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

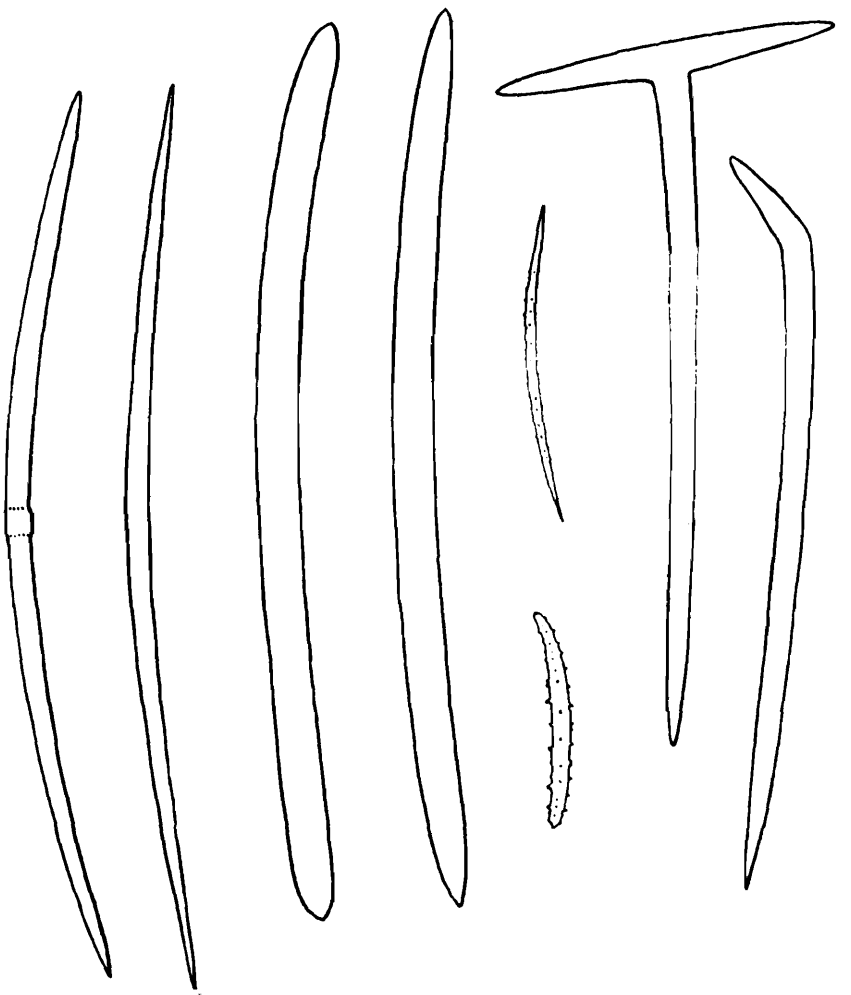


FIG. 1.—Spicules of *Spongilla alba* var. *rhadinaea*, nov., × 250.

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

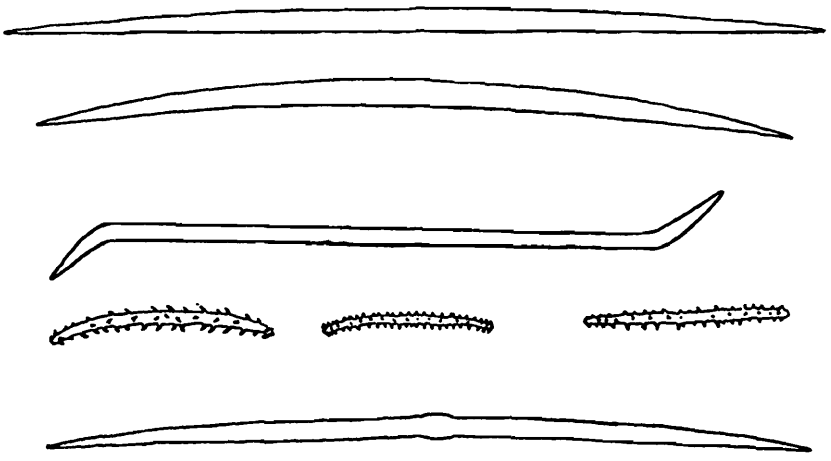


FIG. 2.—Spicules of *Spongilla lacustris* var. *ineptorum*, nov. × 250.

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.

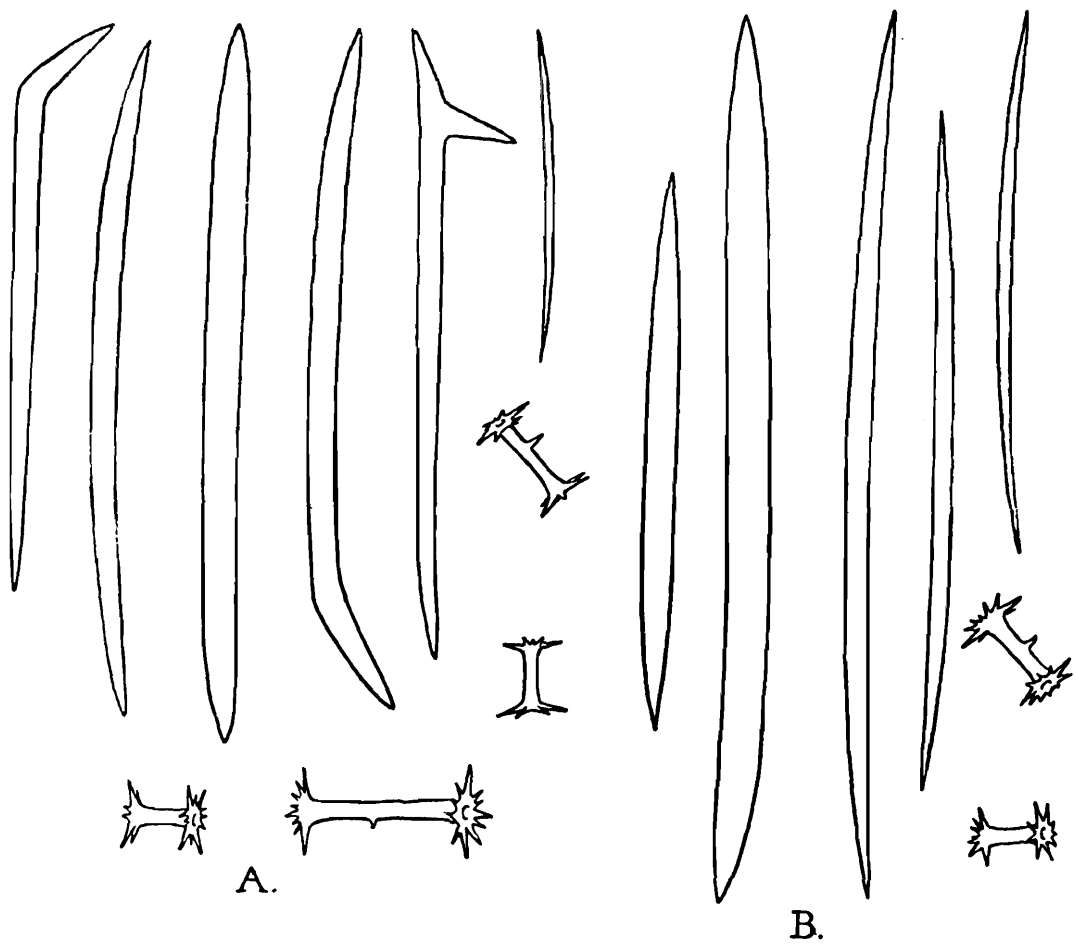
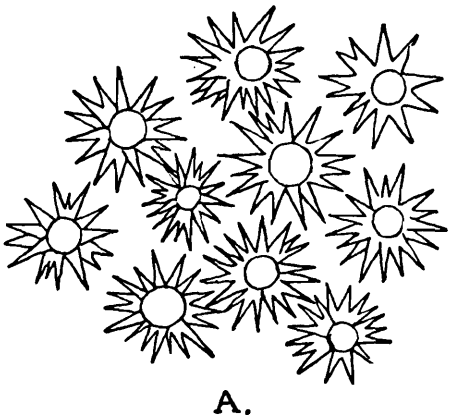


Fig. 3.—Spicules of *Ephydatia fluviatilis* from the Hamun-i-Helmand, × 250. A = spicules of specimens from the lower surface of a block of clay at the edge of the lake. B = spicules of a specimen from the stem of a bulrush in a reed-bed.

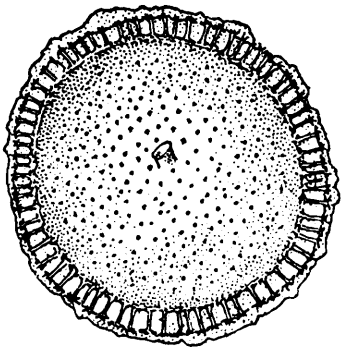
Measurements of spicules, etc.

	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.