Fig. 2. Head of a somewhat smaller animal, from above: *a*, pharynx; *b*, muscles; *c*, brain; *d*, "respiratory tubes."

Fig. 3. Male *Hydatina* (*Enteroplea Hydatina*): *a*, the rudimentary intestinal canal; to which the dark aggregations of granules, *b*, belong; *c*, testis.

Fig. 4. The hinder extremity of an *Enteroplea*, exactly in a lateral position: *a*, remains of the *tractus*; *b*, the aggregations of granules ("uric concretions"); *c*, testis; *d*, efferent ducts; *e*, "prostate."

Fig. 5. Spermatozoa of *Enteroplea*: *a*, stiff, bacillar form; *b*, form furnished with an undulating membrane.

Fig. 6. The animal living in the stomach of the female *Hydatina*. It is represented in its various stages of contraction.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 18, 1857.—The Lord Wrottesley, President, in the Chair.

"On the Development of *Carcinus Mœnas*." By Spence Bate, Esq., F.L.S.

The author, after noticing the history of the subject, and the opposition which the assertion, "that the *Zoëa* of naturalists is the larva of a common crab," received, traces the progress of the development of the animal from the *Zoëa* to the adult, and endeavours to demonstrate, that from the youngest to the most perfect form, the changes are the result of no sudden transformation, but produced by a gradual series of alterations contemporary with every succeeding moult; that the *Zoëa* is connected with the *Megalopa*, and the latter with the adult by many intermediate gradations, each in itself scarcely appreciable, and progressively approximating more and more nearly to the more perfect stages.

The author asserts that the development is earliest and most complete anteriorly; that when first born, the seventh or posterior segment of the head, one or more of the posterior segments of the *pereion* (thorax), and the penultimate of the *pleon* (abdomen) are wanting in the brachyurous Decapods; but that this general law loses somewhat of its force in the descending scale of development; and as it becomes less persistent, the animal approximates in the larval condition nearer to the form of the adult type; while on the other hand, the same appears to be a constant law of the depreciation in adult forms, as exhibited in the more or less aberrant Amphipoda, such as *Cyrtophium*, *Dulichia*, &c. The author likewise shows that the appendages, which act the principal parts in the larvæ, become the secondary parts of the same organs in the perfect animal. For instance, the lower antenna is represented in the larva by the complementary appendage of the adult form; the true antenna is developed from the base of the embryonic organ, which represents

the squamiform and spinous appendages, more or less constant in the macrourous Decapods, but lost in the short-tailed genera, and the organ itself is gradually increased with every successive moult. This is true, more or less perfectly, of all the other appendages present in the larvæ of all Decapoda ; and no change of form, as understood in the term metamorphosis as applied to insects, takes place in the development of *Carcinus*. That the distance between the old and young forms is the result of an exaggeration of parts in the larva as compared with the relative proportion of the same in adult animals, together with the absence of others, which are gradually produced, and assume the permanent condition of the adult type.

The author has observed the rudiments of the future legs shortly after birth. He has dissected and figured eight or nine of the more important stages, and shown the relative alteration of each part consecutively, commencing with the *Zoëa* taken from the egg, and pursued the observations through the older forms to that of the adult *Carcinus*.

"On the Anatomy and Physiology of the *Spongiadæ*." By J. S. Bowerbank, F.R.S., F.L.S. &c.

The arrangement of the *Spongiadæ* 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; 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 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 special circumstances, in a few genera only; as in *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 triradiate 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 keratode, and firmly cemented by it 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 predaceous 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. Their 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.

"On the Fructification of certain Sphæriaceous Fungi." By Frederick Currey, Esq.

The author refers to the recent inquiries into the diversities of form existing in the reproductive organs of Fungi, and notices the physiological importance of the results, and the probable future effect upon systematic arrangement.

Two different classes of Sphæriaceous Fungi are then noticed in detail, in the former of which the different forms of fruit produced are essentially distinct, whilst in the latter the fruit is modified so as to assume a form materially different from the normal form.

The following are the plants included in the former of these classes, with the principal points noticed in each.

1. *Sphæria verrucæformis*, Ehr. The occurrence of an ascigerous and cytisporous state of fructification within the same circumscribing line, and the nature of the cells constituting that line.

2. *Sphæria favacea*, Fr. Points of distinction between it and *S. verrucæformis*. Curious modifications in the shape of the asci.

3. *Sphæria olivacea*, n. s. Aberrant forms of asci, and description of the sporidia.

4. *Sphæria tiliaginea*, n. s. The existence of spermatia and stylospores, and description of the form and modes of growth of those organs.

5. *Sphæria vestita*, Fr. The existence of perithecia and naked spores within a conceptacle common to both, and having a common orifice.

6. *Sphæria fragiformis*, Pers. Description of a secondary form of fruit belonging to the *Sphæria*, hitherto considered to have been a growth parasitical upon it.

7. *Sphæria salicina*, Pers., and *Coniothecium Amentacearum*, Corda. The production of these Fungi (hitherto supposed to be distinct plants) from the same mycelium, and the probability of a similar relation between *Sphæria lanciformis*, Fr., and *Coniothecium betulinum*, Corda.

The following are the plants included in the latter of the two classes, and the principal points noticed with regard to them.

1. *Sphæria angulata*, Fr. The occurrence of a state of fructification similar to that of the genus *Cryptosporium*; the varieties of structure in the normal sporidia, and the probable origin and nature of the abnormal fruit.

2. *Sphæria lanciformis*, Fr., and *Hendersonia polycystis*, B. & Br. Irregularity of form in the sporidia of *Sphæria lanciformis*. The growth of perithecia in the same stroma, some producing the fruit of *Sphæria lanciformis*, others that of *Hendersonia polycystis*. Notice of the probable existence of a third form of fruit of *Sphæria lanciformis*.

3. *Sphæria siparia*, B. & Br., and *Prosthemium betulinum*, Kunze. Constant association of the two forms; their external resemblance; nature of the fruit and other circumstances leading to the conclusion of the identity of the two plants.

"On the Anatomy of *Tridacna*." By John Denis Macdonald, Esq., Assistant-Surgeon R.N.

The author first explains the peculiar position which the animal of *Tridacna* occupies in its shell, in which it differs from bivalves in general. He then describes the mantle and its borders, the membranous interpallial septum, the respiratory and wide pedal openings communicating with the interpallial space, the two pairs of branchiæ, the mouth with the anterior and posterior lip and the four oral palps, the foot, the extensive cloacal cavity with its subdivisions, and the circular contractile cloacal orifice opening on the dorsal surface. He next gives an account of the form and arrangement of the alimentary canal, and its relations to the liver and large ovary; and describes a large viscus situated in the space between the ovary, the adductor muscle, the base of the foot and the pericardium, divided into a central and two lateral portions, and secreting a dark brown liquid loaded with fatty matter. This body he thinks may be connected with the secretion of the byssus, but, at the same time, remarks that it may be homologous with the organ of Bojanus. Lastly, the anatomy of the heart and great arteries is given, and is in substance as follows.

On cutting through the floor of the cloaca, the pericardium is laid open, and in it is seen the large, rather square-shaped ventricle, with a capacious but thin-walled auricle opening into it on either side, through an orifice guarded by semilunar valves. From the thick-walled ventricle, a short tube conducts into a conical dilatation or *bulbus arteriosus*, with muscular walls, having its base included in the pericardium, and giving rise near its narrow end to the anterior and posterior pallial arteries; whilst a visceral artery passes from the ventricle to the ovary and adjacent parts. As in other bivalves, the intestine, before its termination, passes through the heart: in coming through the pericardium, surrounded by that membrane, it forms a short round pedicle which joins the fore part of the ventricle; it is then continued through the ventricle and bulbus arteriosus, and finally opens into the cloaca. The blood from the ventricle flows between the outer surface of the intestine and the inside of the sanguiferous channel; and "that part of the intestine which traverses the bulbus arteriosus is closely surrounded with elongated membranous valvulæ, which arise from the anterior part of the chamber where the gut enters, and are fixed by

a number of chordæ tendineæ to the posterior wall, where it makes its exit;" a contrivance which permits the blood to pass between the rectum and the little valves, but prevents its reflux.

BOTANICAL SOCIETY OF EDINBURGH.

July 9, 1857.—Professor Fleming, President, in the Chair.

Professor Balfour exhibited specimens of *Bryum pallescens*, collected by Mr. W. Wilson near Warrington.

The following papers were read:—

1. "Notice of Cryptogamic Plants found near New Abbey," by the Rev. Hugh Macmillan.

During May 1857, at New Abbey, in Kirkcudbrightshire, I was particularly struck with the immense profusion of *Parmelia Borreri* and *P. tiliacea*. They occurred on almost every tree—pines, oaks, and ashes indiscriminately, sometimes even to the complete exclusion of the common species, such as *P. saxatilis* and *pulverulenta*, which usually monopolize their bark. I found them, also, occasionally spreading in large patches over rough boulders of grey granite. I gathered here and there a few specimens of both species, covered with fine apothecia. They occur in a little wood, with a stream running through it, at the base of Criffel, a lofty mountain rising up immediately behind New Abbey; also in Shambelly Wood, along with immense quantities of *Parmelia caperata* and *perlata*, *Sticta limbata*, *fuliginosa* and *scrobiculata*, and *Opegrapha elegans*, which affects most of the smooth-barked trees, and is particularly beautiful and luxuriant on the hollies. *Hypnum Crista Castrensis* is very abundant on mossy boulders, in damp shady places in the same wood, and *Parmelia sinuosa* occurs sparingly on the exposed rocks at the top of the wood; while *Neckera pumila* spreads in large patches over the oak- and beech-trees, amid dark masses of *Jungermannia tamariscifolia*.

2. "On the occurrence of *Pertusaria Hutchinsiæ* and other rare Lichens on the Breadalbane Mountains," by Mr. Alexander C. Maingay.

3. "Notice of Localities for some of the rarer Plants collected during the recent excursions of the Botanical Class around Edinburgh," by Professor Balfour.

4. "Remarks on certain Glandular Structures in Plants," by Mr. George Lawson.

The author stated that our knowledge of this subject had not kept pace with other branches of vegetable physiology, for it was very much in the same position in which Meyen left it twenty years ago. He pointed out many instances in which the secretions of plants were poured out upon the surface and into the cavities of the plant, and not stored up in its constituent cells; and referred particularly to the glands of Rubiaceæ, Galiaceæ, Aurantiaceæ, Passifloraceæ, &c. The statement that glands are modified epidermal cells, has