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Freshwater Sponges of India

T. D. Soota

Zoological Survey of India

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FRESHWATER SPONGES OF INDIA

By

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I. Introduction

Sponges form a group of aquatic invertebrates technically known as Porifera meaning pore bearers, from Latin derivations. As a commercial product of use in daily life, these organisms were known from very early times though it was only with Aristotle that we find evidence of their concern as objects of scientific curiosity. Not only are they zoologically significant by their unique sedentary mode of living, but they are also of interest as representing a possible first step in the formation of the higher multicellular organisms or metazoans, although unlike the latter they are in general very poorly organised. In fact, they seem to retain some of the earlier evolutionary trends by their display of some obviously unicellular activities such as reconstruction, regeneration, and reaggregation of the dissociated component cells. Because of their extremely conservativeness from the evolutionary angle, they may not be taken, as was generally held, as simple but complex organisms.

Regarding their definition, they have been looked at in different ways by different authors. For instance, Johnston (1842, p. 69) heid them as "zoophytes" which meant a large assemblage of organisms occupying an intermediate position between plants and animals, and emphasised their possible importance as forming the first "matrix and cradle" of all the higher forms of life. Brien (1967, p. 197) opined that they were filterable enterozoan metazoa. Zhuravleva (1970, p. 42) considered them as on the lowermost rung of the ladder of multicellular animals showing no true tissues and separate organs of the higher forms. Tuzet (1970, 1973) defined them as diploblastic, acoelomate Metazoa. Finally, Bergquist (1978, p. 9) stressed their sedentary and filter-feeding habits.

As a group sponges, which inhabit marine, estuarine, and freshwater habitats and constitute an important component of the biota of these ecosystems, are well adapted to a wide range ef environmental conditions. Due to having very poorly organised body structure as well as due to little or no

locomotory activities, they have a tendency to high morphological plasticity which leads to their susceptibility to pronounced polymorphism. They are coloured inconspicuously green, brown, gray, or yellow and are well known for absorbing sestonic material available in water. Of late, their role as indicator species for water is also being realised, for they are capable of undergoing much morphological modifications as a result of certain alterations in the environment. Some of these variations may be due to seasonal changes and even due to no apparent reasons. The effect of environmental influence is to lower the diversity and alter the selectivity and population of the species. So, environmentally induced variations seem to be main problem in taxonomy. Therefore, sponges can be used as fine indicators of specific population alteration, and the analysis ef their cytopathology can be employed for the kind as well as degree of pollution.

As already mentioned in the beginning of this paper, though knowledge of sponges existed since early times, it was only towards the close of the seventeenth century that literary records bearing on the group appeared as evidenced by that of Leonard Plukent in 1696, referred to by Carter (1881a, p. 77). But, sponges received real academic attention only in nineteenth century though this was mainly centered on debating developmental theories, or attempting to resolve their then controversial systematic position between animals and plants. Towards the middle of the century, freshwater sponges came in the lime light when with the improvement of microscope, attention was turned from the gross study of the animal as a whole to the importance of the spicular structure ; and thus, initiating detailed studies of the family Spongillidae commencing with Carter (1849) who while examining Indian forms, described five species from Bombay, while contemporaneously Lieberkuhn at Berlin undertook the study of forms from the German river Spree. The first comprehensive account of the freshwater sponges is that of Bowerbank (1863) who working on British sponges, in his initial revision of all species of *Spongilla* placed twenty-one species under it proposing at

that time that two well defined groups were conveniently discernible as represented by *Spongilla lacustris* and *Spongilla fluviatilis*, but did not give thought of assigning them any rank and name. But, this was remedied by Gray (1867, p. 500) who created six more genera to better accommodate the existing species. However, this arrangement was rejected by Carter (1881a) on the ground of Gray's failure of examining Bowerbank's material before establishing his own new genera ; but instead, basing his own classification on gemmoscleres, he distributed the species under five genera, four newly created by him for the purpose, relevantly declaring (p. 81) that, "Until Meyen had pointed out the form and presence of spicules in the seed-like body, no reliable distinction existed between *Spongilla fluviatilis* and *S. lacustris*, so we may assume that this may be anticipated throughout the family". He further stated that, "The classification which I am about to propose will be based chiefly on the statoblasts", and his classification came into general usage until the following mid-century when after Jewell's (1952) improvement, Penney and Racek (1968) in their outstanding contribution gave a wider currency to their own system which is still in vogue.

In may be appropriate here to mention Weltner's (1893) very helpful bibliography of the existing freshwater sponges towards the turn of the century followed by the efforts to update these forms by other workers leading ultimately to the laying of the foundation of modern taxonomy of the group by Annandale (1906-1919) who not only reintroduced some of Gray's generic names at least to subgeneric levels, but also added to the conglomerate systems of Gray (*op. cit.*), and Carter (*op. cit.*), some well-defined genera of his own. Personally observing (1911 c, p. 39) variability under changing environmental conditions, he later (1919, p. 156) stressed that "Observation of sponges in the natural surroundings is always important." Here may be included the revisions, among others, of Gee (1926-1937), Arndt (1923-1938), and Schröder (1926-1942) ; not excluding the generic revisions of de Laubenfels (1936), and Jewell (1952), the latter of whom also appended a historical review of the group.

According to Penney and Racek (*op. cit.*, p. 2), Gee was first to realise the systematic mess very obvious in the group, and this made absolutely imperative the necessity of re-examination of the available types, as well as study of fresh material in order to remove the existing confusion. Unfortunately, his monumental work remained incomplete before his death. Again, in mid-fifties, attempt was made by Penney with the same aim using Gee's material, but death again interupted the work. Finally, Racek taking up the assignment, managed successfully to bring to completion in 1968 the magnificient and long-awaited work for which Penney was given senior authorship. This very useful work was followed by similar praiseworthy contributions of Racek, Harrison, Poirrier, Volkmer-Ribeiro, Bonetto, Ezcurra de Drago, Bien, and others.

In India, since the pioneering works of Annandale (*op. cit.*) hardly any work was undertaken on the group for more than half a century excepting for an attempt for a check list based on Penney and Racek's (*op. cit.*) work by Khera and Chaturvedi (1976). The recent most work of Soota and Pattanayak (1982) based on the unnamed collection of the Zoological Survey of India, not only extended the range of distribution of several species but also included more uptodate data. To this were added the ecological studies of the forms in Rajasthan and Gujarat initiated by Soota *et al.* (1983) where it was observed that salinity has close bearing on the distribution and abundance of freshwater biota. Since the waters of the Indian desert in general have high salt content, their biota is generally euryhaline (tolerant to high fluctuations in salinity).

The present work is a review of the hitherto known Indian species of freshwater sponges and is based on the study of all the available material coupled with the perusal of the relevant literature todate. The author's views on certain species are based on his long experience in the studies of these animals. Illustrations are included for most of the species and keys to the identification of all the Indian genera and species provided. Under each genus and species an adequate synonymy together with description, distribution, as well as remarks have been given so that it will be a useful guide not

only to the specialists but even to the beginners. The nomenclature followed is after Penney and Racek (1968) excepting where changes were necessary in the light of subsequent studies. The present work does not deal with their evolutionary aspect.

II. A BRIEF HISTORY

For a long time, the taxonomic position of sponges in the animal kingdom was uncertain, and Johnston (*op. cit.*) who dealt with this matter elaborately and almost comprehensively, while accepting (p. 26) Aristotle's favouring the belief in the animality of sponges remarked, ".....but perhaps, we more correctly reflect Aristotle's view when we represent the sponge as a production intermediate between the vegetable and animal kingdoms...". Even Pliny who came much after Aristotle preferred to uphold this intermediate position placing them among those productions "that have a third or middle nature, and are neither living creatures nor yet plants".

But, after a long interval when natural history began to be studied anew, sponges were taken for granted as members of the vegetable kingdom. Thus, Gerarde (1633) looked upon them as virtual plants when, in accordance with the then generally held opinions, considered their generation due to the fermentation of the sea scum ; Ferrante Imperato (1672), as well as Ray considered them allied to Fungi ; Grew (1686) regarded them as just half of a plant ; and Marsingli, in the early eighteenth century, held them wholly as plants. Though, their animal nature was not ignored by every successive compiler or student, none felt it necessary or appropriate to give them animalian status. It was only in the middle of the eighteenth century that Peyssonel's (1727) discovery of animality of zoophytes in general, as even Ferrante Imperato (in 1599, reprinted in 1672, as quoted by de Blainville *vide* Johnston, 1847, p. 409) considered some zoophytes as distinctly animals, received confirmation from Trembley, Donati, Jussieu, and Ellis.

Very soon, Donati regarded sponges as an order of "plant-animals," and Peyssonel believed that sponges were fabricated

by "worms", but it was not accepted by Ellis (1765), who in fact, noting their "sucking and throwing out water" evidenced life characteristics, opined that the sponge is an animal *sui generis*, an opinion accepted by Pallas (1766). Linnaeus in 12th edition (1767) of his "Systema Naturae" following the views of the bast two authors arranged the sponges amongst animal zoophytes. From this date begins the general acceptance of the animality of sponges as well as Ellis' views regarding their fundamental structure and function.

Though, workers like Spallanzani. Lamouroux, Forskall, and Targioni-Tozetti still believed in the vegetable nature of sponges, it appears that others more or less assumed the animality of sponges. But Cavolini, and Schweigger, had no misgiving of their animal nature, and Montagu held them truly of an animal substance.

Gray (1824) while at first opposing the animality of sponges and considering them as plants by the observations that the fresh-water forms contained myriads of minute green granules, later (1825) accepted their animal nature on the basis of their spicules consisting wholly of pure silica ; and following Lamarck considered them to be "true corals, nearly allied to Antipathes and Gorgonians". It may be noted that Lamarck had inferred that sponges were produced from polypes similar to Alcyonarians ; and Cuvier too classified them as Zoophytes or Polypes, allied to anthozoan coelenterates.

The systematic position of sponges lay overshadowed by such ambiguities when Grant initiated those series of studies which have thrown clearer light on their activities. He first satisfied himself that the sponge is not the production of polypes, but as Ellis has shown, an animal *sui generis* only that it lacks discernible locomotory activities, and does not even exhibit any degree of contractility under the strongest irritations.

Still, disbelief on the part of those concerned including lamarck, and Montagu, was not dispelled even when Grant presented the real character and relations of the freshwater sponges in a memoir read before the Wernerian Natural

History Society on 11th February 1826. As a result of his discoveries he, at a later period removed sponges from among zoophytes, and placed them under a distinct order 'Poriphera', which was readily accepted by Audouin, and Milne-Edwards, both of whom, held sponge as an animal albeit the opinion of Link (1831), the celebrated Professor of Botany in Berlin, who proposed to remove the entire family of sponges to Algae.

While Dujardin (1838, p. 9) pointed out further animal characteristic in their showing the presence of gelatinous granules and masses, Hogg (1841b, p. 405) abandoning his earlier opinion about their animality considered them intermediary between Algae and Fungi ; and even Dana (1846) too, entertained doubts about their animality. Although, Owen felt that even accepting the intermediate position of sponges they lean more towards plants, we have to note that several workers including Grant, Schweiger, de Blainville, Milne-Edwards, Fleming, Bowerbank, Forbes, Merat, De Lens, and James-Clark, the last demonstrating the presence of collar cells, continued to consider them as members of the animal kingdom.

Carter (1881a, pp. 80-81) ultimately realised their animality. Minchin (1900, p. 2) showed that their animality was not definitely determined till the middle of nineteenth century. Sollas (1906, pp. 166-167) in a short but informative history of the group remarked that the observations of Grant (1825), Dujardin (1838), Carter (1847), Dobie (1852), and Lieberkuhn (1857), substantiated the claims of sponges to a place in the animal kingdom. Annandale (1911c, p. 54) referring to early Linnaean epoch stated that "notwithstanding the fact that the animal nature of sponges was clearly demonstrated by Ellis in 1765, it was not until the nineteenth century was well advanced that zoologists could regard sponges in anything like an impartial manner. In the eighteenth century Linne', Pallas, and other authors described the commoner European Spongillidae in general terms, sometimes as plants and sometimes as animals, more usually as zoophytes or "plant animals" partaking of the nature of both kingdoms". Hyman (1940, p. 284) in her brief

historical review of the group remarked that "The nature of sponges was debated until well into the nineteenth century, although evidence of animal nature was adduced in 1765 by Ellis who saw the water currents and movements of the oscula." According to Hegner (1961, p. 139) sponges "were not proved to be animals until 1857"; and in fact, according to Meglitsch (1967, p. 106) they "were not finally recognised an animals until 1825." Bergquist (1978 p. 49) observed that the acknowledgement of animality of sponges was established in the beginning of nineteenth century; and according to Pennak (1978, p. 80) it was suspended till 1825 due to inadequate physiological and morphological knowledge. Fry (1979, p. 49) held that acceptance of animality of sponges was in the first half of the nineteenth century; and finally, Storrer *et al.* (1979, p. 361) stated that "Their animal nature was learned in 1765, but their place in the animal kingdom was uncertain until about 1857."

Regarding the origin of fteshwater sponges, the monophylectic one is now considered untenable.

(i) *General structure*

The structure of tbe sponge body is simple as compared to other metazoans, lacking organs and true tissues. The body is covered by a perforated epithelium. There are two layers, an external pinacoderm, and an internal choanoderm formed by flagellated collar cells or choanocytes; in between which there is an intermediate region mesohyl, which can vary in composition and extent, but which always includes apart from some skeletal material, several kinds of mesenchymal amoebocytes, having wide variety of functions like nutrition, storage, transport, excretion, reproduction, etc. and many showing motility. The cells forming the body of the sponge unlike those of the tissues in other metazoans, lack a stable basement membrane, and in fact the constituent cells maintain an almost protozoan independence; thus this absence of organised intimately bound collective activity above the individual cellular level clearly differentiates them from the other metazoans.

A system of rhagon type complex, intricate, and interconnected ramifying canals and chambers pass through the

body wall. The ostia, covering the entire body externally open inside the internal cavities from which minute narrow incurrent canals lead to the spherical cavities or flagellated chambers, each in turn then emptying into minute excurrent canal. Numerous such canals open into a much larger irregular central cavity leading outside through an exit called as osculum, which evidently functions as one way valve in the water flow system of these organisms. Under abnormal conditions of the habitats, the osculum may increase in number to get rid of waste or extraneous matter as observed by Annandale (1913a, p. 76).

The soft body wall is supported by two kinds of siliceous spicules, the megascleres, forming a network and serving as skeletal frame work, and the flesh spicules, the microscleres, when present, are abundantly scattered in an irregular manner in symplasm and dermal membrane. Both kinds may be sharply pointed or blunt and with few to many spines of variable size, depending on the species.

It is to be borne in mind that much reliability cannot be bestowed, more so in the case of truly cosmopolitan forms, on the shape and structure of the spicules for taxonomic purposes, as they are frequently subjected to variations as a result of unusual environments. This subjectivity to environmental influence calls for a separate environmental study for a really valid taxonomic assessment.

(ii) *Colouration*

Sponges are characteristically coloured green though this is susceptible to local variations depending upon the availability of the light. Thus, the sponges which germinate below the surface of a log or a stone in water, as long as they remain below, will tend to be whitish, greyish, or even creamish in colour, but on enlarging, as soon as they creep around the object which affords them the substrate, and come into the full sunlight, gradually turn into the delicate shade of green and then deepening gradually with further exposure, to a bright vegetable hue. However, in some species they never attain green colour; and in fact, Annandale (1911c, p. 36) observed that the colouration of freshwater sponges is

uniformly dull though in *Pectispongilla aurea* it is brilliant yellow. Apparently, they are susceptible to much changes in body colouration as a result of corresponding physical and chemical alterations in the environment. There may be one to four possible agents in the production of body colouration of sponges : (1) the presence of solid inorganic particles which during the normal physiological process find their way in the corpuscles. (2) The presence again in cells, of coloured substances solid or liquid, produced intracellularly during the course of the vital activities of the organisms. (3) Also, the presence in the cells, of "green corpuscles" peculiarly organised and living entities. These, which are not present in all spongillid species are suspected to be an alga in a particular stage of life history when they symbiotically affect the colouration of the body. (4) Finally, to quote Litchfield (1976. p. 28) colour may be considered to be "fortutitous". The author also advances the physiological necessity in the colour production process thinking it possible that carotenoid pigments occurring in most sponges serve as photoprotectors whereby the adverse effects of excess of solar radiation on metabolic products is prevented ; and also that the colour could be a matter of recognition forming survival value in certain sponges which are toxic or indigestible in nature are left alone.

(iii) *Nutrition*

The sponge acquires from the water the streams of nutritive elements which entering through the ostia, are directed towards the oscula. Then the lashing flagella of choanocytes direct them to the flagellated chambers where bacteria and bits of detritus are caught both on the outer sticky surface of the collar cells and on the exposed surface of the cells proper. The choanocytes are responsible for food capture, playing no part in the digestive process which is intracellular function of amoebocytes.

(iv) *Respiration*

In the absence of special respiratory organs in the sponge, every cell is self sufficient and is directly or indirectly

involved in the respiratory process ; thus, there is a rapid exchange of oxygen and carbon dioxide externally and internally through the exposed tissues, whereby practically all cells are brought into participation in the process.

(v) *Circulation*

Sponges also lack an organised circulatory system as generally found among the other multicellular animals, the circulation being effected entirely by the direct diffusion and by amoebocytic transport of nutrients.

(vi) *Excretion*

This involves the simple diffusion into the surrounding water of all dissolved metabolic waste material capable of passing through the sponge body. The non-passable granular materials are generally released by amoebocytes into the excurrent canals though, they may be temporarily retained by the cells for varying intervals of time.

The one or two contractile vacuoles present in choanocytes and amoebocytes have been found to be probably necessary for maintaining osmotic pressure in the tissues. Brauer (1975) has elaborately dealt with osmoregulation in *Spongilla lacustris*.

(vii) *Cell behaviour in aggregation*

One peculiar trait of sponge activity namely, the cellular reaggregation after a portion of body is mechanically dissociated, is a discovery dating only from the beginning of this century *vide* the work of Wilson (1907), whose discovery of this remarkable phenomenon activated many workers to tackle the subject upto 1930 in particular by Huxley (1921), and Galtsoff (1925). It took several decades to students working on developmental biology to realise its deep significance on their discipline. In fact, this aspect of physical response of cells lost interest after a few years, their reassociative process being considered as a peculiarity just confined to sponges alone.

But the resumption of work on the subject recently especially by Humphreys (1963, 1970), and Curtis (1970)

showed, in the light of the surface structure of cell being unearthed by modern technique, the amount of impact of the sponge behaviour on the foundations of intercellular adherence and seggregation of individual cells.

(viii) *Reproduction*

The sexuality of sponges still lacks detailed information. In some respects, they show similarity with plants as shown in the elaborately dealt with work of Volkmer-Ribeiro (1976, p. 278). While, some species exhibit contemporaneous hermaphroditism, others show clearly the separation of sexes (*vide* Fell, 1976, p. 55).

Sponges reproduce both asexually and sexually. The former mode being of vast importance, was first noted by Hogg (1841a, p. 366) when he found the "seed-like bodies" or statoblasts germinated in water to reproduce the animal, and the latter mode was discovered by Lieberkuhn (1856) when he observed the ova along with the spermatozoa, although, Carter (1854, 1857) was also engaged in the study.

Regarding freshwater sponges, till recent date no definite information could be unearthed regarding mode of sexual reproduction. Simpson and Gilbert (1973) as a result of histological preparation of some freshwater sponges discovered a regular timing in development of eggs, sperm, as well as of gemmules. Though, yet the sexual mode requires to be definitely explored, basic evidence is already available supporting the assumption of occurrence of hybridism within the group, possibly due to drastic habitat change.

More information has been amassed regarding asexual methods. For instance, in ecologically variable habitats many species show the adoption of specialised methods like development of gemmules, and surface buds, the former in response to long-term environmental changes, and the latter for environmental stress of short duration.

(ix) *Symbiosis* :

Many spongillid species reportedly have symbiotic relationship with the species of algae present within the cells.

This association is as yet not fully understood, though Gilbert and Allen (1973) seem to have clarified the exact relationship between the two organisms. Their findings suggest that *Spongilla lacustris* is an efficient agent for photosynthetic activity which has been found to be seemingly related and conditioned by the temperature fluctuations of the surrounding water as well as intensity of available light. Also revelaed by them was that during photosynthesis the host sponge could utilise the carbon excreted by the algae. The presence of intracellular zoochlorellae has been reported also to aid in survival of sponge species.

(x) *Commensalism* :

As an example of commensalism connecting sponges with other groups of animals, mention may be made of the occurrence inside the body, of ciliates, small crabs, shrimps, insect larvae, water mites, nematodes, polychaetes, oligochaetes, ophiuroids, mollusc, ascidians, etc. Fishes (*Gobius alcockii*, and *Percilia gillisi* have also been reported to lay eggs inside the osculum of *Eunapius carteri*, and *E. mackayi* (=*E. igloviformis*) respectively, and this relationship may indicate intentional or accidental lodgment. The effect of commensalism, whether physiological or morphological, is practically insignificant. Whatever, modifications take place are at the behavioural level. An account of this subject is to be found in Annandale (1906 b). However, tissue reaction cannot be ignored.

(xi) *Water pollution* :

There is little or no published material covering a very significant aspect of sponge ecology namely, its bearing on the pollution of aquatic environment which certainly has some economic effect. By virtue of the restricted physicochemical parameters within which only the sponge can normally survive, it is obvious that this fixed relationship can be of very useful significance in assessing the physicochemical condition of the surrounding water, and this monitoring value has been vary clearly revealed in the recent works of Racek (1966, 1970, 1974) where paleolimnological

analysis definitely indicated the constant relationship between spicular contents of sediment core and environmental analysis; and this has been fully supported by Harrison (1974, 1988), Harrison *et al.* (1979), Hall and Harrmann (1980), Harrison and Warner (1986).

It may be observed that a fuller understanding of the relevant systematics as also of ecological factors involved, would be helpful in wider application of water quality studies.

(xii) *Temperature* :

In the aquatic environment, no other single factor has so much moulding effect, both directly and indirectly, as temperature, and as such, the sponge which is an entirely aquatic denizen shows very deep relationship with the fluctuations in temperature especially as far as not only its life cycle is concerned, but also its morphology which may be delimited by it. According to Annandale (1913, p. 74) the production of gemmules was accompanied by change in temperature, for he observed in temperate European forms this phenomenon occurred in winter whereas, of forms in tropical Asia, such production took place in summer. Moore (1953, p. 31) also upheld this view when he stated that, "of the habitat factors studied, temperature appeared to be the most critical single factor." Poirrier (1969) stated that higher temperatute 30°C+) could affect the gemmulation process in seasonal forms of freshwater sponges though Harrison (1974, p. 34) expressed doubts about the temperature range. Harrison and Cowden (1983) opined fluctuating watet levels for gemmule formation. However, the present author does not like to emphasise any single factor in affecting the sponges as more than one has to be taken into consideration for producing morphological or physiological changes. Thus, declining water level was found, associated with high temperature in causing sponge degeneration *vide* Moore's (*op. cit.*) observations noted by Harrison (*op. cit.*). Volkmer-Ribeiro (1981b, p. 86) also considered more than one factor namely temperature and water level as principally influencing the growth and appearance of individuals.

Many freshwater species, to tide over short-term inimical ecological changes, adopt the mechanism of reduction in body size during their life cycle. This process is effected by the curling up and withdrawal of body tissue whereby several types of cells are lost and degenerated processes affect others. Deeper down are observable the degeneration of rough endoplasmic reticulum and the formation of typical cytopathological "myelin figures". With the return of favourable habitat situations, restoration may be effected through somatic embryogenesis of its normal shape and structure. In laboratory culture, it has been found that the system serves excellently for cytological and biochemical studies of both degenerative and regenerative process.

IV. COLLECTION AND PRESERVATION

Freshwater sponges, which like their marine cousins are entirely aquatic, attach themselves firmly to any suitable substratum on upper or lower surfaces below water level such as boulders, logs, dam walls, iron pipes, molluscan shells, pebbles, algal entanglements, bushes, and even loose soil. They are variable in size, some being very minute and others extremely large, covering the entire substratum and even extending to several meters, depending on the species, age, and various ecological conditions, and they can be detached with a sharp knife. The basic procedures involved in field collection are described by Potts (1887, p. 163); and the methods for preparing them for examination by Jewell (1959, p. 299), and Schwoerbel (1970, p. 160), while both techniques have been noted by Volkmer-Ribeiro (1981, p. 87). If possible, sponges may also be collected from the guts of sponge eating fishes as recommended by Volkmer-Ribeiro and Grosser (1981, p. 176). Unlike as in the case of marine specimens for which entire individual is necessary, for freshwater forms only parts bearing gemmules are sufficient. It should be borne in mind that to describe a spongillid specimen lacking gemmules is scientifically unwarranted. It may be observed that the best period of the year to collect them is the time when they have formed gemmules, for without gemmules it is difficult to ascertain their specific identity, as in the

current taxonomy, gemmule and gemmosclere morphology play a vital part for diagnostic purposes, though the taxonomic importance of microscleres cannot be ignored. Harrison (1981) demonstrated that the application of scanning electron microscopy to systematic studies of freshwater sponges provided diagnostic capabilities not possible with light microscopy.

The preparation of the material for study purposes will be conditioned by the particular purpose involved, viz. whether for taxonomic or histological. For taxonomic purpose, following the popular method of Bowerbank (1864, p. 225) for obtaining permanent mounts of spicules, small pieces of the body are dissolved in concentrated nitric acid by which the siliceous spicules are freed from the matrix. The separation and sedimentation of the spicules is hastened by frequent shaking, and clearing is achieved by a couple of washings in distilled water before final mounting in balsam or damar on slides. Further details on this aspect can be found in Pennak (1978).

For histological purposes, it is important to treat small parts measuring five cubic millimeter pieces of sponge in Bouin's or ethanolacetic acid (3 : 1) as recommended by Harrison and Simpson (1976, p. 4). After fixation, specimens should be processed through washes, and stored in 70% ethyl alcohol. The remainder of the specimen may be just stored wet in 70% alcohol, or as a dry specimen.

V. IDENTIFICATION

Sponges are generally subject to great seasonal, geographic, and habitat variability which occurs not only among difierent species but also in individuals of the same species. Hence, their external form, size, body consistency, and colour as diagnostic characters are obviously unreliable. In freshwater sponges, it is the spicules, always formed of silica, which are the determining character, and three types are clearly separated, the skeletal, the flesh, and the gemmule. Although, available morphological observations clearly indicate that environmental, physiological, and genotypical factors do influence the spicular form, still these very variations in

spicular morphology such as, their microspination patterns can serve to give most valuable taxonomic clues. Hence, a precise and useful description of the range and nature of the variation between individual specimens, populations or taxa is very necessary for a better understanding of the various fluctuations, whether phenotypic or genotypic, or even both.

The spicules are materially formed of 92 per cent silicon dioxide, 7 per cent water, and trace quantities of magnesium, potassium and sodium (Butschli, 1901). For the formation of their spicule, sponges use only dissolved silicic acid and not quartz (*vide* Jorgenesen, 1947). The correlation between silica concentration and size and formation of spicules has been studied by several workers.

TYPES OF SPONGE SPICULES

1. *Skeletal spicules or Megascleres*

The skeletal spicules which form the main supportive structure upon which the body of the sponge is built up, are slightly bound together by an almost invisible quantity of firmer arcode or perhaps of colloidal silica. These spicules preserve their usual structure intra-specifically under normal conditions. They are usually needle-shaped or rounded at both ends, and both may be covered with very fine spines, and vary much in length and thickness. Gee (1932 e, p. 527) observing specific variations in thickness of skeleton spicules of forms from different localities was not definite as to their cause, whether it was due to the poor silica concentration in the habitat, considered important by Jorgensen (1944), or to the nature of the sponge itself. Regarding such variations in sponges from Posing River, he (p. 539) assigned them to the inadequacy of proper materials in the river for the formation of more robust spicules as present in other localities. He (p. 528) also very commonly observed bulbous swellings in some specimens. The present author too has observed in some forms such structures which he takes as examples of spicular malformation associated with damaged chemistry of the habitat water.

2. *Flesh spicules or Microscleres*

The flesh spicules when present, lie embedded in the parenchyma, and are generally much smaller than the skeletals and are never bound together. In shape, they may be needle-like, of very irregular form, or birotulate, and may be spiny or smooth ; and they may be utilised for generic and specific identification.

3. *Gemmule spicules or Gemmoscleres*

The spicules covering the gemmule, first designated by Penney and Racek (1968) as "gemmoscleres", form the most important criterion in particular for those spongillids lacking true microscleres ; and in their absence reliable identification is extremely difficult. There is a lot of gradations in shape and structure of these scleres ranging from the simple smooth or spiny amphioxea and amphistrongyla to more complex ones such as, scleres showing unilateral or concentric aggregations of terminal spines, birotulates with various marginal incisions, or with entire margins, and finally tubelliform and parmudiform ones. Their shape and structure may be greatly modified by the impact of environment or as the probable result of hybridization.

Gemmules

The possession of these structures is the chief characteristic of freshwater sponges, forming their basic means of dispersal as well as identification. They have been defined in several ways by different authors. Racek (1974, p. 150) viewed them as "asexual reproductive bodies capable of passive dispersal." According to Pennak (1978, p. 86) they were "Briefly, a gemmule is a spherical structure with a multiple, dead, secreted outer layer, a covering of spicules, and an internal mass of undifferentiated mesenchymal amoebocytes....." Volkmer-Ribeiro (1981 b, p. 87) whose work is advancement on Penney and Racek (1968, pp. 5-6), and Bergquist (1978, p. 257) held them as "products of asexual reproduction each covered by an acellular protective coating, which commonly is encrusted with gemmoscleres. The protective covering generally is composed of an internal

layer, a medial or pneumatic layer (containing air chambers) and an external layer. The gemmules have one or more external orifices ; micropyles or foramina, with or without a foraminal tube. This is an expansion of the internal layer through the micropyle to the exterior. The most useful gemmule characteristics are the structure and thickness of the pneumatic layer, the structure of the micropyle or foraminal tube, and the arrangement of the gemmoscleres. Other useful characteristics are the location of the gemmules and their attachment and grouping within the sponge." But due cognissance should definitely be taken of the intrusion of ecomorphic changes brought about by environmental impact while assessing the really valid structural variations for taxonomic purposes.

VI. CURRENT SYSTEMATIC PROBLEMS

Till the middle of the current century, freshwater sponge taxonomy lay in a confused mess when through the painstaking efforts of Penney and Racek (1968) a certain amount of clarification and definition was introduced, and the general global pattern of evolution of gemmule-forming spongillids was hopefully traced out. In the systematics of these forms, the skeletal and gemmule morphology play significant roles. At present, a more wider realisation of the confusing intrusion of the ecomorphic changes into the genetically induced morphic variations has necessitated a more discriminative approach. It is necessary not to rashly misinterpret as genetic differences the slight variations in spicular morphology in different populations. Inspite of the fact that speciation process were far from static, many ecomorphs have been held as valid species. True geographic variation is generally confused by the regional ecomorphic changes.

Inspite of considerable contributions in this century on the group which certainly helped to overcome a number of taxonomic complexities, a stable nomenclature was sadly lacking. It is most regretable that a unified and generally accepted nomenclature common to both freshwater and marine sponges has not yet been evolved due primarily to the absence of co-ordinated studies by different specialists.

When this is undertaken, it would greatly assist in the assessment of the evolutionary interrelationship of the members within the phylum.

The present systematic experience still urges the merging of good many species of freshwater sponges hitherto held as separate. In fact, this has been realised more than half a century back first by Gee and Wu (1928-29, p. 38), and then by Gee (1932 d, pp. 533-534) when he stated that "I find such great variation in sponges that I am more inclined now than I formerly was to 'lump' rather than to 'split' forms."

It may be remarked here that in India, studies hither to conducted on sponges were entirely based on surveys very inadequate and confined only to a few areas of the then larger territory that formed British India. Further, the methods then employed are now considered defective. For instance, no consideration was given to the physico-chemical parameters of that habitat, statistical techniques, biochemical patterns, etc. which are now found of vital importance for the purpose of proper taxonomic assessment, as merely to collect, name, classify, and study them in isolation in the hitherto traditional way may not really serve the purpose. As a matter of fact, it has now been detected that most of the "species" have been erroneously based on ecomorphic variations. Hence, it is absolutely essential that more intensive and extensive surveys have to be conducted for a more valid determination of the existing taxa based on a wide series of specimens from different habitats, not ignoring to take into full account such essential factors as sexual hybridization, malformations (caused by abnormal environmental reactions), seaaonal variations, and speciation trends particularly in distant populations.

VII. SYSTEMATIC ACCOUNT

PHYLUM PORIFERA Grant, 1872
Class DEMOSPONGIAE Sollas, 1875
Order HAPLOSCLERIDA Topsent, 1898
Family SPONGILLIDAE Gray, 1867

1867. Spongilladae Gray, *Proc. zool. Soc. Lond.*, 1867, p. 550.
1881. Spongillidae : Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 77.

1911. Spongillidae : Annadale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 27.

1968. Spongillidae : Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p. 6.

1976. Spongillidae : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Pap., No. 4, p. 2.

1982. Spongillidae : Soota and Pattanayak, *Rec. zool. Surv. India,* **80**, p. 215.

Remarks : The history of family Spongillidae to which a great majority of freshwater sponges belong, has been elaborately dealt with by Bowerbank (1863), and Carter (1881 a), and referred to by Potts (1887, p. 158). Subsequently, following a sort of historical summary included by Marshall in his work (1883), recently Jewell (1952), and Penney and Racek (1968) gave a more elaborate treatment of the subject, and this was referred to by Volkmer-Ribeiro (1981b, p. 87). For quite a long time, attempt at a true systematic definition of "Spongillids" has been either evaded or futile, being given in terms of environmental affinity namely, degree of the salinity of the habitat. Thus, de Laubenfels (1936, p. 34) stated that "This family as here considered is quite frankly defined as consisting of those sponges occurring normally in fresh or occasionally in brackish water". This introduction of ecology vitiates acceptable systematic definition as very aptly pointed out by Penney and Racek (*op. cit.*), who opined that the freshwater forms are essentially a conglomerate ; and a little later Harrison (1974, p. 30) considered them in all probability taking an origin from different evolutionary points. Bergquist's (1978, p. 174) attempt also may be considered unsatisfactory. Hence, it is clearly apparent that definition of the family is still far from clear or final.

Under the circumstances, the author is in perfect agreement with Penney and Racek (*op. cit.*) for the non-splitting of the family Spongillidae into subfamilies, though accepted by many others.

Key to the identification of the Indian genera of Spongillidae

1.	Gemmoscleres spiny amphioxea or amphistrongyla.	... ...	2
	Gemmoscleres birotulates.	... ...	6
	Gemmoscleres otherwise.	... ...	9

2.	Microsclres absent. ...	...	3
	Microscleres present. ...	...	4
3.	Gemmoscleres tangentially embedded in a very thick pneumatic coat consisting of several layers of large polygonal air spaces. ...	*Eunapius* Gray, 1867	
	Gemmoscleres radially embedded in a thick pneumatic coat consisting of air spaces of small size, and also with larger spines aggregated at tip of scleres as sceptor-like termination or pseudorotules...	*Radiospongilla* Penney and Racek, 1968.	
4.	Microscleres amphioxea. ...	...	5
5.	Foramen simple. ...	*Spongilla* Lamarck, 1816	
	Foramen tubular. ...	*Stratospongilla* Annandale, 1909	
	Microscleres minute, slender, birotulates...	*Corvospongilla* Annandale, 1911	
6.	Microscleres absent. ...	...	7
	Microscleres present. ...	...	8
7.	Gemmosclres with both rotules flat. ...	*Ephydatia* Lamouroux, 1816	
	Gemmoscleres with both rotules circular...	*Trochospongilla* Vejdovsky, 1883	
	Gemmoscleres with both rotules umbonate. ...	*Umborotula* Penney and Racek, 1968	
8.	Gemmoscleres with both rotules umbonate. ...	*Dosilia* Gray, 1867	
	Gemmoscleres with lower rotule circular or irregularly polygonal ; upper invariably knoblike. ...	*Metania Gray*, 1867	
9.	Gemmoscleres terminally with a unilateral arrangement of spines in shape of hair brush. ...	*Pectispongilla* Annandale, 1909	

Genus I. **Spongilla** Lamarck, 1816

1758. *Spongia* Linnaeus, *Systema Naturae*, 10th ed., **1**, Animalia, p. 1348 (part).

1816. *Spongilla* Lamarck, *Histoire naturelle des animaux sans vertebres*, **2**, p. 98 (part).

1883. *Euspongilla* Vejdovsky, *Abh. K. Bohm. Ges. Wiss.* **12** (5), p. 15.

1911. *Spongilla* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 69 (part).

1968. *Spongilla* : Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p. 7.

1976. *Spongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 16.

1982. *Spongilla* : Soota and Pattanayak, *Rec. zool. Surv. India,* **80**, p. 223.

Type-species.—*Spongia lacustris* Linnaeus, 1758 [By subsequent designation, Annandale, 1911c].

Definition : Megascleres—amphioxea, always slender to stout, usually entirely smooth.

Microscleres—amphioxea, slender, present in dermal membrane and symplasm, completely spined and different from gemmoscleres.

Gemmoscleres—if present, amphioxea to amphistrongyla, stout, strongly spined, with varying curvature.

Gemmules—spherical, large, numerous, normally occurring throughout body, usually with a moderately strong granular pneumatic layer showing very small nonpolygonal air spaces and with gemmoscleres embedded in it tangentially ; sometimes lacking pneumatic layer and gemmoscleres, as a result either totally unprotected, or ensheathed in surrounding groups of normal or slightly modified megascleres ; foramen or foramina simple to slightly cup-shaped, never markedly tubular.

Sponges generally massive, or extending from an irregular base into elongated tubular branches ; frequently from dull to brilliant green in colour due to presence of zoochlorellae ; sometimes without particular colour due to lack of these bodies ; consistency quite hard, though often brittle.

Distribution : According to Penney and Racek (1968) worldwide, although each species definitely delimited by geographic zones.

Remarks : When Linnaeue (1758) established his genus *Spongia* describing under it two freshwater species, viz. *S.*

lacustris and *S. fluviatilis* based on their shape and colour, there was no method of assessing the deeper morphological characters. Lamouroux (1816) transferred both the species under his own genus *Ephydatia*. In the same year, another genus *Spongilla* was created by Lamarck who supplemented to the diagnostic key of habitat, the structural character the presence of reproductive gemmules as a basis of separation of this genus from marine forms. By then, though the name "Spongia" was more than once changed, that of *Spongilla* instituted for the genus took precedence of all the rest. Meyen (1839) drew attention to the fact that the crust of sphaerula or seed-like body was made up of vertically placed spicula whose either ends terminated in more or less toothed little discs ; and further, in addition to the more familiar simple larger spicules within the substance of the sponge, there also exist others more delicate ones having upon their surface little points. Obviously these two kinds of spicules were to be used as a basis of separation of *Spongilla fluviatilis* and *S. lacustris* respectively. Finally, it was left to Lieberkühn (1856) to use these separate characters to distinguish *S. fluviatilis* from *S. lacustris*, and this was confirmed by Bowerbank (1863). Hence, the separation of the two species was made to rest on more morphological grounds.

According to Penney and Racek (*op. cit.*), and Racek and Harrison (1974), the genus comprised of two groups of species distinguished from each other on the basis of morphological, environmental and distributional grounds.

Hitherto, under the genus, only two species, viz. *S. alba* and *S. lacustris* (=*S. arctica* Annandale, 1915) are known from this area ; a tentative key for them is given below. *S. jammuensis* Malhotra *etal.*, 1977, described in abstract, has been excluded.

Gemmoscleres with spines uniformly distributed along shaft ; microscleres with almost equal spines uniformly distributed ; both characters varying with habitat. ...	*S. lacustris*
Gemmoscleres with spines concentrated at ends of shaft ; microscleres with spines more prominent centrally. ...	*S. alba*

1. **Spongilla alba** Carter, 1849

(Text-fig. 1, A-C)

1849. *Spongilla alba* Carter, *Ann. Mag. nat. Hist.*, **4**, p. 83.

1906. *Spongilla lacustris* var. *bengalensis* Annandale, *J. Asiat. Soc. Beng.*, 2, p. 56.

1907. *Spongilla alba* var. *marina* Annandale, *Rec. Indian Mus.*, **1**, p. 389.

1909. *Spongilla travancorica* Annandale, *Rec. Indian Mus.*, **3**, p. 101.

1909. *Spongilla microsclerifera* Annandale, *Proc. U. S. natn. Mus.*, **37**, p. 131.

1911. *Spongilla alba* var. *bengalensis* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 81.

1915. *Spongilla nana* Annandale, *Mem. Indian Mus.*, 5 (1), p. 31.

1919. *Spongill alba* var. *rhadinea* Annandale, *Rec. Indian Mus.*, **18**, p. 85.

1968. *Spongilla alba* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 16.

1976. *Spongilla alba* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 16.

1982. *Spongilla alba* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 224.

1987. *Spongilla alba* : Soota, *Fauna of Orissa* ; *State Fauna Series* I, p. 66 (Publ. Zool. Surv. India).

Description : Sponge forming bulky growths, or very large encrrustations ; surface smooth though slightly lobose with irregular projections ; oscula fairly large, generally not prominent ; dermal membrane closely adherent to symplasm ; skeleton formed by quite close network of slender primary and secondary spicule fibers, bound together by only little spongin ; consistency of live sponge firm though brittle.

Megascleres-amphioxea, fusiform, slender to stout, entirely smooth, 225-240 μ long, 6-22 μ wide.

Microscleres-amphioxea, innumerable in dermal membrane and symplasm, very slender and slightly curved, completely covered with erect spines which being more prominent and longer in central region and often with knoblike inflations at their tips, 75-125 μ long, 2-3 μ wide.

Gemmoscleres-amphistrongyla, rarely amphioxea, slender, cylindrical, feebly curved and covered with large and recurved spines which often in greater number at tips of scleres where occasionally forming several annular groupings ; 78-130 μ long, 5-10 μ wide.

Gemmules-spherical, large, very numerous, occurring throughout body ; pneumatic layer quite thick, clearly granular in which gemmoscleres embedded rather sparsely at irregular angles with their tips usually protruding out of layer ; foramen slightly elevated but never tubular and normally with a shallow peripheral collar ; 500-600 μ in diameter.

Distribution ; This species which has been reported both from fresh and low salinity waters, is of wide occurrence having been recorded from SE Asia, Africa, Australia, South America, and U. S. A. (Florida & Louissiana), and also from India-North Salt Lake, 24-Parganas ; Port Canning and Calcutta (West Bengal), Rambha and Lake Chilka (Orissa), Bombay and Igatpuri (Maharashtra), and back waters in Kerala. However. its clear distribution is still debatable in view of the fact that according to Racek and Harrison (1975, p, 163) the species shows observable speciation trends from South America northward ; while it has been shown by Poirrier (1976, p. 211) that though its distribution is conditioned by percentage in water salinity of the habitat, probably more commonly restricted to tropical and subtropical climates, its occurrence in temperate latitudes cannot be ruled out.

Colour in life : Pale grey to off white.

Remarks : This species, considered as a good water quality indicator by Poirrier (*op. cit.* p. 203) and described under several different names as shown under the synonymy, has been dealt very elaborately by Poirrier *etal.* (1987).

Carter (1881a) confusingly considered *S. cerebellata* Bowerbank, 1863, a variety of this species. Annandale's (1906, 1907, 1909, 1915, 1919) several forms were just ecomorphic varieties as shown by Penney and Racek (1968). Poirrier's (1976) merging with it of *Spongilla wagneri* Potts, 1889, can not be accepted as final pending the examination of more material.

2. **Spongilla lacustris** (Linnaeus, 1758)

(Text-fig. 1, D-F)

1758. *Spongia lacustris* Linnaeus, *Systema Naturae,* 10th ed., **1**, Animalia, p. 1348.

1816. *Spongilla ramosa* Lamarck, *Histoire naturelle des animaux sans vertebres,* **2**, p. 100.

1816. *Ephydatia lacustris* Lamouroux, *Histoire des polypiers coralligenes flexibles, vulgairement nommes Zoophytes,* p. 7.

1842. *Spongilla lacustris* Johnston, *History of the British Zoophytes,* 2nd ed., London, p. 110.

1842. *Spongilla dawsoni* Bowerbank, *Proc. zool. Soc. Lond.,* 1863, p. 467.

1863. *Spongilla paupercula* Bowerbank, *Proc. zool. Soc. Lond.,* 1863, p. 470.

1867. *Eunapius paupercula* Gray, *Proc. zool. Soc. Lond.,* 1867. p. 552.

1870. *Spongilla lieberkuhni* Noll, Flussaquarien. *Zool. Garten,* **11**, p. 173.

1877. *Spongilla jordanensis* Vejdovsky, *Vesmir,* **6**, p. 212.

1878. *Spongilla flexispina* Dawsan, *Can. Nat.,* **8**, p. 1.

1880. *Spongilla montana* Potts, *Proc. Acad. nat. Sci. Philad.,* p. 330.

1880. *Spongilla abortiva* Potts, *Proc. Acad. nat. Sci. Philad,* p. 330.

1881. *Spongilla multiformis* Carter, *Ann. Mag. nat. Hisi.* (5), **7**, p. 88.

1883. *Euspongilla lacustris* Vejdovsky, *Abh. k. Bohm. Ges. Wiss.,* **12** (5), p. 15.

1883. *Spongilla rhenana* Retzer, *Inaug. Dissert. Univ. Tubingen,* p. 21.

1883. *Spongilla erinaceus* Retzer, *Inaug. Dissert. Univ. Tubingen,* p. 24 (part).

1883. *Spongilla mirabilis* Retzer, *Inaug. Dissert. Univ. Tubingen,* p. 25 (part).

1883. *Suspongilla lacustris* var. *macrotheca* Vejdovsky, *Abh. k. Bohm. Ges. Wiss.,* **12** (5), p. 18.

1883. *Euspongilla jordanensis* Vejdovsky, *Abh. K. Bohm. Ges. Wiss.,* **12** (5), p. 20.

1883. *Euspongilla jordanensis* var. *druliaeformis* Vejdovsky, *Abh. K. Bohm. Ges. Wiss.,* **12** (5), p. 22.

1885. *Spongilla lacustris* var. *dawsoni* Mackay, *Proc. Trans. Nova Scotia Inst. Nat. Sci.,* **6**, p. 233.

1885. *Spongilla lacustrioides* Mackay, *Proc. Trans. Nova Scotia Inst. Nat. Sci.,* **6**, p. 240.

1887. *Spongilla lacustris* var. *abortiva* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 191.

1887. *Spongilla lacustris* var. *multiforis* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 192.

1887. *Spongilla lacustris* var. *montana* Potts, *Proc. Abad. nat. Sci. Philad.*, p. 192.

1887. *Spongilla lacustris* var. *lehighensis* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 193.

1891. *Spongilla lacustris* var. *paupercula* Kellicott, *Bull. Buffalo Soc. nat. Sci.*, **5**, p. 101.

1901. *Euspongilla lacustris* var. *lieberkuhni* Levander, *Fauna Flora fenn.*, **27**, p. 56.

1901. *Spongilla microgemmata* Swartschewsky, *Notizen Kiew Ges. Naturf.*, **14**, p. 346.

1911. *Spongilla lacustris* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 69.

1915. *Spongilla* (*Euspongilla*) *arctica* Annandale, *Mem. Acad. Imp. Sci. St. Petersbourg*, **27**, p. 1.

1919. *Spongilla lacustris* var. *ineptorum* Annandale, *Rec. Indian Mus.*, **18**, p. 86.

1925. *Spongilla lacustroides* Kozhoff, *Bull. int. Sci. biol. Geogr. Univ. Irkoutsk*, **2** (2), p. 45.

1925. *Spongilla fenestrata* Kozhoff, *Bull. int. Sci. biol. Geogr. Univ. Irkoutsk*, **2** (2), p. 50.

1925. *Spongilla crustacea* Kozhoff, *Bull. int. Sci. biol. Geogr. Univ. Irkoutsk*, **2** (2), p. 52.

1926. *Spongilla lacustris* var. *jordanensis Arndt, Arch. Hydrobiol.*, **17**, p. 342.

1926. *Spongilla lacustris* var. *rhenana* Arndt, *Arch. Hydrobiol.*, **17**, p. 342.

1930. *Spongilla lacustroides corticea* Kozhoff, *Zool. Anz.*, **90**, p. 158.

1931. *Spongilla lacustris* var. *crustacea* Gee, *Peking nat. Hist. Bull.* **5** (1), p. 38.

1931. *Spongilla lacustris* var. *fenestrata* Gee, *Peking nat. Hist. Bull.*, **5** (1), p. 38.

1931. *Spongilla lacustris* var. *lacustroides* Gee, *Peking nat. Hist. Bull.*, **5** (1), p. 40.

1968. *Spongilla lacustris* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 9.

1976. *Spongilla lacustris* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 17.

1982. *Spongilla lacustris* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 224.

Description : Mature sponge generally extended into long tubular lobes from an irregular base which in lotic surrounding as absent or reduced ; surface usually hispid, seldom even ; oscula not prominent and small ; dermal membrane well-developed, skeleton formed of polyspicular longitudinal fibers, ensheathed in thick spongin and secondary transverse fibers which variable in number ; consistency of live sponge soft but quite rigid ; skeleton of dry sponge very fragile.

Megascleres—amphioxea, slightly curved or straight, normally fusiform, always completely smooth ; 200-350 μ long, 6-20 μ wide.

Microscleres—amphioxea, slightly curved, abundant in dermal membrane and symplasm, normally completely covered with small spines or granules of more or less equal size and uniformly distributed but variable from different habitats and geographic areas, 70-130 μ long, 2-8 μ wide ; in some very acid habitats 50-60 μ long and fairly thick.

Gemmoscleres—if present, amphioxea or amphistrongyla, quite thick and slightly to sharply curved, normally covered with strong, curved spines, very rarely smooth ; but variable like microscleres in acid habitats ; 80-130 μ long, 3-10 μ wide.

Gemmules—spherical and large, in mature sponge numerous, occurring throughout body ; pneumatic layer either clearly formed, ill-defined, or totally absent ; gemmoscleres, if present, embedded irregularly but normally absent when layer lacking ; foramen usually simple, or showing a shallow peripheral collar ; 500-800 μ in diameter.

Distributian : According to Penney and Racek (1968), distribution restricted to Northern Hemisphere especially in cold temperate ; but reported from India—Simla (Himachal Pradesh), Udhampur (Jammu), Ranchi (Bihar), Igatpuri (Maharashtra), and Mysore (Karnataka).

Colour in life : Usually drab to bright green due to presence of varying number of zoochlorellae.

Remarks : This species, which is one of the earliest known and originally described by Linnaeus as *Spongia lacustris*, later renamed as *Spongilla lacustris* and subsequently accepted by workers, has been dealt very elaborately by Poirrier *et al.* (1987). The species occurs in a variety of water conditions (Harrison, 1974), and is very variable as noted by Potts (1887) *vide* Annandale's (1906 a, pp. 56-57) quotation ".....that Potts (1887) in his monograph of the Freshwater Sponges of the world, recognised six varieties in addition to the typical form", which recognition has been supported by Poirrier (1969, p. 8), and Poirrier *et al.* (*op. cit.*, p. 302), though in the latter reference doubt is expressed as to the extent of the genetic or ecophenotypic influences associated with the variations.

Gee (1932 c, p. 36) doubtfully treated *Spongilla arctica* Annandale, 1915, as its synonym, and Holmquist (1973) definitely held both as conspecific. Eshleman (1950, p. 37) opined *Spongilla wagneri* Potts merely a phase of *S. lacustris*.

Poirrier (1976, p. 211) urged the confirmation of the occurrence of *Spongilla lacustris* in brackish waters as recorded earlier (Tendel, 1967 ; Gosner, 1971). as they could have been based on *S. alba*. Miller (1964) observed that growth and survival of *S. lacustris* is enhanced by the presence of symbiotic algae. Frost (1976) noted that the filtering activity of the sponge may be influenced by the presence within of zoochlorellae, and Williamson and Williamson (1979) seem to have detected the role of these latter in augmenting the host's nutrition. According to Frost and Williamson (1980) symbionts' contribution appears important to the high growth rate of the sponge and the latter's successful survival in the soft-bottom habitats.

Genus II. **Eunapius** Gray, 1867

1851. *Spongilla* Leidy, *Proc. Acad. nat. Sci. Philad.*, **5**, p. 278.

1867. *Eunapius* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 552.

1911. *Spongilla* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 95 (part).

1968. *Eunapius* : Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p. 21.

1976. *Eunapius* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 6.

1982. *Eunapius* : Soota and Pattanayak, *Rec. zool. Surv. India,* 80, p. 219.

Type-species.—*Spongilla carteri* Bowerbank, 1863 [By subsequent designation, Annandale, 1911, for the subgenus *Spongilla* (*Eunapius*)].

Definition : Megascleres—amphioxea or amphistrongyla, stout, normally entirely smooth, rarely strongly spined.

Microscleres—absent.

Gemmoscleres—amphioxea or amphistrongyla, normally strongly spined and only slightly curved.

Gemmules—frequently more or less flattened, relatively small and having well-developed pneumatic layer with clearly several tiers of large and prominent polygonal air spaces like plant tissue, and often surrounding groups of gemmules or entire pavement layer ; gemmoscleres embedded in this layer strictly tangentially and irregularly in inter space between gemmules, which latter quite numerous and occurring in entire body singly or coherently, or forming at base clear pavement layer ; foramen always tubular, at least extending to surface of pneumatic coat ; tube straight or strongly curved.

Sponges normally forming flat encrustations, seldom bulky, generally lacking distinct protuberances ; colour usually drab gray due to normally absence of zoochlorellae ; consistency very fragile to very tough.

Distribution : Worldwide, from the northern polar region to cold-temperate regions of the Southern Hemisphere.

Remarks : Gray (1867) separated those members of the genus *Spongilla* Lamarck, 1816, showing "areolated" and 'reticulate" pneumatic coats, and placing them under his newly established genus *Eunapius*, included then only two

species under it. But this especially as Annandale's (1911) treating it a subgenus under *Spongilla*, was not generally accepted by the later workers. Penney and Racek (1968), however, upheld it as a distinct genus and this was followed by others. *Eunapius* is more closely related to *Stratospongilla* Annandale, 1909, and *Corvospongilla* Annandale, 1911 ; and characterized by showing the presence of polygonal or columnar air spaces of the gemmular pneumatic coat, the strictly tangential arrangement of gemmoscleres in this layer, and the absence of free microscleres from both inner symplasm and dermal membrane. According to Racek (1969, p. 271) "Speciation trends in some species of wide distribution are perceptible but as yet difficult to demonstrate." He (p. 304) further stated that "It is quite interesting to note that those genera which seem unaffected by wide pH fluctuations, e. g. *Eunapius* and *Ephydatia*, have a truly world-wide distribution." Hitherto, from this area, under the genus are known four species of which a key is given below :

1.	Megascleres apmphistrongyla. ...	*E. crassissimus*	
	Megascleres amphioxea. ...	...	2
2.	Gemmoscleres similar in shape and structure to megascleres but smaller. ...	*E. carteri*	
	Gemmoscleres not so ...	...	3
3.	Gemmules bound together in pairs irrespective of their location. ...	*E. geminus*	
	Gemmules bound together in free groups of more than two. ...	*E. calcuttanus*	

3. **Eunapius calcuttanus** (Annandale, 1911) (Text-fig. 1, G & H)

1911. *Spongilla fragilis* subsp. *calcuttana* Annandale, *Fauna, British India*, Freshwater sponges, hydroids and Polyzoa, p. 96.

1968. *Eunapius calcuttanus* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 28.

1976. *Eunapius calcuttanus* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 6.

1982. *Eunapius calcuttanus* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 220.

Description : Mature sponge always forming variably sized flat encrustations, with characteristically smooth and normally even surface ; oscula prominent, though small, frequently producing radial canals in lotic habitats ; dermal membrane well formed ; skeleton formed of radial and transverse spicule fibers held in position by only small quantity of spongin ; consistency of live sponge very soft and fragile.

Megascleres—amphioxea, slender, fusiform and smooth, with tips a bit abruptly pointed and peculiar practically always showing more or less lanceolate apical projections, 170-230 μ long, 6-11 μ wide.

Microscleres—absent.

Gemmoscleres—amphistrongyla, very slender and cylindrical, covered all over with small and regular spines, which on tips of scleres recurved ; 80-120 μ long, 2-4 μ in diameter.

Gemmules—spherical and small, inner gemmular membrane 190-230 μ in diameter ; pneumatic layer well formed and thick, showing large polygonal air spaces and forming a continuous coat over gemmules ; gemmoscleres embedded in this layer tangentially over gemmular membrane, and irregularly in interstices, foramen as a rule tubular, porus tube prominently curved and long, well extending out of pneumatic layer surface.

Distribution : Barring an unconfirmed report from Burma, apparently restricted to India where reported from Calcutta, and 24-Parganas (West Bengal).

Colour in life : Light gray to light brown.

Remarks : This species was originally described by Annandale (1911c) as *Spongilla fragilis* var. *calcuttana* from Calcutta and accepted by later workers. Penney and Racek (1968) insisting on the striking differences of megascleres as well as gemmoscleres, treated it as a distinct species from the allied *E. fragilis*. Though, Soota and Pattanayak (1982) reported the species from 24-Parganas, still more material has to be examined from different areas for confirmation of the impact of environment on spicular structure.

4. **Eunapius carteri** (Bowerbank, 1863)

(Text-fig. 1, I & J)

1863. *Spongilla carteri* Bowerbank, *Proc. zool. Soc. Lond.*, 1863, p. 469.

1867. *Eunapius carteri* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 552.

1911. *Spongilla carteri* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 87.

1911. *Spongilla carteri* var. *cava* Annadale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 88.

1911. *Spongilla carteri* var. *mollis* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 88.

1911. *Spongilla carteri* var. *lobosa* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 89.

1913. *Spongilla aetheriae* Annandale, *Rec. Indian Mus.*, **9**, p. 237.

1923. *Spongilla carteri* var. *balatonensis* Arndt, *Zool. Anz.*, **56**, p. 79.

1923. *Spongilla carteri* var. *melli* Arndt, *Zool. Anz.*, **56**, p. 80.

1925. *Spongilla rotundacuta* Rezvoj, *Am. Mag. nat. Hist.*, **15**, p. 567.

1931. *Spongilla carteri* var. *rotundacuta* Gee, *Peking nat. Hist. Bull.*, **5** (1), p. 48.

1964. *Spongilla carteri* var. *cava* : Tonapi, *Curr. Sci.*, **33** (4), p. 363.

1968. *Eunapius carteri* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 23.

1975. *Spongilla carteri* : Malhotra and Dutta, *Geobios*, **2** (5), p. 158.

1976. *Eunapius carteri* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 5.

1978. *Spongilla carteri* : Kartha and Mookerjee, *Indian J. exp. Biol.*, **16** (8), p. 865.

1979. *Spongilla carteri* : Kartha and Mookerjee, *Indian J. exp. Biol.*, **17** (4), p. 439.

1980. *Eunapius carteri* : Dalal and Rawal, *Vidya*, **23** (2), B-Science, p. 73.

1982. *Eunapius carteri* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 221.

1983. *Eunapius carteri* : Soota *et al.*, *Geobios new Reports*, **2**, p. 151.

1983. *Eunapius carteri* : Soota and Saxena, *Trans. Isdt. & Ucds*, **8** (2), p. 132.

1986. *Eunapius carteri* : Patil, *Geobios new Reports*, **5** (2), p. 167.

1987. *Eunapius carteri* : Soota, *Fauna of Orissa* : *State Fauna Series* **I**, p. 66 (Publ. zool. Surv. India).

Description : Sponge forming irregular and variably sized masses ranging from thinnish to very thick growths with or without rounded or lobose elongations ; surface seldom smooth, more generally hispid ; oscula large, often opening from rounded elevations ; dermal membrane well developed ; skeleton formed of clear errect spicule fibers and a variable number of irregular transverse fibers, held in position by a sufficient quantity of spongin ; consistency of live sponge quite soft to fragile.

Megascleres—amphioxea, stout, fusiform, slightly curved, entirely smooth ; 265-370 μ long, 14-25 μ wide.

Microscleres—absent.

Gemmoscleres—resembling megascleres in form though much smaller, more curved, and sharply pointed ; 145-210 μ long, 5-8 μ wide.

Gemmules—spherical, comparatively large, very numerous in mature sponge, occurring singly throughout skeletal meshes ; pneumatic layer well developed and thick, consisting of several layers of regularly arranged polygonal air spaces in which gemmoscleres embedded tangentially or irregularly ; foramen clearly tubular ; porus tube straight, frequently a bit constricted proximally, terminating into a funnel-shaped depression in pneumatic layer distally ; 440-610 μ in diameter.

Distribution : confined from SE, S and W Asia to eastern Europe ; probably also in Africa. In India, widely represented in the plains and even extending to moderate heights.

Colour in life : Yellowish brown to tan.

Remarks : Taking into account Annandale's (1911c, p. 87), and Gee's (1932 d, p. 512) erroneously assigning authorship to Carter (1849), Penney and Racek (1968) reassigned it to Bowerbank (1863) who had first correctly identified it. As this species is very variable in form, Gee (1932e, p. 193) in his very convincing elaborations rightly treated as synonym of the species its five wrongly held "varieties", *cava*, *lobosa*. *mollis*, *balatonensis*, and *melli*, based on diversity in the mode of growth, and this was accepted by subsequent workers, and now followed here.

5. **Eunapius crassissimus** (Annandale, 1907) (Text-fig. 1, K & L)

1907. *Spongilla crassissima* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 17 & 26.

1907. *Spongilla crassior* Annandale, *Rec. Indian Mus.*, **1**, p. 389.

1907. *Spongilla crassissima* var. *bigemmulata* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 18 & 26.

1911. *Spongilla crassissima* var. *crassior* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 98.

1968. *Eunapius crassissimus* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 30.

1975. *Spongilla crassissima* : Bhatia and Saxena : *Annales Zool. Agra*, **11** (4), p. 103.

1976. *Eunapius crassissimus* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 7.

1982. *Eunapius crassissimus* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 219.

1987. *Eunapius crassissimus* : Soota, *Fauna of Orissa* : *State Fauna Ssries* **I**, p. 66 (Publ. Zool. Surv. India).

Description : Sponge forming bulky encrustations without striking projections but hispid due to protruding spicule fibers ; oscula together in star-shaped areas, prominent ; dermal membrane well-developed ; skeletal frame work of very firm spicule fibers and extensive spongin webs ; consistency of live sponge quite hard.

Megascleres—in mature form amphistrongyla, always stout, cylindrical, entirely smooth, often terminating in a minute projection ; immature megascleres often slender amphioxea ; 250-310 π long, 6-15 μ wide,

Microscleres—absent.

Gemmoscleres—amphistrongyla, rather short and cylindrical, or amphioxea, abruptly pointed, completely covered with small and irregular spines ; 80-120 μ long, 3-9 μ wide.

Gemmules—spherical, fairly abundant in mature sponge, normally restricted to base of sponge but not forming distinct pavement layer, sometimes in free groups of 4-8, also observed by the author in specimens from Ghagral river, Mirzapur (U. P.) ; inner gemmular membrane 280-310 μ in diameter, pneumatic layer well developed and thick, comprising of

large polygonal air spaces, and forming a continuous coat over gemmules ; gemmoscleres embedded in this layer invariably tangentially over gemmular membrane, and irregularly in interstices ; frequently arranged in two separate layers above gemmules, separated from each other by thick pneumatic coat ; foraman always tubular ; porus tube moderately long, rarely protruding out from surface of pneumatic layer.

Distribution : Reportedly represented in S and tropical SE Asia and possibly also in Australia. In India—reported from Calcutta (West Bengal), Sur Lake (Orissa), and Assam. However, the distribution of the species in Australia, requires to be more fully corroborated as in all probability it may be, considering the equally well protected gemmules of the species as those of *E. sinensis* (Annandale, 1910), sympatric with it.

Colour in life : Dark leaden gray to dull green.

Remarks : Excepting that its porus tube is conspicuously shorter, the gemmules and gemmoscleres are very similar to *Eunapius fragilis* ; and although the gemmules are often restricted to the base of the sponge, they rarely form a distinct pavement layer. The megascleres, when fully mature, are distinct amphistrongyla and the extensive amount of spongin involved in their binding renders the skeleton a high rigidity. Annandale (1907 b, p. 389), reported it growing together with *Spongilla alba* in the museum tank in Calcutta.

6. **Eunapius geminus** (Annandale, 1911)
(Text-fig. 1, M & N)

1911. *Spongilla gemina* Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 97.

1968. *Eunapius geminus* Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p, 32.

1976. *Eunapius geminus* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 8.

1982. *Eunapius geminus* : Soota and Pattanayak., *Rec. zool. Surv. India,* 80, p. 219.

Description : Sponge forming small and shallow circular cushions ; surface finely hispid ; oscula numerous but minute and indistinct ; dermal membrane closely attached to symplasm ; skeleton formed of network close and regular at base,

and more diffuse in upper parts ; consistency of live sponge quite hard though fragile.

Megascleres—amphioxea, slender, fusiform, completely smooth ; 175—240μ long, 6—11μ wide.

Microscleres—absent.

Gemmoscleres—amphistrongyles or amphioxea, slender, cylindrical, irregularly covered with minute, straight spines, 75-105μ long, 2-4μ wide.

Gemmules—typically bound together in pairs everywhere ; inner gemmular membrane 180-220μ in diameter ; pneumatic layer only moderately well formed of a thin coat of large polygonal air spaces in which gemmoscleres embedded tangentially ; foramen extended into a long curved tube, opening out.

Distributian : Only in India—Bangalore (Karnataka).

Colour in life : Gray to brown.

Remarks : This species, which is only known from the type locality, has not been reported since its original record ; hence ruling out its comparison with other species. There is every likelihood that future studies will show its conspecificity with *E.* fragilis (Leidy, 1851), a truly cosmopolitan species, or with some of the lesser known congeners. Until then, the species is retained as distinct.

Genus III. **Stratospongilla** (Annandale, 1909)

1909. *Spongilla* (*Stratospongilla*) Anandale, *Zool. Jb.*, **27** (6), p. 561.

1911. *Spongilla* (*Stratospongilla*) : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 122.

1968. *Stratospongilla* Penney and Racek, *Bull. U. S. natn. Mus.,* No. 232, p. 40.

1976. *Stratospongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 18.

1982. *Stratospongilla* : Soota and Pattanayak, *Rec. zool. Surv. India,* **80**, p. 226.

Type-species.—*Spongilla bombayensis* Carter, 1882.

Definition : Megascleres—amphioxea or amphistrongyla, normally stout, smooth or roughened by small irregular projections.

Microscleres-comparable with "flesh spicules" of other genera, if present, amphioxea, invariably short and slender, almost straight, covered with comparatively long irregular spines, normally present in dermal membrane and around gemmules.

Gemmoscleres—either amphistrongyles, rather strongly bent, covered with small unequal spines ; or amphioxea, slightly curved, spined ; or a combination of both.

Gemmules—spherical, large, usually with a flattened base, grouped in basal membrane, normally firmly attached to substratum ; occasionally in inner symplasm freely ; pneumatic layer devoid of perceptible air spaces, frequently weakly formed or totally absent, located clearly beyond gemmoscleres, latter embedded tangentially in outer gemmular membrane in one or more compact layers ; foramen or foramina forming a tube which either short and straight, or long and recurved.

Sponge normally forming moderately sized shallow cushions ; consistency hard to very hard.

Distribution : Confined mainly to tropics (especially in Asia, Africa and South America).

Colour in life : Frequently bright green.

Remarks : This genus was originally established by Annandale (1909) as a subgenus of *Spongilla*, with *S. bombayensis* as its type, and this was followed by subsequent workers, inspite of Rezvoj's (1930) adverse comments. Penney and Racek (1968), however, emending certain diagnostic features raised it to generic rank. They (*op. cit.*, p. 49) rightly observed that "A future study of additional material of all *Stratospongilla* spp. may yet demonstrate the possibility, or necessity, of a generic or subgeneric separation of the group of species possessing free microscleres from those apparently lacking these spicular components. At the present such a separation, appears ill-documented and therefore unwarranted, and additional data are highly desirable" ; and this was referred to by Volkmer-Ribeiro (1970, p. 435) who actually established a new genus *Oncosclera* for two such species, viz.

Spongilla jewelli (Volkmer-Ribeiro, 1963) and *S. navicella* (Carter, 1881), and also felt the need for inclusion of other species. This was accepted by Harrison (1979) who (p. 103) also emphasised that "future studies may require a revision of our present concepts of the systematics of this and other related genera to allow for morphological trends in widely dispersed evolutionary series and for the role of ecomorphic variations."

In accordance with the above conceptual views, the present author too feels the urgent need of a really comprehensive revision of the above and allied genera based on more material and ecological data from wider area ; and pending which it will not at all be harmful for the present to retain Penney and Racek's (*op. cit.*) arrangement.

Hitherto, from this area, under the genus are known four species, of which a key is given below.

1.	Megascleres amphistrongyla. ...	*S. indica*
	Megascleres amphioxea ...	... 2
2.	Gemmoscleres strongly curved often forming wide arc. ...	*S. gravelyi*
	Gemmoscleres straight to weakly curved...	... 3
3.	Gemmoscleres embedded in pneumatic coat in two layers, separated by empty space ...	*S. bombayensis*
	Gemmoscleres closely crowded in pneumatic coat, embedded strictly tangentially and forming mosaic layer. ...	*S. sumatrana*

7. **Stratospongilla bombayensis** (Carter, 1882) (Text-fig. 2, A-C)

1882. *Spongilla bombayensis* Carter, *Ann. Mag. nat. Hist.*, **10**, p. 369.

1909. *Spongilla* (*Stratospongilla*) *bombayensis* Annandale, *Zool. Jb.*, **27** (6), p. 561.

1911. *Spongilla bombayensis* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 102.

1911. *Spongilla* (*Stratospongilla*) *bombayensis* var. *pneumatica* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 241.

1968. *Stratospongilla bombayensis* Penney and Racek, *Bull. U. S.* natn. *Mus.*, No. 272, p. 41.

1976. *Stratospongilla bombayensis* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 19.

1982. *Stratospongilla bombayensis* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 226.

1983. *Stratospongilla bombayensis* : Soota *etal.*, *Rec. zool. Surv. India*, **81**, p. 258.

Description : Sponge forming relatively thin encrustations ; surface irregular ; oscula not prominent ; dermal membrane closely attached to symplasm ; skeleton compact due to large number of spicules, but ambiguous and practically shapeless ; vertical spicule fibers occurring somewhere but lacking spongin cement ; consistency of live sponge moderately hard though brittle.

Megascleres—amphioxea, straight or weakly bent, slender and relatively short, rarely completely smooth, normally irregularly covered with small spines, sometimes roughened, 193-300 μ long, .0065-17 μ wide.

Microscleres—amphioxea, slender and short, sharply pointed, weakly curved or straight, completely microspined, rarely in inner symplasm, practically totally restricted to dermal membrane and surrounding gemmules ; 45-60 μ long, 3-4 μ wide.

Gemmoscleres—either amphistrongyla, more or less stout and short, or amphioxea, abruptly pointed, generally a bit curved, completely granulated ; very variable, ·038-67 μ long, ·0096-8 μ wide.

Gemmules—spherical or ovoid, normally clearly flattened at base, varying in size ; pneumatic layer ill-formed though frequently thick in places, air spaces not distinct ; outer gemmular membrane closely contacted with substratum causing firm adherence of gemmules ; gemmoscleres embedded in this coat normally in two layers separated by an empty space, lower in contact with inner gemmular membrane, outer frequently in many layers of spicules joined together in outer membrane in which dark granules also usually present ; foramen or foramina clearly tubular, tube lateral, varying

from short and straight to long and curved ; .045-6 mm in diameter.

Distribution : Recorded from central Africa. In India—Naukuchia Tal, alt. 4000 ft. (U. P.), Rajkot (Gujarat), Bhim river, Khed, Pune dist., and Bombay (Maharashtra), and Bangalore (Karnataka).

Colour in life : According to Penney and Racek (1968) insufficiently known, but pale yellow as observed by the author.

Remarks : This species is clearly distinct from its closest congeners by the apparently characteristic arrangement of the gemmoscleres which form two distinct layers separated by an empty space. As already pointed out by Annandale (1911 c, pp. 5 & 126) from his collection from Bombay, the resemblance of the species to and its occurrence alongwith *Corvospongilla lapidosa* (Annandale, 1908) has been corroborated by the present author from his own collection from Gujarat. Carter (1882, p. 370) found the species attached to the stem of a herbaceous plant around which the specimens of *Eunapius carteri* had grown.

8. **Stratospongilla gravelyi** (Annandale, 1912)

(Text-fig. 2, D-G)

1912. *Spongilla* (*Stratospongilla*) *gravelyi* Annandale, *Rec. Indian Mus.*, 7, pp. 384 & 385.

1918. *Spongilla sumatrana* var. *gravelyi* Annandale, *Mem. Asiat. Soc. Beng.*, 6, p, 212.

1968. *Stratospongilla gravelyi* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 45.

1976. *Stratospongilla gravelyi* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p, 19.

1982. *Stratospongilla gravelyi* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 226.

Description : Sponge forming small and shallow encrustations ; surface smooth : oscula very small, encircled by shallow radiating channels from below dermal membrane ; skeletal framework composed of a regular network of single spicules as well as slender, ill-defined spicule fibers, vertical

ones being more prominent than transverse ; consistency of live sponge extremely hard though highly fragile.

Megascleres—amphioxea, more or less straight, fusiform, sharply pointed, covered with tiny irregular blunt projections, occasionally terminally ringed with short spicules ; 230-310μ long, 11-17μ wide.

Microscleres—amphioxea, straight, sharply pointed, covered with comparatively long, very irregular perpendicular spines ; not numerous, mainly confined to dermal membrane and surrounding gemmules ; 42-56μ long, 3-4μ wide.

Gemmoscleres—amphistrongyla, strongly curved, frequently forming a wide arc, generally with swollen tips, completely covered with tiny blunt spines or granules ; 35-63μ long, 6-8μ wide.

Gemmules.—spherical, located in small loculi at base, appearing unattached to substratum ; pneumatic coat weakly formed, lacking perceptible air spaces, and unlike majority of other species of the genus, not forming a basal membrane ; gemmoscleres forming a dense, tangentially arranged mosaic pattern over inner gemmular membrane ; foramen with a short, straight, porus tube.

Distribution : Only in India—Koyna river, Teloshi, Satara dist. (Maharashtra).

Colour in life : Reportedly bright green.

Remarks : This species, originally described by Annandale (1912) as *Spongilla* (*Stratospongilla*) *gravelgi*, was later (1918 a) treated by him as a variety of another species *Spongilla sumatrana*, and this was followed by others, But Penney and Racek (1968) raising *Stratospongilla* to generic rank, placed the species under it as distinct on the ground of its showing a peculiar mode of gemmular attachment, and also compared to other species its free microscleres are entirely different. However, in view of the fact that its relationship with another species, viz. "mountain form" of *Radiospongilla cinerea* (Carter, 1849) is unconfirmed, it is necessary to study more material to definitely establish its position.

9. **Stratospongilla indica** (Annandale, 1908)

(Text-fig. 2, H-K)

1908. *Spongilla indica* Annandale, *Rec. Indian Mus.*, **2**, p. 25.

1911. *Spongilla indica* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 100.

1912. *Spongilla* (*Stratospongilla*) *indica* Annandale, *Rec. Indian Mus.*, **7**, p. 384.

1918. *Spongilla sumatrana* var. *indica* Annandale, *Mem. Asiat. Soc. Beng.*, **6**, p. 212.

1919. *Spongilla sumatrana* var. *centralis* Annandale, *Rec. Indian Mus.*, **16**, p. 161.

1932. *Spongilla sumatrana* var. *siamensis* Gee, *J. Siam. Soc. nat. Hist., Suppl.*, 8(4), p. 305.

1932. *Spongilla sumatrana* var. *baniensis* Topsent, *Bull. Mus. Hist. nat.*, ser. 2, **4**, p. 578.

1968. *Stratospongilla indica* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 14.

1976. *Stratospongilla indica* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 20.

1982. *Stratospongilla indica* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 226.

Description ; Sponge forming small and shallow encrustations; surface smooth ; oscula small ; skeleton very ill-defined, formed of slender spicule fibers ; consistency of live sponge appearing hard though brittle.

Megascleres—amphistrongyla, quite long, more or less straight, cylindrical, covered with numerous tiny spines arising from quite a wide base, and frequently ringed by several small spines terminally ; 210-270μ long, 12-17μ wide.

Microscleres—amphioxea, more or less straight, sharply pointed, covered with comparatively long and irregular perpendicular spines ; 37-59μ long, 3-4μ wide.

Gemmoscleres—amphistrongyla, weakly bent to straight, stout, thickly covered with minute granules or blunt spines ; 35-48μ long, 7-8μ wide.

Gemmules—subspherical, with flattened base, generally strongly attached to substratum ; pneumatic coat weakly and irregularly formed, without perceptible air spaces, usually

forming a basal membrane by which gemmule attached ; gemmoscleres forming a thick tangentially arranged mosaic pattern over inner gemmular membrane ; foramen with a short, straight, porus tube ; 420-500 μ in diameter.

Distribution : Reported from Thailand through India to Africa. In India—Chakradharpur, Chota Nagpur (Bihar) ; and Nasik & Igatpuri (Maharashtra.).

Colour in life : Reportedly green to gray.

Remarks : This species can easily be separated from others of the genus by the shape of megascleres which are distinctly amphistrongyla, and the usual basal location in groups of gemmules. Penney and Racek (1968) included under the species several 'varieties' earlier placed under *S sumatrana*. The present author follows this arrangement until more material is examined.

10. **Stratospongilla sumatrana** (Weber, 1890) (Text-fig. 2, L-O)

1890. *Spongilla sumatrana* Weber, *In : Zoologische Ergebnisse einer Reise nach Neiderlandisch Ost-Indien*, **1**, p. 38.

1898. *Spongilla sumatrana* var. *a* Weltner, *Mitt. naturh. Mus. Hamb.*, **15**, p. 129.

1898. *Spongilla sumatrana* var. *B* Weltner, *Mitt. naturh. Mus. Hamb.*, **15**, p. 130.

1911. *Spongilla* (*Stratospongilla*) *sumatrana* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 53.

1919. *Spongilla sumatrana* var. *rivularis* Annandale, *Rec. Indian Mus.*, **16**, pp. 158 & 161.

1968. *Stratospongilla sumatrana* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 42.

1976. *Stratospongilla sumatrana* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 20.

1982. *Stratospongilla sumatrana* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 226.

Description : Sponge forming circular or irregularly shaped thin layers ; surface smooth ; skeleton compact, though

loosely structured of large, thin, spicule fibers ; consistency quite hard.

Megascleres—amphioxea, more or less straight, fusiform, sharply pointed, excepting at their tips sparsely covered with short spines arising from rather broad bases ; 210-290 μ long, 9-14 μ wide.

Microscleres—amphioxea, weakly curved, sharply pointed, completely covered with tiny spinules, sometimes occurring in inner symplasm but more or less confined to around gemmules ; 47-65 μ long, 3-4 μ wide. [the larger microscleres recorded by Weber (1890) possibly deformed gemmoscleres].

Gemmoscleres—amphistrongyla, stout, short, straight to weakly curved, covered with quite uniform minute spines ; 32-43 μ long, 11-13 μ wide.

Gemmules—reportedly not numerous in mature sponge, free, never occurring in groups ; pneumatic layer irregularly formed, without observable air spaces ; outer gemmular membrane in continuity with a short and straight porus tube, gemmoscleres occurring densely in this coat strictly tangentially and forming a mosaic pattern, 450-600μ in diameter.

Distribution : Reported from Indonesia through India to Africa. In India—river Yenna, Medha (Maharashtra).

Colour in life : Light gray.

Remarks : The species seems to be highly plastic as the examined specimens showed great variations in the form of seleres making it possible for five varieties to be recognised (Annandale, 1919, p. 160), but this was not acccepted by Penney and Racek (1968, p. 44). Hence, examination of more material alongwith ecological data, will resolve the difficulty pending which the synonymies may be treated only as tentative as already stressed by Penney and Racek (*op. cit.*).

Genus IV. **Corvospongilla** Annandale, 1911.

1911. *Corvospongilla* Annandale, *Fauna British India,* Freshwater Sponges, hydroids and Polyzoa, p. 122.

1968. *Corvospongilla* : Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p. 51.

1976. *Corvospongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 2.

1982. *Corvospongilla* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 215.

Type species.—*Spongilla loricata* Weltner 1895

Definition : Megascleres—amphistrongyles, normally robust, frequently swollen terminally, plain to rough, very little curved, rarely amphioxea, very rarely showing two distinct series.

Microscleres—microbirotulates, with smooth or spined shafts, almost straight to slightly curved, and with a few terminal recurved spines of variable length, very rarely also spined amphioxea, which latter probably adventitious.

Gemmoscleres—amphistrongyla, of rather unequal size, always spined and clearly curved.

Gemmules—spherical, but flattended at base, or oval, medium to large ; usually occurring in groups at base, and attached to substratum by an outer sheath of megascleres or without such envelop ; pneumatic coat ill-formed or absent ; gemmoscleres embedded contiguously in inner gemmular membrane forming a mosaic pattern ; foramen usually tubular and frequently lateral ; sometimes free gemmules also occur though, generally different in form and structure of pneumatic coat.

Sponges forming flat encrustations, very hard and firm ; in some species delicate ; colour black to dark gray.

Distribution : Reportedly confined to Africa, Asia, South and North America (Louisiana, U. S. A.)

Remarks : This genus, with *Spongilla loricata* Weltner, 1895, as its type species, was established by Annandale (1911c) on the basis of the occurrence of typical birotulates as free microscleres in the symplasm of sponges. Again, he (1912c, p. 384) proposed the revision of the genus especially the Indian forms. Penney and Racek (1968) also stressed the necessity for the same ; as also Volkmer-Ribeiro (1981b, p. 88) when she remarked on the "uncertain position within Spongillidae", of the genera *Corvomeyenia, Corvospongilla,* and

Drulia. The genus has been split by Penney and Racek (*op. cit.*) into three groups, viz. 1. *C. loricata-burmanica-lapidosa*, which all share the common spicular components ; 2. *C.* bohmii, *C micramphidiscoides*, and *C scabrispiculis* ; 3. *C. ultima* and *C. caunteri* ; also observing (p. 52) that "The group represented by *C. ultima* and *C caunteri* is most characteristic not only by their amphioxous megascleres and more or less delicate skeletal structure, but also by the frequent presence of free gemmules, which in *C. caunteri* possess a pneumatic coat displaying minute but clearly defined air spaces". They (*op. cit.*, p. 53) also correctly grasped that the members of the genus have great affinity with those of *Stratospongilla* differentiated only by the presence or absence of free microbirotulates in the symplasm. Hence, with the future discoveries of such structures in the present members of *Stratospongill*a, these will automatically be transferred to *Corvospongilla*.

Hitherto, from this area, under the genus are known five species, of which a key is given below.

1.	Megascleres amphioxea ...	...	2
	Megascleres amphistrongyla ...	...	3
2.	Gemmules attached to substratum ; penumatic coat weakly developed, without discernible air spaces. ...		*C. ultima*
	Gemmules not so attached ; pneumatic coat thick, appearing to consist of very minute air spaces. ...		*C. caunteri*
3.	Gemmoscleres amphioxea. ...		*C. bhavnagarensis*
	Gemmosclres amphistrongyla. ...	...	4
4.	Gemmoscleres in concentric layer or layers on inner gemmular membrane. ...		*C. burmanica*
	Gemmoscleres in one or two layers, patterned in mosaic-like covering on inner gemmular membrane. ...		*C. lapidosa*

11. **Corvospongilla bhavnagarensis** Soota, Pattanayak and Saxena, 1983.
(Text-fig. 2, P-R)

1983. *Corvospongilla bhavnagarensis* Soota *et al.* ; *Rec. zool. Surv. India*, **81**, p. 255.

Description : Sponge forming over a large area on the surface of an embankment thick blackish encrustation showing rough and irregular surface ; consistency fragile.

Megascleres—amphistrongyla, rather short, not very thick, slightly curved, entirely smooth, swollen terminally ; 190-205 mm long, .016-0.18 mm wide.

Microscleres—microbirotulates, with smooth shaft, slightly curved, terminally with four recurved hooks ; shaft ·041-·042 mm long, rotules .008-.009 mm in diameter.

Gemmoscleres—amphioxea, strongly pointed, slightly curved, covered with short acute spines ; ·043-·045 mm long, .0042-.0048 mm wide.

Gemmules—spherical, smooth, loosely attached to sponge surface ; foramen not exactly tubular but as a conical projection ; .005-.006 mm in diameter.

Distribution : Embankment about 4 meters away from Gorishankar Lake, Bhavnagar (Gujarat).

Colour : Black in dry specimen.

Remarks : This species comes closer to *C. loricata-lapidosa* group, differing from all the members in shape of porus tube, and gemmoscleres structure, which being amphioxea and not amphistrongyla. Its comparison with the inadequately described African species *C zambesiana* (Kirkpatrick, 1906) is, however, for the present practically ruled out.

12. **Corvospongilla burmanica** (Kirkpatrick, 1908)

1908. *Spongilla loricata* var. *burmanica* Kirkpatrick, *Rec. Indian Mus.*, **2**, p. 97.

1911. *Corvospongilla burmanica* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 123.

1911. *Corvospongilla burmanica* var. *bombayensis* Annandale, *Rec. Indian Mus.*, **6**, p. 225.

1968. *Corvospongilla burmanica* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 54.

1976. *Corvospongilla burmanica* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 2.

1982. *Corvospongilla burmanica* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 216.

Description : sponge forming flat and very extensive encrustations ; surface coarsely hispid due to protrusion of skeletal fibers ; oscula usually raised on turret—like eminences, or similar irregularly shaped protrusions ; skeleton reticulate, formed of well-formed spicule fibers, but with only little spongin ; consistency of live sponge hard though brittle.

Megascleres—amphistrongyla, large, weakly curved, completely smooth, frequently swollen terminally ; 220-235μ long, constantly 20μ wide.

Microscleres—microbirotulates having weakly curved smooth shafts, and terminelly with lesser number of medium sized recurved hooks ; average 30μ long, rotule 6-12μ in diameter.

Gemmoscleres—amphistrongyla, weakly to strongly curved, comparatively short and stout, covered with fine spinules or tubercles of greatly different dimensions ; 38-56μ long, 7-8μ wide.

Gemmules—subspherical, rather large, not numerous, generally singly attached to substratum, but sometimes also free in inner symplasm ; pneumatic layer weakly formed in attached gemmules, which latter encircled by loculi of megascleres, but well-formed in free ones ; gemmoscleres forming a concentric layer or layers on inner gemmular membrane ; foramen elongated into a short cylindrical porus tube.

Distribution : Extending from Burma (type locality) to India—Bhima river, Khed, Pune dist., & Pimpli, Ratnagari dist. (Maharashtra) ; Idar ("occurring as incrustations on pebbles of recent conglomerate left by subsidence of the water").

Colour : Dry sponge pale brown.

Remarks : Kirkpatrick (1908) held it as a variety of *Spongilla loricata*, while Annandale (1911c) preferred to treat it as a distinct species which was followed by others. The latter author (*op. cit.*) also described a variety *C. burmanica bombayensis*, which though accepted by some, was rightly rejected by Penney and Recek (1968, p, 55) on the basis that

"The retention of the varietal form *C. b. bombayensis*, merely based on the absence of turret—like oscular elevations, does not, however, appear to be of any taxonomic significance," The taxonomic position of the species has to remain ill-defined till esential details of *C. loricata* (Weltner, 1895) are made available.

13. **Corvospongilla caunteri** Annandade, 1911 (Text-fig. 3, A-D)

1911. *Corvospongilla caunteri* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 243.

1968. *Corvospongilla caunteri* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 60.

1976. *Corvospongilla caunteri* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 3.

1982. *Corvospongilla caunteri* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 216.

1983. *Corvospongilla caunteri* : Soota *et al.*, *Geobios new Reports*, **2**, p. 151.

1983. *Corvospongilla caunteri* : Soota *et al.*, *Rec. zool. Surv. India*, **81**, p. 257.

1983. *Corvospongilla caunteri* : Soota and Saxena, *Trans. Isdt & Ucds*, 8 (2), p. 132.

Description : Sponge forming thin and very extensive encrustations ; surface smooth ; skeleton reticulate but ill-formed and lacking spongin ; basal membrane stout and well formed ; consistency of live sponge quite hard though brittle.

Megascleres—amphioxea, of varying shape and size usually more or less straight, bluntly, abruptly, or sharply pointed, completely smooth, sometimes granulated or spiny terminally; 190-220μ long, 15-20μ wide.

Microscleres—microbirotulates, with smooth shaft, which never markedly curved, terminal spines comparatively short, not strongly incurved ; 22-33μ long, rotules 4-9μ in diameter.

Gemmoscleres—amphistrongyla, generally slightly curved, rarely amphioxea, blunt, irregularly spined and of extremely different lengths ; 30-68μ long, 7-14μ wide.

Gemmules—spherical to somewhat depressed, varying in size, unattached to substratum, occurring in lower parts of inner symplasm ; pneumatic coat quite thick, seemingly composed of extremely small air spaces, below that gemmoscleres present tangentially in mosaic pattern on inner gemmular membrane ; foramen (according to Annandale depressed) slightly raised to form a rather bent tube ; average 600μ in diameter.

Distribution : Only in India—Hazratganj, Lucknow (U. P.), Santhal Parganas (Bihar), Lake Kailana, Jodhpur (Rajasthan), Gori Shankar Lake & Kodiyar Lake, Bhavnagar (Gujarat), and Medha, Satara dist. (Maharashtra).

Colour in life : reportedly bright green, but the author has also observed pale yellow specimens.

Remarks : This species comes closest to *C. ultima* (Annandale, 1910) from which it differs only in minor characters of gemmules and the pneumatic coat, calling for more study with the addition of fresh material from wider area supplemented by ecological data.

14. **Corvospongilla lapidosa** (Annandale, 1908) (Text-fig. 3, E-G)

1908. *Spongilla lapidosa* Annandale, *Rec. Indian Mus.*, 2, pp. 25 & 26.

1911. *Corvospongilla lapidosa* Annandale, *Fauna, British India,* Freshwater sponges, hydroids and Polyzoa, p. 124.

1964. *Corvospongilla lapidosa* : Tonapi, *Curr. Sci.*, **33** (12), p. 373.

1968. *Corvospongilla lapidosa* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 55.

1976. *Corvospongilla lapidosa* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 3.

1982. *Corvospongilla lapidosa* : Rao and Khan, *Proc. Indian Acad. Sci.*, **91** (6), p. 553.

1982. *Corvospongilla lapidosa* : Soota and Pattanayak, *Rec. zool. Surv. India,* **80**, p. 217.

1983. *Corvospongilla lapidosa* : Soota *et al., Rec.. zool. Surv. India,* **81**, p. 257.

1987. *Corvospongilla lapidosa* : Rao *et al., J. Hydrobiol.,* 1987, p. 189.

Description : Sponge forming flat encrustations, surface smooth, lacking spicular protrusions ; skeleton composed of well-formed spicule fibers cemented together by a sufficient quantity of spongin ; consistency of live sponge very hard.

Megascleres—amphistrongyla, stout and slightly curved, varying from microspined to entirely smooth, 190-230μ long, 17-21μ wide.

Microscleres—microbirotulates with smooth shaft and terminally with less, medium sized, recurved hooks ; average 22-35μ long, rotules 5-11μ in diameter.

Gemmoscleres—amphistrongyla, stout, slightly curved, covered with blunt spines or tubereles excepting terminally, of largely different dimensions ; 33-68μ long, 8-14μ wide.

Gemmules—invariably subspherical to considerably flattened, firmly attached to substratum ; pneumatic coat weakly developed, without perceptible air spaces ; gemmoscleres occurring in one or two layers, patterned mosaic-like on inner gemmular membrane ; foramen elongated into small, straight, and usually laterally situated tubule ; 600-700μ in diameter.

Distribution : Only in India—Pulta (West Bengal), Azi dam, Rajkot (Gujarat), Igatpuri and river Godavari, Nasik, and Pune (Maharashtra), and Manjra reservoir, Sangareddy (Andhra Pradesh).

Colour in life : reportedly black to gray, but pale yellow examples have also been observed by the author.

Remarks : This species differs from its closest congeners primarily by its stony consistency. However, Annandale(1908a, p. 26) considered it more closely related to *C. loricata* (=*S. loricata* Weltner, 1895), and his specimens (1911 c, p. 126) collected from Igatpuri lake, Nasik (Maharashtra), were accompanied by gemmules of *Stratospongilla bombayensis* (=*Spongilla bombayensis*). The present author also found both the species occuring together in the same locality at Azi dam, Rajkot (Gujarat). The author is in total agreement with Penney and Racek (1968) that "additional collections of data" should be obtained to make any definite statement

with regard to its position, pending which it is practically wise to retain its "separate specific status". Rao and Khan (1982, p. 553) remarked that "Its sausage shaped spicules have adaptive value to thrive in low silica environments", though in some species variations in spicule abundance and morphology in relation to the amount of silica present, has been reported by several workers.

15. **Corvospongilla ultima** (Annandale, 1910)

1910. *Spongilla* (*Stratospongilla*) *ultima* Annandale, *Rec. Indian Mus.*, 5, p. 31.

1911. *Spongilla ultima*: Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 104.

1912. *Corvospongilla ultima* Annandale, *Rec. Indian Mus.*, 7, pp. 99, 384 & 389.

1912. *Corvospongilla ultima* var. *spinosa* Annandale, *Rec. Indian Mus.*, 7, pp. 384, 389 & 390.

1968. *Corvospongilla ultima* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 59.

1976. *Corvospongilla ultima*: Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 3.

1982. *Corvospongilla ultima* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 216.

1983. *Corvospongilla ultima* : Soota *et al.*, *Geobios new Reports*, 2, p. 151.

1983. *Corvospongilla ultima*: Soota and Saxena, *Trans. Isdt & Ucds*, 8 (2), p. 132.

Description: Sponge forming thin encrustations, surface slightly rough to clearly spiny; oscula prominent though minute; skeleton forming a compact but rather irregular reticulation, with a sufficient quantity of cementing spongin; consistency of live sponge hard.

Megascleres—amphioxea, stout, more or less straight to weekly curved; completely smooth; 200-255μ long, 16-20μ wide.

Microscleres—microbirotulates, seemingly rare in symplasm, with a smooth, only weakly curved shaft, terminal spines relatively short though clearly incurved, 24-40μ long, rotules 4-9μ in diameter.

Gemmoscleres—amphistrongyla, stout, generally slightly to moderately curved, irregularly spined, of largely different dimensions, 33-70μ long, 8-10μ wide.

Gemmules—spherical, large, normally attached to substratum, but frequently several also occurring freely in inner symplasm ; pneumatic coat weakly formed, lacking perceptible air spaces ; gemmoscleres occurring in two clear layers not separated from each other by an empty space, inner layer lying on inner gemmular membrane, outer ensheathed in strong basal membrane of sponge ; gemmular aperture always tubular, tube short and cylindrical ; in free gemmules usually 2 micropyles present ; 400μ (free) to almost 900μ (attached) in diameter.

Distribution : Only in India—Lake Kailana, Jodhpur (Rajasthan), Medha (Maharashtra), Kerala, and Cape Comorin & Tanjore (Tamil Nadu).

Cclour : Dried sponge pale green.

Remarks : This species, originally described by Annandale (1910) as *Spongilla ultima*, was later transferred by him (1912) to the genus *Corvospongilla*. He (*op. cit.*) also separated *C. ultima spinosa* as a variety mainly on the basis of sponge surface. Penney and Recek (1968), inspite of its being accepted by others, looked upon it as untenable. Annandale (1912 c, p. 388) too remarked on the great individual skeletal variations as well as the abnormal forms shown by the members. This species, appears to be different from all the other species of the genus coming closely only to *C. caunteri* Annandale, 1911.

Genus V. **Radiospongilla** Penney and Racek, 1968.

1863. *Spongilla* Bowerbank, *Proc. zool. Soc. Lond.*, 1863, p. 465 (part).

1882. *Meyenia* Potts, *Proc. Açad. nat. Sci. Philad.*, p. 12.

1895. *Ephydatia* Weltner, *Arch. Naturgesch*, **61** (1), p. 114 (part).

1911. *Spongilla* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 76 (part).

1915. *Pectispongilla* Annandale, *Rec. Indian Mus.*, **11**, p. 17 (part).

1968. *Radiospongilla* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 61.

1976. *Radiospongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India,* Misc. Publ. Occ. Paper No. 4, p. 13.

1982. *Radiospongilla* : Soota and Pattanayak, *Rec. zool. Surv. India,* **80**, p. 222.

Type-species.—Spongilla sceptroides Haswell, 1882 [By Penney and Racek, 1968].

Definition : Megascleres-amphioxea, rarely amphistrongyla, quite thick to slender, usually covered with a varying number of tiny to prominent spines, excepting in a single species where completely smooth.

Microscleres—true microscleres absent, those indicated as microscleres in developmental phase are nothing but aberrant gemmoscleres present abundantly in dermal membrane and inner symplsm.

Gemmoscleres—amphioxea or amphistrongyla, rather slender, always densely spined, varying in different degrees of length and from straight to clearly curved ; their spines often prominently crowded together and larger towards the terminal points forming club-or scepter-like structures, or pseudorotules in different stages of perfection.

Gemmules—spherical, large, frequently numerous in maturing sponges, in perennial forms normally rare or lacking ; usually occurring throughout body ; when occasionally found concentrated at base, never occurring in a distinct pavement layer ; typically with a strong and thick pneumatic layer composed of air spaces of small size and slightly irregular outline in which gemmoscleres embedded rather radially ; foramen always tubular, tube delicate, straight, or slightly curved, rarely protruding out from outer gemmular membrane, encircled by a conical depression caused by displacement of gemmoscleres around micropyle.

Sponges ranging from tiny cushions to huge flat encrustations with or without occasional delicate and cylindrical branches, rarely bulky ; often an emerald green colour due to presence of a specific pigment ; consistency rather firm and normally elastic.

Distribution : Worldwide, in tropics and subtropics, very seldom extending into cold-temperate regions.

Remarks : The genus, which was established by Penney and Racek (1968) with *Spongilla sceptroides* Haswell, 1882, as its type species, was characterized as showing gemmules with a thick pneumatic coat and a conspicuous porus tube, more or less radially arranged gemmoscleres with terminal spines typically arranged, and lacking microscleres. The taxonomic position of many species under the genus is still in doubt.

This genus, the members of which seem to fall into two groups, includes some still ill-defined species. There is hardly any doubt regarding the central position of the genus in the phylogeny, as evidenced by recent paleolimnological studies which have established its antiquity as far back as Pleistocene and Pleiocene.

Hitherto, from this area, under the genus, are known five species of which, a key is given below.

1.	Megascleres smooth ; gemmoscleres in two definite layers ...	*R. cerebellata*
	Megascleres incipiently to strikingly spined ; gemmoscleres in a single layer ...	... 2
2.	Immature gemmoscleres abundant in symplasm and dermal membrane ; porus tube surrounded by 3-4 mammiform aspiculus enlargements of pneumatic coat ...	*R. hemephydatia*
	Immature gemmoscleres not abundant ; porus tube with or without any surrounding feature ...	... 3
3.	Porus tube surrounded by a conical depression ...	*R. indica*
	Porus tube with a crater-like depression ...	*R. crateriformis*
	Porus tube lacking any surrounding depression ...	*R. cinerea*

16. **Radiospongilla cerebellata** (Bowerbank, 1863) (Text-fig. 3, H-J)

1863. *Spongilla cerebellata* Bowerbank, *Proc. zool Soc. Lond.*, 1863, p. 465.

1890. *Spongilla cinerea* Weber (*nec* others), *In* : *Zoolcgische Ergebnisse einer Reise nach Niederlandisch Ost-Indien*, **1**, p. 35.

1895. *Spongilla biseriata* Weltner, *Arch. Naturgesch.*, **61** (1), p. 117.

1907. *Spongilla reticulata* (?) Annandale, *Rec. Indian Mus.*, **1**, p. 387.

1907. *Spongilla proliferens* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 15 & 26.

1909. *Spongilla lacustris* subsp. *reticulata* Annandale, *Rec. Indian Mus.*, **3**, p. 275.

1909. *Ephydatia semispongilla* Annandale, *Annotnes. zool. Jap.*, **7**, p. 107.

1910. *Spongilla* (*Euspongilla*) *proliferens* Annandale, *Rec. Indian Mus.*, **5**, p. 197.

1911. *Spongilla proliferens* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 72.

1911. *Spongilla alba* var. *cerebellata* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 76.

1911. *Spongilla lacustris* subsp. *reticulata* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa pp. 71 & 241.

1916. *Spongilla semispongilla* Annandale and Kawamura, *J. Coll. Sci. Imp. Univ. Tokyo*, **39**, p. 5.

1916. *Spongilla micron* Annandale, *J. North China Branch R. Asiat. Soc.*, **47**, p. 49.

1926. *Spongilla sectospina* Rezvoj, *Compts. Rend. Acad. Sci. USSR*, p. 108.

1931. *Spogilla lacustris* var. *proliferens* Gee, *Peking nat. Hist. Bull.*, 5 (1), p. 47.

1968. *Radiospongilla cerebellata* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 73.

1976. *Radiospongilla cerebellata* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 13.

1982. *Radiospongilla cerebellata* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 222.

1987. *Radiospongilla cerebellata* : Soota, *Fauna of Orissa : State Fauna Series I*, p. 66 (Publ. Zool. Surv. India).

Description : Sponge in shape and structure ranging from tiny and shallow cushions to as big as a fist ; surface in larger specimens uneven, showing clearly brain-like corrugations ; oscula prominent ; dermal membrane well-formed ; skeleton in small and flat specimens irregular, in larger ones showing clearly transverse and radiating spicule fibers of varying thickness ; spongin always quantitatively insignificant ; consistency of live sponge soft, loosely textured.

Megascleres—amphioxea, weakly curved to more or less straight, fusiform, sharply pointed at tips ; completely smooth ; 240-330μ long, 10-12μ wide.

True microscleres absent ; however, immature and slender gemmoscleres frequently numerous in dermal membrane and also as isolated batches in inner symplasm.

Gemmoscleres—amphistrongyla, typically frequently clearly curved, rarely straight, cylindrical, sometimes showing in the prolonged axis a single terminal spine, thus resembling amphioxea ; their shaft densely spined, spines errect and often split centrally at the scleres, gradually recurving terminally ; 72-100μ long, 2-4μ wide.

Gemmules—spherical, numerous in mature sponge, abundantly produced in small specimens ; pneumatic coat well formed, normally thick, comprising of small spherical air spaces in which gemmoscleres embedded in two clear layers, i. e. (1) a rather radial pattern originating from inner gemmular membrane, frequently cutting across one another at different angles, and not extending to outer gemmular membrane ; and (2) superimposed on first, tangentially patterned, embedded proximally in pneumatic coat, distally projecting from outer gemmular membrane ; foramen clearly tubular, porus tube slender and straight, always at least extending to level of pneumatic coat ; 420-590μ in diameter.

Distribution : Shown as distributed in tropical and subtropical S and SE Asia, as well as from China to USSR, even perhaps extending to south-eastern Europe. In India—Mangal-dai near Bhutan frontier (Assam), Sur Lake and Rambha (Orissa), River Jharia, Siripur, Saran dist. (Bihar), Calcutta and neighbourhood, Behrampore (West Bengal), Malwa Tal, alt. 3600 ft., Kumaon (U. P.), Igatpuri, Aurangabad, & Khandalla (Maharashtra), Bangalore (Karnataka), Ernakulum & Trichur (Kerala), Madras and neighbourhood (Tamil Nadu), and Pagnor talug, Nellore dist. (Andhra Pradesh).

Colour in life : Ranging from yellowish gray to dark green.

Remarks : Though, Bowerbank (1863) had originally given an elaborate description of the species, it has been redescribed

under several different names by various authors. To add to this confusion, the abundant presence of immature gemmoscleres in the dermal membrane and inner symplasm of some forms, led to their being taken as true microscleres, leading to the creation of false "varieties" for *Spongilla lacustris* or *S. alba*. Penney and Racek (1968) found all the species shown under the synonymy as its conspecific, as the main character by which these were held distinct, viz. the presence of immature gemmoscleres, is not a very constant feature, and the other characters, i. e. megascleres, gemmoscleres, and characteristics of the gemmules, are fully identical in all the sponges of this complex. Hence, the separate status of all these "species" even on a subspecific level appears unjustified as rightly observed by Penney and Racek (*op. cit.*). The species differs from the other members of *Radiospongilla* in showing smooth megascleres and peculiar double arrangement of gemmoscleres on its gemmules, which usually attain a rather large diameter. Penney and Racek (*op. cit.*) maintained that the occasionally occurring single layer of gemmoscleres in *S. semispongilla* described by Annandale (1909) was either due to immaturity of gemmules of developing specimens, or a result of seasonal effect.

17. **Radiospongillla cinerea** (Carter, 1849)

1849. *Spongilla cinerea* Carter, *Ann. Mag. nat. Hist.* (2), **4**, p. 82.

1911. *Spongilla cinerea* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, pp. 79 & 241.

1919. *Spongilla* (*Euspongilla*) *perviridis* Annandale, *Rec. Indian Mus.*, **16**, p. 159.

1960. *Spongilla perviridis* Penney, *Univ. S. Carol. Publs*, ser. 3, **3** (1), p. 26.

1968. *Radiospongilla cinerea* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 75.

1976. *Radiospongilla cinerea* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ, Paper No. 4, p. 14.

1982. *Radiospongilla cinerea* : Soota and Pattanayak, *Rec. zool. Surv. Iudia;* **80**, p. 22.

Description : Sponge forming small, flat encrustations ; consistency fragile.

Megascleres—amphioxea, clearly fusiform, sharply pointed, slightly curved, covered with tiny and indiscernible spines excepting terminally ; 230-275μ long, 8-10μ wide,

Microscleres—absent.

Gemmoscleres—amphioxea, slightly curved, somewhat abruptly pointed, entirely covered with rather coarse spines somewhat grouped terminally without much increasing in length ; 47-62μ long, 3-4μ wide.

Gemmules—spherical ; pneumatic layer well developed, formed of clearly discernible subspherical air spaces, or granular without perceptible air spaces in which gemmoscleres embedded strictly radially, forming a single layer, their tips projecting into outer gemmular membrane, making its surface clearly hispid ; foramen clearly tubular, porus tube slender and straight, slightly exceeding outer gemmular membrane in length, and lacking a surrounding conical depression ; 310-330μ in diameter.

Distribution : Only in India—Bombay ; Nasik ; Bhima river, Khed ; Kayna, Satara fort ; and Karla, Pune dist. (Maharashtra) ; Chakradharpur, Chhota Nagpur (Bihar) ; and Naukuchia Tal (alt. 4000 ft.), Kumaon (U. P.).

Colour in life : Ash gray to bright green. According to Annandale (1921 b, p. 137) colour in fresh condition bright green, and pale yellow in dry, and "The dark greyish colour of Carter's specimens was probably due to their having grown in muddy water."

Remarks : Even the generic position under which this species is to be considered is doubtful, making it essential all the more for an elaborate study for the establishment of the true identity of the species. Annandale (1911 c, p. 81) reported it occurring in the company of *Stratospongilla indica* (=*Spongilla indica*) and *Corvospongilla lapidosa*, and later (1912c, p. 386) suggested that it possibly represented, to quote Penney and Racek (1968, p. 76), "a distinct growth form of a *Stratospongilla* species."

18. **Radiospongilla crateriformis** (Potts, 1882)
(Text-fig, 4, A-C)

1882. *Meyenia crateriformis* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 12.

1895. *Ephydatia crateriformis* Weltner, *Arch. Naturgesch.*, **61** (1), p. 122.

1911. *Spongilla crateriformis* Annandale, *Fauna British India*, Fresh-water sponges, hydroids and Polyzoa, p. 85.

1942. *Ephydatia crateriformis* var. *arndti* Carvalho, *Bolm. Fac. Filos Cierc. Univ. S. Paulo*, **15**, p. 267.

1968. *Radiospongilla crateriformis* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 66.

1976. *Radiospongilla crateriformis* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 14.

1978. *Radiospongilla crateriformis* : Rutzler, *Agua. Biol.*, **3**, p. 144.

1982. *Radiospongilla crateriformis* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 222.

Description : Sponge forming thin and small cushions of a rather even surface ; oscula numerous though not prominent ; dermal membrane well developed ; skeleton formed of irregular spicule fibers, cemented together by a small quantity of spongin ; consistency of live sponge soft.

Megascleres—amphioxea, slender, fusiform, sharply pointed, sparsely microspined excepting terminally ; 240-300μ long, 9-11μ wide.

Microscleres—absent.

Gemmoscleres—amphistrongyla, typically slender, slightly curved, covered with a varying number of small conical spines, terminally with one to several rows of radiating slightly recurved spines, giving the appearance of pseudorotules, 60-75μ long, 3-5μ wide.

Gemmules—spherical, moderately numerous to numerous in mature sponge ; pneumatic layer well formed and thick, composed of tiny irregular air spaces in which gemmoscleres embedded rather radially, but frequently cutting across one another at different angles, present in one layer only, their distal pseudorotules not projecting from outer gemmular membrane ; foramen clearly tubular, porus tube short and straight, not extending to level of outer gemmular membrane ; gemmoscleres surrounding this tube displaced and slanting, forming a crater-like depression around micropyles ; 370-450μ in diameter.

Distribution : Discontinuously distributed in U.S.A. and Mexico, China, Japan, and SE Asia ; and also in India—Malabar (Kerala), Khandalla (Maharashtra), and Ross Island & Diglipur (Andamans).

Regarding its occurrence in Andamans (Ross Island), Gee (1931, p. 40) notes Annandale's allusion (1911c, p. 85) that "The existence of this widely distributed species on an oceanic island is noteworthy".

Colour in life : Ranging from flesh coloured to light green.

Remarks : Gee (1929, p. 4) rightly observed that "*Ephydatia crateriformis* is evidently a very variable form and there are still a number of interesting points to be investigated in connection with it." Penney and Racek (1968) also quoted that due to this variability especially with regard to gemmoscleres, it was hazardous to fix the number of different forms placed under the present species. Similar difficulties were acknowledged by others in the assessment of varying shape of pseudorotules, especially as such structures are also present in the other members of the genus and not to be relied upon as a definite taxonomic character. In fact, the species was constantly transfered from one subfamily to another ; this has been further encouraged by its discontinuous distribution which naturally gives sufficient room for speciation trend in distant populations. Therefore, only further detailed studies on fresh material can clearly indicate its possible existenee or otherwise of definite subspecies or races. Till this is done, and considering Gee's (1932d, p. 524) statement that "it would be difficult in most cases to separate out varieties which are constant enough and distinct enough for recognition", it is practically discreet to follow Penney and Racek (*op. cit.*) in accepting the present forms, whether induced ecomorphically or genetically as provisionally falling within the morphometric range of the species.

19. **Radiospongilla hemephydatia** (Annandale, 1909) (Text-fig. 4, D-G)

1909. *Spongilla hemephydatia* Annandale, *Rec. Indian Mus.*, **3**, p. 275.

1911. *Spongilla hemephydatia* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 82.

1964. *Spongilla hemephydatia* : Tonapi, *Curr. Sci.*, **33** (12), p. 373.

1968. *Radiospongilla hemephydatia* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 69.

1976. *Radiospongilla hemephydatia* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 15.

1982. *Radiospongilla hemephydatia* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 222.

1987. *Radiospongilla hemephydatia* : Soota, *Fauua of Orissa* : *State Fauna Series* **1**, p. 66. (Publ. Zool. Surv. India).

Description : Sponge occurring on acquatic plants as small, flat cushions ; surface smooth and even, oscula not prominent ; skeleton formed of irregular spicule fibers, cemented together by a very small quantity of spongin ; consistency of live sponge very soft and fragile.

Megascleres—amphioxea, slender, and clearly fusiform, sharply pointed, either completely smooth or covered with a small number of indiscernible spinules centrally, 290-330μ long, 9-12μ wide.

True microscleres—absent ; however, immature gemmoscleres frequently numerous in dermal membrane and also as dense isolated batches in inner symplasm.

Gemmoscleres—amphistrongyla, more or less straight, club-shaped, entirely covered with short and straight spines clearly crowded terminally without increasing in length ; 60-68μ long, shaft 3-4μ wide.

Gemmules—spherical, numerous in maturing sponge, loosely embedded in skeletal network ; pneumatic layer well formed and thick, composed of minute irregular air spaces in which gemmoscleres embedded rather radially in a single layer, their extremities rarely slightly protruding through outer gemmular membrane ; foramen clearly tubular , porus tube flask-shaped, slender, and comparatively long, encircled by 3-4 mammiform aspiculous enlargement of pneumatic coat ; 310-370μ in diameter.

Distribution : Recorded from eastern Australia, and possible occurrence in New Guinea. In India—Sur Lake (Orissa) where reportedly growing together with *Radiospongilla*

cerebellata (=*Spongilla lacustris* subsp. *reticulata*), *Eunapius carteri* (=*Spongilla carteri*) and *Eunapius crassissimus* (=*Spongilla crassissima*). Its report from Matha river near Kharakwasla, Pune (Maharashtra) by Tonapi (1964) requires confirmation as possibly confused with *Stratospongilla*.

Colour in life : Ranging from dirty yellow to bright green.

Remarks : This species, which shows affinities with *R. sansibarica* (Weltner, 1895) differs from it by its smaller and sparsely spined megascleres, some differences in shape and length of its gemmoscleres, and by the presence of mammiform aspiculous elevations of the pneumatic coat surrounding the gemmular micropyle. But, according to Annandale (1909 d, p. 275 ; & 1911 c, p. 83), it shows affinities with *R. crateriformis* in general structure.

The specimens obtained from Coorg in January agree in most of the characters with the above species excepting that mammiform enlargements are not discernible. Whether this is due to seasonal effect or due to immaturity of gemmules, needs more study for a definite decision.

Arndt's (1930) record of the species from New Guinea needs confirmation. Here, the magascleres are entirely smooth and almost cylindrical, and the gemmoscleres figured resemble those of *R. crateriformis* or *R. cantonensis*. Only examination of additional material will clear the true identity of this particular spongillid.

20. **Radiospongilla indica** (Annandale, 1907)
(Text-fig. 4, H-K)

1907. *Ephydatia indica* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 20 & 26.

1909. *Ephydatia crateriformis* Annandale, *Proc. U. S. natn. Mus.*, **37**, p. 402.

1909. *Ephydatia fluviatilis* var. *ramsayi* Annandale, *Nova Guinea*, **5**, p. 421.

1911. *Spongilla crateriformis* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 83.

1968. *Radiospongilla indica* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 68.

1976. *Radiospongilla indica* : Khera and Charturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 15.

1982. *Radiopongilla indica* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 222.

Description . Sponge forming flat, moderate encrustations ; surface smooth and even, oscula not prominent ; dermal membrane seemingly well developed ; skeleton formed of irregular spicule fibers cemented together by a small quantity of spongin ; consistency of live sponge soft, loosely textured.

Megascleres—amphistrongyla, subcylindrical and relatively long, rarely amphioxea, generally with bulbous terminal swelling, rarely showing lanceolate tips, and with acute though scattered spines centrally and densely situated blunts ones terminally ; 230-360μ long, in center 9-13μ wide.

Microscleres—absent.

Gemmoscleres—amphistrongyla, slender, slightly curved or more or less straight, showing a variable number of small conical spines, and terminally with several rows of larger straight ones, distal of which forming comparatively flat pseudorotules ; 60-72μ long, shaft 3-4μ wide, pseudorotule about 8μ in diameter.

Gemmules—spherical, relatively small, occurring throughout the skeletal framework ; pneumatic layer well formed and thick ; composed of minute irregular air spaces in which gemmoscleres embedded radially, occasionally cutting across one another at different angles, present in a single layer, their distal pseudorotules not protruding from outer gemmular membrane ; foramen clearly tubular, porus tube short and straight, encircled by a conical depression formed by slanting gemmosclres around it.

Distribution : Ranging from india to Indonesia and southeastwards to as far as probably New Guinea. In India—Calcutta (West Bengal), and Igatpuri (Maharashtra).

Colour in life : Colourless even when exposed to light.

Remarks : According to Annandale (1907 a, p. 272) the species is closely allied to *R. crateriformis* (Potts, 1882) though,

"the aperture of the gemmule is situated on a distinct prominence and is not markedly crateriform". However, in the views of Penney and Racek (1968, p. 69), it is clearly distinguished from the latter species in showing, "amphistrongylus megascleres, which display most typical bulbous aggregations of terminal blunt spines, as well as the structure of the pseudorotules on the gemmoscleres." Further, these authors also observed that in the case of forms from all localities of our subcontinent the megascleres are amphistrongyla with distinct terminal bulbous swellings, while those from Indonesia they merely bear terminal aggregations of spines or attain lanceolate spiny tips, though the gemmoscleres in both cases can be taken as just morphometric variations. But, Annandale (*op. cit.*) held his described *Ephydatia indica* (1907c, p. 20) as intermediate between *Ephydatia* and *Spongilla*.

Genus VI. **Pectispongilla** Annandale, 1909

1909. *Pectispongilla* Annandale, *Rec. Indian Mus.*, 3, p. 103.

1911. *Pectispongilla* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 106.

1968. *Pectispongilla* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 77.

1976. *Pectispongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 12.

1982. *Pectispongilla* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 228.

Type-species.—*Pectispongilla aurea* Annandale, 1909

Definition : Megascleres—amphioxea, fusiform, varying from microspined to entirely smooth.

Microscleres—amphioxea, slender, straight, fusiform, microspined, frequently of two different sizes, sometimes spherasters also present.

Gemmoscleres—very tiny, cylindrical, and relatively stout, weakly curved, smooth, and terminally with a unilateral arrangement of spines in shape of a hair brush.

Gemmules—small, spherical and occurring throughout skeletal network ; pneumatic layer clearly granular, well

formed, in which gemmoscleres embedded rather radially, but generally at a slanting angle, foramen extended into a short porus tube.

Sponges forming small encrustations ; colour bright yellow to golden ; consistency soft and fragile.

Distribution : This genus appears to be restricted to SE Asia and Australia though, Annandale, (1912 c, p. 394) held it to be endemic in India in western Ghats ; and subsequently (1915 a, p. 173) declared that "The geographical distribution of *Pectispongilla* is peculiar. It is apparently the only genus of the Spongillidae that has so limited range."

Remarks : de Laubenfels (1936, p. 35) stated that "The genus *Pectispongilla* Annandale is another of the Spongillidae which is very like *Spongilla* but it is separated for the remarkable shape of its spiny gemmule spicules." Racek and Harrison (1975, p. 157) while dealing with *Palaeospongilla chubutensis* Ott and Volkmer-Reibeiro, 1972, the first fossil spongillid ever recorded remarked that "Further more, the fossil spongillid is obviously closely related to two extant genera, i. e. *Spongilla* and *Pectispongilla,* which also share some of its structural characteristics". They (p. 162) further stated that "At the same time, the Mesozoic fossil displays spicular and constructional criteria which are now found separately in species of three extant genera, i.e. *Radiospongilla, Spongilla* and *Pectispongilla.*"

Hitherto from this area, under the genus, are known three species of which a key is given below.

1.	Megascleres completely smooth.	...	*P. aures*
	Megasclres covered with minute rounded spines or tubercles save terminally.	...	2
2.	Spherasters present.	...	*P. stellifera*
	Spherasters absent.	...	*P. subspinosa*

21. **Pectispongilla aurea** Annandale, 1908
(Text-fig. 4, L-O)

1909. *Pectispongilla aurea* Annandale, *Rec. Indian Mus.*, 3, p. 103.

1911. *Pectispongilla aurea* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 106.

1968. *Pectispongilla aurea* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 77.

1976. *Pectispongilla aurea* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 12.

1982. *Pectispongilla aurea* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 228.

Description : Sponge forming small encrustations, oscula few but relatively large ; dermal membrane closely attached to symplasm ; surface minutely hispid ; skeleton formed of weakly coherent spicule fibers ; consistency of live sponge soft.

Megascleres—amphioxea, fusiform, sharply pointed, weakly curved or nearly straight, completely smooth ; 270-320μ long, 13-16μ wide.

Microscleres—of two different series : (1) amphioxea, small, slender, straight, fusiform and microspined, 45-52μ long, 1.5-2.5μ wide ; (2) amphioxea, minute, rhomboidal, comparatively thick, and smooth, 22-24μ long, 3-3.5μ wide.

Gemmoscleres—typical for this genus, minute, with smooth, cylindrical, slightly curved shafts, and a bipolar but unilateral arrangement of rows of spines arising from a broad base and appearing connected to one another by siliceous webs ; 31-37μ long, shaft 2.5μ wide, comb-rows 17μ long.

Gemmules—spherical, very small, occurring in skeletal network ; pneumatic coat well formed and clearly granular in which gemmoscleres embedded radially, but cutting across one another at slanting angles, with their comb-rows pointing in all directions ; foramen tubular, porus tube rather short ; 190-220μ in diameter.

Distribution : Only in India—Tenmalai, (Kerala).

Colour in life : Deep golden as observed by Annandale (1911 c, p. 106), who (1909 c, p. 103) also considered it as the most brilliantly coloured.

Remarks : The species shows close affinities with the other two Indian species, viz. *P. stellifera* Annandale, 1915, and *P. subspinosa* Annandale, 1911, differing mainly in lacking microspines or tubercles on megascleres, and in the slightly varying structures of the microscleres which seem to occur in two series in all species known (*vide* Penney and Racek,

1968, p. 78). It can be expected that with examination of more specimens, forms with microspines will undoubtedly turn up when the true identity of the other species may be clearly shown.

22. **Pentispongilla stellifera** Annandale, 1915
(Text-fig. 4, P)

1915. *Pectispongilla stellifera* Annandale, *Rec. Indian Mus.*, **11**, p. 175.

1968. *Pectispongilla stellifera* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 78.

1976. *Pectispongilla stellifera* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper, No. 2, p. 12.

1982. *Pectispongilla stellifera* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 228.

Description : Shape and structure similar to the preceding species.

Megascleres—amphioxea, slender, covered with minute, rounded spines or tubercles but not terminally ; length and width ranges same as those of the precedings one.

Microscleres—of two different types : (1) amphioxea, slender, fusiform, spiny and straight, 52-56μ long, 2.5-4μ wide ; and (2) spherasters, subspherical, tuberculate, 8-13μ in diameter.

Gemmoscleres—identical with those of the preceding species but a little stouter.

Gemmules—hardly dissimilar from those of the previous species.

Distribution : Only in India—Trichur (Kerala).

Remarks : This species can be separated from the other two, in the presence of spherasters though, this structure may be the result of ecomorphic influence.

23. **Pectispongilla subspinosa** Annandale, 1911
(Text-fig. 4, Q & R)

1911. *Pectispongilla aurea* var. *subspinosa* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 107.

1915. *Pectispongilla subspinosa* Annandale, *Rec. Indian Mus.*, **11**, p. 177.

1968. *Pectispongilla subspinosa* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 79.

1976. *Pectispongilla subspinosa* : Khera and Chaturvedi ; *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 13.

1982. *Pectispongilla subspinosa* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 228.

Description : Shape and structure similar to preceding two species.

Megascleres—similar in shape and structure to preceding species but their spines somewhat more prominent.

Microscleres—probably of only one group, comparable to those of series (1) in *P. aurea* in all characteristics.

Gemmoscleres and gemmules hardly dissimilar from those of *P. stellifera*.

Distribution : Only in India—Trichur & Ernakulum (Kerala).

Remarks : The species differs from the preceding *P. stellifera*, only in lacking spherasters which, however, cannot be taken as a valid character.

Genus VIII. **Ephydatia** Lamouroux, 1816

1758. *Spongia* Linnaeus, *Systema Nature*, 10th ed., vol. 1, Animalia, p. 1348 (part).

1816. *Ephydatia* Lamouroux, Histoire des polypiers coralligenes flexibles, Vulgairement nommes Zoophytes, p. 2 (part).

1816. *Spongilla* Lamarck, Histoire naturelle des animaux sans vertebres, 2, p. 98 (part).

1828. *Halichondria* Fleming, *A History of British Animals*, p. 524 (part).

1878. *Trachyspongilla* Dybowsky, *Zool. Anz.*, **1**, p. 53.

1881. *Meyenia* Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 90 (part).

1884. *Pleiomeyenia* Mills, *Proc. Am. Soc. Micr.*, p. 147.

1911. *Ephydatia* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 108.

1968. *Ephydatia* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 80.

1976. *Ephydatia* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 4.

1982. *Ephydatia* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 227.

Type-species.—Spongia fluviatilis Linnaeus, 1758 [By subsequent designation, Penney and Racek, 1968].

Definition : Megascleres—amphioxea, slender and fusiform to rather robust and cylindrical, completely smooth or covered with a varying number of spines excepting terminally.

Microscleres—absent.

Gemmoscleres—typically birotulates of fixed length in all species with smooth megascleres ; those possessing spiny megascleres often show varying length, but lengths can overlap the first kind ; rotules of similar or a little differing outline, invariably flat in lateral view ; shafts either slender, smooth or incipiently spined, or rather robust and covered with erect acute spines.

Gemmules—subspherical to spherical, moderately large to large, occurring throughout skeletal network, usually very numerous ; pneumatic layer well formed but of irregular thickness, composed of minute, spherical to subspharical air spaces, in which gemmoscleres embedded radially, in one or more layers, their distal rotules often clearly discernible through outer gemmular membrane ; foramen a simple elevation, without a porus tube, usually encircled by a narrow peripheral collar.

Sponges forming flat to bulky encrustations, surface as a rule clearly corrugated ; associations with zoochlorellae recorded for some species ; consistency of sponge ranging from soft to moderately firm.

Distribution : According to Penney and Racek (1968), one species widely distributed, preferring cold and warm temperate climates, several species only occurring in the northern hemisphere in a scattered manner.

Remarks : This genus established by Lamouroux (1816) received a dubius generic acceptance, and even inspite of its restoration by Gray (1967) continued to be problematic. Later, its replacement by Carter (1881) by his own genus *Meyenia*, did not lead to the abatement in the least to the technical controversies for a considerably long period, leading to the acceptance of *Meyenia* very

generally in North America ; whereas all other systematists concerned, European, South American, and Asian, preferred to uphold *Ephydatia*. Its taxonomic position has been elaborately dealt with by de Laubenfels (1936), Jewell (1952), and Penney and Racek (1968). The last two authors selected as type species *Spongia fluviatilis* Linnaeus, 1758, in view of the fact that this specific name was practically universally used for a very well-defined and clearly recognizable common species and also further, most of the species in the early history of sponge systematics remain ill-defined and questionable. In recent years, the genus while being very elaborately dealt with by Ezcurra de Drago (1975), was divided into two groups based both on morphometric considerations and distributional grounds ; who also found it necessary to split the species *E. fluviatilis* into two subspecies, viz. *E. fluviatilis fluviatilis* (Linnaeus, 1758) and *E. fluviatilis ramsayi* (Haswell, 1882) based on their distribution ; the former with northern and the latter with a tropical and southern distribution. Thus, according to the author, the genus covers the following members ; *E. fluviatilis fluviatilis, E. fluviatilis ramsayi, E. mulleri, E. meyeni*, and *E. millsii*.

It should be noted that considerable variations are available within the individual members. As already observed by Gee and wu (1928, p. 48), Poirrier (1974) too while dealing with these in gemmoscleres of *Ephydatia fluviatilis* remarked (p. 346) that "The gemmoscleres exhibit extreme ecomorphic variations which transcend the taxonomic criteria established for other nominal species". Other species also show similar variations ; thus warranting more desirable elaborations.

Hitherto, from this area, under the genus, are known a species and a variety, of which a key is given below.

Bubble cells abundant.	...	*E. meyeni*
Bubble cells absent.	...	*E. fluviatilis ramsayi*

24. **Ephydatia fluviatilis ramsayi** (Haswell, 1882)

(Text-fig. 4, S)

1882. *Meyenia ramsayi* Haswell, *Proc. Linn. Soc. NSW*, 7, p. 210.

1885. *Meyenia mexicana* Potts, *Amer. Nat.*, **19**, p. 810.

1887. *Spongilla fluviatilis* var. *ramsayi* Lendenfeld, *Zool. Jb.*, **2**, p. 92.

1887. *Meyenia fluviatilis* var. *mexicana* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 226.

1887. *Meyenia subdivisa* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 226.

1887. *Meyenia robusta* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 225.

1890. *Ephydatia fluviatilis* Weber, *In* : *Zoologische Ergebnisse einer Reise nach Neiderlandisch ost-Indien*, **1**, p. 32.

1895. *Ephydatia fortis* Weltner, *Arch. Naturgesch.*, **61** (1), p. 141.

1898. *Ephydatia ramsayi* forma *talaensis* Weltner, *Boll. Musai Zool. Anat. comp. R. Univ. Torino*, **13**, p. 331.

1907. *Ephydatia robusta* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 24 & 26.

1907. *Ephydatia fluviatilis* var. *capensis* Kirkpatrick, *Ann. Mag. nat. Hist.* (7), **20**, p. 524.

1909. *Ephydatia ramsayi* Annandale, *Nova Guinea*, **5**, p. 421.

1910. *Ephydatia fluviatilis* var. *syriaca* Topsent, *Rouen Bull. Soc. Sci. Nat.*, 1910, p. 1.

1911. *Ephydatia fortis* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 58.

1912. *Ephydatia fluviatilis* var. *himalayensis* Annandale, *Rec. Indian Mus.*, **7**, p. 138.

1918. *Ephydatia fluviatilis* var. *intha* Annandale, *Mem. Asiat. Soc. Beng.*, **6**, p. 212.

1929. *Ephydatia fortis* var. *hebridensis* Gee, *Am. Mag. nat. Hist.* (4), **9**, p. 131.

1930. *Ephydatia fortis vorstmani* Gee, *Treubia*, **12** (1), p. 94.

1968. *Ephydatia fluviatilis* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 82 (part).

1975. *Ephydatia fluviatilis ramsayi* : Ezcurra de Drago, *Physis, B. Aires*, **34** (89), p. 168.

1976. *Ephydatia fluviatilis* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 4.

1982. *Ephydatia fluviatilis* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 228.

Description : Mature sponge forming bulky and corrugated growths, rarely flat encrustations ; surface uneven ; oscula numerous and comparatively large ; dermal membrane well developed ; skeleton formed of polyspicular longitudinal

fibers, ensheathed in spongin and a varying number of secondary transverse fibers ; consistency of live sponge firm though fragile ; skeleton of dry sponge very brittle.

Megascleres—amphioxea, slightly curved, rarely straight, ranging from fusiform to almost cylindrical, completely smooth, 210-400μ long, 6-19μ wide.

Microscleres—absent.

Gemmoscleres—birotulates of one form, with a slender and smooth shaft, and rotules equal in diameter and clearly flat, irregularly and not very much incised ; frequently axis projecting through rotules due to malformations in adverse environments, or irregular spines occur on shafts ; shaft less than 30μ long ; rotules less than 24μ in diameter.

Gemmules—spherical, very numerous, occurring all over skeletal network ; pneumatic layer well-developed but relatively shallow, formed of very small spherical air spaces in which gemmoscleres embedded radially in a single layer with one rotule on inner gemmular membrane, and the other just extending to outer membrane ; foramen only very slightly raised, encircled by a very small collar, never tubular.

Distribution : All faunal realms. In India—only in western Himalayas namely, Kumaon, Naukuchia Tal, Bhim Tal, Sat Tal, and Nainital.

Colour in life : Usually drab yellow to brown, occasionally green due to presence of zoochlorellae which according to Moore (1953) might create a microenvironment.

Remarks : Unlike, as in the case of more widely distributed forms, the observed capacity for variability in this variety cannot be imputed to any other cause than considered as rather just structural malformations. The above listed synonymies may be treated as only tentatative. The synonymy of the briefly and incompletely described *Ephydatia facunda* Weltner, 1895, with the above variety proposed by Ezcurra de Drago (1975), was not accepted by De Rosa-Barbosa (1979) who redescribed the holotype, and this is followed here.

25. **Ephydatia meyeni** (Carter, 1849)

1849. *Spongilla meyeni* Carter, *Ann. Mag. nat. Hist.*, **4**, p. 84.

1867. *Ephydatia meyeni* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 550.

1887. *Meyenia fluviatilis* var. *meyeni* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 221.

1895. *Ephydatia mulleri* Weltner, *Arch. Naturgesch.*, **61** (1), p. 125 (part).

1907. *Ephydatia fluviatilis* var. *meyeni* Annandale, *Rec. Indian Mus.*, **1**, p. 389.

1907. *Ephydatia mulleri* var. *meyeni* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, p. 26.

1911. *Ephydatia meyeni* : Annandale. *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 108.

1964. *Ephydatia meyeni* : Tonapi, *Curr. Sci.*, **33** (12), p. 373.

1968. *Ephydatia meyeni* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 84.

1969. *Ephydatia meyeni* : Lahiry, *Adv. Abstr. Contr. Fish. aquat., Sci. India*, 3 (2), p. 101 (Abstract).

1969. *Ephydatia meyeni* : Bhaduri, *Adv. Abstr. Contr. Fish. aquat. Sci. India*, 3 (2), p. 101 (Abstract).

1971. *Ephydatia meyeni* : Mookerjee, *Indian J. exp. Biol.*, 9 (2), p. 227.

1971. *Ephydatia meyeni* : Mookerjee *etal.*, *Z. Biol.*, **116** (6), p. 452.

1972. *Ephydatia meyeni* : Mookerjee, *Indian J. exp. Biol.*, **10** (2), p. 91.

1972. *Ephydatia meyeni* : Mulherkar *etal.*, *Indian J. exp. Biol.*, **10** (3), p. 236.

1976. *Ephydatia meyeni* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 5.

1982. *Ephydatia meyeni* : Soota and Pattanayak, *Rec. Zool. Surv. India*, **80**, p. 228.

1982. *Ephydatia meyeni* : Ghaskadbi and Mulherkar, *Exp. cell Biol.*, **50** (3), p. 155.

1983. *Ephydatia meyeni* : Ghaskadbi and Mulherkar, *Indian J. exp. Biol.*, **21** (8), p. 468.

1983. *Ephydatia meyeni* : Soota *etal.*, *Geobios new Reports*, **2**, p. 151.

1983. *Ephydatia meyeni* : Soota and Saxena, *Trans. Isdt. & Ucds*, **8** (2), p. 132.

Description : Mature sponge forming irregularly shaped bulky growths ; surface uneven and clearly corruagated ; oscula rather indistinct, dermal membrane well formed : skeleton composed of polyspicular radiating fibers, ensheathed in spongin, and a varying number of secondary transverse fibers ; consistency of live sponge firm and

moderately hard, skeleton of dry sponge very brittle ; bubble cells abundant in inner symplasm.

Megascleres—amphioxea, very little curved, more or less cylindrical, completely smooth ; 275-300μ long, 11-15μ wide.

Microscleres—absent.

Gemmoscleres—birotulates of one form having moderately stout shafts, rarely with 1-3 sharp spines, generally completely smooth, and with rotules equal in diameter and clearly flat, irregularly and very much incised ; malformations common in adverse environments ; shafts 28-33μ long, rotules 25-29μ in diameter, marginal teeth on rotules 19-22.

Gemmules—spherical, numerous in mature sponge, occurring all over skeletal network ; pneumatic layer well developed but irregular, formed of minute spherical air spaces in which gemmoscleres embedded in one or two layers, inner always strictly radially arranged, outer frequently irregularly inserted ; while inner layer is invariably fully confined within pneumatic coat, distal rotules of outer always protruding from outer gemmular membrane ; formen clearly raised but simple, never like a tube, 480-610μ in diameter.

Distribution : China. In India—Calcutta and neighbourhood (West Bengal), Bhim Tal, Kumaon, alt. 4500 ft. (U. P.), Jodhpur, Udaipur and Kota (Rajasthan), Bombay and Pune (Maharashtra), Kerala, and Cape Comorin (Tamil Nadu). Specimens examined by the author from new localities : Lake Rainuka (H. P.) ; Dudhwa National Park, and Roorkee (U. P.) ; and Rohtak, Panipat, Ottu lake, and Sirsa, Hissar (Haryana).

Colour in life : Light to dark brown.

Remarks : This species, which has been elaborately dealt with by Annandale (1907a, p. 272 & 1908c, pp. 306-307), and Gee (1932c, pp. 535-539), has been considered by Poirrier (1974, p. 346) as a doubtful one, inspite of the fact that its validity was upheld by Penney and Racek (1968), and later by Ezcurra de Drago (1975), and this is followed here.

Genus VIII. **Umborotula** Penney and Racek, 1968

1890. *Ephydatia* Weber, *In* : Zoologische Ergebnisse einer Reise nach Niederländisch Ost-Indien, **1**, p. 33 (part).

1911. *Ephydatia* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 54 (part).

1960. *Meyenia* Penney, *Univ. S. Carol. Publs,* ser. 3, 3 (1), p. 46 (part).

1968. *Umborotula* Penney and Racek, *Bull. U. S. natn. Mus.,* No. 272, p. 121.

Type-species.—Ephydatia bogorensis [By monotypy, Penney and Racek, 1968].

Definition : Megascleres-amphioxea, long, slender, generally covered with a few tiny and inconspicuous conical spines, rarely completely smooth.

Microscleres—absent.

Gemmoscleres—birotulates, equal, with long shafts bearing large conical spines and terminally with equal and similar umbonate rotules having slightly recurved margins with many small and regular indentations.

Gemmules—spherical, large and very few ; pneumatic coat well developed, granular, formed of minute and regular air spaces, in which gemmoscleres inserted always radially, with their proximal rotules practically touching one another ; foramen clearly tubular, tube delicate and slightly extending pneumatic layer.

Sponges occurring as minute, soft encrustations on aquatic plants ; colour normally vivid green, due to occurrence of zoochlorellae ; consistency soft and fragile.

Distribution : Reportedly restricted to SE Asia.

Remarks : This monotypic genus was created by Penney and Racek (1968) for the single species earlier placed under the genus *Ephydatia*.

26. **Umborotula bogorensis** (Weber, 1890)
(Text-fig. 4, T-V)

1890. *Ephydatia bogorensis* Weber, *In* : Zoologische Ergebnisse einer Reise nach Niederländisch Ost-Indien, **1**, p. 33.

1901. *Ephydatia blembingia* Evans, *Q. Jl. microsc. Sci.,* **44**, p. 71.

1911. *Ephydatia blembingia* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 54.

1911. *Ephydatia bogorensis* : Annandale, *Fauna British India,* Freshwater sponges, hydroids and Polyzoa, p. 54.

1931. *Ephydatia bogorensis* var. *blembingia* Gee, *Peking nat. Hist. Bull.*, 5 (1), p. 34.

1960. *Meyenia bogorensis* Penney, *Univ. S. Carol. Publs*, ser. 3, 3 (1), p. 46.

1960. *Meyenia bogorensis* var. *blembingia*, Penney, *Univ. S. Carol. Publs*, ser. 3, 3 (1), p. 46.

1968. *Umborotula bogorensis* Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 122.

1978. *Umborotula bogorensis* : Rutzler, *Aqua. Biol.*, 3, p. 143.

Description : Sponge forming small circular or irregular crusts or nodules on aquatic plants ; surface a bit hispid due to protrusion through dermal membrane of skeletal fibers ; oscula not prominent ; skeleton formed of an open network of spicule fibers cemented together by a little spongin ; consistency of live sponge very soft though fragile.

Megascleres—amphioxea, slender, weakly curved, fusiform and covered with very small conical spines excepting terminally ; 240-370μ long, 11.2-16μ wide.

Microscleres—absent.

Gemmoscleres—when fully developed, birotulates with relatively long and spiny shafts, showing equal umbonate rotules with clearly recurved and regularly incised margins ; 60-83μ long, 3-6μ wide, rotules 21.3-27μ in diameter.

Gemmules—spherical to slightly ovoid, few, and occurring throughout sponge body, 450-600μ in diameter ; pneumatic coat well developed, formed of very small air spaces and granular, in which gemmoscleres embedded radially with their proximal rotules practically touching one another and distal ones protruding out of pneumatic layer ; foramen elongated into a short, more or less conical porus tube.

Distribution : In Indian region recently reported from Andaman Islands. According to Recek (1969, p. 300) SE Asia to eastern Australia. He remarked that "The typically minute size of this species represents a major obstacle in the assessment of its true distributional range and additional collections may yet demonstrate the fallacy of the present assumption, that U. *bogorensis* displays a widely scattered dispersal."

Colour in life : Light brown to dark green,

Remarks : The species has already been dealt with very elaborately by Penney and Racek (1968). Rutzler's (1978) examination of subsequent collection which formed the first record for the Indian region (Andaman Islands) has not given material for any fresh discussion.

Genus IX. **Dosilia** Gray, 1867.

1867. *Dosilia* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 55 (part).

1881. *Meyenia* Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 94 (part).

1888. *Heteromeyenia* Mills, *Ann. Mag. nat. Hist.* (6), **1**, p. 313 (part).

1895. *Ephydatia* Weltner, *Arch. Naturgesch.*, **61** (1), p. 126 (part).

1911. *Dosilia* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 110.

1912. *Asteromeyenia* Annandale, *Proc. U. S. natn. Mus.*, **40**, p. 593.

1927. *Astromeyenia* Schröder, *Zool. Anz.*, **73**, p. 101.

1968. *Dosilia* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 126.

1976. *Dosilia* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 4.

1982. *Dosilia* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 218.

Type-species.—Spongilla plumosa Carter, 1849 [By subsequent designation, de Laubenfels, 1936].

Definition : Megascleres—amphioxea, slender, clearly fusiform, either completely smooth, or covered with small and scattered spines excepting terminally.

Microscleres—occurring in varying densities in dermal membrane and symplasm, either clear asters, generally with rays arising from a central spherical nodule, or rough amphioxea which centrally showing several long perpendicular radiating rays, or a combination of both.

Gemmoscleres—birotulates, of two distinct lengths, one differing slightly, and the other greatly, which latter of two clear types, never of equal length, stout, with strongly spined shafts, and terminally showing clearly umbonate rotules of equal diameter, with margins incised into many recurved teeth.

Gemmules—invariably subspherical, frequently clearly ovoid, large, usually very numerous, occurring in skeletal network ; pneumatic layer formed of small spherical air spaces, gemmoscleres with upper rotules frequently protruding through its outer surface ; foramen extended into a short and straight tubule.

Sponges normally large and spherical with more or less lobose surface, rendering a feathery appearance ; oscula prominent though small ; dermal membrane well formed ; skeleton composed of clearly radial spicule fibers, and irregularly arranged slightly coherent transverse fibers ; consistency of sponge moderately soft though very fragile ; colour ranging widely from green to brown.

Distribution : Distinctly discontinuous, most species probably preferring tropical and subtropical climates.

Rvmarks : Gray (1867) established the genus *Dosilia.* Subsequently, two other genera were errected namely, *Heteromeyenia* by Potts (1887) including a heterogeneous assemblage of unrelated spongilled species ; and another *Asteromeyenia* by Annandale (1912) to cover species showing stellate microscleres. Schröder (1927) failing to note in *Heteromeyenia* strong affinities existing among "heterogeneous" stellate microscleres-bearing species, grouped them in his new subgenus *Astroheteromeyenia* under *Dosilia*, a "homogeneous" group. But, considering the current definition of this genus by Penney and Racek (1968), giving it a wider coverage, Schröder's arrangement was unnecessary.

Hitherto, from this area, under the genus a single species *Dosilia plumosa* (Carter, 1849) is known, which is described below.

27. **Dosilia plumosa** (Carter, 1849)
(Text-fig. 4, W-Z)

1849. *Spongilla plumosa* Carter, *Ann. Mag. nat. Hist.*, **4**, p. 85.

1867. *Dosilia plumosa* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 551.

1881. *Meyenia plumosa* Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 94.

1895. *Ephydatia plumosa* Weltner, *Arch. Naturgesch.*, **6** (1), p. 126 (*nec. Heteromeyenia plumosa* Weltner, 1895).

1911. *Dosilia plumosa* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 111.

1968. *Dosilia plumosa* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 128.

1976. *Dosilia plumosa* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 4.

1982. *Dosilia plumosa* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 218.

1983. *Dosilia plumosa* : Soota *et al.*, *Geobios new Reports*, 2, p. 151.

1983. *Dosilia plumosa* : Soota and Saxena, *Trans. Isdt. & Ucds*, 8 (2), p. 132.

Description : Sponge massive and spherical ; surface lobose ; oscula conspicuous though small ; dermal membrane well formed ; skeleton composed of clearly formed radial spicule fibers cemented together with spongin of varying quantity and much thinner transverse fibers ; consistency of sponge moderately soft though very fragile.

Megascleres—amphioxea, clearly fusiform, completely smooth, and a bit curved ; 400-520μ long, 15-21μ wide.

Microscleres—numerous in symplasm and surrounding gemmules, stellate, formed of 8-12 rays arising from a clear central globular nodule, rays normally smooth, having a few small recurved distal spines ; at times microscleres represented by granulated amphioxea bearing centrally several radiating and perpendicular rays or a combination of both ; length extremely variable, rays below 15-18μ in radius,

Gemmoscleres—birotulates having a strongly spined cylindrical shaft, abruptly increasing in width just below rotules which latter clearly umbonate and identical, and their margins incised into many blunt and recurved teeth ; 55-85μ long, shaft 3-4μ thick, rotules 23-25μ in diameter.

Gemmules—strongly subspherical to ovoid, generally numerous, occurring all over skeletal network ; pneumatic layer well developed, granular and formed of small spherical air spaces in which gemmoscleres regularly embedded, their upper rotules rarely protruding through its outer surface ; foramen extended into a short and straight tubule ; 500-680μ in diameter.

Distribution : Reported from the Philippines, probably also in other parts of SE Asia, [vide Gee (1932, p. 533), and Penney and Racek (1968)]. In India—Pulta water tank (West Bengal), Hazaribagh (Bihar), Jodhpur, Udaipur, and Jaipur (Rajasthan), Bombay (Maharashtra), and Rambha (Orissa).

Colour in life : Green and pale brown. According to Gee (*op. cit.*, p. 531), "Carter's Bombay specimens were some green and some yellow ; Annandale's were of a pale brown or a brilliant green. The Philippine specimens are all green. The difference in colour is doubtless due to whether or not the position of the sponge is favourable for the growth of the algae which are the cause of the color".

Remarks : This species, which was originally described as *Spongilla plumosa* by Carter (1849) from Bombay, and later redescribed by him (1881a) as *Meyenia plumosa*, has been dealt with by Bowerbank (1863), Potts (1887), Annandale (1911), and Gee (*op. cit,*). But, contrary to the observations of earlier workers, Penney and Racek (1968) showed the gemmoscleres slightly but distinctly unequal in length, more or less forming two length series ; and their shafts as in other related species distinctly increasing in thickness just below the rotules, a character, however hardly of any significance. However, study of more material may not prove wasteful.

Genus X. **Trochospongilla** Vejdovsky, 1883

[After Volkmer-Ribeiro and De Rosa-Barbosa (1985)]

1883. *Trochospongilla* Vejdovsky, *Abh. K. böhm. Ges. Wiss.*, **12** (5), p. 31.

1884. *Tubella* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 216.

1888. *Uruguaya* Hinde, *Ann. Mag. nat. Hist.* (6), **2**, p. 10 (part).

1911. *Trochospongilla* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 113.

1968. *Trochospongilla* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 133.

1968. *Uruguaya* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 143 (part).

1976. *Trochospongilla* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 21.

1982. *Trochospongilla* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 228.

Type-spcies.—Trochospongilla horrida Weltner, 1893.

Definition : Megascleres-generally amphioxea or amphistrongyla, short, thick, either entirely smooth or covered with few to many small or stout spines.

Microscleres-absent.

Gemmoscleres-birotulates, small, with more or less stout, smooth, and relatively short shafts and terminally with circular rotules of entire margins, which often recurved in same direction, both rarely identical in some species, outer very frequently strikingly smaller than inner, in exceptional cases reduced to a small regularly or irregularly shaped disc.

Gemmules-subspherical to spherical, very small, frequently very numerous, occasionally sheathed in a capsule of normal megascleres ; both gemmular membranes well formed ; pneumatic coat usually very thin but well developed, formed of small rounded air spaces in which gemmoscleres embedded radially to form only one layer, their inner rotules frequently overlapping one another ; foramen simple to slightly tubular, invariably somewhat raised.

Sponges forming shallow though generally large encrustations ; surface hispid and uneven, showing several short and erect tubular projections ; most species seemingly avoiding light ; colour dark brown ; consistency moderately soft to extremely hard.

Distribution : The genus showing worldwide distribution, though most species seem to occupy well-defined geographical zones.

Remarks : This genus, which was established by Vejdovsky (1883) and subsequently dealt with by Bonetto and Ezcurra de Drago (1965, 1973), Penney and Racek (1968), Volkmer-Ribeiro *et al.* (1975), and Volkmer-Ribeiro and De Rosa-Barbosa (1985), was accepted by later workers. But it had a controversial relationship with *Uruguaya* Carter, 1881, which Annandale (1911c) preferred to place under *Trochospongilla* as subgenus, an arrangement held untenable by Penney and

Racek (*op. cit.*). However, the genus was invalidated by Bonetto and Ezcurra de Drago (1969), but revalidated and redefined as a monotypic by Volkmer-Ribeiro and De Rosa-Barbosa (1978), and later (1985) continued to uphold their action. It is possible that forms may be available showing transitional or intermediate skeletal arrangements when only true systematic position of the two genera can be definitely established pending which the genus is now accepted. *Trochospongilla* has been reported to occur with *Acalle recurvata* (Bowerbank, 1863) by Volkmer-Ribeiro and De Rosa-Barbosa (1972, p. 310).

Hitherto, from this area, under the genus, three species are known, of which a key is given below.

1.	Megascleres entirely smooth. ...	*T. paulula*
—	Megascleres covered with small conical spines.	2
2.	Megascleres amphioxea. ...	*T. pennsylvanica*
—	Megascleres amphistrongyla ...	*T. philottiana*

28. **Trochospongilla paulula** (Bowerbank, 1863)

(Text-fig. 5, A-C)

1863. *Spongilla paulula* Bowebank, *Proc. zool. Soc. Lond.*, 1863, p. 453.

1867. *Metania paulata* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 551.

1881. *Tubella paulula* Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 96.

1907. *Trochospongilla latouchiana* Annandale, *Rec. Indian Mus.*, **1**, p. 389.

1911. *Trochospongilla latouchiana* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 115.

1919. *Trochospongilla latouchiana* subsp. *sinensis* Annandale, *Rec. Indian Mus.*, **16**, p. 457.

1931. *Trochospongilla paulula* Gee, *Peking nat. Hist. Bull.*, **5** (1), p. 45.

1932. *Trochospongilla latouchiana* var. *pasigensis* Gee, *Peking nat. Hist. Bull.*, **6** (2), p. 14.

1936. *Spongilla paulata* de Laubenfels, *Carnegie Inst. Work Publ.* 467, p. 370.

1968. *Trochospongilla latouchiana* Penney and Racek, *Bull. U. S. natn. Mus.* No. 272, p. 140.

1976. *Trochospongilla latouchiana* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 21.

1982. *Trochospongilla latouchiana* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 228.

Description : Sponge forming relatively shallow cushions, which range from practically indiscernible to very striking encrustations ; surface rather uneven, rarely smooth, very frequently with numerous irregular tubular projections ; oscula relatively few but prominent, and often opening from conical elevations ; skeleton formed of distinct vertical spicule fibers cemented together by spongin and irregularly arranged transverse fibers ; consistency of live sponge very rigid but often brittle.

Megascleres—amphioxea, almost straight or only weakly curved, cylindrical, generally completely smooth ; 220-310μ long, 11-16μ wide.

Microscleres—absent.

Gemmoscleres—birotulates, small to moderately large, with a slender shaft, and rotules circular differing in diameter ; upper frequently considerably recurved, forming a bowl-like structure ; shaft 13-29μ long, 3-5μ thick, 9-16μ in diameter, lower 16-26μ in diameter.

Gemmules—spherical, numerous, occurring throughout and loosely held in position by skeletal network, unsheathed in capsules of megascleres ; pneumatic layer comparatively thin and granular in which gemmoscleres embedded to form a single layer ; foramen extended into a conical and short purus tube ; 175-235μ in diameter.

Distribution : Ranging from southern and SE Asia north to China and south to eastern Australia ; and Amazon River (type locality). In India—Calcutta and neighbourhood (West Bengal). In Burma (now Myanmar)-Kawkarlik, Amherst dist., Tenasserim.

Colour in life : Varying shades of brown, usually dark brown.

Remarks : This species, originally described as *Spongilla paulula* by Bowerbank (1863) and accepted by Jewell (1952),

was placed successively under three genera, viz. *Metania*, *Tubella*, and *Trochospongilla*, all newly created respectively by Gray (1867), Carter (1881), and Vejdovsky (1883), the last being recognised by Gee (1931), and Schröder (1932), contrary to the preference of Potts (1887), and Weltner (1895), both of whom accepted *Tubella* ; and of de Laubenfels (1936) who retained it to the original genus *Spongilla*. Annandale (1907c) added *T. latouchiana* which was accepted by later workers, though Gee (1932a, p. 21) considered it and its variety *sinensis* as a possible synonym of *T. paulula* while realising that further studies would possibly reveal "whether or not the *Trochospongilla latouchiana* group should not all become *T. paulula* since that sponge has the priority of some years in its description over Annandale's species." Though Penney and Racek (1968), Racek (1969), and Volkmer-Ribeiro and De Rosa-Barbosa (1972) firmly held both the species as clearly distinct, the present aurhor following the recentmost view of Bonetto and Ezcurra de Drago (1973), detailing the ecomorphic variations, and followed by Volkmer-Ribeiro *et al.* (1975), and some others, accepts their conspecificity.

29. **Trochospongilla pennsylvanica** (Potts, 1882) (Text-fig. 5, D & E)

1882. *Tubella pennsylvanica* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 14.

1887. *Tubella fanshawi* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 252.

1887. *Tubella intermedia* Potts, *Proc. Acad. nat. Sci. Philad.*, p. 252.

1911. *Trochospongilla pennsylvanica* Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 118.

1931. *Trochospongilla pennsylvanica* var. *mackayi* Gee, *Peking nat. Hist. Bull.*, 5 (1), p. 42.

1931. *Trochospongilla pennsylvanica* var. *minima* Gee, *Peking nat. Hist. Bull.*, 5 (1), p. 43.

1947. *Tubella mello-leitaoi* (sic) Machado, Publ. 102, Anexo 5. Ministero Agricultura conselho Nacional de Protecao aos Indios, Zool. (partim only plate VI, fig. 1).

1968. *Trochospongilla pennsylvanica* : Penney and Racek, *Bull. U. S. natn. Mus.* No. 272, p. 137.

1976. *Trochospongilla pennsylvanica* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 21.

1982. *Trochospongilla pennsylvanica* : Soota and Pattanayak, *Rec. zool. Surv. India*, 80, p. 228.

Description : Sponge forming moderately large encrustrations ; surface slightly hispid snd uneven, showing many sloping eminences encircled by radiating furrows : oscula not many, small, though conspicuous ; skeleton formed of irregular network, cemented together but with very little spongin ; consistency of live sponge moderately soft and even sometimes fragile.

Megascleres.—amphioxea, rarely amphistrongyla, somewhat slender, weakly curved, sharply pointed, completely covered with small, conical and sharp spines ; 140-210μ long, 8-11μ wide,

Microscleres.—absent.

Gemmoscleres—birotulates, small, with slender shafts, 9-11μ long, 2μ thick ; rotules showing more or less recurved circular margins, usually similar in shape but varying in diameter, lower always normally developed, 16-20μ in diameter ; upper often rudimentary, sometimes irregular, 3.5.-8.5μ in diameter.

Gemmules—spherical, small, quite numerous, restricted to base of body, discernibly uncovered by megascleres ; pneumatic layer granular and relatively thin, rarely covering upper rotule of gemmoscleres which crowded in the layer with lower rotules clearly overlapping one another ; foramen produced into a conical and short porus tube ; 190-398μ in diameter.

Distribution : Cosmopolitan. In India—Kerala.

Colour : Light gray to light brown.

Remarks : This species, which was recently redescribed by Volkmer-Ribeiro and Maciel (1983), was originally described as *Tubella pennsylvanica* by Potts (1882), and subsequently, dealt with under different names as shown under the synonymy. But Annandale (1911c) rightly relegated it to the genus *Trochospongilla* considering that in most of the gemmoscleres the rudimentary growth of the upper rotule was nothing but ecomorphic condition, "representing a convergence of characters comparable to but not identical with that found in *Tubella* species". According to Gee (1932a,

p. 22) this form shows close affinity to the genus *Tubella*, and he almost expected intermediate forms to exist between the two genera, showing thereby that both are congeneric. But this was contested by Penney and Racek (1968, p. 138) according to whom "The species discussed merely represents one extreme of an intergrading series of species, almost all of which display some degree of size differences between their upper and lower gemmosclere rotules. It cannot possibly be left in *Tubella*, relegated to a synonym of *Metania* in this paper, since all true members of this genus possess free microscleres....." According to Simpson and Gilbert (1973), the species is dioecious.

30. **Trochospongilla philottiana** Annandale, 1907

(Text-fig. 5, F-J)

1899. *Spongilla tanganyikae* Evans, *Q. Jl. microsc. Sci.*, **41**, p. 481.

1907. *Trochospongilla philottiana* Annandale, *J. Proc. Asiat. Soc. Beng.*, **3**, pp. 22 & 26.

1911. *Trochospongilla philottiana* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 117.

1926. *Trochospongilla tunghuensis* Gee, *China J. Sci. Arts*, **4** (4), p. 181.

1930. *Trochospongilla philottiana* var. *minima* Gee, *Rec. Indian Mus.*, **32**, p. 492.

1930. *Trochospongilla philottiana* var. *tunghuensis* Gee, *Rec. Indian Mus.*, **32**, p. 493.

1930. *Trochospongilla tunghuensis* var. *javanensis* Gee, *Treubia*, **12** (1), p. 102.

1968. *Trochospongilla philottiana* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 142.

1976. *Trochospongilla philottiana* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 22.

1982. *Trochospongilla phillottiana* : Soota and Pattanayak, *Rec. zool. Surv. India*, **80**, p. 228.

Description : Sponge forming moderately large flat encrustations ; surface more or less even but clearly hispid ; oscula neither many nor conspicuous ; skeleton composed of comparatively slender spicule fibers to form triangular meshes ; consistency of live sponge hard, though more or less brittle.

Megascleres—amphistrongyla, somewhat slender, weakly curved, only rarely abruptly pointed amphioxea or tornota, a more or less uniformly covered with small conical spines; typical scleres 165-190μ long, 9-12μ wide.

Microscleres—absent.

Gemmoscleres—birotulate, small, with slender shafts, and rotules circular differing in diameter and frequently much recurved, upper usually forming bowlike structure, 14-18μ in diameter; typical shaft 14-16μ long, 3-4μ thick, lower rotule 18-22μ in diameter.

Gemmules—spherical, small, quite numerous, restricted to base of body, generally encircled by a capsule of normal megascleres; pneumatic layer clearly granular and very thin in which gemmoscleres embedded in a single layer, their lower rotules alternatively overlapping one another; foramen produced into a conical and short porus tube; 340-390μ in diameter.

It may be noted that Annandale's (1907C) earlier observations of gemmular structure in type species, were corrected by his later (1907a, p. 269) observations.

Distribution: From India—Calcutta & neighbourhood (West Bengal) and through southern China and SE Asia to the Philippines, and possibly also occurring in Africa.

Colour in life: Pale yellow to light brown.

Remarks: This species, which was first described by Annandale (1907c), has subsequently been dealt with under several names by workers particularly Gee (1932a), who (p. 30) held that the forms, though, closely related, showed considerable variations, considering them as separate "varieties". But, according to Penney and Racek (1968, p. 43) these variations were not stable being just passing alterations due to differences in physico-chemical parameters; and further, it is possible that with the availability of more data of the earlier inadequately described species *Spongilla tanganyikae* Evans, 1899, the present species may even become its synonym.

Genus XI. **Metania** Gray, 1867

1867. *Metania* Gray, *Proc. zool. Soc. Lond.*, 1867, p. 551.

1881. *Tubella* Carter, *Ann. Mag. nat. Hist.* (5), **7**, p. 96 (part).

1934. *Acalle* Burton, *Revue Zool. Bot. afr.*, **24**, p. 412.

1938. *Potamolepis* Burton, *Revue Zool. Bot. afr.* 461 (nec Marshall 1883), p. 568 (part).

1968. *Metania* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 147.

1968. *Parametania* Brien, *Bull. Acad. R. Belg. Cl. Sci.* (54), p. 394.

1976. *Metania* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p. 10.

1986. *Metania* : Volkmer-Ribeiro, *Amazoniana*, 9 (4), pp. 493, 497 & 500.

Type-species.—*Spongilla reticulata* Bowerbank, 1863.

Definition : Megascleres—amphistrongyla or amphioxea, thick, smooth or microspined, frequently varying in length in the same individual, sometimes of two separate types. Volkmer-Ribeiro (1979, 1981, 1986) referred the larger, smooth, and more abundant ones as alpha, and smaller spinose ones as beta megascleres.

Microscleres—always present but occurring in varying densities, amphioxea, slender, fusiform, and spined, with central ones large and erect.

Gemmoscleres—boletiform, with almost spiny shafts, lower rotule circular or irregularly polygonal, with or without indented margin, frequently with radial striations ; upper always knoblike, either smooth or showing several recurved marginal spines.

Gemmules—large and spherical, numerous in mature sponge, usually occurring throughout skeletal network, rarely confined to base ; pneumatic layer weakly developed, often thin, formed of rather large polygonal air spaces in which gemmoscleres embedded strictly radially lying with fully developed rotules on inner gemmular membrane, and protruding with terminal knob from surface of gemmule ; outer gemmular membrane ill-defined or absent ; foramen tubular, porus tube straight and relatively short, encircled by slanting

gemmoscleres with or without an out curved collar at the extremity.

Sponges always massive and spherical, often resembling in growth a wasp nest, surface rather reticulate and hispid ; consistency hard, but quite brittle ; colour dark gray to dark brown.

Distribution : Probably restricted to the tropics, with discontinuous distribution.

Remarks : This genus, as redefined by Penney and Racek (1968), covers all the species with "true tubelliform gemmoscleres which possess free microscleres in the form of spined amphioxea, and whose gemmules lack an external arrangement of typically birotulate gemmoscleres" ; with the result that the genus *Tubella* Carter has to be removed from current spongillid taxonomy for it actually includes more than one genus such as, *Metania* Gray, *Trochospongilla* Vejdovsky, and even *Heterorotula* Penney and Racek. Henceforward all the species of *Metania* will be taken as possessing free microscleres. The genus has recently been recorded from Australia for the first time by Stanisic (1979) who suggested its possible origin from *Radiospongilla* stock. Volkmer-Ribeiro (1979, 1984 & 1986) has undertaken study of its evolution in which she has proposed a new family Metaniidae under the order Poecilosclerida for its reception and traced its relation with the marine genus *Acarnus* Gray, 1867, but this is not acceptable because the order Poecilosclerida Topsent, 1898, following de Laubenfel's' (1963, p. E. 38) may be defined as follows : Demospongiae with dermal specialization or other complexities of spicules but no radiate structure or astrose microscleres ; spiny spicules, spongin, or both commonly present. Cam Rec.

There is no justification in the removal of the genus *Metania* Gray from Haplosclerida to Poecilosclerida as both types of cladotylotes ('rose stem' and 'palm tree') seen in the genus *Acarnus* Gray, are only modifications of tylotes, and are echinating in function, and its principal spicules are styles arranged in a plumose fashion. Microscleres of *Metania*

are spined amphioxea which show no similarity with those of the genus *Acarnus*.

Therefore, study of more material is necessary for creating a new family for the genus *Metania* or for a complex of species placed in the original genus *Tubella* of Carter, which is a heterogenous assemblage of fresh water sponges.

Hence, for the present it is enough that the Spongillidae be considered with its extant families only as with the current extreme paucity of material there is a danger of multiplying the same. It may be noted that de Laubenfels (1936) accepted Spongillinae and Meyeniinae under the family ; the first possibly originating from the family Haliclonidae of the order Haplosclerida, and in the second the birotulate character seems to have evolved from within the family Desmacidonidae. But, by the application of the less widely applied chemotaxonomic methods, there is a possibility of the clearing of the "uncertainties" of some species/genera.

The conspecificity with *M. vesparia* (von Martens 1868) of two species, viz. *Tubella pottsi* Weltner, 1895, and *Metania lissostrongyla* Burton, 1938, is recognised, showing that no tenable diagnostic differences are available.

Metania vesparioides (Annandale, 1908) which is described below, is the only species known from the area. This species, along with all other members of the genus has been shown to possess free microscleres.

31. **Metania vesparioides** (Annandale, 1908)

(Tex-fig. 5, K-M)

1908. *Tubella vesparioides* Annandale, *Rec. Indian Mus.*, 2, p. 157.

1911. *Tubella vesparioides* : Annandale, *Fauna British India*, Freshwater sponges, hydroids and Polyzoa, p. 120.

1968. *Metania vesparioides* : Penney and Racek, *Bull. U. S. natn. Mus.*, No. 272, p. 151.

1976. *Metania vesparioides* : Khera and Chaturvedi, *Rec. zool. Surv. India*, Misc. Publ. Occ. Paper No. 4, p, 11.

Description : Sponge massive and spherical ; surface rigidly reticulate and hispid, due to protrusion of radiating spicule fibers through dermal membrane, which closely

attached to symplasm ; skeleton composed of firm radial spicule fibers and slightly thinner transverse fibers, both forming a strong and close network of open meshes ; consistency of dry sponge firm though brittle.

Megascleres—amphioxea, fusiform, slightly curved, smooth, and of same length ; 300-325μ long, 12-15μ wide.

Microscleres—amphioxea, more or less straight, fusiform, sharply pointed, covered with small granules terminally, and showing several larger spines centrally ; 68-75μ long, 2-3μ wide.

Gemmoscleres—boletiform, shaft irregularly covered with large tubercles or blunt spines, 42-58μ long, 3μ wide ; lower rotule frequently irregular or polygonal and showing slightly recurved margin, which normally entire ; radial striations of this rotule generally well developed, giving erroneous impression of marginal indentations, rotules 16-20μ in diameter, terminal knob either smoothly rounded or showing a few recurved minute spines, 6-8μ in diameter.

Gemmules—spherical, occurring throughout skeletal network, 400-500μ in diameter ; pneumatic layer not fully developed and relatively thin, formed of rather large air spaces in which gemmoscleres arranged typically for the genus ; foramen extended to form a straight and short porus tube encircled by slanting gemmoscleres.

Distribution : Reportedly restricted to Burma (now Myanmar).

Colour in life : Dry sponge almost black.

Remarks : This species can be separated from other members of the genus including *M. vesparia*, by its amphioxous megascleres lacking abruptly pointed tips ; microscleres, though rare, are present ; [Annandale's (1908b) observations of marginal indentations of the lower rotule of gemmoscleres are erroneous]. Penney and Racek (1968) held that "*M. vesparioides* is thus very closely allied to *M. vesparia*, and future research may yet relegate it to subspecific rank," which was not agreed by Ezcurra de Drago (1975, p. 179).

SUMMARY

The present paper is a review of the hitherto known Indian species of freshwater sponges and is based on the study of all the available material as well as of the relevant literature todate. The nomenclature followed is after Penney and Racek (1968) excepting where changes have been absolutely necessitated. It provides keys for identification of all the Indian genera and species along with descriptions and illustrations as well as remarks. The new family Metaniidae created by Volkmer-Ribeiro (1986) is not accepted here.

The paper also emphasises the vital bearing of the physico-chemical aspects apart from the importance of the latest techniques for correct systematic assessment of the known spongillids. It also points out the urgency of future more intensive and extensive surveys of the poorly explored or even unexplored parts of the country for obtaining a more accurate picture of its sponge fauna.

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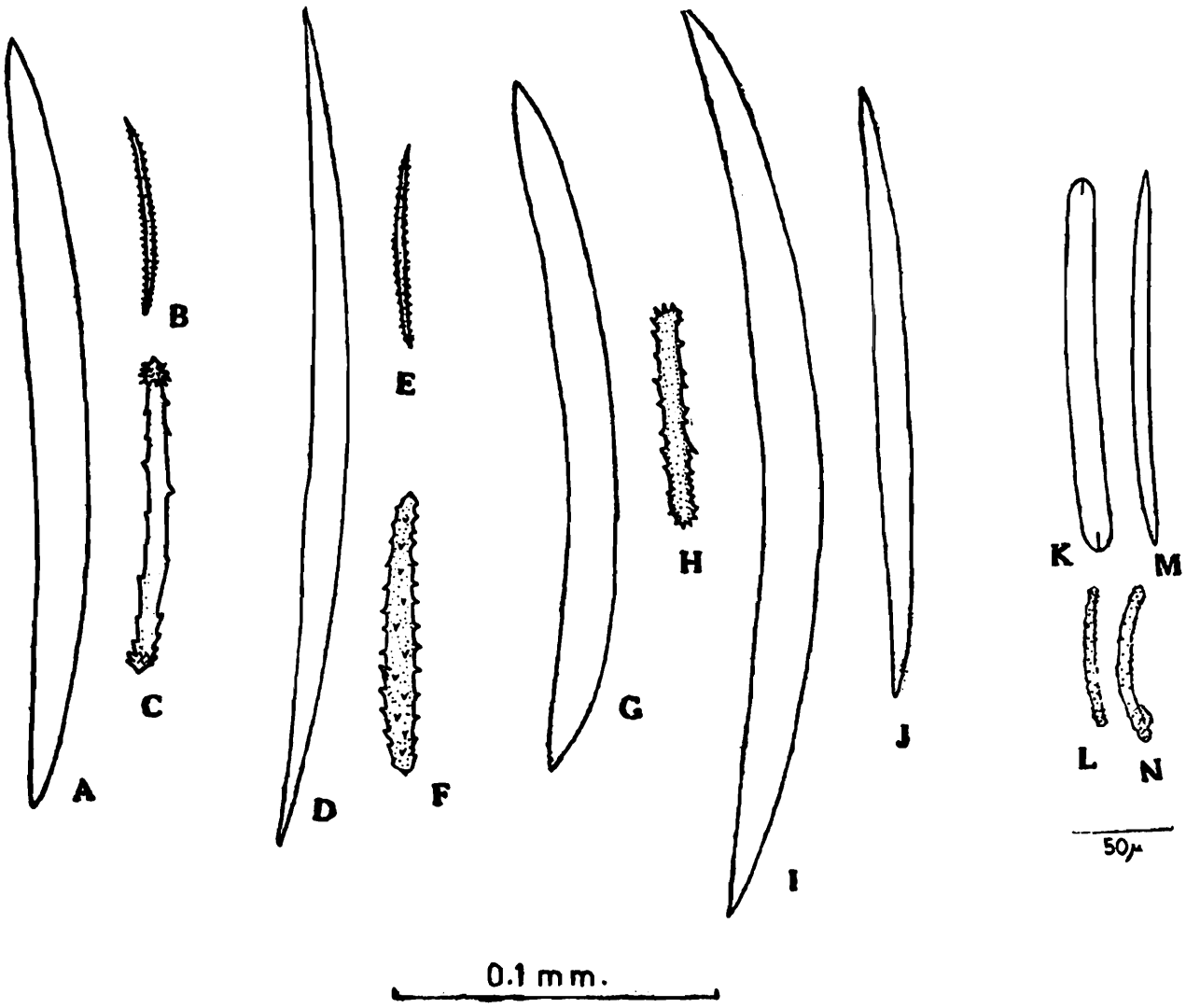
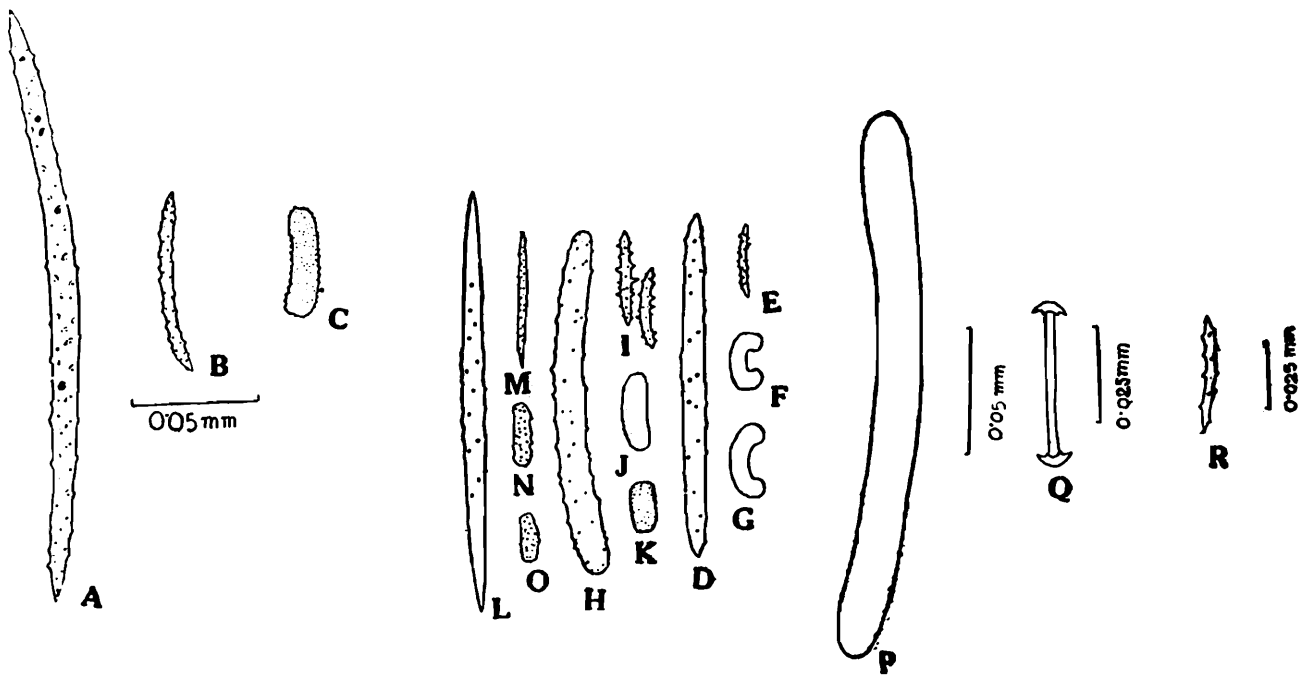


Text-fig. 1

Text-fig. 1. A-C. *Spongilla alba* Carter, 1849 ; D-F. *Spongilla lacustris* (Linnaeus, 1758) ; G & H. *Eunapius calcuttanus* (Annandale, 1911) ; I & J. *Eunapius carteri* (Bowerbank, 1863). (After Soota and Pattanayak, 1982.)

K & L. *Eunapius crassissimus* (Annandale, 1907) ; M & N *Eunapius geminus* (Annandale, 1911). (After Penney and Racek, 1968.)

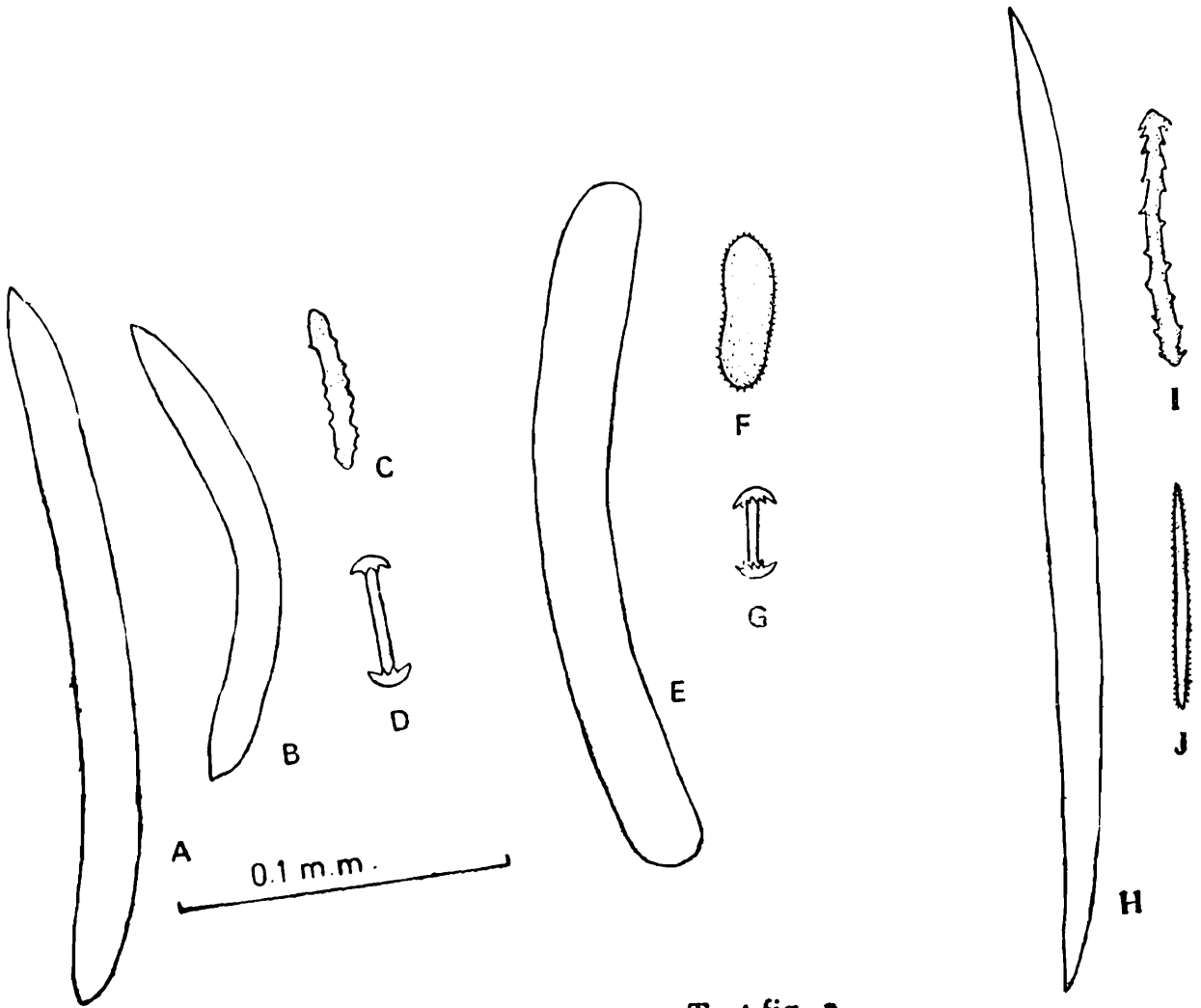
A-Megasclere ; B-microsclere ; C-gemmosclere ; D-Megasclere ; E-microsclere ; F-gemmosclere ; G-Megasclere ; H-gemmosclere ; I-Megasclere ; J-gemmosclere ; K-Megasclere ; L-gemmosclere ; M-Megasclere ; N-gemmosclere.



Text-fig. 2

Text-fig. 2. A-C. *Stratospongilla bombayensis* (Carter, 1882). (After Soota, Pattanayak and Saxena, 1983.) D-G. *Stratospongilla gravelyi* (Annandale, 1912) ; H-K. *Stratospongilla indica* (Annandale, 1908) ; L-O. *Stratospongilla sumatrana* (Weber, 1890). (After Penney and Racek, 1968.) P-R. *Corvospongilla bhavnagarensis* Soota, Pattanayak and Saxena, 1983. (After Soota *et al.*, 1983.)

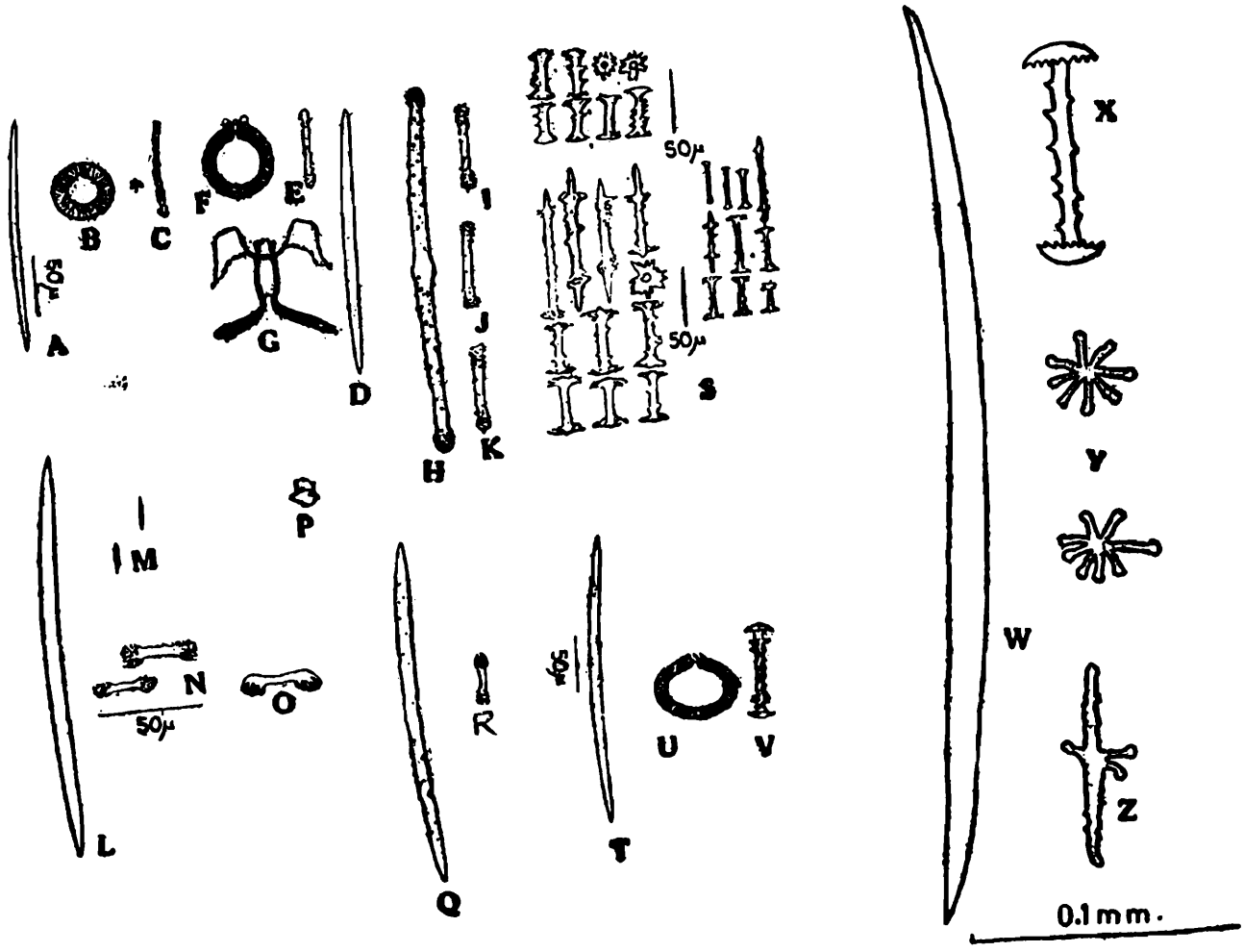
A-Megasclere ; B-microsclere ; C-gemmosclere ; D-Megasclere ; E-microsclere ; F & G.—gemmosclere ; H-Megasclere ; I-microscleres ; J & K—gemmoscleres ; L-Megasclere ; M-microsclere ; N & O-gemmoscleres ; P-Megasclere ; Q-microsclere ; R-gemmosclere.



Text-fig. 3

Text-fig. 3. A-D. *Corvospongilla caunteri* Annandale, 1911 ; E-G. *Corvospongilla lapidosa* (Annandale, 1908) ; H-J. *Radiospongilla cerebellata* (Bowerbank, 1863). (After Soota and Pattanayak, 1982.)

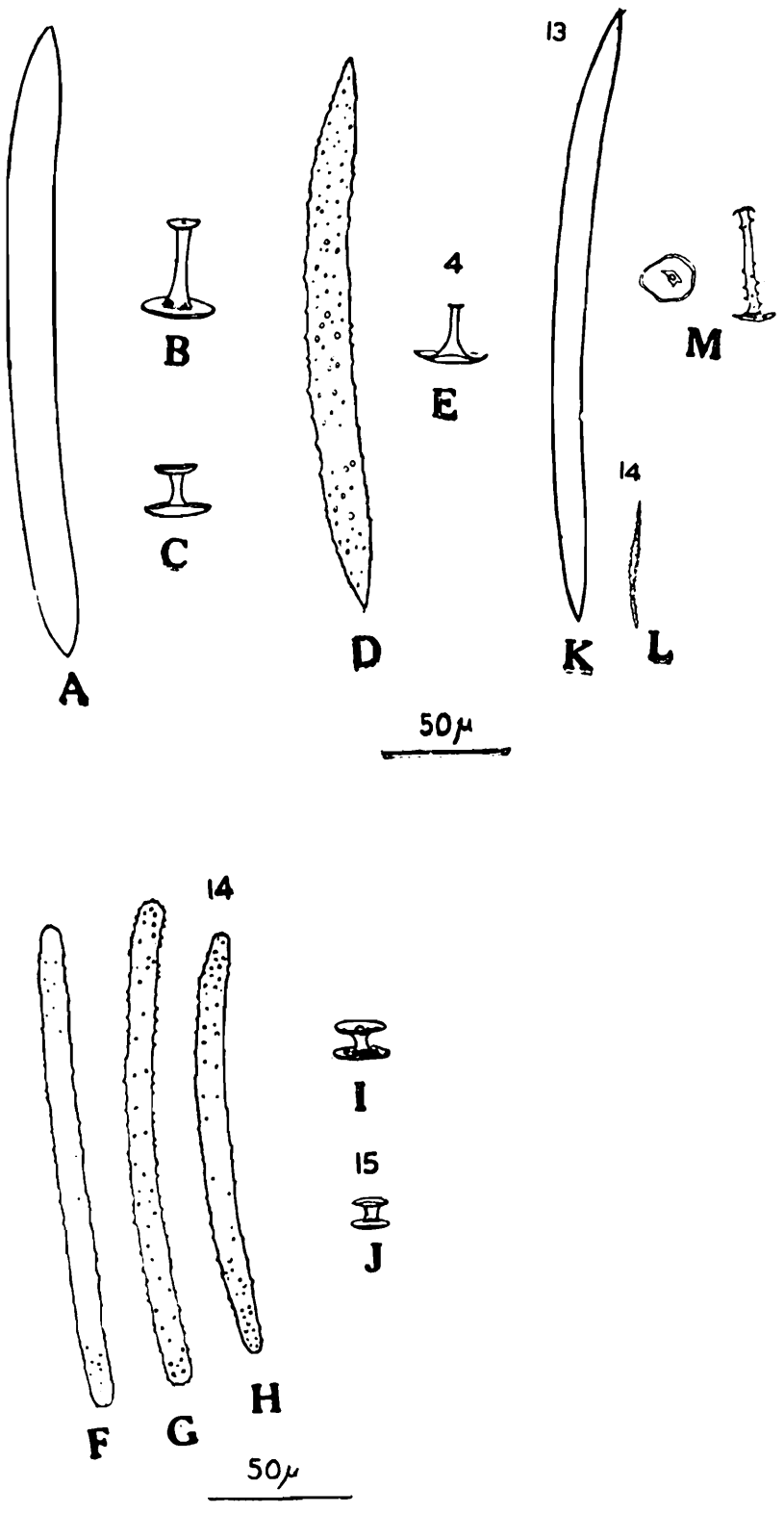
A & B. Megascleres ; C-gemmosclere ; D-microsclere ; E-Megasclere ; F-gemmosclere ; G-microsclere ; H-Megasclere ; I-gemmosclere ; J-immature gemmosclere.



Text-fig. 4

Text-fig. 4. A-C. *Radiospongilla crateriformis* (Potts, 1882); D-G. *Radiospongilla hemephydatia* (Annandale, 1909); H-K. *Radiospongilla indica* (Annandale, 1907); L-O. *Pectispongilla aurea* Annandale, 1909; P. *Pectispongilla stellifera* Annandale, 1915; Q & R. *Pectispongilla subspinosa* Annandale, 1911. (After Penney and Racek, 1968.) S. *Ephydatia fluviatilis ramsayi* (Haswell, 1882). (After Ezcurra de Drago, 1975.) T-V. *Umborotula bogorensis* (Weber, 1890). (After Penney and Racek, 1968.) W-Z. *Dosilia plumosa* (Carter, 1949). (After Soota and Pattanayak, 1982.)

A-Megasclere; B-gemmule; C-gemmosclere; D-Megasclere; E-gemmosclere; F-gemmule, optical section; G-enlarged gemmule porus tube; H-Megasclere; I, J & K-gemmoscleres; L-Megasclere; M-microscleres; N & O-gemmoscleres; P-Spheraster; Q-Megasclere; R-gemmosclere; S-showing some variations in gemmoscleres; T-Megasclere; U-gemmule, optical section; V-gemmosclere; W-Megasclere; X-gemmosclere; Y-stellate microscleres; Z-acerate microsclere.



Text-fig. 5

Text-fig. 5. A-C. *Trochospongilla paulula* (Bowerbank, 1863) ; D & E. *Trochospongilla pennsylvanica* (Potts, 1882) ; F-J. *Trochospongilla philottiana* Annandale, 1907 ; K-M. *Metania vesparioides* (Annandale, 1908). (After Penney and Racek, 1968.)

A-Megasclere ; B & C-gemmoscleres ; D-Megasclere ; E-gemmosclere ; F, G & H-Megascleres ; I & J-gemmoscleres ; K-Megasclere ; L-microsclere ; M-gemmosclere.

ERRATA

Page	**Line*	*Instead af*	*Read*
19	T 15	SYSTEMATIC	SYSTEMATICS
21	T 1	Annadale	Annandale
22	T 18	Gemmosclres	Gemmoscleres
25	T 14	*Spongill*	*Spongilla*
27	T 11	1842	1863
27	B 10	*Suspongilla*	*Euspongilla*
34	T 16	*Am,*	*Ann.*
38	B 14	(Annandale, 1909)	Annandale, 1909
43	B 11	*gravelei*	*gravelyi*
50	B 11	Ratnagari	Ratnagiri
66	T 3	*Radiopongilla*	*Radiospongilla*
68	B 10	*P. aures*	*P. aurea*
68	B 5	Annandale, 1908	Annandale, 1909
71	T 20	*Epbydatia*	*Ephydatia*
74	B 15	*Am.*	*Ann.*
81	T 19	spongilled	spongillid

*T=from Top, B=from Bottom

Note: On page 8 after line 19, before "(i) *General structure*" there should be the omitted heading "III. GENERAL ACCOUNT".