

VII. FAUNA SYMBIOTICA INDICA.

NO. 5.—SOME SPONGES COMMONLY ASSOCIATED WITH OYSTERS AND MUSSELS IN MADRAS HARBOUR AND THE CHILKA LAKE.

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(Plates X, XI.)

The sponges described in this paper all occur commonly on living shells of *Ostrea* and *Mytilus* either in the harbour of Madras or in lagoons of brackish water on the east coast of India. There is no evidence that any one of them is invariably associated with any one genus or species of mollusc, or with molluscs at all. Indeed, we know that one of them (*Suberites aquaedulcioris*) is not always associated with molluscs. But the fact that an association of the kind is common, although it is not exclusive, is of considerable interest, and, as I stated in the introduction to this series of papers (*Rec. Ind. Mus.* V, p. 123), I propose to deal in it with associations of varying degrees of intimacy.

From the systematic and geographical point of view the interest of the sponges lies in the fact that they are from a region hitherto practically unexplored so far as the Porifera are concerned. The multitudinous species that are found in the Gulf of Manaar have been described in a series of papers by Bowerbank,¹ by Carter² and by Dendy³ and the marine sponges of Ceylon are now at least as well known as those of any other tropical country; but those that form a part of the much less luxuriant fauna of the littoral zone north of Palk Straits have hitherto almost escaped the notice of zoologists.

The biological differences between the portions of the east coast of India that lie respectively north and south of Palk Straits are much greater than is perhaps as a rule realized. In the one we have a sea full of coral reefs; in the other an almost uninterrupted stretch of barren sand and mud. It is only at a few places, notably in the harbour of Madras, that any solid support for fixed sedentary organisms exists, and there it is mostly artificial.

¹ *Proc. Zool. Soc. London*, 1873, p. 25.

² *Ann. Mag. Nat. Hist.* (5) V, p. 437; VI, pp. 35 and 129 (1880) and VII, p. 361 (1881).

³ *Ann. Mag. Nat. Hist.* (5) XX, p. 153 (1887) and (6) III, p. 73 (1889); *Herdman's Pearl Oyster Fisheries* III, p. 57 (1905).

South of the estuaries of the Mahanaddi, north of which mud prevails, the coast is sandy and the sand extends outwards from the shore for some miles. Off the northern part of this coast, in from 15 to 30 fathoms of water, there are areas in which the sea-bottom is coated with a recent conglomerate of sand and partially dissolved shells,¹ while in the southern part solid masses are produced at about the same depth by the growth of gregarious gastropods and stony sponges.² These harder areas are, however, restricted to water which, although shallow as compared with the abysses of the central region of the Bay of Bengal, is deep as compared with the strictly marginal zone, from which the species to be considered here were obtained.

The sponges described below are all encrusting species, dependent, therefore, for their existence on comparatively hard areas on which to spread. These areas they find on the surface of the shells of oysters and mussels.

The general absence of algae of any considerable size from the Indian coast north of Palk Straits is one of its most striking biological features; it is one that naturally restricts the space suitable for the growth of small encrusting sponges, which in other seas are frequently found on the stems and fronds of seaweeds.

A.—Sponges from Madras Harbour.

The stonework of Madras harbour affords a support for large numbers of mussels (*Mytilus latus*, Lam.) which in their turn are usually coated with various encrusting organisms. During a recent visit to Madras I was indebted to the assistance of Prof. K. Ramunni Menon of the Presidency College of that city in obtaining a large supply of these mussels in a living condition. The majority of them bore on their surface, mingled with compound ascidians, branching Cheilostomatous polyzoa, barnacles (*Balanus amphitrite*), etc., specimens of one or more of the sponges here described.

The largest shell measures 11 cm. in length and 5.6 cm. in breadth.

The list of the encrusting sponges found on the mussel-shells is as follows :—

Family DESMACIODONIDAE.

Mycale aegagropila (Johnston) var. *militaris*, nov.

Mycale mytilorum, sp. nov.

Mycale madraspatana, sp. nov.

Lissodendoryx balanophilus, sp. nov.

In addition to these encrusting forms a small and poorly developed specimen of the widely distributed and well characterized

¹ Jenkins, *Rec. Ind. Mus.* VII, p. 51 (1912).

² Annandale, *ibid.*, VI, p. 47 (1911).

tubular Haplosclerid *Reniera implexa*, Schmidt, was found on a shell of the same mussel. This sponge will probably be discovered in all warm and tropical seas; it has been recorded from the Adriatic, the West Indies, Ceylon and the Red Sea, and I have examined specimens from a rock-pool on the island of Bombay. Its bathymetrical range is also great:—from between tide-marks to at least 450 fathoms.

No burrowing sponge was found in oysters or mussels in the Madras harbour, but I have a specimen of *Cliona celata*, Hancock, in a chank shell (*Turbinella pyrum*, L.) from the immediate neighbourhood of the town; it was presented to me by Professor Ramunni Menon.

Genus *Mycale*, Gray.

- Mycale*, Gray, *Proc. Zool. Soc.*, 1867, p. 533; Thiele, *Abh. Seuckenb. Nat. Gesellsch.* XXV, p. 949 (1903); Lundbeck, *Dan. 'Ingolf'-Exp.* VI, pt. 2, pp. 7, 23 (1905).
Esperia, Nardo, *Isis*, 1833, p. 522.
Esperella, Vosmaer, *Bronn's Thierreichs. Porifera*, p. 353 (1885); Ridley, *Rep. Zool. 'Challenger'* XXII (LIX) (Monaxonida), p. 62 (1887); Dendy, *Herdman's Ceylon Pearl Fish.* III, p. 159 (1905); Row, *Journ. Linn. Soc. (Zool.)* XXXI, p. 33 (1911).

Mycale aegagropila (Johnston).

Esperella aegagropila, Vosmaer and Pekelhering, *Verh. K. Akad. Wet. Amsterdam* VI (2), p. 17 (1897).

var. *militaris*, nov.

(Plate x, fig. 2.)

In the structure of their skeleton and soft parts and in the general form of their spicules my specimens from mussel-shells in Madras harbour agree well with Vosmaer and Pekelhering's description.

The sponge in these specimens forms a film not more than 2 mm. thick. In life it is of a bright scarlet colour owing to the presence of symbiotic algae in the parenchyma. In spirit these minute organisms turn of a dull green colour. The lengths of the spicules of my specimens are as follows; their forms are shown in figs. 2, 2a, pl. x:—

Megascleres, 0·257 mm. (average): 0·24 to 0·27 (extremes).

Anisosclerae, 0·044 mm. (very uniform).

Sigmata, about 0·095 mm.

Toxa, 0·148 to 0·2 mm.

The microscleres of all forms are somewhat scarce.

Type No. Z.E.V. 61⁵/₇² Ind. Mus.

Locality.—Madras harbour in 4 to 6 feet of water; on living shells of *Mytilus latus*, Lam.

The spicules do not agree precisely with those of any of the forms included in the synonymy of *M. aegagropila* by Vosmaer and Pekelharing, who have discussed the species in an exhaustive manner. I, therefore, describe my specimens as the type of a new "variety." Whether it is a true variety or a geographical race (subspecies) cannot of course be settled until more is known of the smaller and more delicate sponges of Indian seas.

The authors mentioned in the preceding paragraph found *M. aegagropila* only on young oysters (*op. cit.*, p. 29). They describe the method of growth as follows: "They [the sponges] formed their crusts, generally not more than 0.5 or 1 mm. thick. They often covered the shells entirely, growing over the free borders. If new layers of shell are formed, the sponge immediately covers them. Hence in sections there can be found shell-layers in the middle of the sponge body." Nothing of the kind occurred in the case of sponges growing on mussel-shells at Madras, but these shells are of course much smoother than oyster-shells and the layers of calcareous matter of which they consist are much more closely compacted. No sponge that I saw grew over the edge of a shell, although in some cases the exposed surface of one valve was almost completely covered.

Mycale mytilorum, sp. nov.

(Plates x, fig. 1 and xi, figs. 2, 3.)

The *sponge* forms a delicate film not more than 2 mm. thick and of a bright brick-red colour; it sometimes covers the whole of a large mussel-shell. In spirit the colour, which is apparently not due to the presence of symbiotic algae, disappears rapidly. The external surface is smooth except for the presence of angular and apparently (not actually) spiny ridges on the central parts, often interrupted and never as much as 1 mm. high. These are largely artifacts, not being visible in the living sponge; they occupy the spaces between the superficial exhalent canals.

Both *dermal pores* and *oscula* are minute and inconspicuous. The latter are situated in the central, thicker parts of the sponge; their position is indicated by the course of the superficial canals that converge towards them. The dermal pores, when not entirely obliterated by contraction, are oval in outline and of variable size; they are scattered on the peripheral parts of the sponge. Their position can be discovered readily by the aid of a hand-lens, because they open, either directly or by short passages partly closed by diaphragms, into larger circular lacunae belonging to the inhalent system. These extend downwards nearly to the base of the sponge and the finer inhalent canals lead from them to the ciliated chambers. The finer exhalent canals open into broader ones which run obliquely upwards through the sponge and, long before reaching the oscula, form

branching grooves on the surface of the parenchyma easily seen through the colourless dermal membrane that forms their roof.

The *skeleton* is composed of single fibres which ramify feebly or not at all. Its exact structure differs considerably in different parts of the sponge. Towards the periphery (pl. xi, fig. 3) the spicule-fibres are short, slender and simple; their course is almost vertical; they are somewhat sparsely scattered and they never branch; their upper extremities form comparatively small brushes that support the dermal membrane, hardly penetrating it. The sponge contains numerous tubes made by polychaete worms and in their intermediate vicinity the fibres, which to some extent radiate out from them take on a somewhat different character, becoming longer, branching dichotomously or even trichotomously at the upper end and adopting a more nearly horizontal course. It is, however, in the central parts of the sponge that the fibres are best developed, especially at the sides of the superficial exhalent channels. Here they assume a contorted but mainly horizontal course, are greatly elongated and densely crowded together. Their upper extremities, indicated by the fact that the pointed ends of the skeleton-spicules are directed towards them, are arranged in parallel lines of fan-like brushes along the sides of these channels, one row on each side, and thus forms a support for the floor of the channels (pl. xi, fig. 2).

Towards the periphery of the sponge there is no dermal skelëton except a fairly dense layer of sigmata, but in the central parts numerous macroscleres lie scattered, without fasciculation, in the dermal membrane.

Spicules: Megascleres.—The megascleres are slender, smooth, sharply pointed, straight or nearly straight tylostyles with well-defined, narrowly oval heads. The axial tubule is well developed in them, extending into the head. The average length of the whole spicule is about 0·216 mm. and the average diameter 0·0047 mm., the corresponding measurements of the heads being 0·008 mm., and 0·0047 mm.; but considerable variation in size and proportions occurs, the total length varying from 0·18 to 0·26 mm. and the diameter of the shaft from 0·004 to 0·0054 mm.

Microscleres.—There are no toxa. The sigmata, which are most numerous in the dermal membrane but also occur singly in the parenchyma, are not grouped in any definite manner. They are smooth and slender and as a rule somewhat twisted in their long axis; the average sector of their arc is about 0·04 and the average thickness of their shaft 0·0027 mm. The anisochelae are found scattered sparingly in the dermal membrane and parenchyma; they are very minute. Their form, in which they differ from those of *Mycale aegagropila* (Johnston), is best shown by figures (figs. 1, 1a, pl. x); their average length is about 0·0189 mm.; they are the most uniform in size of the spicules and by far the smallest in numbers as well as size.

Habitat.—Madras harbour in from 4 to 6 feet of water; on shells of living *Mytilus latus*, Lam.

Type No. Z.E.V. ⁶¹⁵¹ Ind. Mus.

This sponge is closely allied to *Mycale aegagropila*. The size and proportions of the spicules are, however, different; the skeleton, at any rate in the central parts of the sponge, is much denser, and the complete absence of toxa, substantiated by an examination of many fragments mounted whole as well as by preparations of cleaned spicules, is apparently a distinctive character.

Gemmules closely resembling those of *M. aegagropila* as figured by Vosmaer and Pekelharing (*op. cit.*, p. 30, pl. 1, fig. 3) occur in specimens collected in October.

Mycale madraspatana, sp. nov.

(Plates x, fig. 3 and xi, fig. 4.)

In the structure of its soft parts, in dimensions and in the form of its spicules this species closely resembles *M. aegagropila*, but the chelae are arranged in rosettes and the skeleton is much more highly organized: the colour in life is that of *M. mytilorum*.

Skeleton.—Two distinct kinds of spicule-fibres can be recognized. On the external surface, partly in the dermal membrane and partly in the parenchyma immediately below it, run comparatively stout, sinuous, non-anastomosing fibres, which cross one another occasionally but branch sparingly and do not fuse together. They are a little splayed out and occasionally fork at both extremities, but form regular brushes at neither; in optical section as many as 12 spicules abreast can sometimes be detected. These broad fibres are best developed round the oscula. In the lower part of the parenchyma thinner fibres, 2 (or even 1) to 7 spicules abreast in optical section form a regular horizontal network, branching freely and anastomosing. Transitional forms between the two kinds of fibres occur very sparingly. In addition to the fibres there are many macroscleres scattered horizontally in the parenchyma. These are not shown in figure 4, pl. xi.

Spicules: Macroscleres.—The majority of the macroscleres closely resemble those of *M. aegagropila* except that the shaft tapers more distinctly towards the blunt extremity; the heads, if they can be distinguished, are narrowly oval. Together with macroscleres of this type very much more slender styli of approximately the same length occur sparingly. The average length of the typical macroscleres is 0.279 mm., the extremes being 0.265 and 0.296 mm.

Microscleres.—Anisochelae, sigmata and toxa are found. The anisochelae are arranged in rosettes, but the size and regularity of these groups varies, together with the number of anisochelae present in the sponge, in different specimens from the same locality. The form of the spicule closely resembles that of the spicule of the same type in *M. aegagropila*, but there are certain differences (best shown

in figs. 2a and 3a on pl. x) in the structure of the extremities and the size is a little greater, the average length being 0.0473 mm. (extremes 0.043 and 0.0516 mm.). Sigmata are very scarce; they are a little more contorted as a rule than those of *M. aegagropila* from the same locality. The toxa, which are fairly abundant, are extraordinarily variable in size: 0.140 to 0.352 mm. in length. Most of them fall into one of two series characterized by size. In the smaller toxa the central curve is as a rule more compressed than in the larger ones, which are actually longer than the macroscleres.

Type No. Z.E.V. ⁶¹¹⁷ Ind. Mus.

Locality.—Madras harbour in 4 to 6 feet of water; on living shells of *Mytilus latus*, Lam.

The degree of development reached by the skeleton in this species is probably somewhat variable, but it is only in well-preserved specimens on which no artificial pressure has been exerted that the double system of spicule-fibres can be adequately observed.

Specimens of this species collected in October are full of gemmules in early stages of development. Indeed, parts of the sponge appear to consist of little else but morula-like masses of cells evidently of this nature.

Genus *Lissodendoryx* (Topsent) Lundbeck.

Topsent, *Mem. Soc. Zool. France* IV, p. 457 (1897); *Rés. Camp. Sci. Monaco*, fasc. II, p. 173 (1907); Lundbeck, *Dan. 'Ingolf'-Exp.* VI (2), p. 153 (1905).

Lissodendoryx balanophilus, sp. nov.

(Plates x, fig. 4 and xi, fig. 5.)

The *sponge* forms a crust not more than 4 mm. thick on the shells of Lamellibranchs, often occurring together with *Balanus amphitrite*, Darwin. It fills up the interstices between individual barnacles as well as growing over their shells in a thin film. The external surface is irregular, but not spiny and without definite projections. The colour is pale yellowish green and fades little in spirit. The structure is somewhat cavernous owing to the comparatively great calibre of the main exhalent channels, which run obliquely upwards through the sponge and do not form branching grooves on the surface of the parenchyma. The oscula are rather larger than those of the species of *Mycale* described above, but the pores are minute and difficult to detect. The whole sponge is very fragile, but rather less so than the others found with it.

The *skeleton* contains little binding substance. The dermal macroscleres form short, somewhat plumose fibres in which as many as 12 spicules abreast can sometimes be seen in optical section. These fibres branch dichotomously or irregularly at

their extremities, or at any rate at the extremity nearest the surface. They are usually somewhat contorted, but they do not anastomose; their course is mainly horizontal but as a rule dips down into the sponge more or less deeply; they are connected together to form a somewhat loose reticulation by single tornote spicules. The styli and tylostyl form in the parenchyma a fairly regular reticulation for the most part composed of single spicules and comparable with the typical skeleton of *Reniera*; but traces of fasciculation can be detected at some points.

Spicules: Macroscleres.—The majority of the dermal macroscleres are tornota with well-defined smooth oval extremities of comparatively large size. Their shafts are as a rule smooth, slender and straight. Both amphioxi and amphistrongyli occur, however, among them, always sparingly. These spicules, which must be regarded as abnormalities, invariably have their shafts irregular in outline and as a rule are inflated at several or many points. The skeleton-spicules are as a rule a little shorter and stouter than the tornota; their shafts are usually smooth, but occasionally bear a few scattered spines near the blunt end; this end, which is in most cases distinctly globular and well differentiated from the shaft, is rarely or never quite smooth, but as a rule may be called irregular in outline rather than actually spiny. The other extremity is sharply and gradually pointed. These spicules are from 0·124 mm. to 0·16 mm. long. Sometimes much shorter and stouter tylostyles of very irregular form occur in small numbers, and even what may be called normal spicules of the type vary considerably both in proportions and in outline. Typical tornota are on an average about 0·167 mm. in length (0·166 to 0·176 mm.).

Microscleres.—The microscleres include minute and very slender C- and S-shaped sigmata as well as isanchorae. In the latter the shaft is stout, somewhat compressed laterally and feebly curved; the three teeth at either end are subequal, narrow and sharply pointed; those at the sides project outwards in such a way that it is hardly possible for the spicule to rest on its dorsal surface. (This makes it impossible to obtain an accurate *camera lucida* drawing of the front view).

Type No. Z.E.V. ⁹⁰⁷⁰ Ind. Mus.

Locality.—Madras harbour in 4 or 5 feet of water; on living shells of *Mytilus latus*, Lam. (together with *Balanus amphitrite*, Darwin) and also on those of *Ostrea* sp.

This sponge would not fall within the genus *Lissodendoryx* as originally defined by Topsent, for all the parenchymal macroscleres are not smooth, although most of them are nearly so. Lundbeck has, however, pointed out that the critical character lies not in the form of the macroscleres, but in that of the hooded microscleres. These belong to the type known to him and to some other writers as iso-anchorae, whereas the corresponding spicules in *Myxilla* are true iso-chelae. The distinction may be accepted as convenient; but it should be noted that the impor-

tance thus attributed to the difference between the two types of microscleres is not accepted by all spongologists.

B.—A Sponge common on Oyster-shells in Brackish Water.

Fam. SUBERITIDAE.

***Suberites aquae-dulcioris*, sp. nov.**

Sponge.—The sponge forms a film not more than 2 mm. thick, in most places quite flat but slightly raised in the neighbourhood of the oscula, which are sparsely scattered on the surface. The oscula are very small and can be closed completely; each is connected with a branching and occasionally anastomosing system of superficial exhalent channels the roof of which is formed by the dermal membrane. Except over these channels, the external surface is minutely hispid. The dermal pores are minute and occur in considerable numbers all over the membrane except where it forms the roof of the exhalent channels. The subdermal cavity is ample, being supported by bunches of spicules. The inhalent canals run vertically downwards below the pores. The colour of the living sponge varies from leaf-green to orange-yellow; in specimens in spirit or dry it is dirty white. The superficial area of the largest specimen seen did not exceed that of a moderate-sized oyster-shell.

Skeleton.—In living or carefully preserved sponges the skeleton consists of numerous plumose spicule-fibres which radiate outwards and obliquely upwards through the sponge, their general course being directed away from the oscula, towards which their blunt ends point. At their external extremity, as they approach the surface of the sponge, each fibre bears a large bunch of vertical spicules with their sharp ends pointing upwards and outwards. It is these bunches of spicules that support the dermal membrane over the dermal cavity; only their tips protrude through it. The floor of the superficial exhalent channels, in which there are no bunches of spicules, is supported by single spicules, which are directed outwards from the oscula and never project vertically upwards. There are numerous loose spicules lying parallel to the base of the sponge, especially in its lower parts. The spicule-fibres are devoid of any binding substance and the regular arrangement just described is apt to break down if specimens are not carefully preserved. In this case the skeleton-fibres often disappear almost completely, but the terminal bunches are more consistent.

Spicules.—The only spicules proper to the sponge are macroscleres, but if, as is often the case, it is growing in close contact with *Cliona vastifica*, Hancock, the zigzag microscleres of that sponge are apt to intrude into it. The macroscleres are of two sorts, amphioxi and tylostyles; the former are, however, extremely scarce and should be regarded as abnormalities. They are slender and always more or less distorted. With few excep-

tions, therefore, the skeleton is composed of slender tylostyles of very variable size and proportions. One extremity is sharply and gradually pointed, while the other forms a distinct head, which usually bears some resemblance to an acorn, being divided into a rounded terminal portion, as a rule longer than broad, and an enlarged ring-like base. The differentiation is, however, not always distinct and the exact form of the whole head is very variable. The largest macroscleres are about 0.033 mm. in length and their stem nowhere exceeds 0.0056 mm. in thickness. The curvature of the spicules is usually slight and regular, if they are not absolutely straight; but some are a little sinuous and a few are always to be found in which the stem is curved or angularly bent at one point. The head is relatively small, as a rule distinctly longer than broad.

Type No. Z.E.V. $\frac{6039}{7}$ Ind. Mus.

Habitat.—Chilka Lake, Orissa, near the east coast of India, in brackish water on leaves of *Halophila* and shells of *Ostrea*; also on the latter in the backwater at Ennur near Madras. This sponge has been found at two places in the Chilka Lake, namely about a mile off Burkul near the inner shore and at Manikpatua in the outer channel a few miles from the mouth.¹ At the former place several very young specimens were found in July on the leaves of a plant actually floating on the surface but probably detached from the bottom in about 6 feet of water. The specimens from Manikpatua are larger and were found in September on the external surface of the valves of oysters (*Ostrea* sp.) living in about 4 feet of water.

In its form and method of growth this sponge approaches *Prosuberites*, Topsent, but the possession of horizontal spicule-fibres distinguishes it from the species of that genus.

¹ Further particulars about the distribution, etc., of this sponge will be given in a subsequent paper on the fauna of the Chilka Lake. Feb. 24th, 1914.