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**XXVI. On the Rhizopodal Fauna
of the Deep Sea**

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upramarginal lobules are connected by numerous bands of fibres, that the ascending parietal gyri have central and callosal fibres entering their extremities, the middle portion receiving comparatively few; the first, however, sometimes called the ascending frontal gyrus, seems to have numerous fibres from the centres and C. callosum along its entire length. The second frontal convolution sends bands of fibres obliquely to the two others, and has fewer radiating fibres than they have. When it is removed, fibres can be traced transversely across the valley left from the first to the third.

A few additional particulars are given respecting the arrangement and course of the fibres in the callosal and marginal gyri on the internal surface of the hemisphere, and the contrast between the thalamus and C. striatum as to structure and relations is pointed out, the thalamus sending large masses of fibres in every direction, chiefly with the radiating crus, the corpus striatum consisting of soft grey matter enclosed in fibrous planes which arise in the comparatively small grey nuclei, and have apparently no communication with the main body of the ganglion. The thalamus again does not seem to receive terminating ascending fibres, while both divisions of the crus give off numerous fibres, which are seen to end in the C. striatum.

The differences in naked-eye appearances indicate differences in the relations between cells and fibres in the two ganglia, the exact nature of which can be ascertained only by the microscope.

XXVI. "On the Rhizopodal Fauna of the Deep Sea." By WILLIAM B. CARPENTER, M.D., V.P.R.S. Received June 17, 1869.

(Abstract.)

The Author commences by referring to the knowledge of the Rhizopodal Fauna of the Deep Sea which has been gradually acquired by the examination of specimens of the bottom brought up by the Sounding-apparatus; and states that whilst this method of investigation has made known the vast extent and diffusion of Foraminiferal life at great depths,—especially in the case of *Globigerina-mud*, which has been proved to cover a large part of the bottom of the North Atlantic Ocean,—it has not added any new Generic types to those discoverable in comparatively shallow waters. With the exception of a few forms, which, like *Globigerina*, find their most congenial home, and attain their greatest development, at great depths, the general rule has seemed to be that *Foraminifera* are progressively dwarfed in proportion to increase of depth, as they are by a change from a warmer to a colder climate; those which are brought up from great depths in the Equatorial region bearing a much stronger resemblance to those of the colder-temperate, or even of the Arctic seas, than to the littoral forms of their own region.

The Author then refers to the recent researches of Prof. Huxley upon

the indefinite protoplasmic expansion which he names *Bathybius*, and which seems to extend itself over the ocean-bottom under great varieties of depth and temperature, as among the most important of the results obtained by the Sounding-apparatus.

By the recent extension of Dredging-operations, however, to depths previously considered beyond their reach, very important additions have been made to the Foraminiferal Fauna of the Deep Sea. Several new generic types have been discovered, and new and remarkable varieties of types previously known have presented themselves. It is not a little curious that all the *new* types belong to the Family LITUOLIDA,—consisting of Foraminifera which do not form a calcareous shell, but construct a "test" by the agglutination of sand-grains,—which was first constituted as a distinct group in the author's 'Introduction to the Study of the Foraminifera' (1862). The first set of specimens described seems referable to the Genus *Proteonina* of Prof. Williamson; but the test, instead of being composed (as in his specimens) of sand-grains, is constructed of sponge-spicules, cemented together with great regularity, so as to form tubes, which are either fusiform or cylindrical, being in the former case usually more or less curved, and in the latter generally straight. Of the genus *Trochammina* (Parker and Jones), many examples were found of considerable size, resembling Nodosarians in their free moniliform growth, but having their tests constructed of sand-grains very firmly cemented together, with an intermixture of fragments of sponge-spicules, which give a hispid character to the surface.—The Genus *Rhabdammina* of Prof. Sars is based on a species (the *R. abyssorum*) first obtained in his Son's dredgings, of which the test is very regularly triradiate, sometimes quadriradiate, and is composed of sand-grains very regularly arranged, and firmly united by a ferruginous cement. Not only was this type represented by numerous specimens in the 'Lightning' dredgings, but another yet more considerable collection was formed of irregularly radiating and branching tubes, which are composed of an admixture of sand-grains and sponge-spicules, united by ferruginous cement. These seem to originate in a "primordial chamber" of the same material, which extends itself into a tube that afterwards branches indefinitely. This type may be designated *R. irregularis*.—Of the protean Genus *Lituola* (Lamarek), a large form was met with, which bears a strong resemblance to the *L. Soldani* of the Sienna Tertiaries. Its nearly cylindrical test is composed of sand-grains very loosely aggregated together, forming a thick wall; and its cavity is divided by septa of the same material into a succession of chambers, arranged in rectilinear series, each having a central orifice prolonged into a short tube.—The Genus *Astrorhiza*, instituted a few years ago by Dr. O. Sandahl, was represented by a wide range of forms, referable to two principal types,—the one an oblate spheroid, with irregular radiating prolongations, the other more resembling a stag's horn, with numerous digitations,—passing into one another by insensible gradations. The composition of

s thick arenaceous test is exactly the same as that of the test of the *Lituola* found on the same bottom; but its cavity is undivided, and there is no proper orifice, the pseudopodial extensions having apparently found their way out between the sand-grains that formed the termination of the radiating extensions or digitations.—The Genus *Saccamina* (Sars) is characterized by a very regular spherical test, built up of large angular sand-grains strongly united by ferruginous cement, which are so arranged as to form a wall-surface well smoothed off externally, whilst its interior is roughened by their angular projections. The cavity is undivided, and is furnished with a single orifice, which is surrounded by a tubular prolongation of the test, giving to the whole the aspect of a globular flask.

The family MILIOLIDA, consisting of Porcellaneous-shelled Foraminifera, was represented at the depth of 530 fathoms by a *Cornuspira foliacea* of extraordinary size; and at the depth of 650 fathoms by a series of *Biloculina*, of dimensions not elsewhere seen except in tropical or subtropical regions.

Of the family GLOBIGERINIDA a considerable number of forms presented themselves; but with the exception of the ordinary *Globigerina* and *Orbulina*, these were not remarkable either for number or size. The *Globigerina-mud* brought up in large masses by the Dredge, exhibited the same composition as had been previously determined by the examination of Soundings; but it included a large amount of animal life of higher types, whilst it seemed everywhere permeated by the protoplasmic *Bathybius* of Huxley, as described in the Author's "Preliminary Report." The *Globigerina* vary enormously in size; and the Author gives reason for the belief that this variation is not altogether the result of growth, but that many small as well as large individuals have (speaking generally) attained their full dimensions. He describes the sarcodic body obtained by the decalcification of the shell; and discusses the question whether (as some suppose) *Orbulina* is the reproductive segment of *Globigerina*, as to which he inclines to a negative conclusion. He describes the curious manner in which the shells of *Globigerina* are worked-up into cases for Tubicolar Annelids; of which cases several different types presented themselves, the Foraminiferal shells in some of them being combined with sponge-spicules.—A remarkably fine specimen of *Textularia* was met with alive, of which the porous shell was encased by sand-grains; this being laid open by section showed the sarcodic body of an olive-greenish hue, corresponding with that of the *Lituola* and *Astrorhiza* also found alive.—Several Rotaline types presented themselves sparingly in the *Globigerina-mud*, which are specially characteristic of the Cretaceous Formation.

The family LAGENIDA was represented not merely by its smaller forms, but also by a large and beautiful living *Cristellaria*, that closely corresponds with one of the forms described by Fichtel and Moll from the Siennese Tertiaries, whilst even exceeding it in dimensions.

These results conclusively show that reduction in the Size of *Foraminifera*

cannot be attributed to increase of Pressure; since the examples of *Cornu spira*, *Biloculina*, and *Cristellaria* found at depths exceeding 500 fathoms were *far larger* than any that are known to exist in the shallower waters of the colder temperate zone. But as these all occurred in the *warm area*, whose bottom-temperature indicates a movement of water from the Equatorial towards the Polar region, it is probable that their size is related to the *temperature* of their habitat, which is found to be in like relation to the general character of the Fauna of which they formed part. On the other hand, as we now know that the climate of the deepest parts of the ocean-bottom, even in Equatorial regions, has often (if not universally) Arctic coldness, the dwarfing of the abyssal *Foraminifera* of those regions is fully accounted for on the same principle.

Besides these examples of new or remarkable forms of *Foraminifera*, the 'Lightning' dredgings yielded some peculiar bodies, the examination of which would seem to throw light upon the obscure question of the mode of Reproduction in this group. One set of these are cysts, of various shapes and sizes, composed of sand-grains loosely aggregated, as in the tests of *Lituola* and *Astrorhiza*; which, when broken open, are found to be filled with aggregations of minute yellow spherules, not enclosed in any distinct envelope. These are supposed by the Author to be *reproductive gemmules* formed by the segmentation of the sarcodic body of a Rhizopod, in the same manner as 'zoospores' are formed in Protophytes by the segmentation of their endochrome. Of such segmentation he formerly described indications in the sarcodic body of *Orbitolites*; and corresponding phenomena have been witnessed by Prof. Max Schulze. But in another set of cysts, of similar materials but of firmer structure, bodies are found having all the characters of *ova*, with *embryos* in various stages of development. In none of these, however, does the embryo present characters sufficiently distinctive to enable its nature to be determined; and the hypothesis of the Foraminiferal origin of these bodies chiefly rests upon the conformity in the structure of the wall of the cysts with that of the tests of *Lituola* and *Astrorhiza*, and upon the improbability that such cysts should have been constructed by animals of any higher type.

"Spectroscopic Observations of the Solar Prominences, being Extracts from a Letter addressed to Sir J. F. W. HERSCHEL, Bart., F.R.S., by Captain HERSCHEL, R.E., dated 'Bangalore, June 12th and 15th, 1869*.'" Communicated by Sir J. HERSCHEL.
Received July 19, 1869.

I have too little time to devote to lengthy descriptions, and so I send you a *sketch* of what I saw this morning (fig. 1). I have seen many such views during the last month, but none so distinct in outline as to-day—more by

* Received since the end of the Session.