. We know in a general way what salts are present in the waters of Seistan,[2] but no information is available about the composition of those of the Euphratic delta.

Thinness, fragility and paleness of shell in *Limnaea* are usually associated with unfavourable conditions of life, but more precise information is needed on the point. The reduction of the spire and enlargement of the body-whorl and mouth provide additional space for the branchial chamber and allow a larger portion of the animal to be extended from the shell. This character, moreover, seems to be definitely correlated with difficulty in obtaining the necessary oxygen, and we find different forms of the same species [3] (living in different types of environment in the same localities) in which it is more developed in those that live in still water than in those that inhabit streams. Both in Seistan and in Mesopotamia the *Limnaeae* live mainly in flooded country, perishing in large numbers when the floods subside. The few individuals that survive to perpetuate the species from year to year retire to shallow pools, backwaters or lakes. In the course of such an existence conditions must be encountered in which life is difficult and water lacking in free oxygen.

The *Limnaeae* of Mesopotamia are, except *L. peregra canalifera*, clearly depauperated forms, and the considerably larger size attained

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[1] Baker, *Spec. Pub. Chicago Ac. Sci.* III (1911).
[2] Annandale, *Rec. Ind. Mus.* XVIII, pp. 10, 15 (1919).
[3] Annandale, *Rec. Ind. Mus.* XIV, p. 149, fig. 4 (1918).

by this race is in itself evidence of a different origin from that of the others associated with it—evidence which is greatly strengthened by an examination of the young shell.

In this discussion we have left *L. hordeum* out of account. It is so different from the other species of the fauna that there can be no doubt of its different origin; there can be little doubt of its relationship to *L. truncatula*. It has, however, a larger mouth to the shell than that species and more tumid whorls, especially of the spire. It has, therefore, followed a line of evolution in some respects parallel to, in others divergent from, that which has resulted in such forms as *L. cor*.

Key to shells of Limnaea *from S. Persia and Lower Mesopotamia.*

A. Height of mouth less than $\frac{2}{3}$ that of shell.[1]
  1. Whorls of spire tumid; suture oblique .... *L. hordeum.*
  2 Whorls of spire not tumid; suture much less oblique ... *L. truncatula.*

B. Length of mouth more than $\frac{2}{3}$ that of shell.
  1. Upper surface of body-whorl not flattened; suture above it not canalized. (Height less than 20 mm.)
    a. Mouth of shell projecting strongly in ventral view; arc of lip practically a semicircle ... ... *L. persica.*
    b. Mouth less expanded, projecting less; arc of lip less than a semicircle.
      i. Whorls of spire somewhat tumid[2]; suture impressed; main axis of mouth forming an acute angle with that of shell. ... ... *L. bactriana.*
      ii. Whorls of spire not at all tumid; suture little or not at all impressed; main axis of mouth parallel to that of shell.
        α Arc of lip quite regular; apex sharply pointed ... ... *L. iranica.*
        β Arc of lip irregular; apex bluntly pointed.
          † Arc of lip never more than slightly flattened ... ... *L. gedrosiana.*
          * Arc of lip so flattened as to form a slanting straight line ... ... *L. gedrosiana* var. *rectilabrum.*
  2. Upper surface of body-whorl distinctly flattened and deeply depressed round suture.
    a. Shell over 15 mm. high, not very fragile, with the spire usually about $\frac{1}{6}$ as long as the body-whorl and the latter much narrower than high .. *L. peregra canali-* [*fera.*
    b. Shell not higher than 15 mm., fragile, with the spire always less than $\frac{1}{6}$ the height of the body-whorl, which is as broad or nearly as broad as high.
      i Spire very small; upper surface of body-whorl transverse, almost at right angles to the main axis; deeply depressed round suture ... *L. cor.*
      ii Spire small; upper margin of body-whorl cutting main axis obliquely, less depressed round suture. *L. tenera euphratica.*

The key applies only to adult shells; for young shells our figures in the plates issued with this paper and our former one

[1] *Cf.* p. 41, *Rec. Ind. Mus.* XVIII. The specimens now before us show that the mouth may be, and probably always is in the adult, more than $\frac{1}{2}$ as long as the shell.

[2] On p. 45, line 19 of this volume, the word "greatly" has slipped out between "not" and "swollen."

on the molluscs of Seistan may be consulted (see plates vi, vii, xiii, xiv of this volume).

Limnaea gedrosiana, Annand. and Prashad.

1918. *Limnaea subpersica*, Annandale, *Rec. Ind. Mus.* XV, p. 146, pl. xx, fig. 5.

1919. *Limnaea gedrosiana*, Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 48, pl. vii, figs. 2-4.

There is in Captain Boulenger's collection a fairly good series of specimens in spirit which we cannot separate from our recently described species. The shells, however, though not thicker or less fragile, possess much stronger longitudinal ridges on the body-whorl than specimens from Seistan or Baluchistan. There is no spiral sculpture. The mouth of the shell is also as a rule a little narrower, but this difference is hardly beyond the limits of normal variation and is not so great as that observed between shells from Baluchistan and those from Seistan. The largest shell is 10 mm. high and its maximum diameter is 7 mm. The specimen recently figured by one of us provisionally as *L. subpersica*, Locard, is a very young shell of this species.

The radula is so variable in *L. gedrosiana* that it cannot be regarded in this species as possessing sound diagnostic characters. In a specimen from Mesopotamia it is very like that of some individuals from Baluchistan.

The genitalia resemble those of the Seistan form figured and described by us in the original description of the species. Some differences exist, but these are due to the fact that the Seistan specimen we figured was abnormal in certain respects, as is borne out by dissection of another specimen from the same country. This specimen was found to have the genitalia quite similar to those of specimens in the present collection. The abnormality in the individual figured consisted in the large development of the accessory gland and in the poorer development of the hermaphrodite gland, its duct and the uterine duct; all these latter structures are much better developed in normal specimens, while the accessory gland is usually a small structure. The proximal part of the vas deferens also is rather thicker in normal specimens.

It is clear, therefore, that individual differences must be looked for in the genitalia as well as in the shell and radula of species belonging to this group of *Limnaea*.

The precise locality of Capt. Boulenger's specimens is given by him as "higher reaches of Khandag Creek, Basra, Mesopotamia." The species is not uncommon in swamp-deposits in the delta of the Euphrates.

Limnaea bactriana, Hutton.

(Pl. XIV, fig. 3.)

1919. *Limnaea bactriana*, Annandale and Prashad, *Rec. Ind. Mus.* XVIII, p. 45, pl. v, figs. 1, 2; pl. vii, fig. 6.

Three specimens in spirit collected by Capt. Boulenger in ponds connected with the Khandag Creek in a palm-grove near Basra seem to belong to this species. The shells are, however, thicker and are sculptured with curious flattened opaque ribs on the body-whorl. The form is also narrower, perhaps because the specimens had not reached their full growth, and the basal whorl of the spire is smaller and not so distinctly separated from the body-whorl. Otherwise the spire has the characteristic features of Hutton's species. A shell is 10·5 mm. long, and its maximum diameter is 6 mm.

The three shells are all more or less broken. With more abundant material racial differences might perhaps be found between shells from the eastern parts of the range of the species and those from Mesopotamia.

The radula of a specimen has the approximate formula 18.8.1.8.18. The asymmetry of the cusps of the central tooth is very distinctly marked, as also is its tridentate character. The inner cusp of the lateral tooth though situated at a higher level than the outer is not much larger; all the cusps of the laterals, however, are pointed, differing in this respect from those of the Seistan specimens. The marginals have four to seven blunt cusps, all situated in the same straight line, and one or two small pointed cusps situated on the outer margins of the teeth near the base.

The genitalia. Owing to paucity of material and to the specimens being very much contracted we are not able to add much to our previous account. The genitalia of a Mesopotamian specimen resemble those of specimens from Seistan except that the uterine duct is much thicker at its commencement, the prostate is better developed and lies a little higher up on the male duct, which also is much thicker in its proximal part. These differences may be due at any rate in part to the state of sexual activity in which the molluscs were killed.

Limnaea peregra race **canalifera,** Mousson.

(Pl. XIV, figs. 1, 2.)

1874. *Limnaea canalifera,* Mousson, *Journ. de Conchyl.* XXI, p. 41.
1918. *Limnaea peregriformis,* Annandale, *Rec. Ind. Mus.* XV, p. 165, pl. xx, fig. 4.

This is much the largest form of *Limnaea* known to us from Mesopotamia, and the only one in which the shell grows more than 20 mm. long. The shell is also stouter and more coarsely sculptured than that of other species from the lower Euphrates. It has as a rule—though the fact is not mentioned in the original description—one more whorl, *i.e.* five whorls instead of four.

In dorsal view the shell is very asymmetrical bilaterally. The spire is acuminate, conical, vertical, exserted but short, but not so short as that of other shells of the same group from Mesopotamia, being at least (in adult shells) $\frac{1}{5}$ as long as the body-whorl. Its whorls increase rapidly and evenly in size and the spiral between them is oblique, linear and somewhat impressed.

Each whorl is nearer the inner than the outer margin of the one that succeeds it. They are slightly swollen and slightly flattened above. The apex is small and rounded. The body-whorl is long but rather narrow and not very convex. Its upper surface is flattened and oblique but not angulate. The inner margin is Z-shaped, the upper half of the outline consisting of a somewhat flat curve. It then slopes in fairly abruptly and finally forms a broad projecting lobe, which corresponds with the inner anterior angle of the mouth. This lobe does not project so far sideways as the outline of the upper part of the whorl. The outer margin of the whorl forms an arc of wide diameter and less than a semicircle. The surface is not highly polished. It is ornamented with rather coarse and irregular longitudinal ridges, some of which may be called low costae, and striae. Minute spiral striae are also present. The first three whorls are, however, almost smooth.

In ventral view the shell is ovoid. The body-whorl is swollen above and transverse at its upper margin. It disappears behind the mouth some little distance above the anterior extremity of the latter. The shell is very narrowly rimate. The mouth is long and somewhat expanded, ovate, nearly vertical, sometimes narrowly rounded or truncate both above and below, sometimes pointed above and rounded below. The lip is thin and sharp and its curvature is often uneven but never highly convex. The callus is well developed above, joining the columellar border to the lip. The columella is long and twisted but not curved. The margin of the mouth is long, straight and vertical below the umbilicus. The columellar border is expanded and flattened over the umbilicus. The inner anterolateral border of the mouth is very slightly expanded and produced. The sculpture of the surface is not so well developed in this view as in the dorsal.

As seen from above, the spire increases gradually but often irregularly and the suture becomes gradually more impressed until it is practically canaliculate as it approaches the outer lip.

The radula has the dental formula 13.8.1.8.13. The central tooth though minute is distinctly bicuspid, having a small, sharp subsidiary cusp at the base of the main one, which is narrow and sharp. The laterals are tricuspid and their cusps are long, slender and sharply pointed. The lateral cusps are equal and a little smaller than the central one, but the inner cusp arises at a considerably lower level than the outer one. The marginals are very uniform in structure. Each has three (or occasionally four) subequal cusps arranged in a slanting line. The only difference between those of the inner and the outer rows is that in the later the cusps are blunter and a little less regular in shape.

The jaw is broad, dark and stout. The free margin of the upper part is broadly truncate and the internal surface is concave in the middle region.

The animal, as seen in a highly contracted state and preserved in spirit, offers no particular external diagnostic features. The mantle is pale with large dark spots.

The genitalia. On comparing the genitalia of this form with those of *L. gedrosiana*[1] we find that the hermaphrodite gland is much larger and more lobose. The hermaphrodite duct is much longer, more convoluted and more swollen in its distal portion. The situation of the prostate is similar but the gland itself is larger and the upper part of the male duct above the prostate much more swollen; the penis-sac is also more elongate. The uterus is swollen in the middle but pointed at the two ends. The spermatheca has a shorter duct than in *L. gedrosiana*, but nearly equal in length to the spermatheca itself.

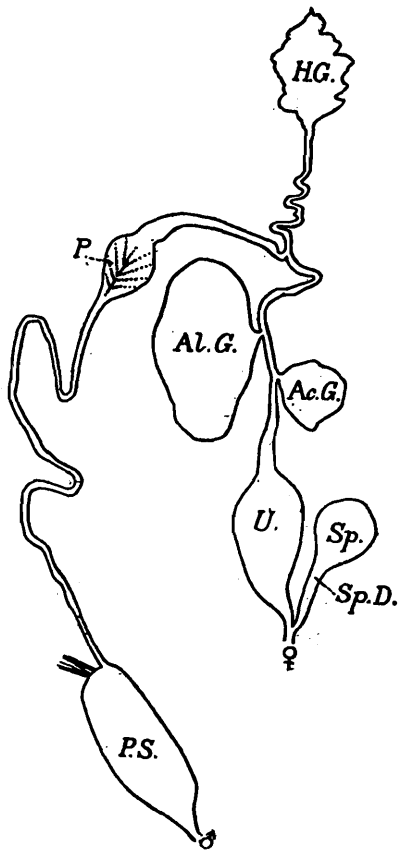


FIG. 1.—Genitalia of *Limnaea peregra canalifera*, Mousson.

Measurements (in millimetres) and Proportions of Shells.

Height	21	21	21	17	17
Maximum diameter ...	15	13	13	13	11
Height of mouth	16	17·5	15	14	12
Maximum diameter of mouth	8	8	7	7	5
Maximum diameter to height of shell	1 : 1·4	1 : 1·61	1 : 1·61	1 : 1·55	
Maximum diameter to height of mouth	1 : 2	1 : 2·17	1 : 2·14	1 : 2·4	
Height of mouth to that of shell	1 : 1·31	1 : 1·2	1 : 1·4	1 : 1.42	
Maximum diameter of mouth to that of shell	1 : 1·87	1 : 1·62	1 : 1·71	1 : 2·2	

[1] *Rec. Ind. Mus.* XVIII, p. 40, fig. 5B (1919).

The height of the shell is from $1\frac{2}{5}$ to $1\frac{3}{5}$ the maximum diameter; the height of the mouth at least twice its maximum diameter. The height of the shell is from $1\frac{1}{5}$ to $1\frac{2}{5}$ that of the mouth and the maximum diameter from $1\frac{3}{5}$ to $2\frac{1}{5}$ that of the mouth.

Capt. Boulenger obtained a number of living specimens in the Khandag Creek at Basra.

The specimen recently figured by one of us and assigned provisionally to *L. peregriformis*, Locard, is a young shell of this species. It differs considerably from older ones. Adult shells only differ from a series from the Rhineland in the Indian Museum, labelled *L. ovata* var. *inflata*, in having the upper surface of the body-whorl flatter and more depressed round the suture.

Limnaea cor, sp. nov.

(Pl. XIII, figs. 1, 2.)

The shell is moderately small (less than 15 mm. high), thin and fragile, diaphanous, tinged with rose-pink when fresh, conspicuously striate longitudinally, and remarkable for its short, erect acuminate spire, the base of which is deeply depressed, and its large, irregularly heart-shaped, transverse body-whorl, the maximum diameter of which is practically the same as the height.

In dorsal view the following particulars are apparent: The spire consists of three whorls and is not more than $\frac{1}{6}$ as high at the body-whorl. The apical whorl is minute and rounded, the second at least three times as deep and broad as the first, which is set upon it nearer the inner than the outer margin of the shell. It is somewhat convexly flattened above and its outer margin slopes gradually outwards and downwards, while its inner margin is vertical. The third whorl, which is at least five times as large as the second, possesses the same characters in a more developed manner. The suture of the spire is oblique, linear and depressed, but not very deeply. The body-whorl is bilaterally very asymmetrical and irregularly heart-shaped. Its upper surface is broadly flattened and decidedly angulate at its outer margin. The suture just above it is deep and broad. The inner margin is conspicuously Z-shaped. In its upper half it is very convex, representing an arc of nearly a semicircle. It then slopes gradually inwards for some distance, and finally projects outwards to form a semicircular lobe corresponding to the outer anterior extremity of the lip. Just above this lobe there is a broad, slanting longitudinal depression on the surface of the shell. The outer margin of the whorl possesses a fairly even convexity in an arc greater than a semicircle, but its middle region is often more or less flattened and straight. The upper and outer part of the whorl is tumid, but the surface slopes somewhat abruptly towards both the lip and the anterior extremity of the shell. The sculpture on this surface is conspicuous even to a good naked eye, but has a very delicate appearance. It consists, as seen under a powerful lens,

of numerous curved, flattened ridges or fine ribs separated by sharp-cut furrows and themselves composed of numerous sharp lesser ridges divided by striae. Transverse striae are ill-developed or obsolete. The polish of the surface is exceptionally bright.

In ventral view the spire appears nearly of the same size as in dorsal view and, except that the spiral is of course reversed, has much the same appearance. The body-whorl in this view is broad and transverse above, with its surface highly convex, but it disappears rapidly behind the mouth, which is of great relative length and nearly in the same axis as that of the shell. The mouth is more or less quadrate, narrowly truncate or subtruncate above and by no means broadly rounded at its anterior end, where the lip is hardly at all expanded or everted. Its upper extremity is situated a very short distance below that of the body-whorl The lip is sharp and convex in an arc greater than a semicircle. Its arc is, however, often a little flattened in the middle region and the extreme margin is occasionally introverted in this flattened part. The callus is well developed but not coarse above, connecting the columellar border with the lip. The columella is strongly arcuate. Its expanded border completely or almost completely closes the narrowly rimate umbilicus. Below the body-whorl the inner edge of the mouth is straight and vertical. The sculpture on this surface is not so delicate or regular as on the dorsal surface and the polish is less marked.

As seen from above the shell presents several characteristic features. Rapid and regular increase of the whorls is apparent and also the flattened upper surface of all the whorls but the apical one. It is also evident that the upper surface of the body-whorl is not only flattened towards its margin, but deeply hollowed outside the suture, especially in the region near the lip. The lip projects from the shell with an almost semicircular concavity in its margin and then slopes outwards gradually.

Measurements (in millimetres) and Proportions of Shells.

Height	12·0	11·0	10·5	8·25
Maximum diameter ...	9·5	8·5	9·5	5·5
Height of mouth ...	10·0	9·0	8·5	5·5
Maximum diameter of mouth	6·5	5·5	5·0	3·0
Maximum diameter to height of shell	1 : 1·26	1 : 1·29	1 : 1·1	1 : 1·5
Maximum diameter to height of mouth	1 : 1·45	1 : 1·54	1 : 1·7	1 : 1·83

The total height of the shell varies from almost equal to $1\frac{1}{4}$ times the maximum diameter. In young shells it may be as much as $1\frac{1}{2}$ times as great. The height of the mouth is about $1\frac{4}{5}$ times its maximum diameter and nearly $\frac{4}{5}$ the total height. Its maximum diameter is from about $\frac{1}{2}$ to about $\frac{2}{3}$ that of the shell. The proportions of the height of the spire and the body-whorl vary owing to the fact that the former is occasionally almost flat. *Type-series.* No. $\frac{11666}{2}$ M. *Z.S.I* (*Ind. Mus.*).

The type-series consists of recent shells and was collected by Capt. C. L. Boulenger in a marsh five miles north of Samara on the lower Euphrates. Col. W H. Lane also obtained many broken subfossil shells in a lake-deposit at Nasariyeh.

Limnaea cor bears a resemblance, perhaps quite superficial, to certain forms of *L. auricularia* and allied species or races, but the direction of the spiral, the form of the spire and body-whorl and especially the comparatively narrow, quadrate or subquadrate outline of the mouth are very different on actual comparison. It is probably an extreme form derived from *L. lagotis*. The young shell departs much less conspicuously from this type than the adult. It is unfortunate that we have no anatomical material.

Limnaea tenera race **euphratica**, Mousson.

(Pl. XIII, figs. 3–5.)

1874. *Limnaea euphratica*, Mousson, *Journ. de Conchyl.* XXI, p. 40.
1918. *Limnaea tenera*, Annandale, *Rec. Ind. Mus.* XVI, p. 165, pl. xx, fig. 3.

At first sight the shell looks like a connecting link between *L. peregra canalifera* and *L. cor*, but many differences from both appear on a close inspection. Both the adult and the young shell are more like those of *L. cor*.

The differences from *L. cor* to be noted in the dorsal aspect of the mature shell are the following. The spire is longer and more prominent and has its basal whorl less depressed and more swollen and its suture less transverse. The upper surface of the body-whorl is less broadly flattened and the suture above it less transverse. The outline of the shell is more graceful and still more asymmetrical. The upper part of the inner margin is less convex and the slope inwards more abrupt and the terminal lobe more prominent and narrower. The outer margin is practically semicircular. The sculpture of the surface is less regular and the composite longitudinal ribs less distinct and less curved.

In ventral view the part of the body-whorl visible is longer, narrower and less tumid. Its upper margin is more oblique and less flattened. The spire is considerably shorter than in the dorsal view. The upper extremity of the mouth is removed from that of the body-whorl by a distance nearly equal to the length of the spire as seen in this view. The outline of the mouth is regularly oval. The lip at its inner anterior extremity is distinctly expanded and flattened. The callus is poorly developed above the columella, which is straighter.

As seen from above, the most noteworthy differences between the shells are, apart from those already noted in the dorsal and ventral views, (1) that the surface of the body-whorl is much less concave and that its concavity near the lip has a less confined character; (2) that the lip on leaving the shell has at first a comparatively narrow concavity and then proceeds outwards and backwards abruptly with a slight arc.

The specimens we have examined are also colourless and opaque and seem to be thicker than those of *L. cor*, but they are perhaps not so fresh.

Measurements (in millimetres) and Proportions of Shells.

Height ...	...	13	10·5	11	10·5	7·5
Maximum diameter	...	8	9·5	7	7·0	5·25
Height of mouth	...	11	8·0	7·5	7·5	6·0
Maximum diameter of mouth ...	...	5·25	4·5	4·5	3·25	3·0
Maximum diameter to height of shell	...	1 : 1·5	1 : 1·1	1 : 1·57	1 : 1·5	1 : 1·33
Maximum diameter to height of mouth	...	1 : 2·09	1 : 1·77	1 : 1·37	1 : 2·3	1 : 2

These measurements, few as they are, illustrate the variable character of the race. We do not, however, find it possible to draw any line between the *forma typica* and Mousson's var. *angustior*, as narrowness of the shell and flattening of the arc of the lip are by no means always correlated and shells with the arc of the lip flattened are mixed indiscriminately with those in which it is convex. The mouth, however, is as a rule narrower and more elongate than in the typical *L. tenera*, Küster, and the shell seems to be more variable, some individuals departing from the *forma typica* more than others. (Küster, however, only figures one shell). For these reasons we think it best to recognize the Mesopotamian race as distinct, though not specifically. Fully adult shells are perhaps more different than young ones. The differences between the extreme types of the typical form of the race and its phase *angustior* and those between phases A and B of *L. bactriana* are very much the same, but intermediate individuals are much more numerous.

L. tenera euphratica is common along the banks of the lower Euphrates in both recent and subfossil deposits. Capt. Boulenger obtained a series of rather small shells in a marsh 5 miles north of Samara.

Limnaea hordeum, Mousson.

(Pl. XIV, figs. 4, 5.)

1874. *Limnaea hordeum*, Mousson, *Journ. de Conchyl.* XXII, p. 42.
1919. *Limnaea hordeum*, Annandale & Prashad, *Rec. Ind. Mus.* XVIII, p. 57, pl. vii. fig. 5.

We have found in the collection of the Indian Museum a shell (identified by Mr. H. B. Preston as *Succinea bensoni*, var.) which we believe to represent the adult of this species. It was associated with a young shell of *L. gedrosiana* under the same name and came from the banks of the Gaud-i-Zirreh in the Afghan desert, where it was collected by Sir Henry McMahon some years ago. This shell agrees better in dimensions with Mousson's type than those we have hitherto examined but is slightly larger. It differs from young shells in having the body-whorl proportionately smaller and the mouth larger and broader and the lip thinner—differences that

might be expected in an adult shell. The measurements are as follows:—Height 7 mm., maximum diameter 3·5 mm., height of mouth 4·7 mm., maximum diameter of mouth 2·2 mm.

The species is only known in what may be a subfossil state. It has been found on the banks of the lower Euphrates at two places, in Seistan, and in the Afghan desert to the south-east of that district. The Gaud-i-Zirreh is a great basin of strongly saline marshland into which the Helmand river at one time drained. See p. 4 and plate 1 of this volume.

The adult shell is still more like that of *L. truncatula* than the young, but the same differences persist in a sufficiently strong degree for specific separation. The Mesopotamian specimens we have examined are all young.

EXPLANATION OF PLATE XIII.

Limnaea cor, sp. nov.

FIG. 1.—Type-specimen from marsh near Samara, Mesopotamia. Actual height 12 mm.

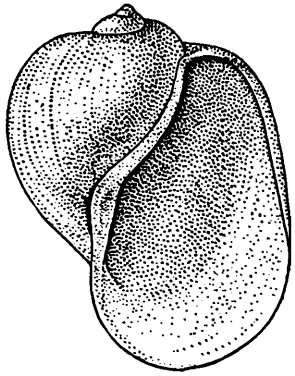
,, 2.—Young shell from the same locality. Actual height 6 mm.

Limnaea tenera euphratica, Mousson.

FIG. 3, 3*a*.—Shell of the phase *angustior*, Mousson, from a marsh near Samara. Actual height 10·5 mm.

,, 4.—Shell of the *forma typica* of the race from the same locality. Actual height 10·5 mm.

,, 5.—Young shell from the same locality. Actual height 6·5 mm.



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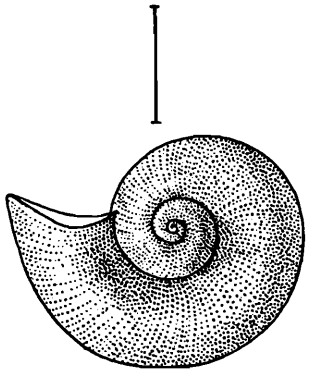

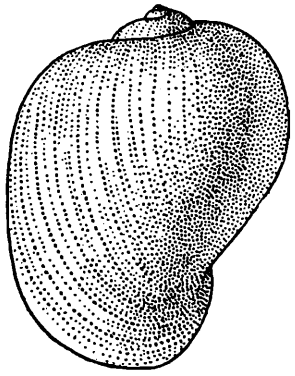

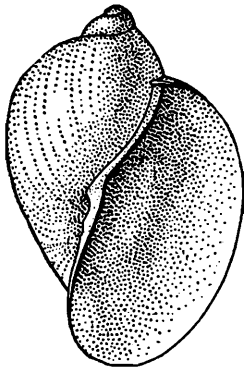

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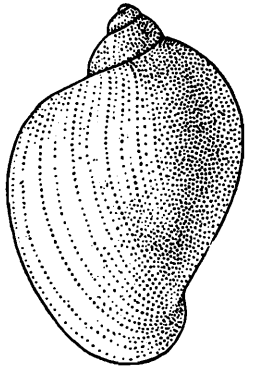

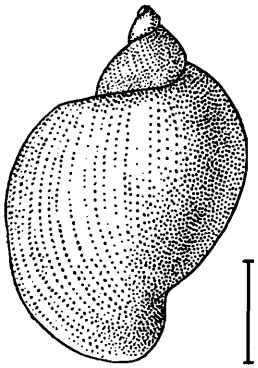

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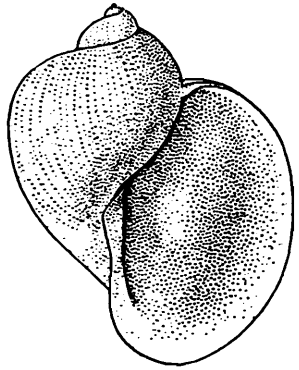

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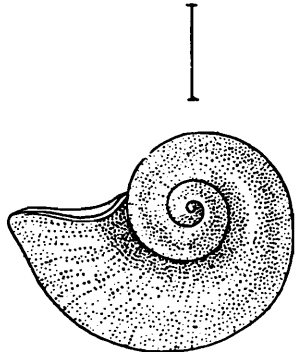

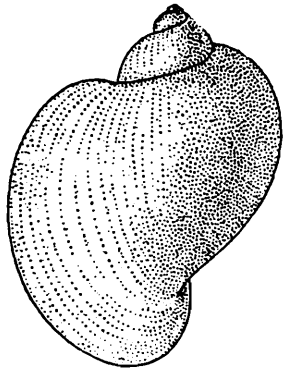

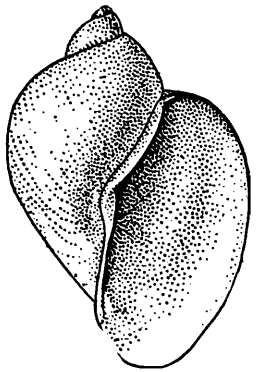

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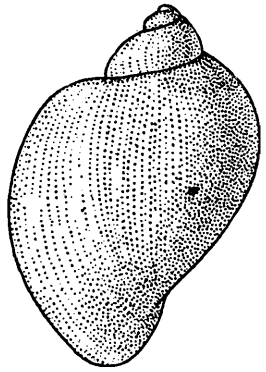
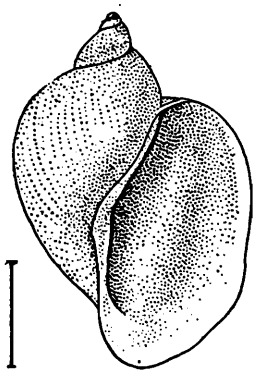




3*a*.

A. Chowdhary del.

LIMNAEIDAE OF MESOPOTAMIA.

EXPLANATION OF PLATE XIV.

Limnaea peregra canalifera, Mousson.

FIG. 1.—Shell from Khandag Creek near Basra. Actual height 22 mm.

,, 2.—Young shell from the same locality. Actual height 7·5 mm.

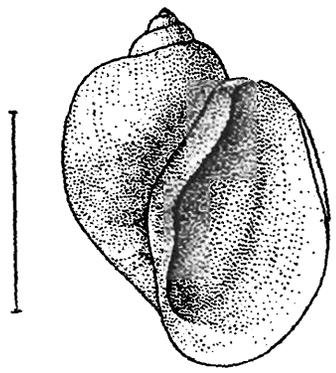
Limnaea bactriana, Hutton.

FIG. 3.—Shell from Khandag Creek near Basra. Actual height 8 mm.

Limnaea hordeum, Mousson.

FIG. 4.—Adult shell (? subfossil) from the Gaud-i-Zirreh in the Afghan Baluch desert. Actual height 7 mm.

,, 5.—Young shell (? subfossil) from the banks of the Euphrates at Nasariyeh, Mesopotamia. Actual height 4·5 mm.



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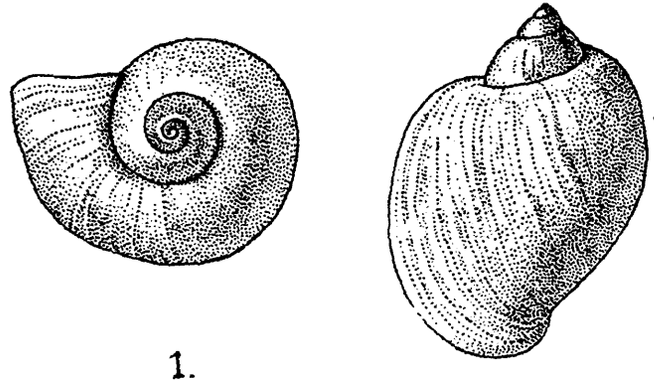

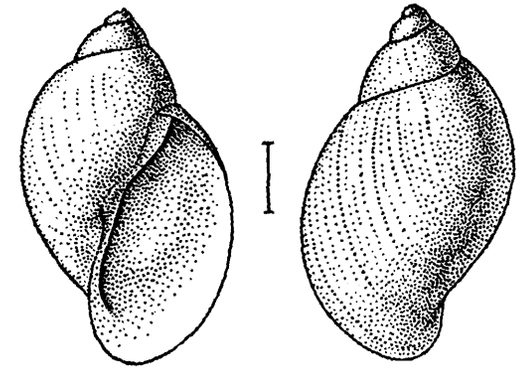

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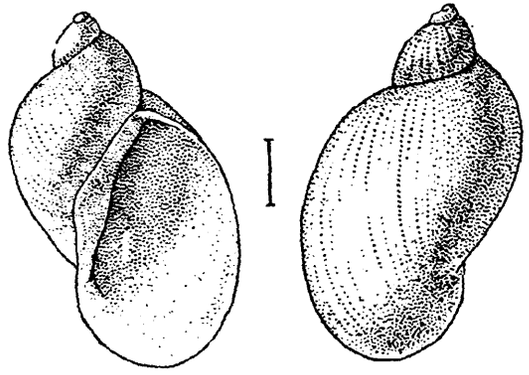

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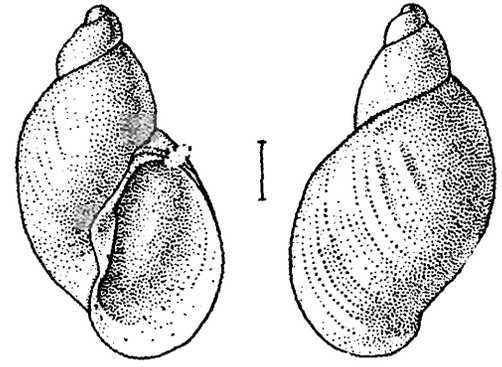

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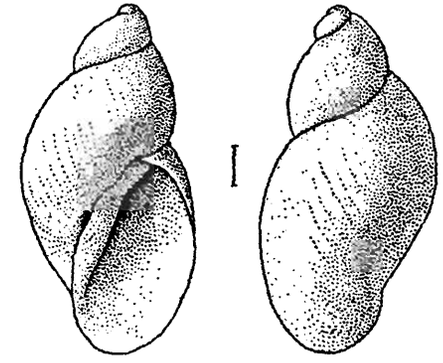


5.

A. Chowdhary del.

LIMNAEIDAE OF MESOPOTAMIA.

ON A NEW GENUS AND SPECIES OF COCCIDAE FROM NORTH-WESTERN INDIA AND EASTERN PERSIA

By E. ERNEST GREEN, *F.E.S., F.Z.S*

(With Plates XXI—XXII.)

Genus **Naiacoccus**, nov.

Characters as in *Erium* (of the subfamily Pseudococcinae): but with an enormously elongated ovisac, within the anterior extremity of which the adult insect lies concealed. Type *serpentinus*, Green.

Naiacoccus serpentinus, sp. nov.

Adult female occupying the extremity of a long, white, tubular ovisac which may form either a simple loop or be twisted into an irregular coil (see fig. 1). When uncoiled and extended the ovisac may attain a length of approximately one and three-quarter inches, the average length being well over one inch.

Adult female, removed from the ovisac, dull slaty grey or purplish brown: broadly ovoid when viewed from above (fig. 2*b*): irregularly tumescent when viewed from the side (fig. 2*a*): the dorsal area of the abdomen contracted and transversely wrinkled, the posterior segments assuming a dorsal position. Antennae small, 7- to 9-jointed (see fig. 3), the proportionate lengths of the several joints varying considerably. The normal number is apparently 8 (fig. 3*b*, *c*, *d*), the larger number (fig. 3*a*) being exceptional and produced by a fracture of the normal 4th joint, while the smaller number has presumably resulted from the fusion of two joints (fig. 3*f*). In some instances the division between the 7th and 8th is incomplete (see fig. 3*e*). Apex of terminal joint truncate or obtuse, with 5 or 6 stout hairs: each of the remaining joints usually with 1 or 2 small hairs on one side. Limbs small but comparatively stout (fig. 4): the tibia and tarsus together markedly shorter than the femur and trochanter; coxa unusually large, especially in some examples (see fig. 4*b*); digitules simple. Anal ring (fig. 5) with 6 stout setae: some smaller setae immediately above and below the anal aperture. Anal lobes inconspicuous, represented by two small rounded prominences on the dorsum—one on each side of, and slightly below the anal aperture (see fig. 2*b*). Spines of the form shown at fig. 5*b* occur in transverse series across the dorsum of the abdominal segments—sparsely on the basal but more numerously on the

posterior segments. Similar spines are clustered on the small anal lobes and on a corresponding tract on the preceding segment. Intermingled with the spines are many minute, obscurely trilocular pores, which occur (rather more abundantly) on the venter also. There are some larger circular pores near the posterior extremity of the venter. Length (under compression) 2·5 to 4 mm. Breadth 2 to 3 mm.

The early adult insect (before the production of the ovisac) is enclosed in a more compact, felted covering, of a grayish ochreous colour, which may be observed—even in older examples—as a pointed cap at the anterior extremity of the ovisac. The freshly deposited eggs are of a pale yellow colour, but become reddish before hatching. The number of ova produced by a single female probably amounts to several thousands.

On a large arboreal Tamarisk (*Tamarix articulata*). Lahore. Collected by Dr. N. Annandale in May. "*T articulata* is one of the chief shade-trees in Lahore. Mr. Sundar Lal Hora, M.Sc., Research Assistant, Z.S.I., found the Coccid upon it in abundance in October, but I have failed to do so on several occasions in January. *N A.*"

The extraordinary masses of tangled ovisacs must be very conspicuous objects on the trees, but might easily be mistaken for collections of bird droppings, such as may often be seen on branches beneath the roosting places of flocks of sparrows. The insects excrete a considerable amount of viscid fluid which soon assumes a brownish colour.

Lt.-Col. Stephenson (of the Government College, Lahore), to whom I am indebted for some excellent photographs of the insect and for fresh living material, informs me that—in nature—the long ovisac is always attached at each end, forming a simple loop. The subsequent tangled condition may be the result of wind.

Naiacoccus serpentinus var. **minor,** nov.

Distinguishable from the type by its smaller size and by the greater number of dorsal spines and dermal pores (fig. 6*f*). The circular pores of the venter are particularly conspicuous and are densely crowded on the posterior segments (see fig. 6*g*). The average size of the insect ranges from 1·5 to 3 mm.; but little difference can be observed in the length of the ovisacs which have precisely the same appearance as those of typical *serpentinus*. The antennae (figs. 6*a-d*) are shorter, the number of joints varying from 5 to 7, being usually reduced by complete or partial fusion. In some examples only 5 complete joints can be distinguished; but the 6-jointed from (fig. 6*b*, *c*) is the most frequent.

On *Tamarix stricta*. Collected by Dr. N. Annandale in two localities several hundred miles apart, viz.:—

No. 8740, "In desert north of Nasratabad in Seistan, Eastern Persia; November. The roots and stems of *T stricta*, which

rarely grows larger than a small bush, are the chief source of firewood in Seistan."

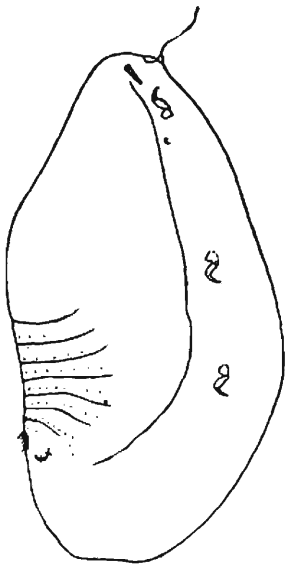
No. 8745, "From Kushdil Khan, in the Pishin District north of Quetta, Baluchistan; December."

EXPLANATION OF PLATE XXI.

FIG. 1.—*Naiacoccus serpentinus*. Collection of ovisacs, on branch of *Tamarix articulata*; × about ¾. (From photograph by Lt-Col. Stephenson.)

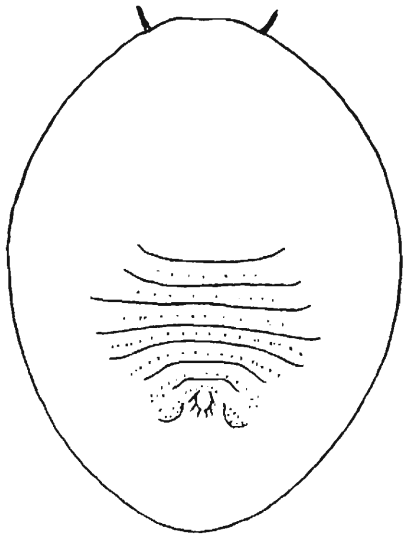
„ 2.—*Naiacoccus serpentinus*. (*a*) Diagrammatic view from side of adult female; (*b*) dorsal view; × 15.

„ 3.—*Naiacoccus serpentinus*. (*a-f*) Different forms of antennae of adult female; × 220.



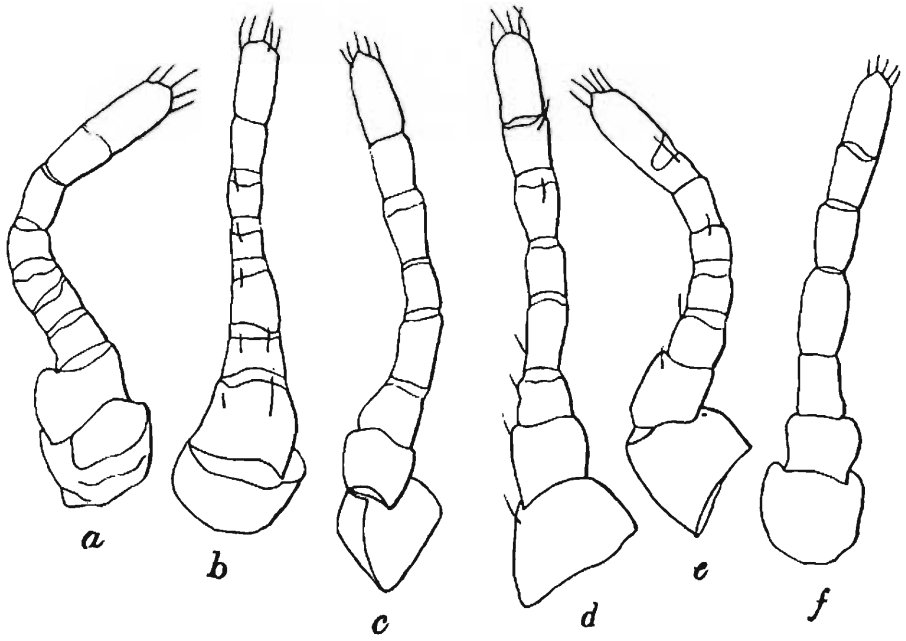
a

2.



b

1.



a *b* *c* *d* *e* *f*

3.

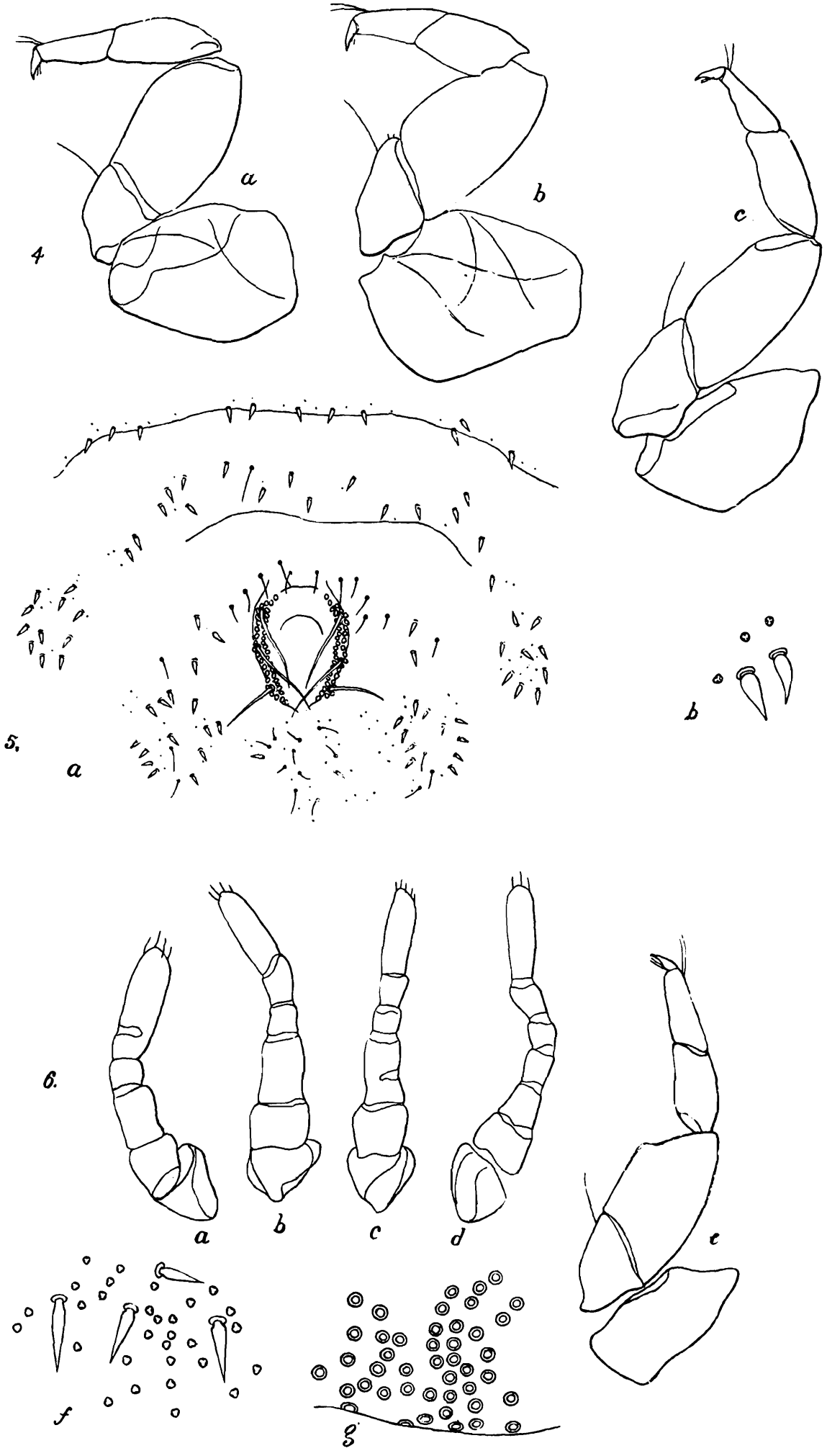
COCCIDAE FROM N. W. INDIA & PERSIA.

EXPLANATION OF PLATE XXII.

FIG. 4.—*Naiacoccus serpentinus.* (*a-c*) Various forms of mid leg of adult female; × 220.

,, 5.—*Naiacoccus serpentinus.* (*a*) Anal ring of adult female and surrounding parts; × 130. (*b*) Spines and pores from dorsum; × 450.

,, 6.—*Naiacoccus serpentinus.* var. *minor.* (*a-d*) Different forms of antennae of adult female; × 220. (*e*) Mid leg of adult female; × 220. (*f*) Dorsal spines and pores; × 450. (*g*) Circular pores, from venter of abdomen; × 450.



COCCIDAE FROM N. W. INDIA & PERSIA.

NOTES ON TWO COLLECTIONS OF BIRDS FROM SEISTAN

By E. C. STUART BAKER, *F.L.S., F.Z.S., M.B.O.U., C.F.A.O.U.*

In the years 1903-05 a small collection of birds numbering 106 specimens was made by Mr. J W N. Cumming and other members of the Seistan Arbitration Commission and has been described by him in *Journ. Bombay Nat. Hist. Soc.* XVI, pp. 686-699 (1905). Another, consisting of only 31 specimens, was obtained by Dr. N. Annandale and Mr. S. W. Kemp on their recent visit to Seistan. Both these collections belong to the Indian Museum. As it was throughout advisable that the specimens should be named after comparison with the magnificent material available in the British Museum, especially with that in the Hume collection, the Director of the Zoological Survey of India kindly sent me the birds to work out

The results show that the collection of 137 specimens contain examples of 79 species all of which belong to the Indian avifauna with the exception of *Sylvia mystacea* and *Passer moabiticus yatii*.

The geographical affinities are Indo-Palaearctic, the races of resident birds nearly all belonging to the Palaearctic rather than to the Indian forms; for instance *Corvus cornix sharpii*, *Corvus frugilegus tschusii*, *Coracias garrula semenowi*, *Falco aesalon insignis*. On the other hand a few sub-species, apparently resident, are typically tropical Indian, such as *Gallinula chloropus parvifrons*.

As many recent alterations in names have been made since Blanford's time, owing to discoveries by ornithologists of earlier names having priority, etc., it has been thought advisable to add in brackets the number of the bird according to Oates and Blanford's Avifauna. This will it is hoped facilitate recognition by those field workers who might otherwise be puzzled.

The field-notes in brackets over the initials *N. A.* have been added by Dr. Annandale.

[The birds of Seistan, as might be expected from the peculiar conformation of the country, are, with few noteworthy exceptions, either water-birds or desert-birds. As our work in Seistan was chiefly connected with water and occupied only a few weeks in the middle of winter, such observations as we made on bird-life were necessarily meagre and concerned only the birds of the Hamun-i-Helmand, for a brief account of which the Geographical Introduction to this volume may be consulted. Thirty-four of the seventy-nine races and species enumerated by Mr. Baker may be classed as water-birds. What struck us most in a general way about these birds was their enormous numbers and the apparent paucity of food for them. Nevertheless, both ducks and the wading-birds

were exceptionally fat. We watched large flocks of the Black-tailed Godwit and other species continually grubbing in the mud where we ourselves found no living thing. An examination of their stomach-contents proved that they were feeding on the seeds of water-plants, which were doubtless lying ready to sprout when the flood-season began.

Water-birds, especially the Coot and the Gray Lag Goose (of which no specimens were preserved) play an important part in the economy of the Saiyad or Hunters, a peculiar almost outcaste tribe, who live on the shores of the Hamun in primitive reed-huts and navigate its reed-beds in skiff-like rafts (*tutin*) of bulrush leaves.

In winter the most abundant and conspicuous birds in Seistan peculiar neither to the desert nor to the lake is the Rook. Enormous flocks, so large that we frequently mistook them for clouds in the distance, fly about the country at this season and settle on the ground in open spaces, often among tamarisk bushes round small pools in the desert. What they get to eat is a mystery. We were told that these flocks arrived about October and were popularly believed to eat up the "Hamun fly," a blood-sucking fly (? *Tabanus* or *Haematopota*) that spreads surra among camels and horses. It is quite possible that the birds do devour these insects, but it is also probable that their arrival coincides with the close of the flies' season of aerial life. *N.A.*]

1. **Corvus cornix sharpii** Oates. (6).

1905. *Corvus cornix*, Cumming, *op. cit.*, p. 686.

♂ No. 24685; Rudbar, R. Helmand, Feb. 03.
♀ ,, 25492; Lab-i-Baring, *ca.* 1600 ft., 15.12.18.

2. **Corvus frugilegus tschusii** Hartert. (5).

1905. *Corvus frugilegus*, Cumming, *op. cit.*, p. 686.

♀ No. 24707; Nad-i-Ali on the Helmand, 13.3.05.
♀ ,, 24881; Kuhak, 20.3.05.
♂ ,, 25469; Lab-i-Baring, *ca.* 1600 ft., 15.12.18.
♂ ,, 25470; ,, ,, 15.12.18.

Of these Rooks the first two specimens have nearly completed their facial moult but still have all the nareal bristles present; No. 3 has the face quite bare whilst the fourth is a young bird with the face fully feathered. [See notes at end of introduction. *N.A.*]

3. **Argya caudata huttoni** (Blyth). (105).

1905. *Argya caudata*, Cumming, *op. cit.*, p. 686.

♂ No. 24880; Kuhak, 26.4.05.

This is a typical *huttoni* in appearance but is a very small bird with a wing of only 83 mm. The striae on the breast are almost obsolete.

4. **Tichodroma muraria** (Linn.). (348).

1905. *Tichodroma muraria*, Cumming, *op. cit.*, p. 686.

♀ No. 24877; Peshawaran, 20.12.06.

5. **Sylvia mystacea** (Ménétr.).

1905. *Sylvia jerdoni*, Cumming, *op. cit.*, p. 687.

♂ No. 24883; Kuhak, 21.3.05.

6. **Agrobates galactodes familiaris** (Ménétr.). (359)

1905. *Aedon familiaris*, Cumming, *op. cit.*, p. 686.

♀ No. 24875; Kuhak, 22.4.05.

7. **Prinia gracilis lepida**, Blyth. (462).

1905. *Prinia lepida*, Cumming, *op. cit.*, p. 687.

♂ No. 24879; Kuhak, 2.10.04.

8. **Lanius cristatus isabellinus**, Ehrenb. (479).

1905. *Lanius phoenicuroides*, Cumming (in part), *op. cit.*, p. 687.

♀ No. 24709; Kaod on the Asinki Canal, 28.3.03.

9. **Lanius cristatus phoenicuroides** (Hemp. and Ehrenb.). (480).

1905. *Lanius phoenicuroides*, Cumming (in part), *op. cit.*, p. 687.

♂ No. 24878, Kuhak, 22.4.05.

The former of these shrikes is presumably only a migrant but the latter is resident and breeds, for General R. Betham took many of its eggs and nests when stationed at Quetta.

10. **Sturnus vulgaris poltaratskii**, Finsch. (532).

1905. *Sturnus menzbieri*, Cumming (in part), *op. cit.* p. 687.

♂. No. 24686; Hamun, Seistan, Jan. 04.

♂. ,, 25489; Lab-i-Baring, *ca.* 1600 *ft.*, 12.12.18.

11. **Sturnus vulgaris nobilior**, Hume. (533).

1905. *Sturnus menzbieri*, Cumming (in part), *op. cit.*, p. 687.

♂ No. 25472; Lab-i-Baring, *ca.* 1600 ft., 11.12.18.

Hartert has recently written a long article on the races of *Sturnus vulgaris* (*Novitates Zoologicae* XXV, p. 327) but gives no key and in some cases does not even say how they can be discriminated. The deep colour of No. 25472, its almost black white-edged under wing-coverts and deep red wings satisfy me that this specimen must be referred to Hume's *nobilior*. The other two birds are certainly both *poltaratskii* with which *menzbieri* is now generally placed as a synonym.

[Both No. 25472 and No. 25489 were shot at the edge of the Hamun near Lab-i-Baring in December. Small flocks of starlings are not uncommon in the fields at this season, at which ploughing is just commencing in Seistan. *N. A.*]

12. **Oenanthe deserti atrogularis** (Blyth). (626).

1905. *Saxicola deserti*, Cumming, *op. cit.*, p. 688.

♂ No. 24712; Khwaja Ahmed, 3.4.03.
♂ ,, 24868; Khwaja Ahmed, Jan. 05.
o. ,, 25481; Lab-i-Baring, 7.12.18.
♂ ,, 25485; Lab-i-Baring, 8.12.18.

13. **Oenanthe alboniger** (Hume). (617).

1905. *Saxicola albinigra*, Cumming, *op. cit.*, p. 687.

♂ No. 24710; Kaod on the Asinki Canal, no date.
♀ ,, 25476; Lab-i-Baring, 7.12.18.

[Very common with the last in the Seistan desert in December. *N A.*]

14. **Oenanthe picata** (Blyth). (618).

1905. *Saxicola capistrata*, Cumming, *op. cit.*, p. 687.

♂ No. 24711; Kaod on the Asinki Canal, 26.3.03.

This specimen belongs to the white-headed form which has generally been separated as *Oenanthe capistrata.*

15. **Oenanthe isabellina** (Cretzschem). (625).

1905. *Saxicola isabellina*, Cumming, *op. cit.*, p. 688.

♀ No. 24866; Kuhak, 31.3.04.
♂. ,, 24867; Kuhak, 3.4.04.

16. **Phoenicurus erythronotus** (Eversm.). (642).

o. No. 25480; In garden at Nasratabad, 18.12.18.

This bird although not sexed is obviously an adult female; the wing is rather small, only 72 mm.

17. **Monticola solitaria pandoo** (Sykes). (693).

♂. No. 24713; Khwaja Ahmed, 7.4.03.

This specimen is marked "male" but is undoubtedly an old female.

18. **Passer montanus dilutus**, Rechm. (779).

1905. *Passer montanus*, Cumming, *op. cit.*, p. 688.

♂. No. 24869; Kuhak, 20.4.05.

19. **Passer moabiticus yatii**, Sharpe.

♀ No. 24714; Nad-i-Ali on the Helmand, 13.3.03.

This specimen is not in adult plumage and has very little yellow on the lower plumage but is almost certainly of this race of the Palestine Sparrow.

20. **Motacilla alba personata**, Gould. (829).

1905. *Motacilla personata*, Cumming, *op. cit.*, p. 688.

♂ No. 24870; Kuhak, 28.4.05.
♂ „ 25477; Lab-i-Baring, 13.12.18.
♂. „ 25482; „ 13.12.18.

Of the three specimens the first is in full summer plumage, the two others in winter plumage. [Very common in the desert, and at the edge of the Hamun in December. *N. A.*]

21. **Alaemon alaudipes pallida** (Blyth). (854).

1905. *Alaemon desertorum*, Cumming, *op. cit.*, p. 688.

♂ No. 24871; Kuhak, 21.9.04.

Though marked "male" this is probably a female and even for that sex is an unusually small one, wing 126, bill from front 25 mm. This is considerably below normal measurements which are (vide Hartert) ♂, wing 138-141 mm., ♀, 128-130 mm. Larger series of *pallida*, Blyth and *desertorum* (Stone) might possibly prove that they are divisible but at present most ornithologists lump them together.

22. **Galerida cristata? magna**, Hume. (874).

1905. *Galerita cristata*, Cumming, *op. cit.*, p. 689.

♂. No. 24874; Kuhak, 20.4.05.
♂. „ 25478; Lab-i-Baring, 13.12.18.

These birds are very small both having a wing of 106 mm., whilst Hartert gives the minimum for this sub-species as 110 mm; on the other hand he gives the maximum for *chendoola*, the common Indian form, as 105 mm. As a matter of fact throughout the intervening country between the Northern and Southern areas the birds are intermediate both in size and general appearance.

23. **Ammomanes deserti iranica** (Hartert). (878).

1905. *Ammomanes phoenicuroides*, Cumming, *op. cit.*, p. 639

♂ No. 24873; Khwaja Ahmed, 24. 4. 05.

Quite a typical specimen.

24. **Ammomanes phoenicura zarudnyi,** Hartert.

O. No. 25484; Lab-i-Baring, 14.12.18.

I have compared this specimen with others in the Tring Museum as I was rather doubtful of some of those in the British Museum where the forms of *phoenicura* have not yet been thoroughly worked out.

25. **Coracias garrula semenowi,** Loudon and Tschusi (1024).

1905. *Corracias garrula,* Cumming, *op. cit.,* p. 689.

O. No. 24684; Khwaja Ahmed, May 1903.
♂ ,, 24861; ,, 24.4.05.

26. **Merops persicus persicus,** Pall. (1028).

1905. *Merops persicus,* Cumming, *op. cit.,* p. 689.

♂. No. 24862; Kuhak, 22.4.05.

27. **Caprimulgus mahrattensis,** Sykes. (1089).

1905. *Caprimulgus mahrattensis,* Cumming, *op. cit.,* p. 690.

♀ No. 24688; Helmand, no date.
♀ ,, 24689; ,, ,,

28. **Bubo bubo bengalensis** (Frank.). (1168).

1905. *Bubo bengalensis,* Cumming, *op. cit.,* p. 690.

♀ Juv. No. 24864, Shaharistan, 6.5.05.

This appears to be *bengalensis,* which has already been obtained in Afghanistan. The wings measure respectively, right, 380 and left, 370 mm., whereas *turcomanus* (Eversm.) has a wing varying between 425 and 500 mm. From the date on which killed, and also from its juvenile appearance, it is evidently a bird locally bred and it raises an interesting doubt as to the specific or sub-specific value of some of the differences hitherto held to be sub-specific only between some of the nearest allies of *Bubo bubo.* We cannot have two geographical races breeding in the same area and if *turcomanus* and *bengalensis* do breed in the same, then they are good species and not sub-species only.

29. **Athene noctua bactriana,** Blyth. (1180).

1905. *Athene bactriana,* Cumming, *op. cit.,* p. 691.

♂. No. 24863; Kuhak, 21.10.04.

30. **Buteo ferox** (Gmel.). (1239).

O. No. 24722; "Caught in Seistan," Feb. 1904.

An adult but beautifully pale bird in very fine plumage, apparently a male.

31. **Circus macrurus** (Gmel.). (1233).

♂. No. 24716; Band-i-Seistan, Feb. 03.
♂. ,, 24865; Shaharistan, no date.

Although these specimens have not been sexed the first is certainly a ♂ and the second almost equally certainly an adult female.

32. **Circus aeruginosus** (Linn.). (1237).

♂. No. 24717; Takht-i-Shah, March 04.
♂. ,, 24719; Nadali, March 03.
♂. ,, 24720; ? no date.
♀ ,, 25494; Lab-i-Baring, 10.12.18.

[The commonest bird of prey over the reed-beds of the Hamun. We saw one capture a small water-vole or shrew among the reeds. *N. A.*]

33. **Falco aesalon insignis** (Clark). (1263).

♂. No. 24724; Takht-i-Shah, March 04.

The wing measures 190 mm.

34. **Tinnunculus tinnunculus saturatus**, Blyth. (1265).

♂. No. 24726; ? no date.

The wing of this specimen measures 236 mm.

35. **Columba livia intermedia**, Strick. (1292).

1905. *Columba intermedia*, Cumming, *op. cit.*, p. 691.

♀ No. 24850; Kuhak, 22.4.05.
♂. ,, 25463; Lab-i-Baring, no sex; December.

Both these specimens are very typical *livia intermedia* with the lower back quite grey, not white. These geographical races of *Columba livia* are generally very inconstant, partly due, no doubt, to crosses with domesticated birds but also due to the very wide range of individual variation which occurs. Major C. R. S. Pitman informs me that even well North in Mesopotamia he found birds breeding together some of which were the true white rumped *livia*, whilst others were as dark as the darkest Indian *intermedia*.

36. **Columba eversmanni**, Bonap. (1295).

1905. *Columba eversmanni*, Cumming, *op. cit.*, p. 691.

♀ No. 24851; ? 28.4.05.

This is a resident Pigeon in Afghanistan and Persia.

37. **Streptopelia turtur decaorta**, Friv. (1310).

1905. *Turtur risorius*, Cumming, *op. cit.*, p. 691.

♂ No. 24858; Khwaja Ahmed, 7.5.05.

38. **Pterocles arenarius caudacuta,** Pall. (1316).

1905. *Pterocles arenarius,* Cumming, *op. cit.,* p. 691.

♂. No. 25488, in desert S. of Lutak, 21.12.18.

This specimen is not sexed but is a female adult.

39. **Francolinus francolinus henricii,** Bonap. (1372).

1905. *Francolinus vulgaris,* Cumming, *op. cit.,* p. 692.

♀ Juv. No. 24847; Kuhak, Augt. 04.

Hartert in 1917 reviewed the races of *Francolinus francolinus* in *Novitates Zoologicae* and there points out that the small pale bird from Sind to Afghanistan must bear Bonapartes' name *henricii.* The present specimen is very typical, a small, decidedly pale bird.

40. **Coturnix coturnix** (Linn.). (1355).

1905. *Coturnix communis,* Cumming, *op. cit.,* p. 692.

♀ No. 24848; Kuhak, 22.9.04.

41. **Zaponia parva parva,** Bechst. (1392).

1905. *Porzana parva,* Cumming, *op. cit.,* p. 693.

♀ No. 24859; Kuhak, 6.9.04.

The wings are very imperfect, one moulting, and from the other several quills missing. They measure approximately 81 mm. In spite of its comparatively small size I have no doubt that it can be correctly assigned to this race. The colour generally is decidedly light and the bill is longer than in any specimen of *pusilla* in the British Museum Collection.

42. **Porzana porzana** (Lin.). (1394).

No. 24696; ? no date or sex.

43. **Gallinula chloropus parvifrons** (Blyth). (1402).

No. 24727; Band-i-Seistan, no date or sex.

This specimen is somewhat intermediate between typical *chloropus* of Europe and *parvifrons* of India, but is on the whole nearer the latter and should come under that name.

44. **Fulica atra atra,** Linn. (1405).

1905. *Fulica atra,* Cumming, *op. cit.,* p. 693.

♀ No. 25468; Lab-i-Baring, 9.12.18.

♂. ,, 25471; ,, 9.12.18.

These two specimens, both fully adult, were obtained at Lab-i-Baring, Seistan, E. Persia, at an elevation of some 1600 feet. I cannot separate these in any way from typical *atra.*

[Coot live in enormous flocks among the reed-beds of the Hamun. Large numbers are caught for food in nets stretched across channels in the reed-beds into which the flocks are driven by men on *tutin* or rafts. The nets are stretched on sticks stuck into the mud, their lower edge being in the water and their upper edge about 2 feet above the surface. *N.A.*]

45. **Cursorius gallicus** (Gmelin). (1423).

1905. *Cursorius gallicus*, Cumming, *op. cit.*, p. 694.

No. 24681; Khwaja Ahmed, April 1903, not sexed.
,, 24682; ,, ,, 1903, ,,
,, 24683; Nadali, Helmand, March 1903, ,,

46. **Chettusia leucura** (Licht.). (1438).

1905. *Chettusia leucura*, Cumming, *op. cit.*, p. 694.

♀ No. 24677; ? no date.
♀ ,, 24678; Shahgul on Rud-i-Pariun, 23.3.1903.
♀ ,, 24679; Nadali, Helmand, March 03.
♂ ,, 24849; Nasratabad, 6.5.05.

The White-tailed Plover is an exceedingly common bird in suitable parts of Persia and has been found breeding in great numbers during the Mesopotamian campaign, the nests being placed, as a rule, in small patches of raised land in the marshes. The eggs number three or four, most often the latter.

47. **Aegialitis dubia jerdoni**, Legge. (1447).

1905. *Aegialitis dubia*, Cumming, *op. cit.*, p. 694.

♂ No. 24854; Kuhak, 1.4.04.
♀ ,, 24855; ,, 9.5.05.

These specimens, which are both in full breeding plumage, belong, as we should expect in birds obviously breeding, to the Indian race of Little Ringed Plover. The wings measure about 110 mm., the yellow base to the bill is very distinct, especially in one bird, and the black on the forehead is very narrow. (See Hartert and Jackson, *Ibis* 1915, pp. 531-3.)

48. **Himantopus himantopus** (Linn.). (1451).

1905. *Himantopus candidus*, Cumming, *op. cit.*, p. 694.

♀ No. 24836; Kuhak, 3.9.04.
♀ ,, 24837; Khwaja Ahmed, 24.4.05.
♂ ,, 24838; Kuhak, 3.3.04.

Of the two females only the second is fully adult.

49. **Limosa limosa** (Linn.). (1456).

1905. *Limosa belgica*, Cumming, *op. cit.*, p. 695.

♂ No. 24852; Nasratabad, 6.5.05.
♂ ,, 25491; Lab-i-Baring, 12.12.18.
♂ ,, 25493; ,, 12.12.18.

The specimen killed in May is in an interesting stage of plumage, the breast being partly red and the plumage above also in rather more than half summer plumage. The two birds killed in winter are, of course, in winter plumage.

[Feeding in large flocks at the edge of the Hamun in December. *N. A.*]

50. **Totanus glareola** (Linn.). (1461).

1905. *Totanus glareola*, Cumming, *op. cit.*, p. 695.

o. No. 24730; ? no sex or date.
♀ „ 24856; Khwaja Ahmed, 5.5.05.
♀ „ 24857, Nasratabad, 7.5.05.

51. **Totanus totanus eurhinus,** Oberholser. (1455).

o. No. 24731; Seistan, Jan. 04, no sex.
o. „ 24732; „ 7.1.04. „
o. „ 24733; „ no date or sex.

The Eastern form breeding from the Himalayas to Eastern Siberia has been separated as a geographical race under the name of *eurhinus* by Oberholser (*Proc. U. S. Nat. Mus.* XXII, p. 208; 1900) on the grounds of its greater size. He gives the average size for his new sub-species as follows: wing 163 mm., culmen 46·6 mm., and tarsus 47·2 mm.

The three specimens noted above have the wings 157-165 mm., bills 43 to 45 mm., and tarsi 52 to 55 mm. They must all therefore be accredited to the Eastern rather than to the Western form. Specimens of both birds and eggs obtained in Tibet fully bear out Oberholser's diagnosis of *eurhinus*.

52. **Machetes pugnax,** Linn. (1468).

o. No. 24734; Shaharistan, Seistan, 1.3.03, not sexed.

The wing measures 167 mm., large for a female and small for a male, but probably the latter not yet adult.

53. **Tringa alpina alpina** (Linn.). (1478).

♂ No. 25474; Lab-i-Baring, 8.12.18.
♀ „ 25475; „ 7.12.18.
♂ „ 25479; „ 13.12.18.
♂ „ 25483; „ 13.12.18.

The wings of these four specimens vary from 108 to 115 mm. so that they must belong to the smaller Western sub-species rather than to the larger Eastern one.

54. **Grus grus** (Linn.). (1407).

o. No. 24728; Khwaja Ali, Feb. 03.

This specimen is that of a not quite adult bird with the crown of the head still fairly well covered with feathers as in the young bird.

55. **Larus ichthyaëtus,** Pall. (1489).

1905. *Larus ichthyaëtus*, Cumming, *op. cit.*, p. 695.

o. No. 24691; Seistan, March 1904.

In full breeding plumage.

56. **Larus ridibundus,** Linn. (1490).

o. No. 24736; Seistan, Jany. 1904.

o. ,, 25464; Lab-i-Baring, 11.12.18.

57. **Larus gelastes,** Licht. (1493).

1905. *Larus gelastes*, Cumming, *op. cit.*, p. 695.

♀ No. 24841; Kuhak, 26.4.05.

♀. ,, 24853; ,, 26.4.05.

58. **Larus argentatus cachinnans,** Pall. (1495).

o. No. 24738; Landi Barech, Feb. 03.

59. **Hydroprogne caspia** (Pall.). (1498).

1905. *Hydroprogne caspia*, Cumming, *op. cit.*, p. 696.

♀ No. 24842; Kuhak, 26.4.05.

60. **Sterna nilotica,** Gmelin. (1499).

1905. *Sterna anglica*,, Cumming, *op. cit.*, p, 696.

♀ No. 24839; Kuhak, 22.4.05.

61. **Sterna hirundo** (Neum.). (1506).

1905. *Sterna fluviatilis*, Cumming *op. cit.*, p. 696.

♀ No. 24860; Kuhak, 28.4.05.

The wing of this bird measures 265 mm.

62. **Sterna minuta gouldi,** Hume. (1510).

1905. *Sterna minuta*, Cumming, *op. cit.*, p. 696.

♀ No. 24843; Khwaja Ahmed, 5.5.05.

♂. ,, 24844; Nasaratabad, 7.5.05.

♂. ,, 24845; ,, 6.5.05.

The wings of the two males measure 163 and 175 mm. respectively and that of the female 170 mm.

All these specimens appear to be the same as the Indian *S. m. gouldi* rather than true *S. m. minuta*. They are identical in shade of grey on the upper parts and in colour of outer primaries with specimens from N.W India.

63. **Pelecanus onocrotalus onocrotalus,** Linn. (1521).

1905. *Pelicanus onocrotalus*, Cumming, *op. cit.*, p. 696.

o. No. 24739; ? no sex or date.

A very typical specimen of this species with a bill fully 17 inches, or 435 mm., in length from forehead to tip of culmen.

64. **Phalacrocorax carbo subcormoranus** (Brehm). (1526).

1905. *Phalacrocorax carbo*, Cumming, *op. cit.*, p. 696.

O. No. 24740; Seistan, Feb. 04.

This is the form which Hartert has recently shewn (*Novitates Zoologicae*, XXIII, p. 294; 1916) must bear Brehm's name of *subcormoranus*.

[Cormorants are captured or shot in large numbers by the Saiyad. The down from the breasts is sometimes mixed with the soft wool out of which the felt hats worn by Persians are made. *N. A.*]

65. **Ardea cinera**, Linn. (1555).

1905. *Ardea cinerea*, Cumming, *op. cit.*, p. 696.

O. No. 24741; Khwaja Ali, Feb. 03; no sex.

O. „ 24882; Farrah Rud, Dec. 04.

These are both adult birds.

66. **Botaurus stellaris**, Linn. (1574).

1905. *Botaurus stellaris*, Cumming, *op. cit.*, p. 696.

O. No. 24846; Farrah Rud, Dec. 04. No sex.

O. „ 24744; ? Dec. 04. No sex.

These are both adult birds with wings of 335 and 342 mm. respectively, but otherwise call for no remark.

67. **Ixobrychus minutus** (Linn.). (1570).

1905. *Ardetta minuta*, Cumming, *op. cit.*, p. 696.

O. No. 24687; Khwaja Ali, Seistan, April 03.

An adult bird and evidently a male though it has not been sexed. The generic name *Ixobrychus*, Billberg of 1828 antedates that of *Ardetta*, Gray of 1842, which must therefore be discarded.

68. **Phoenicopterus minor**, Geoff. (1575).

1905. *Phoenicopterus minor*, Cumming, *op. cit.*, p. 697.

O. No. 24840; Kuhak, June 1904.

A young bird, but exceptionally large with a wing of 13-6 inches (345 mm).

69. **Cygnus cygnus** (Linn.). (1578a).

1905. *Cygnus musicus*, Cumming, *op. cit.*, p. 697.

O. No. 24884; Hamun-i-Sabous, Seistan, Dec. 04.

This is a very large specimen with a wing of 602 mm. (23·75 inches); bill 111 mm. (4·4 inches). Although not sexed it is undoubtedly a male.

70. **Tadorna tadorna** (Linn.). (1587).

1905. *Tadorna cornuta*, Cumming, *op. cit.*, p. 697.

♂ No. 25466; Lab-i-Baring, 14.12.18.
♂ ,, 24818; Seistan, 3.10.04.
♂. ,, 24819; Kuhak, Sept. 04.
♂. ,, 24820; Seistan, 3.10.04.
Juv. ,, 24821; Kuhak, Aug. 04.
,, ,, 24822; Seistan, no date.

The first bird is an adult in full plumage, the next three are ducklings of about a month old, or rather less, and the last two are still younger.

71. **Querquedula crecca** (Linn.). (1597).

1905. *Nettium crecca*, Cumming, *op. cit.*, p. 697.

♂. No. 24830; Kuhak, 3.10.14.
♂ ,, 25473; Lab-i-Baring, 11.12.18.
♂ ,, 25490; ,, 8.12.18.

Of these three birds the first is in eclipse plumage, the second in full breeding plumage, whilst the third appears to be a female and not a male. [One of the commonest ducks among the reed-beds of the Hamun. *N. A.*]

72. **Dafila acuta acuta** (Linn.). (1600).

1905. *Dafila acuta*, Cumming, *op. cit.*, p. 698.

♂. No. 25487; Lab-i-Baring, 8.12.18.

In full, but not very bright, breeding plumage. [Another very common species in the reed-beds. *N. A.*]

73. **Spatula clypeata** (Linn.). (1602).

1905. *Spatula clypeata*, Cumming, *op. cit.*, p. 698.

♂ 24832; Hamun-i-Sabari, 29.12.04.

This drake is still in eclipse plumage.

74. **Marmaronetta angustirostris** (Ménétr.). (1603).

1905. *Marmaronetta angustirostris*, Cumming, *op. cit.*, p. 698.

♀. No. 24823; Kuhak, juv., 6.7.04.
♀. ,, 24824; ,, ,, 6.7.04.
♂ ,, 24825; ,, adult, 22.4.05.
♀. ,, 24826; ,, juv., 6.7.04.
♀. ,, 24827; ,, ,, 6.7.04.

Apparently the four ducklings, though all young birds recently hatched when obtained, are in two stages of growth, the first two being some days older than the other two. This little duck breeds freely from as far South as the Mackran coast and Sind throughout South, Central and Eastern Persia wherever the country is suitable.

The two youngest birds of those above enumerated have the wing quills only just beginning to sprout.

75. **Netta rufina** (Pall.). (1604).

1905. *Netta rufina*, Cumming, *op. cit.*, p. 698.

♀ No. 24833; Farrah Rud, Dec. 04.

76. **Nyroca ferina** (Linn.). (1605).

1905. *Nyroca ferina*, Cumming, *op. cit.*, p. 698.

♂ No. 25465; Lab-i-Baring, 10.12.18.
♂ ,, 25467; ,, 10.12.18.

77. **Glaucionetta clangula**, Linn. (1610).

1905. *Clangula glaucion*, Cumming, *op. cit.*, p. 699.

♂ No. 24829; Hamun, Seistan, Dec. 04.

In full breeding plumage.

Stejneger has shown that we cannot use the generic name *Glaucion* for the Golden-eye and has substituted *Glaucionetta* in its place (*Proc. U.S. Nat. Mus.* VIII, p. 409; 1885).

78. **Podiceps cristatus** (Linn.). (1615).

1905. *Podiceps cristatus*, Cumming, *op. cit.*, p. 699.

♀ No. 24692; ? no date, adult.
♀ ,, 24694; ? no date, juv.
♀ ,, 24693; ? no date, adult.

79. **Podiceps fluviatilis albipennis** (Sharpe). (1617).

1905. *Podiceps albipennis*, Cumming, *op. cit.*, p. 699.

♂. No. 24835; Seistan, juv., no date.
♀ ,, 25486; Lab-i-Baring, 11.12.18., adult.

[Very common among the reed-beds of the Hamun. *N A.*]