

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

SPONGES.

By N. ANNANDALE, D.Sc., F.A.S.B.

CONTENTS.

I. TWO MARINE SPONGES FROM A CREEK IN THE MALAY PENINSULA.		Page
Introduction		
Bionomics of the two sponges	.. .. .	195
Comparison with other cases of divergence	.. .. .	196
Systematic Description.		
<i>Reniera implexa</i> , Schmidt	.. .. .	197
<i>Amorphinopsis excavans</i> var. <i>robinsonii</i> , var. nov.	.. .. .	198
II. FRESHWATER SPONGES FROM JAPAN, CHINA AND THE MALAY PENINSULA.		
List of Japanese species	.. .. .	200
<i>Spongilla inarmata</i> , sp. nov.	.. .. .	200
List of Chinese species	.. .. .	201
<i>Spongilla micron</i> , Annandale	.. .. .	201
<i>Spongilla semispongilla</i> (Annandale)	.. .. .	202
<i>Spongilla geei</i> , sp. nov.	.. .. .	202
<i>Spongilla conifera</i> , Annandale	.. .. .	203
<i>Spongilla sinensis</i> , Annandale	.. .. .	203
<i>Spongilla stanleyi</i> , Annandale	.. .. .	204
<i>Ephydatia meyeri</i> (Carter)	.. .. .	204
<i>Ephydatia bogorensis</i> , Weber	.. .. .	205
<i>Trochospongilla latouchiana</i> , Annandale	.. .. .	205
<i>Trochospongilla sol</i> , sp. nov.	.. .. .	205
List of species from the Malay Peninsula	.. .. .	207
<i>Spongilla lacustris</i> , auct	.. .. .	207
<i>Spongilla nana</i> , Annandale	.. .. .	208
<i>Spongilla potamolepis</i> , sp. nov.	.. .. .	208
List of the Spongillidae of Asia	210
Bibliography of the Asiatic Freshwater Sponges	214

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

Plate II, figs. 3, 5; Plate IX.

I. TWO MARINE SPONGES FROM A CREEK IN THE MALAY PENINSULA.

The two sponges discussed in this note were found growing on the wooden piers of a landing stage at Port Weld in Perak on the east coast of the Malay Peninsula. This place is situated some miles up a narrow creek that opens into the Straits of Malacca, but, so far as I could learn, the water remains quite or almost salt at all seasons and at all states of the tide. The chief biological interest of the sponges lies not in their precise locality but in the fact that they grew high up on the piers immediately below high-tide level and were, therefore, exposed daily for considerable periods to the air and to the heat of a tropical sun. Moreover, the water which covered them at high tide was full of finely divided silt.

The two species belong to two different genera and families of the Monaxonelida, one to the genus *Reniera* of the family Haploscleridae, the other to the peculiar and somewhat anomalous genus *Amorphinopsis*, which is assigned provisionally to the Axinellidae.

The *Reniera* is a well-known species (*R. implexa*, Ridley & Dendy) of very wide bathymetric range in the warmer seas, while the *Amorphinopsis* seems to be no more than a phase or variety of a species (*A. excavans*, Carter) of which two other forms remarkably different in external structure have already been described from the eastern side of the Bay of Bengal.

The most interesting feature of the bionomics of these two sponges is the divergence of the means whereby they are able to exist in the peculiar circumstances in which they were found at Port Weld. *R. implexa* is remarkable in its genus in that the sponge forms masses of more or less finger-shaped and at least partially hollow processes each of which is provided with a large and gaping osculum. Indeed, this is its most constant specific character, for its spicules, which are of one kind only, vary considerably in size and proportions in different specimens. The sponge is thus unusually cavernous and is able to retain a considerable amount of water in its interior. Were it not for the fact that the species has been found not only in rock-pools and on the walls of a harbour but also in the deep sea, this structural peculiarity might be taken as an adaptation to enable it to resist external desiccation. Possibly it may be correlated with life in muddy water, and even if it has not been evolved in direct

correlation with life in very shallow water, it must be useful in the circumstances in which the sponge was found at Port Weld. In my Malay specimens the processes are recumbent or semi-recumbent.

The other sponge, for which I propose the name *Amorphinopsis excavans* var. *robinsonii*, is, more strictly speaking, an encrusting sponge. It has a very massive structure in spite of its thinness, but contains relatively broad water-channels running parallel to the surface a short distance below the external membrane. The two other phases of the species already known differ considerably in their mode of life. The *forma typica* was found growing on, or rather in, rotten coral in the Andamans. It forms a very thin film on the surface of the coral and sends root-like processes down into the burrows of Clionidae, the spicules of which it sometimes incorporates within its own substance. The outgrowths on its external surface are very short and compact. The var. *digitifera*, on the other hand, was found growing on hard rock and had incorporated numerous shells and pebbles, which it had not dissolved or excavated. It formed a mass of short, pointed, somewhat compressed upright branches of rather irregular outline, joined together by means of a relatively thin crust. The longest branches were about 10 cm. long by 4 cm. broad. The new variety is almost exactly intermediate between these two forms, consisting mainly of a crust about 5 mm. deep, but bearing numerous short upright processes not more than 3 mm. long. It has no basal root-like outgrowths. Like all the phases of the species it is able to close its oscula and pores very tightly. The large holes shown in the photograph of a fragment reproduced on Pl. II of this volume are due to the burrows of a mollusc in the wood below the sponge, and do not open into the interior of the sponge, which merely grows round them.

The two sponges on the landing stage at Port Weld have not, therefore, undergone any special structural evolution in correlation with the particular dangers to which they are exposed, *viz.* those of partial disiccation and of muddy water. They possess structural peculiarities that identical or closely related sponges living in totally different circumstances also possess, but these peculiarities are of great use to them in their peculiar environment. Without peculiarities of some kind, indeed, they would hardly have been able to establish themselves in their present habitat. The useful structural features are not the same in the two sponges. In the *Reniera* the principles adopted are those of receiving water in large empty spaces and of giving a free passage to small particles of inorganic matter through patent channels. In the *Amorphinopsis*, on the other hand, the open spaces are more restricted, the whole structure more massive and the orifices capable of complete contraction. The two sponges thus afford a parallel to two other cases of a similar nature that I have discussed recently, namely that of *Nudospongilla asper* and *Cortispongilla barroisi* in the Lake of Tiberias¹ and that of *Tetilla dactyloidea* var. *lingua* and *T. limicola* in muddy lagoons on the coasts of India and Ceylon.² In both cases we find sponges living in muddy water and adopting divergent means of protection, in one species by decreased size of the aper-

¹ *Journ. As. Soc. Bengal* (n.s.), IX, p. 75 (1913).

² *Mem. Ind. Mus.* V, p. 54 (1915).

tures and even of the channels, in the other by increased size of the apertures and channels. The freshwater sponges, however, and the two species of *Tetilla* are in each instance closely related forms, not, as in that of the sponges at Port Weld, belonging to different families. In both instances, moreover, the chief danger is that of water containing inorganic particles liable to cause obstruction in the canals of the sponge; the danger of desiccation hardly entered into the question. Moreover, we know of cases, such as that of *Spongilla alba* in the Gangetic delta, in which the adaptations of sponges living in muddy water are physiological rather than structural.

Family HAPLOSCLERIDAE.

***Reniera implexa*, Schmidt.**

1868. *Reniera implexa*, Schmidt, *Spong. Algier*, p. 27.
 1887. *Reniera implexa*, Ridley and Dendy, "Challenger" Rep. XX, *Monaxonida*, p. 15, pl. i, fig. 4.
 1892. *Siphonochalina mollis*, Topsent, *Rés. Camp. Sci. Monaco* 11, p. 66.
 1903. *Reniera implexa*, *id.*, *ibid.* xxv, p. 244.
 1905. *Reniera implexa*, Dendy, *Sponges, in Herdman's Rep. Ceylon Pearl Fish.* 111, p. 142.
 1914. *Reniera implexa*, Annandale, *Rec. Ind. Mus.* X, p. 151.

This species is variable in the size of its spicules, the structure of its skeleton and the direction of its main growth. A constant specific character is, however, that the sponge consists of a mass of more or less cylindrical tubes with large oscula at their free extremities and of hollow structure. In typical specimens from the Adriatic and in those from the Azores (of which one is figured by Ridley and Dendy) the tubes are vertical, but in all those I have examined from India and Malayan waters they are recumbent or semi-recumbent.

In the collection of the Zoological Survey of India there are examples from three localities, from a rock-pool at Bandra near Bombay, from Madras harbour and from Port Weld. Those from the two Indian localities agree with the specimens from Ceylon described by Dendy as "consisting of a few irregularly branched tubes." In one from Madras harbour, fixed to a mussel-shell, there are only two tubes, which are only 2.5 mm. in diameter. Others from Bombay are rather better developed, but the tubes are not more than 5 mm. in diameter. Specimens from Port Weld originally formed a rather dense network covering a considerable area and confused with the growth of the new variety of *Amorphinopsis excavans* described below. Their tubes are sometimes as much as 7 mm. in diameter but are less regular in shape and uniform in diameter than in some specimens.

The following are average measurements of spicules from the three lots of specimens:—

	Madras.	Bombay.	Perak.
Length of spicule . .	0.096 mm.	0.116 mm.	0.152 mm.
Greatest breadth of spicule . .	0.0038 mm.	0.0054 mm.	0.0063 mm.

In spite of these considerable differences in size and proportions, the spicules agree in general form, being very sharply and gradually pointed and as a rule slightly bent.

The skeletons of the different specimens exhibit the same variation as has been noted in specimens from other localities. In one from Madras, which was preserved with great care so as to avoid all pressure, the skeleton, as in Schmidt's original specimens, forms an irregular network of single spicules. On the external surface single spicules also project outwards from the nodes of this network. In examples from Bombay, on the other hand, longitudinal spicule-fibres 4 or even 6 spicules thick are well developed. In the Perak specimens the condition is intermediate, for the longitudinal fibres, though they can be detected, are not at all well defined and have not more than 3 spicules abreast.

Of all known sponges *Reniera implexa* has one of the greatest, if not the greatest of bathymetric ranges. It has been found in shallow water in the Adriatic and on the coasts of India and Ceylon, at various depths, all considerable, up to 450 fathoms in the Atlantic, and now between tide-marks in the Straits of Malacca. Differences in size of spicules or in skeleton-structure are not correlated with depth of habitat, but it is probable that an upright growth is maintained only in very still water.

Family AXINELLIDAE.

Amorphinopsis excavans, Carter.

1915. *Amorphinopsis excavans*, Annandale, *Rec. Ind. Mus.* XI, pp. 467-470, figs. 4, 5.

I have redescribed this species, with a new variety, in the paper cited. Here I have to describe a second new variety.

var. *robinsonii*, var. nov.

(Plate II, fig. 3; plate IX, fig. 1.)

The sponge formed a layer about 5 mm. thick and of considerable area. It had a greenish-grey colour when alive and is grey in spirit. It is tough and rather elastic, not very hard. The surface is uneven, covered with a network of low ridges which often bear at the nodes short upright conical projections not more than 3 mm. high. These projections have a hirsute appearance under a hand lens. No orifices are apparent in the preserved sponge but the whole structure is pierced by a number of oval gaps of relatively large size. These, however, are not natural to the sponge but covered the burrows of bivalve molluscs burrowing in the wood to which it was attached.

In internal structure the sponge closely resembles the typical *A. excavans* (*op. cit.*, 1915). The upright spicule-fibres are well defined and below the external surface are splayed out as shown in fig. 1 on pl. IX. There is also an irregular skeletal reticulation of spicules of various forms and sizes and a distinct external layer of small spicules arranged horizontally in the ectosome. The conical projections on the surface apparently represent conuli in which the orifices are closed by contraction. Large horizontal channels with a circular or horizontally oval cross-section run through the substance of the sponge, especially in the region immediately below the ectosome. There is a stout horny basal membrane.

The normal spicules are of three types and each type is represented among those

both of large and of small size. All are smooth. The three types are (1) straight or feeble curved styli, (2) curved amphioxi with a median swelling and (3) curved or geniculate amphioxi without any swelling of the kind.

(1) The larger spicules of this type occasionally reach a considerable size and may be as much as 0.548 mm. long; but this is exceptional. They are not less than 23 times as long as broad. The head is not at all dilated but abruptly rounded; the diameter of the spicule is uniform for about $\frac{3}{8}$ of its length. The tip is gradually and sharply pointed. The smaller spicules of this type are from 0.15 mm. to 0.3 mm. long and have similar proportions to the larger ones. Occasionally they bear a median swelling. Styli of all kinds are scarce.

(2) The proportion of amphioxious spicules with a median swelling is small. I have not been able to find geniculate spicules of this type. Large amphioxi with the swelling are sometimes as much as 0.44 mm. long, but often not more than 0.2 mm. They are from 24 to 25 times as long as broad, omitting the swelling. The extremities are sharply and gradually pointed.

(3) The majority of the spicules are of this type, slender, amphioxious, curved or geniculate, without median swelling. The proportions of geniculate spicules is small, but such spicules occur among both the large and the small amphioxi. The length is from 26 to 33 times as great as the maximum breadth and the extremities are sharply and gradually pointed.

Abnormal spicules with one extremity angulate are not uncommon among those of larger size.

Type-specimen. No. ZEV. 7137/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Port Weld, Perak, Malay Peninsula: between tide-marks on a landing-stage in a salt-water creek some miles up from the Straits of Malacca.

This sponge is distinguished from the two varieties of *A. excavans* already described by Carter (*op. cit.*; 1887) and myself (*op. cit.*; 1915) mainly in external structure. There are, however, slight differences in the spicules.

II. FRESHWATER SPONGES FROM JAPAN, CHINA AND THE MALAY PENINSULA.

A. JAPANESE SPECIES.

The archipelago of Japan is still to a large extent unexplored so far as the Spongiidae are concerned and only two of its numerous lakes have been investigated. These lakes are Lake Biwa in the interior of the Main Island and Kasumi-ga-Ura on the Pacific coast of the same island. The sponges of Lake Biwa have recently been discussed in considerable detail by Dr. T. Kawamura and myself, and no species which does not occur in the lake has been found elsewhere in Japan. The only form in which this is the case is the *forma typica* of *Ephydatia mulleri*, which has been found at Tokyo, but in neither lake. It will be sufficient here to give a list of the known Japanese species and to publish an adequate diagnosis of a new form incorrectly identified in the former paper.

List of the Japanese species :—

<i>Spongilla (Euspongilla) lacustris</i> , auct.	<i>Spongilla (Eunapius) fragilis</i> , Leidy.
<i>Spongilla (Euspongilla) semispongilla</i> (Annandale).	<i>Ephydatia mülleri</i> (Liebk.).
<i>Spongilla (Euspongilla) inarmata</i> , sp. nov.	<i>Ephydatia mülleri</i> var. <i>japonica</i> (Hilgen- dorf).
<i>Spongilla (Stratospongilla) clementis</i> , Annandale.	<i>Heteromeyenia kawamurae</i> , Annandale.

***Spongilla inarmata*, sp. nov.**

(Plate IX, fig. 2.)

1917. *Spongilla aspinosa*. Annandale and Kawamura (*nec* Potts), *Journ. Coll. Sci. Tokyo*, XXXIX, p. 8, pl. ii, fig. 1.

I have compared a fragment of the sponge from Lake Biwa noticed by Dr. Kawamura and myself under the name *Spongilla aspinosa* with an authentic specimen of that species from the United States of America and find the differences much greater than we believed to be the case. It becomes necessary, therefore, to describe the Japanese form as a new species.

The sponge forms a thin, very brittle crust and has (dry) a yellowish colour; the external surface is irregular and pitted, and upright bunches of spicules project through the external membrane in the form of spines.

The skeleton forms a close, irregular network in which it is possible to distinguish only ill-defined and relatively broad spicule-fibres.

The gemmules lie at the base of the sponge, probably attached to a basal membrane, of which only traces remain in the specimen examined. They are fairly numerous and vary considerably in size; their outline is often oval. Each gemmule is covered with a rather thick layer of "granular" pneumatic substance and is enclosed in a regular network of macroscleres, which are sometimes slightly smaller than those of the skeleton. There is a single foraminal tubule, which is not conspicuously curved.

The macroscleres are of moderate size, relatively slender, straight or feebly curved, perfectly smooth and sharply pointed at both ends. There are no gemmule-spicules. The flesh-spicules are practically confined to the dermal membrane; they are slender, sharply and gradually pointed at both ends and as a rule somewhat crescentic in form; they bear short scattered spines on the middle region, but are smooth or almost smooth at the extremities.

Measurements of spicules :—

Length of macrosclere	..	..	..	0.288 mm.
Breadth of macrosclere	..	..	..	0.012 ,,
Length of microsclere	..	..	..	0.052—0.068 mm.

Type-specimen. No. P, 49-1, Zool. Survey of India (*Ind. Mus.*).

Locality. Lake Biwa, Japan (T. Kawamura: 24-7-15).

This sponge differs from *S. aspinosa*, Potts in its stouter skeleton-spicules, spined microscleres and stouter and less regular skeleton. It has no relationship to *S. sinensis*, with which we formerly compared it. As it is devoid of gemmule-spicules its precise systematic position is a little uncertain, but as the gemmules possess a well-developed pneumatic layer, it seems best on the whole to place it in the subgenus *Euspongilla*.

B. CHINESE SPECIES.

Freshwater sponges are known from only two of the provinces of China, from Yunnan in the west and Kiangsu in the east. From Yunnan three species have been recorded, *Spongilla* (*Euspongilla*) *lacustris*, auct., *S.* (*Stratospongilla*) *clementis*, Annandale (syn. *S. yunnanensis*, id.) and *Nudospongilla coggini* (Annandale). From Kiangsu I am able, thanks largely to the assistance of the Rev. N. Gist Gee of Soochow, to record ten species, of which six are known only from that province. The following is a list of the ten species now known from Kiangsu:—

<i>Spongilla</i> (<i>Euspongilla</i>) <i>micron</i> , Annandale.	<i>Spongilla</i> (<i>Stratospongilla</i>) <i>stanleyi</i> , Annandale.
<i>Spongilla</i> (<i>Euspongilla</i>) <i>semispongilla</i> , (Annandale).	<i>Ephydatia meyeri</i> (Carter).
<i>Spongilla</i> (<i>Eunapius</i>) <i>geei</i> , sp. nov.	<i>Ephydatia bogorensis</i> , Weber.
<i>Spongilla</i> (<i>Eunapius</i>) <i>conifera</i> , Annandale.	<i>Trochospongilla latouchiana</i> , Annandale.
<i>Spongilla</i> (<i>Stratospongilla</i>) <i>sinensis</i> , Annandale.	<i>Trochospongilla sol</i> , sp. nov.

Two (*E. meyeri* and *T. latouchiana*) of the four species found outside the province occur in India; *E. meyeri* has been found also in Sumatra and *T. latouchiana* in Burma. *E. bogorensis* was described from the Malay Archipelago, and *S. semispongilla* from Japan.

Genus **Spongilla**, Lamarck.

Subgenus **Euspongilla**, Vejdovsky.

Spongilla micron, Annandale.

1916. *Spongilla* (*Euspongilla*) *micron*, Annandale, *Journ. N. China Roy. As. Soc.*, XLVII, p. 49.

This species is closely allied to *S. alba*, Carter and *S. semispongilla* (Annandale). From the former it differs in its invariably minute size, in the sub-rotulate form of its gemmule-spicules and in the absence of true flesh-spicules; from *S. semispongilla* it may be distinguished by the entire absence of chlorophyll bodies and by its much more slender macroscleres. The macroscleres are always smooth but often somewhat abnormal in form (see figure). There are no true flesh-spicules but immature gemmule-spicules often occur in considerable numbers in the parenchyma. I regret to say that the original description gives a totally wrong account of the measurements of the spicules owing to the fact that the specimen selected as the type was a mixture of two

species. The actual length of the skeleton-spicules is about 0.42 mm. and they are about twenty-one times as long as thick.

Localities. The Tai-Hu (type-locality) and Soochow (*Gee*), Kiangsu Province, China.

Type-specimen. ZEV. 7103/7, Zool. Survey of India (*Ind. Mus.*).

This sponge grows on the leaves of submerged water-plants.



FIG. 1.—Spicules of *Spongilla micron*, $\times 250$.

Spongilla semispongilla (Annandale).

1909. *Ephydatia semispongilla*, Annandale, *Annot. Zool. Jap.*, VII, p. 107, pl. ii, fig. 2.

1916. *Spongilla semispongilla*, Annandale and Kawamura, *op. cit.*, p. 5, pl. i, fig. 4.

Mr. Gee has sent me a fragment of this sponge from Soochow. It was growing with *Ephydatia bogorensis*. The species has otherwise been found only in the Main Island of Japan.

Subgenus **Eunapius**, Gray.

Spongilla geei, sp. nov.

I describe this species from a broken fragment about 40 mm. long. The sponge appears to be massive and of irregular form. It was evidently in a degenerate condition when discovered, and in this state has a greyish colour.

The skeleton is very compact, but contains little horny matter; both vertical and transverse fibres are well-developed and thick, forming together a fairly regular network.

The gemmules are subspherical but a little broader than high, they are small and very numerous, and are not grouped, but scattered singly through the substance of

the sponge, each closely embraced in the network of the skeleton. The pneumatic layer is thick and uniform, its cells relatively large. There is a single, long, curved, for a minute tubule, lying in a crater-like depression in the pneumatic coat. The gemmule-spicules are scattered among the inner cells of this coat and also on its external surface; they lie more or less parallel to the surface of the gemmule.

The macroscleres are small, stout, smooth, straight or feebly curved, somewhat bluntly and abruptly pointed at both ends. The axial channel can often be detected in them. There are no flesh-spicules. The gemmule-spicules, which are not at all numerous, are small and slender, irregularly spiny and as a rule pointed at both ends. Their spines are always very short.

Measurements :—

Gemmule	..	..	..	0.476 × 0.425 mm.
Length of macrosclere	..	..	..	0.168 — 0.2 „
Breadth of macrosclere	..	..	..	0.016 — 0.024 „
Gemmule-spicules	..	..	..	0.072 — 0.08 „

Locality. Loen Mong, Soochow, Kiangsu Province, China. (*Gee*).

Type-specimen. No. P. 50/1, Zool. Survey of India (*Ind. Mus.*).

This species resembles *Spongilla nitens*, Carter from tropical Africa more closely than any other, but the skeleton-spicules are considerably smaller and are pointed instead of being rounded at the tips and the skeleton is less massive.

Spongilla conifera, Annandale.

(Plate IX, figs. 3-5).

1916. *Spongilla conifera*, Annandale, *op. cit.*, p. 51.

The most remarkable features of this sponge are the small size of all its parts and the peculiar structure of the gemmules; this is clearly shown in the figures on pl. IX. Round the base of the gemmule there is often a circle of minute spinelets formed owing to an imperfect development of the pneumatic cells in this region.

I have discovered a few free-microscleres in specimens since the original description was published. These microscleres are cylindrical, straight, blunt at the extremities and covered with short spines. Minute smooth amphioxi occur occasionally in the parenchyma, but are probably young macroscleres, also spiny amphioxi and amphistrongli which are apparently adventitious. The macroscleres are occasionally amphistrongylous and vary greatly in size, proportions and outline; they are always smooth.

Subgenus *Stratospongilla*, Annandale.

Spongilla sinensis, Annandale.

1910. *Spongilla (Stratospongilla) sinensis*, Annandale, *Proc. U.S. Nat. Mus.*, 38, p. 183.

Mr. Gee has sent me further specimens from Soochow, the original locality, and from Foo Mong in the same neighbourhood. The gemmule-spicules are often very irregular, never spiny. I have nothing else to add to the original description.

Spongilla stanleyi, Annandale.

1916. *Spongilla (Stratospongilla) stanleyi*, Annandale, *op. cit.*, p. 50.

This sponge, which has been found as yet only in the Tai-Hu on the lower surfaces of stones and on shells (living) of *Vivipara lapillorum*, closely resembles

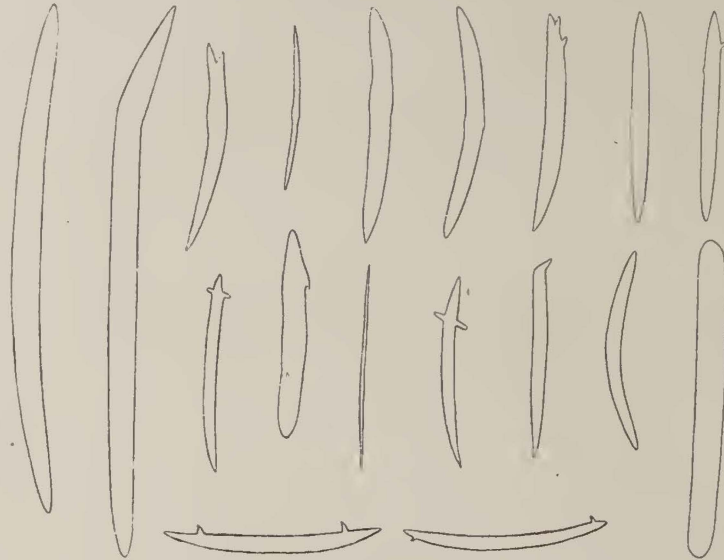


FIG. 2.—Spicules of *Spongilla sinensis*, $\times 250$.

S. sinensis in structure, but differs in the greater irregularity and habitual spininess of the gemmule-spicules. The two species form a distinct group in the subgenus, differing considerably from any other with which I am acquainted.

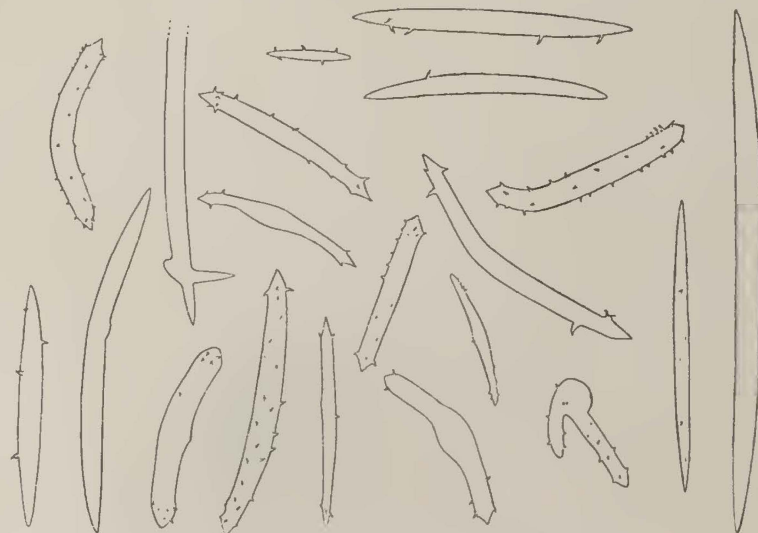


FIG. 3.—Spicules of *Spongilla stanleyi*, $\times 250$.

Genus **Ephydatia**, Lamouroux.**Ephydatia meyeri** (Carter).

1911. *Ephydatia meyeri*, Annandale, *Fauna Brit. Ind., Freshw. Sponges, etc.*, pp. 108, 109, fig. 21.

Mr. Gee has sent me specimens from Foo Mong, Soochow which undoubtedly belong to this species. The skeleton-spicules are smooth, but often irregular in outline, the gemmule-spicules as a rule rather stout, the length of the shafts hardly exceeding the diameter of one rotule. Some, however, are considerably longer. The shaft is as a rule smooth, but occasionally bears one or two short spines. The skeleton is compact. Bubble-cells are numerous in the parenchyma. The specimens are too fragmentary to permit any statement as to the external form of the sponge.

Embryos and young gemmules occur together in a fragment I have examined. Numerous gemmule-spicules lie free in the parenchyma.

Ephydatia bogorensis, Weber.

1890. *Ephydatia bogorensis*, Weber, *Zool. Ergebn. Res. Nied. Ost.-Ind.*, I, p. 33, pl. iv, fig. 11.

The sponge forms small irregular masses attached to weeds. In spirit it is of a dirty white colour; it is soft and the texture rather loose; the external surface appears to have been smooth and no large apertures are apparent. Slender horizontal spicule-fibres are well-defined, branching freely in the sponge, but the transverse fibres are irregular and ill-defined. I can detect no bubble-cells.

The gemmules are small, spherical, densely covered with upright spicules, but with the pneumatic layer feebly developed. There is a single short foraminal tubule. The skeleton-spicules are short, slender and as a rule sharply pointed at both ends. Their outline is irregular and they sometimes bear short scattered spines. The gemmule-spicules are long and have relatively small rotules, which have minutely denticulated and somewhat introverted margins. The shafts bear a considerable number of sharp, moderately elongate spines. These spicules are scattered in considerable numbers in the parenchyma, as well as surrounding the gemmules.

I have compared specimens collected at Soochow by Mr. Gee with one from Java sent me by Dr. Max Weber. There are slight differences in the form and proportions of the skeleton-spicules, but the structure of the skeleton and of the gemmule is identical.

E. bogorensis has been recorded from Java and Celebes. It is closely related to *E. blembingia*, Evans, from the Malay Peninsula. The gemmule-spicules of both species resemble those of *Dosilia plumosa*, Carter.

Genus **Trochospongilla**, Vejdovsky.

Trochospongilla latouchiana, Annandale.

1911. *Trochospongilla latouchiana*, Annandale, *op. cit.*, pp. 114, 115, figs. 23A, 24.

A specimen collected by Mr. Gee at Loean Mong, Soochow agrees with Indian examples, except that the shafts of the gemmule-spicules are a little longer, nearly equalling the diameter of a single rotule.

Trochospongilla sol, sp. nov.

(Plate IX, fig. 6.)

This sponge is described from a number of dry specimens attached to the lower surface of a stone. They form small oval or circular patches of a pale yellowish

colour and consists of groups of gemmules covered by skeleton-spicules. No patch is more than 5 mm. long. It is impossible, therefore, to describe the structure of the sponge.

The gemmules are firmly attached to the stone and lie closely adjacent to one another; each is covered by a dome formed of a dense network of single skeleton-spicules, the different domes coalescing at the margin. Each gemmule is nearly spherical, but the upper surface of most of them has collapsed and become concave. In the middle of this surface there is a single curved forminal tubule, which projects through the dome of skeleton-spicules.

The skeleton-spicules are very small and relatively slender, sharply pointed at both ends and densely covered with short spines. The gemmule-spicules are minute. Their rotules are relatively large and their shafts short. Both rotules are slightly

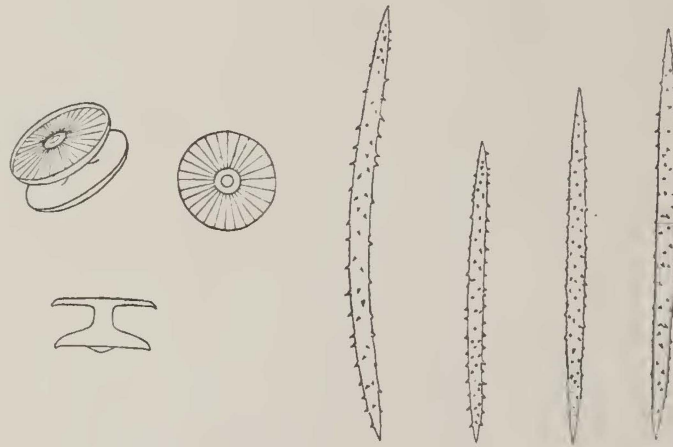


FIG. 4.—Spicules of *Trochospongilla sol*; macroscleres, $\times 250$; birotulates, $\times 780$.

concave and the upper rotule is slightly smaller than the lower one, the shaft projects upwards as a knob in the middle of the upper rotule; the surface of the rotules is ornamented by straight radiating striae.

Measurements :—

Diameter of gemmule	..	..	0.357 mm.
Length of macrosclere	..	..	0.162—0.31 „
Breadth of macrosclere	..	..	.. 0.011 „
Length of gemmule-spicule	..	...	.. 0.009 „
Diameter of lower rotule of gemmule-spicule	..	..	.. 0.011 „

Type-specimen. No. ZEV. 7183/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Shore of Si Dong Ding I., Tai-Hu, Kiangsu Province, China.

The sculpture of the gemmule-spicules distinguishes this species from any other with which I am acquainted. The dried masses of gemmules were not distinguished in the field from similar masses of the gemmules of *Spongilla stanleyi* with which they occurred.

C. MALAYAN SPECIES.

The only freshwater sponge hitherto recorded from the Malay Peninsula is *Ephydatia blembingia*,¹ Evans from Legeh in the interior of the Siamese Peninsular province of Patani. No species has yet been found in the Federated Malay States or the Straits Settlements. It is improbable that the Spongillidae are entirely absent from the southern parts of the Peninsula, but Dr. Evans found only one species in Peninsular Siam in 1899, Mr. Robinson and I only a few indeterminate specimens in 1901-1902, and I failed to find any at all in apparently favourable localities at Penang and Singapore in 1915 and 1916. There can be no doubt, therefore, that in most parts of Malaya, as in Ceylon,² some unknown obstacle to the growth of sponges is wide-spread in fresh water. In the basin of the inner lake of the Talé Sap I found specimens of three species, all of which were, however, scarce. Four species are, therefore, now known to occur in the eastern Peninsular provinces of Siam.

List of Species of Malay Peninsula :—

<i>Spongilla (Euspongilla) lacustris</i> , auct.	<i>Spongilla (Eunapius) potamolepis</i> , sp. nov.
<i>Spongilla (Euspongilla) nana</i> , Annandale.	<i>Ephydatia blembingia</i> , Evans.

The first of these sponges is of course cosmopolitan, the second had been found hitherto only in brackish water in the Chilka Lake on the east coast of India, the third is a very distinct new species, and the fourth is known only from a single small pool (a deserted gold-mine) in Peninsular Siam. *S. nana* is, however, closely allied to *S. alba*, the range of which extends from India to Egypt, while *E. blembingia* is by no means remotely related to *E. bogorensis*,³ Weber, recorded from Java, Celebes and northern China.

Family SPONGILLIDAE.

Genus **Spongilla**, Lamarck.

Subgenus **Euspongilla**, Vejdovsky.

Spongilla lacustris, auctorum.

(Plate II, fig. 4.)

1910. *Spongilla (Euspongilla) lacustris*, Annandale, *Rec. Ind. Mus.*, V, p. 197.

1915. *Spongilla lacustris*, *id.*, *Mem. Ind. Mus.*, V, p. 26.

1916. *Spongilla lacustris*, Annandale and Kawamura, *op. cit.*, p. 3, pl. i, figs 1-3.

If we include in this species the forms I have described under the name *prolifera* and *reticulata* it is evidently as wide-spread in Eastern Asia as it is in the Holarctic Zone. Kawamura and I (1916) have recently figured the forms it assumes in Lake Biwa in Japan and I have already recorded (1910) its occurrence in Western China. Specimens from the Talé Sap in Peninsular Siam, though they possess certain peculiar characters, must also be assigned provisionally to the species.

¹ Evans, *Quart. Journ. Microsc. Sci. London*, XLIV, p. 81 (1901).

² Annandale, *Spolia Zeylanica*, VIII, p. 133 (1912).

³ Weber, *Zool. Ergebn. Res. Neid. Ost.-Ind.*, I, p. 33 (1890).

These specimens consist of several dried fragments found lying in a field at the edge of the inner lake near Pak Payum (see map on p. 6 of this volume). They had evidently been torn from their support and cast up on the field by a flood that had occurred some weeks previous to my visit. The basal membrane, which seems to have been attached to a branch or a rough stone, is intact but the epidermal membrane has entirely disappeared. The sponge is hard and rather brittle, the skeleton comparatively stout. Most of the skeleton-spicules are normal, but many have one or more annular swellings. All are otherwise smooth. The flesh-spicules, which are numerous, are slender, closely and regularly spined in the middle but smooth or nearly smooth at the ends. The form of the spicules is well shown in text-figure 1. There are no gemmules. There is no trace of buds on the surface of the sponge, which bears short irregular branches or prominences. The specimens were bright green when found, but the colour has faded somewhat.

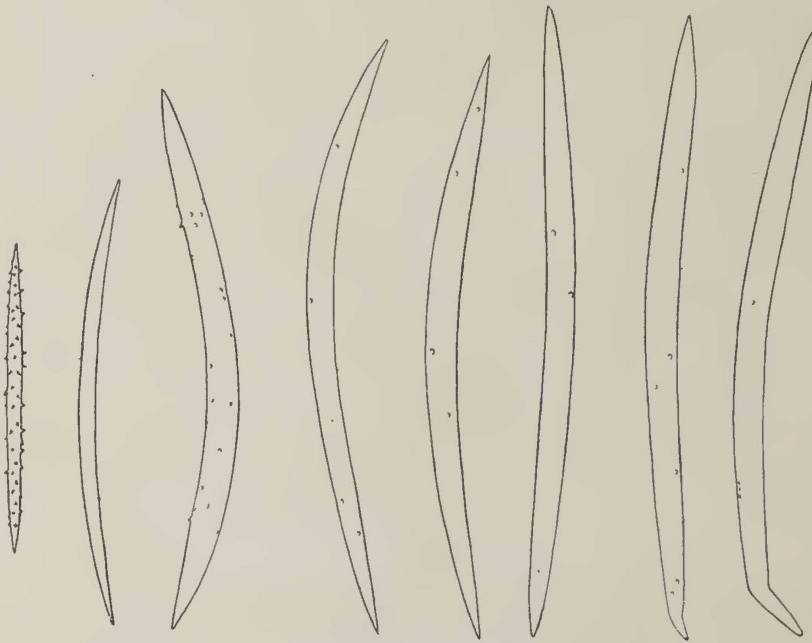


FIG. 5.—Spicules of *Spongilla nana* from Patalung, $\times 250$.

Spongilla nana, Annandale.

1915. *Spongilla nana*, Annandale, *Mem. Ind. Mus.*, V, pp. 31, 32, fig. 3, pl. iv, fig. 3.

Several minute cushion-shaped sponges attached to twigs from the mouth of the Patalung river at Lampam belong to the species recently described from the Chilka Lake. Their spicules, however, differ slightly from those of the type-specimen. Compare fig. 2 on this page with that printed on p. 31 of the paper cited above. A few gemmules were present.

Spongilla potamolepis, sp. nov.

(Plate II, fig. 5.)

The sponge forms a crust from 2 to 3 mm. thick on sticks and bamboos. It is very hard and not at all brittle. The external surface is smooth and there are no

branches. The oscula are small and scattered; each is approached by a ramifying horizontal subdermal channel into the floor of which the main exhalent channels open. The colour is brownish or clay-coloured.

The gemmules form a pavement-layer at the base of the sponge or are arranged in small groups which adhere tightly to the object to which the sponge is attached. Each gemmule is small (0.68 mm. in diameter) and subspherical and has a single foraminal tubercle, which is situated in the middle of the upper surface. The pneumatic layer is fairly thick but rather irregular; its cells are small but well-defined. The gemmules are of a dark brown colour.

The skeleton is extremely compact and hard, resembling that of *Potamolepis*, Marshall: it consists of a close network of single spicules and bundles of spicules with interstices that are polygonal both in vertical and in transverse sections. There are

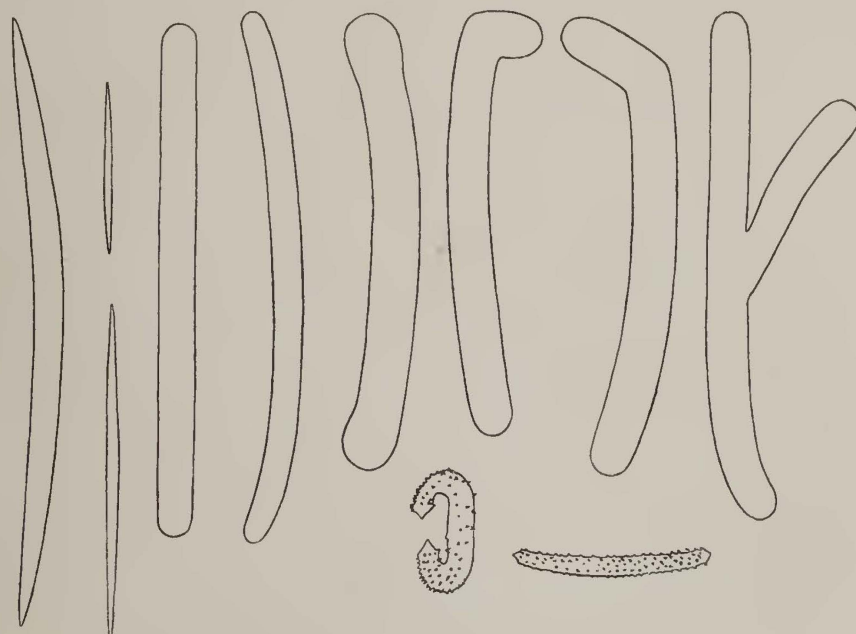


FIG. 6.—Spicules of *Spongilla potamolepis*, $\times 250$.

no well-defined spicule-fibres, but there seems to be a fairly, but diffuse secretion of horny matter at the nodes of the skeleton. There is very little if any inhalent subdermal cavity.

The skeleton-spicules are all smooth and at least moderately stout but vary greatly in shape. In the older parts of the largest specimen I have examined the majority are amphistrongylous and often a little inflated at the extremities. In less well-developed sponges, though similar spicules can be discovered, the majority of the macroscleres are both longer and more slender; they are still distinctly amphistrongylous but not inflated at the tips. Spicules of this type are gradually replaced towards the periphery of young sponges by amphioxi sometimes considerably longer than themselves. We may thus find a single sponge with spicules that are from 9 to 20 times as long as thick. The longest amphioxi are about 0.32 mm. long and the shortest amphistrongyli 0.24 mm. long. There are no flesh-spicules. The gemmule-spicules,

which form an irregular mass outside the pneumatic layer of the gemmules, are short, fairly stout and cylindrical, densely covered with minute spicules and as a rule abruptly pointed at the extremities. Occasionally they are sigmatoid but in most cases the main axis is feebly curved.

Type-specimen. ZEV 7164/7, Zool. Survey of India (*Ind. Mus.*).

Locality. Mouth of the Patalung R. at Lampam, Talé Sap, Siam.

My largest specimen of this sponge (Pl. II, fig. 5) was attached to a branch which had been cast up by a flood at the edge of the Talé Sap near Lampam, and is about 30 cm. long and 3 cm. thick including the twig in the middle. It was discovered in a dry condition. Smaller specimens were found growing on bamboo piles inside the river at the same place.

Had I found the large specimen only I should certainly have assigned it to the tropical African genus *Potamolepis*, for it contains no gemmules and in all other respects conforms to the original description of that genus. Further, I was long in doubt as to the specific identity of the different specimens, until I discovered that the peripheral parts of some of them, having amphioxous spicules, merged gradually without a break into thicker regions in which the spicules were amphistrongylous. This species, therefore, provides additional evidence as to the provisional nature of the classification of the Spongillidae that I put forward in 1913, fully recognizing that it was provisional. *Spongilla (Eunapius) nitens*, a tropical African species, is undoubtedly a close ally of *S. potamolepis*, and I should not be surprised to discover ultimately that some or all of the sponges now assigned to the genus *Potamolepis* will have to be transferred ultimately to the subgenus *Eunapius* of the genus *Spongilla*, the name *Eunapius* having a priority of sixteen years. The only generic basis on which *Potamolepis* now rests is the fact that gemmules have not been discovered in the few specimens that have been collected, and, as I pointed out in 1913 (*op. cit.*, p. 83), it is by no means improbable that any gemmules they may have contained were left behind adhering to the object to which they were attached. The gemmules of *S. potamolepis* adhere in this way.

LIST OF THE SPONGILLIDAE OF ASIA (INCLUDING THE MALAY ARCHIPELAGO) WITH SYNONYMS.

Genus **Spongilla**, Lamarck (1836).

Subgenus **Euspongilla**, Vejdovsky (1883).

SPONGILLA LACUSTRIS, auct.	Cosmopolitan.
Syn. <i>Spongilla cinerea</i> , Weber (not Carter).	
S. LACUSTRIS var. PROLIFERENS, Annandale.	India and Burma.
Syn. <i>Spongilla proliferens</i> , Annandale.	
S. LACUSTRIS var. RETICULATA, Annandale.	India and Burma.

- Syn. *Spongilla reticulata*, Annandale.
- SPONGILLA ARCTICA, Annandale. North Siberia.
- SPONGILLA MICROSCLERIFERA, Annandale. Philippines.
- SPONGILLA ALBA, Carter. India: Egypt.
- Syn. *Spongilla cerebellata*, Bowerbank:
- Spongilla alba* var. *bengalensis*, Annandale:
- Spongilla travancorica*, Annandale.
- SPONGILLA NANA, Annandale. Peninsular India: Malaya.
- SPONGILLA PHILIPPINENSIS, Annandale. Philippines.
- SPONGILLA CINEREA,¹ Carter. Peninsular India.
- SPONGILLA MICROGEMMATA, Svartschevsky. L. Baikal, Siberia.
- SPONGILLA INARMATA, Annandale. Japan.
- SPONGILLA HEMEPHYDATIA, Annandale. Peninsular India.
- SPONGILLA CRATERIFORMIS (Potts). N. America: Peninsular India.
- Syn. *Meyenia crateriformis*, Potts.
- SPONGILLA MICRON, Annandale. N. China.
- SPONGILLA SEMISPONGILLA (Annandale.) Japan: N. China.
- Syn. *Ephydatia semispongilla*, Annandale.
- Subgenus **Eunapius**, Gray (1867).
- SPONGILLA CARTERI, Carter. Mauritius: India: Malay Archipelago:
- Syn. *Spongilla friabilis*? Carter. (?) Tropical Africa: E. Europe.
- Spongilla carteri* varr. *mollis* and *cava*, Annandale.
- SPONGILLA CARTERI var. LOBOSA, Annandale. Travancore, Malabar Zone of Peninsular India.
- SPONGILLA GEMMINA, Annandale. Peninsular India.
- SPONGILLA GEEI, Annandale. N. China.
- SPONGILLA POTAMOLEPIS, Annandale. Malay Peninsula.
- SPONGILLA FRAGILIS, Leidy. Europe: N. America: N. and E. Asia:
- Syn. *Spongilla lordii*, Bowerbank: Australia: S. America.
- Spongilla contecta*, Noll.:
- Spongilla ottavaensis*, Dawson:
- Spongilla sibirica*, Dybowski:
- Spongilla moriana*, Potts.

The green mountain form hitherto referred to this species is distinct and will be described shortly in the *Rec. Ind. Mus.*

- SPONGILLA FRAGILIS *var.* CALCUTTANA, . Gangetic Delta : Shan States.
Annandale.
- SPONGILLA FRAGILIS *var.* DECIPIENS, Malay Archipelago.
Weber.
- SPONGILLA CRASSISSIMA, Annandale. Peninsular India.
- SPONGILLA CRASSISSIMA *var.* CRASSIOR, Bengal : Assam.
Annandale.
- Subgenus **Stratospongilla**, Annandale (1909).
- SPONGILLA BOMBAYENSIS, Carter. Peninsular India : S. Africa.
- SPONGILLA BOMBAYENSIS *var.* PNEUMATICA, Annandale. Lower Himalayas.
- SPONGILLA SUMATRANA ¹, Weber. Malay Archipelago : W. India : E. Africa.
- SPONGILLA SUMATRANA *var.* INDICA, Annandale. Peninsular India.
- SPONGILLA SUMATRANA *var.* GRAVELYI, Peninsular India.
Annandale.
- SPONGILLA CLEMENTIS, Annandale. E. China : Philippines : Japan.
Syn. *Spongilla yunnanensis*,
Annandale.
- SPONGILLA SINENSIS, Annandale. N. China.
- SPONGILLA STANLEYI, Annandale. N. China.

Genus **Pectispongilla**, Annandale (1909).

- PECTISPONGILLA AUREA, Annandale. Travancore, Malabar Zone.
- PECTISPONGILLA SUBSPINOSA, Annandale. Cochin, Malabar Zone.
- PECTISPONGILLA STELLIFERA, Annandale. Cochin.

Genus **Ephydatia**, Lamouroux (1816).

- EPHYDATIA FLUVIATILIS, auct. Probably almost cosmopolitan.
Syn. Still uncertain.
- EPHYDATIA FLUVIATILIS *var.* INTHA, Shan States, Burma.
Annandale.
- EPHYDATIA FLUVIATILIS *var.* SYRIACA, Syria and Palestine.
Topsent.
- EPHYDATIA FLUVIATILIS *var.* HIMALAYENSIS, Annandale. Lower Himalayas.
- EPHYDATIA FORTIS, Weltner. Philippines.
- EPHYDATIA MULLERI (Lieberkühn). Europe : N. America : N.E. Asia.
- EPHYDATIA MULLERI *var.* JAPONICA N. America : Japan.
(Hilgendorf).
- EPHYDATIA MEYENI (Carter). India : Sumatra : N. China.
Syn. *Spongilla meyeri*, Carter.

¹ I have recently obtained specimens in the Bombay Presidency some of which provide evidence that the forms I have named *indica* and *gravelyi* are merely varieties of this species, while others belong to the *forma typica* and yet others to undescribed varieties.

EPHYDATIA RAMSAYI (Haswell).	New South Wales : New Guinea :
Syn. <i>Meyenia ramsayi</i> , Haswell.	? S. America.
EPHYDATIA OLCHEONENSIS, Svartevsky.	L. Baikal, Siberia.
EPHYDATIA GORIAEVII, Svartevsky.	L. Baikal, Siberia.
EPHYDATIA BLEMBINGIA, Evans.	Malay Peninsula.
EPHYDATIA BOGORENSIS, Weber.	Java : Celebes : N. China.

Genus **Heteromyenia**, Potts (1881).

HETEROMEYENIA KAWAMURAE, Annandale.	Japan.
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Genus **Dosilia**, Gray (1867).

DOSILIA PLUMOSA (CARTER)	Peninsular India.
Syn. <i>Spongilla plumosa</i> , Carter.	

Genus **Trochospongilla**, Vejdovsky (1883).

TROCHOSPONGILLA LATOUCHIANA, Annandale.	Gangetic Delta : Burma : N. China.
TROCHOSPONGILLA PHILOTTIANA, Annandale.	Gangetic Delta : Burma.
TROCHOSPONGILLA PENNSYLVANICA. (Potts).	N. America : Peninsular India.
Syn. <i>Tubella pennsylvanica</i> , Potts.	
TROCHOSPONGILLA SOL, Annandale.	N. China.

Genus **Tubella**, Carter (1881).

TUBELLA VESPARIUM, v. Martens.	Borneo.
TUBELLA VESPARIOIDES, Annandale.	Tenasserim, Burma.

Genus **Corvospongilla**, Annandale (1911).

CORVOSPONGILLA CAUNTERI, Annandale.	Peninsular India.
CORVOSPONGILLA ULTIMA (Annandale).	Peninsular India.
Syn. <i>Spongilla ultima</i> , Annandale.	
CORVOSPONGILLA ULTIMA var. SPINOSA, Annandale.	Malabar Zone.
CORVOSPONGILLA BURMANICA (Kirkpatrick)	Burma.
Syn. <i>Spongilla burmanica</i> , Kirkpatrick.	
CORVOSPONGILLA BURMANICA var. BOMBAYENSIS, Annandale.	Western Peninsular India.

Genus **Nudospongilla**, Annandale (1913).

NUDOSPONGILLA COGGINI (Annandale).	W. China.
Syn. <i>Spongilla coggini</i> , Annandale.	
NUDOSPONGILLA SARASINORUM (Weltner)	Celebes.
Syn. <i>Spongilla (?) sarasinorum</i> , (Weltner.)	

NUDOSPONGILLA MAPPA, Annandale.	Palestine.
NUDOSPONGILLA REVERSA, Annandale.	Palestine.
NUDOSPONGILLA ASTER, Annandale.	Palestine.
NUDOSPONGILLA VASTA (Weltner).	Celebes.
Syn. <i>Spongilla</i> (?) <i>vasta</i> , Weltner.	

Genus **Cortispongilla**, Annandale (1913).

CORTISPONGILLA BARROISI (Topsent).	L. of Tiberias, Palestine.
Syn. <i>Potamolepis barroisi</i> , Topsent.	

Genus **Pachydictyum**, Weltner (1901).

PACHYDICTYUM GLOBOSUM, Weltner.	L. Posso, Celebes.
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EXPLANATION OF PLATE IX.

***Amorphinopsis excavans* var. *robinsonii*, var. nov.**

FIG. 1.—Thick hand-section of the outer parts ($\times 11$), showing the spicule-fibres, the external layer of small macroscleres and the wide horizontal channels.

***Spongilla inarmata*, sp. nov.**

FIG. 2.—Gemmule in its cage of skeleton-spicules, $\times 75$.

***Spongilla conifera*, Annandale.**

FIG. 3.—Part of the skeleton of a sponge as seen from above, magnified.

FIG. 4.—Lateral view of a gemmule, $\times 112$.

FIG. 5.—Oblique section of a gemmule, $\times 112$. Somewhat diagrammatic.

***Trochospongilla sol*, sp. nov.**

FIG. 6.—Gemmules as seen from above, $\times 75$.

PLATE II.

(This plate was issued with part I of the present volume in December, 1916.)

***Amorphinopsis excavans* var. *robinsonii*, var. nov.**

FIG. 3.—A schizotype from Port Weld, showing lacunae in the sponge over the mouths of the burrows of boring molluscs. Nat. Size.

***Spongilla lacustris*, auct.**

FIG. 4.—A fragment from Pak Payum on the Talé Sap. Nat. Size.

***Spongilla potamolepis*, sp. nov.**

FIG. 5.—Type-specimen from Lampam on the Talé Sap. Somewhat reduced.

