

XXIV. "Supplementary Researches on the Partition of Numbers." By ARTHUR CAYLEY, Esq., F.R.S. Received March 19, 1857.

(Abstract.)

The paper is supplementary to the author's memoir, "Researches on the Partition of Numbers," which comprises the two papers abstracts of which appear in the 'Proceedings' of the Meeting of the 3rd of May, 1855. It contains some additional developments in relation to the theorem referred to at the conclusion of the former memoir, and an application to the determination of the expression for $P(1, 2, 3, 4, 5, 6, \dots)$ 9.

XXV. "On the Anatomy and Physiology of the *Spongiadae*." By J. S. BOWERBANK, F.R.S., F.L.S., &c. Received June 17, 1857.

(Abstract.)

The arrangement of the *Spongiadae* by Lamarck, based entirely on external form, is wholly inadequate for the discrimination of species. The classification adopted by Drs. Fleming, Grant, and Johnston, dependent more especially on the chemical constituents of those bodies, is far too limited to be applied in generic characters. The author has, therefore, for this purpose rejected both systems, and has retained the latter one for forming primary divisions only, and he purposes founding the generic characters principally on the organic structure and mode of arrangement of the skeleton, in accordance with the practice so generally adopted by naturalists with regard to many of the higher classes of animals. *Tethea*, *Geodia*, *Dysidea* and a few others are the only well-defined genera that have yet been established; while others, such as *Halichondria*, even in the narrow circle of the list of British species, contain at least ten distinct modes of arrangement of the skeleton, each of which is constant and well-defined in its character.

It is not intended to propose the rejection of any of the well-established genera of preceding authorities, but to confine each genus strictly within the bounds indicated by the peculiar mode of structure of the skeleton which exists in that species of sponge which is

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the oldest-established and best-known type of the genus, and to refer all others that may distinctly differ from that type to new genera founded on structural principles.

It is proposed to characterize the elementary tissues in the following order :—

1. Spicula.
2. Keratode or horny substance.
3. Membranous tissues.
4. Fibrous tissues.
5. Cellular tissues.
6. Sarcode.

And, in the second place, to treat of the organization and physiology in the following order :—

1. The skeleton.
2. The sarcodous system.
3. The interstitial canals.
4. The intermarginal cavities.
5. The dermal membrane.
6. The pores.
7. The oscula.
8. Inhalation and exhalation.
9. Nutrition.
10. Cilia and ciliary action.
11. Reproduction, gemmules, &c.

And to conclude with observations on the generic characters.

The author then proceeds to describe the spicula, which he states are essentially different in character from the fibres of the sponge ; although the latter may be equally siliceous with the former. However closely the spicula may be brought into contact with each other, or with siliceous fibre, they appear never to unite or anastomose ; while the fibre, whether siliceous or keratose, always anastomoses when it comes in contact with other parts of its own body or with those of its own species. A detailed description is given of the origin and progressive development of these organs, from which it is inferred that they are the homologues of the bones in the higher classes of animals, and that the forms they assume are always of an organic type, never crystalline or angular ; and the same forms of spicula are found composed of either silex or carbonate of lime,

demonstrating the fact that the deposits of earthy matter are influenced by the laws of animal organization only, and never by those of inorganic or crystalline arrangement.

Each species of sponge has, not one form of spiculum only, equally dispersed throughout its whole substance; but, on the contrary, separate parts have their appropriate forms; and thus we find that there are often three, four, or even more forms of spicula in the same individual. The author therefore, in describing them, proposes to treat of these organs in the following order:—

1. Spicula of the skeleton.
2. Connecting spicula.
3. Defensive spicula.
4. Spicula of the membranes.
5. Spicula of the sarcode.
6. Spicula of the gemmules.

1st. The spicula of the skeleton in the siliceous sponges are usually simple, elongate in form, slightly curved, and are occasionally more or less furnished with spines. They are either irregularly matted together, collected in fasciculi, or dispersed within or upon the keratose fibres of which the skeleton is to a great extent composed. All these elongate forms of spicula are subject to extreme variety of length. In some species they maintain a great degree of uniformity, while in others they vary to a very considerable extent, according to the necessities arising from the mode of the construction of the skeleton.

2nd. The connecting spicula are not necessarily a part of the skeleton; they are a subsidiary portion of it under especial circumstances, in a few genera only, as *Geodia*, *Pachymatisma*, and other sponges which have a thick crustaceous surface, which the spicula serve to support and retain in due connexion with the mass of the animal beneath. The normal form of these spicula is very different from that of the general mass of those of the skeleton, and they are much more complex and varied in their structure. They usually have a long, stout, cylindrical or attenuating shaft terminating either acutely or hemispherically at the base, while the apex is divided into three equi-angular radii, which assume in different species a considerable amount of variety as regards form and direction. The tri-radiate apices are usually cemented firmly to the inner surface of the

crustular coat of the sponge ; while the stout and elongated shaft is intermingled with, and firmly cemented by, keratode to the general mass of the skeleton.

3rd. The defensive spicula are divisible into two classes : those of the exterior, and those of the interior of the sponge. They are neither of them necessarily present in every species, nor are they confined to particular genera, but occur occasionally, and in certain species of various genera apparently as the necessities of the animal may render their presence requisite. Their office is evidently to defend the sponge from the attacks of predacious animals. They are projected for about half or two-thirds of their length at various angles from the surface of the sponge, or they are based on the fibre of the skeleton, and are projected at about right angles into its interstitial cavities.

4th. The spicula of the membranes are of two distinct classes. The office of the first of these is to strengthen and support those delicate tissues, and to communicate to them a certain amount of tension. The forms are few in number, and their structure comparatively simple. The office of the second class is that of assisting in the retention of the sarcode on the interstitial and other structures. They are usually minute in size, and often very complicated in form.

5th. Spicula of the sarcode. The numerous and beautiful tribe of stellate spicula appear to be devoted to connect and give substance to the gelatinoid sarcode which so abundantly covers the whole of the interior membranous structures of the sponges in which they occur. They are often exceedingly minute, and are occasionally remarkably complex and beautiful in structure, and we frequently find more than one form imbedded in the sarcode of the same sponge.

6th. The spicula appropriated to the gemmules of sponges occur in various modes of disposition. First, they are imbedded irregularly in an external envelope of the gemmule, or on the surface of the gemmule itself at right angles to lines radiating from its centre. Secondly, they are arranged symmetrically in the crust of the gemmule parallel to lines radiating from its centre. Thirdly, they are disposed in fasciculi in the substance of the gemmule from the centre to the circumference.

The forms occurring in the second class of these spicula are

exceedingly varied and beautiful, and especially characteristic of the species in which they occur.

The author has named and figured the whole of the spicula described in the paper, and has traced some of the most complicated ones from their earliest and simplest state, through all the stages of their development to the adult condition. More than a hundred distinct forms of these organs are thus described, so as to render them available hereafter to naturalists as characteristic of species.

XXVI. "Researches on the Intimate Structure of the Brain; Human and Comparative.—Part I. The Medulla oblongata." By J. LOCKHART CLARKE, Esq., F.R.S. Received June 18, 1857.

(Abstract.)

The medulla oblongata, as described in this memoir, extends from the first cervical nerve to the lower border of the pons Varolii. Of its elementary parts, the author first traces the *arciform fibres*, which may be divided into a superficial and a deep layer. Those of the superficial layer may in turn be divided into three sets. The connexions of these are first followed out in detail; the fibres of the deep layer are described further on. In all mammalia these fibres are very distinct, but less intricate than in man. They may be found also in birds, reptiles, and fishes.

The *anterior pyramids* are found to be composed of *four* orders of fibres:—

1. *Decussating fibres* from the *lateral columns*, forming their chief bulk.
2. *Decussating fibres* from the *posterior columns* and *posterior grey substance*, chiefly at the upper part.
3. *Decussating fibres* from the *anterior grey substance*.
4. *Non-decussating fibres* of the *anterior columns*, separate on their outer side, and on their inner side incorporated with those which form the decussation.

In mammalia generally the decussating fibres are much less numerous than in man. In birds there is an evident but feeble decussation.