

on in the foregoing statement. From the purely exploratory point of view much might be urged in favour of an Antarctic Expedition at an early date; for the further progress of scientific geography it is essential to have a more exact knowledge of the topography of the Antarctic regions. This would enable a more just conception of the volume relations of land and sea to be formed, and in connection with pendulum observations some hints as to the density of the sub-oceanic crust and the depth of ice and snow on the Antarctic continent might be obtained. In case the above sketch may possibly have created the impression that we really know a great deal about the Antarctic regions, it is necessary to restate that all the general conclusions that have been indicated are largely hypothetical, and to again urge the necessity for a wider and more solid base for generalizations. The results of a successful Antarctic Expedition would mark a great advance in the philosophy—apart from the mere facts—of terrestrial science.

“No thinking person doubts that the Antarctic will be explored. The only questions are: when? and by whom? I should like to see the work undertaken at once, and by the British Navy. I should like to see a sum of £150,000 inserted in the estimates for the purpose. The Government may have sufficient grounds for declining to send forth such an expedition at the present time, but that is no reason why the scientific men of the country should not urge that the exploration of the Antarctic would lead to important additions to knowledge, and that, in the interests of science among English-speaking peoples, the United Kingdom should take not only a large but a leading part in any such exploration.”

The Duke of Argyll, Sir J. D. Hooker, Dr. Nansen, Dr. G. Neumayer, Sir Clements Markham, Dr. Alexander Buchan, Sir A. Geikie, Dr. Sclater, Professor D'Arcy Thompson, Admiral Sir W. J. L. Wharton, and others, took part in the discussion which followed.

## REVIEWS.

### WACHSMUTH AND SPRINGER'S MONOGRAPH ON CRINOIDS.

THE NORTH AMERICAN CRINOIDEA CAMERATA. By CHARLES WACHSMUTH and FRANK SPRINGER. *Mem. Mus. Comp. Zool.* Harvard, vols. xx and xxi, containing 838 pp. and 83 plates. (Cambridge, U.S.A., May, 1897).

#### FIRST NOTICE.

**I**N the last letter that he wrote me, Charles Wachsmuth repeated a wish already expressed by word of mouth, namely, that in some English publication I should review this grand monograph, then in active preparation. Although, through the kindness of Mr. Alexander Agassiz and Mr. Frank Springer, a copy has been in my hands for a twelvemonth, yet the wish of my departed friend is still unfulfilled. The reasons for delay have been two. The first is the size and importance of the work, coupled with my desire to do it justice. What has taken twenty years to write cannot be digested

and criticized at a week's notice. The second reason is the large amount of personal controversy and criticism of my own writings. Of this so much was made in certain premature reviews published in America, that I could not, at an earlier date, have avoided some remarks in self-defence; and I was unwilling to attack one whose mouth had so recently been sealed by death. The time has at last arrived when I can venture on a satisfactory appreciation of this work, and when argument may meet argument without suspicion of personal bitterness. Therefore, with the kind permission of the Editor of the *GEOLOGICAL MAGAZINE*, I propose to deal, in a series of notices, with the several sections of the book, directing special attention to facts or opinions first published therein.

The perusal and reperusal of this work has brought to light a few errors. The correction of these, as the pages are passed in review, will, I trust, be ascribed less to a love of censoriousness than to a desire to increase the usefulness of a book that must be the standard of reference for many years to come. Several of these errors are by no means peculiar to Messrs. Wachsmuth and Springer, and it was hardly in their power to discover them.

This memoir consists of three parts:—Introductory, dealing with the history of our knowledge and with terminology; Morphological, dealing with the elements of the crinoid skeleton, and with such internal organs as leave traces in the fossils; Systematic, first dealing with the classification of the Crinoidea, and then describing the North American genera and species referred by the authors to their Order Camerata. Eight plates and a few text-figures elucidate the morphological questions discussed, while seventy-five illustrate the descriptions.

The drawings have been made in pencil by C. R. Keyes, J. L. Ridgway, and A. M. Westergren, and have been reproduced by the Heliotype Printing Co., Boston. There are also a few drawings by G. Liljevall. This mode of illustration is the most satisfactory for palaeontological work when fine detail is to be shown. Its peculiar difficulties have been overcome, so far as possible, by the attention of Mr. Westergren. Many of the figures are admirable examples of draughtsmanship; whether they are correct cannot be decided (except in a case to which I shall recur) without comparison with the specimens figured. A thoughtless habit of praising scientific illustrations because they look pretty has made the reputation of many a careless draughtsman. The magnification of the figures should have been stated in all cases where they are not of natural size, not merely in some cases. Information is given as to the collections in which the figured specimens are, but the original locality of each specimen is not indicated. The type-specimens are distinguished, but nothing tells us that several other specimens have been already figured elsewhere. In a few instances it is hard to see how the information that is given can be correct. It is, for example, impossible that figs. 2a and 2b on pl. xv should represent, as they are said to do, the ventral and dorsal aspects of "the same specimen" of *Gilbertocrinus dispansus*; even more does this apply

to figs. 2c and 2d. I would also suggest that figs. 5 and 7 of pl. v are incorrectly described; if they really are in the position stated, then they show a variation of fundamental structure, remarkable not merely in itself but also from the fact that it is not alluded to in the text. While grateful for the numerous figures, so admirably illustrative of specific form, one could have wished to see more drawings of detail on an enlarged scale. The pores of *Batocrinus*, to instance a structure much discussed by our authors, are nowhere adequately figured. Similarly, the representations of the assumed slits or pores in the anal sac of the *Fistulate Inadunata* are not enough magnified to form evidence worth opposing to the numerous enlarged and detailed figures already published by me as proof that these supposed slits are nothing but deep folds. It is a great boon to have gathered in one volume such charming and, no doubt, trustworthy figures of nearly all the species of North American *Camerata*; but it may be suggested to future workers that the time has gone by for nothing but pictures of specimens, however exquisite. We want accurate drawings of structure and variations of structure, represented in the most intelligible manner possible. Apparently it is thought undignified or inartistic to put reference letters on the plates illustrating a book of this importance. Such, at any rate, is the custom, with the result that it is often hard to follow descriptions of structure. When an exact drawing of an obscure specimen is given, and in many cases most rightly given, let us at least have an explanatory diagram. Too many of our scientific "ships" are spoiled for want of this "ha'porth of tar"; though this is not always the author's fault. One feature of Messrs. Wachsmuth and Springer's plates is the consistency of orientation: "in illustrating the plates of the calyx, the dorsal view is figured with the anal interradius *up*, and the ventral view with the anal side *down*. Right and left remain the same in both cases." This example should always be followed; and when a specimen is drawn from the side its orientation should invariably be stated.

Let us turn now to the text. The Historical Introduction is of value chiefly for its account of discovery and work in North America. Fourteen hundred crinoid species from that country are now described, but in 1858 only seventy had been defined. In that year remarkable finds were made, and the now famous localities of Burlington, Crawfordsville, Keokuk, and Louisville yielded hundreds of perfect specimens. Troost had already reported, though not published, 86 new species and 16 new genera from Tennessee, but Burlington furnished over 300 species, a greater number than those hitherto known from the whole world. Crinoid-collecting became the rage, while "men of science, anxious to publish the new forms, and fearing they might be preceded by competitors, brought out preliminary descriptions to secure priority for their species. These descriptions, in many cases, were so indefinite that the identification of the species was almost impossible, and this created considerable annoyance and labour to later writers." It is to be feared that the creation of annoyance in this manner has not yet ceased, and that it

is by no means the prerogative of writers on crinoids. Many descriptions issued forty years ago as "preliminary" remain uncompleted to this day. It is pleasant to find that the earlier English authors are not accused of similar bad faith; at the same time, "their descriptions in many cases are so primitive that neither genera nor species can be identified."

The account of the American localities for fossil crinoids, given in this part of the work, is interesting and useful enough to indicate the value there would be in a complete list of such localities with the geological horizon as now ascertained. If the names of the chief collectors could be added, as here, and also a list of the chief species from each locality, so much the better. There are in the Old World, and doubtless in the New, numerous ancient collections of North American crinoids, with somewhat imperfect labels bearing names, both of locality and horizon, which it is hard to identify with names on modern maps or in modern manuals of geology. Nor would it be only on such obscurities that the table we desire would throw light. If drawn up by a competent authority, such as Mr. Springer, it would advance the study of distribution in space and time, an accurate knowledge of which is so necessary to the zoological evolutionist. In this research no help is to be despised. As our authors say in a passage that comes with great weight from practical collectors and palæontologists:

"The trouble is that all our generalizations are necessarily based upon the Crinoids as they are represented in our museums, and not upon the Crinoids as they actually existed in geological time, which is a very different thing. It is like trying to reconstruct a book from detached fragments of the chapters, some of them written in hieroglyphics for whose decipherment the key has not yet been found. We are accustomed to speak of the imperfection of the geological record, but it is doubtful if in our practical studies we always bear in mind what this really means. . . . How much do we actually know of the life represented in the rocks accessible to us? Nearly all the known Silurian Crinoids come from the outcroppings of the strata at two localities in Europe, and three or four in America. The Devonian exposures producing well preserved specimens are even more limited. The Lower Carboniferous collections are better and more widely distributed, but are insignificant after all. Take the Burlington and Keokuk limestones, which in a few localities have produced more Crinoids in number and species than any other formation. They consist of several hundred feet of strata almost entirely composed of the comminuted remains of countless myriads of Crinoids—fragments which are worthless to the Palæontologist. It is only rarely that a thin layer is found in which the calcareous skeletons are preserved well enough for study;—little basins of limited extent, in which, during a period of temporarily quiet waters, the Crinoids lived, died, and were imbedded at sufficient depths to escape the destructive effects of shore action. If the collector happens to be present when one of these colonies is uncovered by the quarrymen, the specimens may be rescued for the

benefit of Science. But it is an even chance that they will be buried in the debris of the quarry, broken up for ballast, or walled up in the foundation of a building, and thus be lost again. Out of the thousands of square miles in which these rocks lie nearest the surface, all the collections that have ever been made represent only the imperfect gleanings of not more than a few acres. If it be supposed that we get, even in this way, a fair representation of the crinoidal life of that period, the answer is that almost every new discovery of 'nests' or 'colonies' of good specimens brings to light new forms, and that species or genera hitherto very rare are often suddenly found within a limited space quite abundantly. In the Upper Coal Measures, to judge from our books and museums, one would suppose that Crinoids were well-nigh extinct. Scarcely a dozen species are known, and most of them only by their lower calyx plates. Yet there are many beds in this formation which extend over hundreds of thousands of square miles from the Missouri Valley far into the Rocky Mountains and tilted up along their flanks, which are completely filled with fragments of Crinoids. Suddenly the collectors at Kansas City, who have studied these rocks for years, discover an abundant deposit of well preserved specimens in a shale so soft that a few minutes' rain dissolves them into unrecognizable fragments." (pp. 167-8.)

The historical account of the European literature will no doubt be of use to American workers, but it would have been of more value to them, and to all of us, had Messrs. Wachsmuth and Springer been in a position to verify their references and quotations instead of copying from De Koninck and W. B. Carpenter. The writings of Agricola and Rosinus may not be accessible to workers in Iowa or New Mexico, but no specialist on Crinoidea can be forgiven for misrepresenting J. S. Miller and Johannes Müller, as do our authors. Let me substantiate this criticism in detail.

Agricola, we are told (p. 11), applied the name "*Encrinus* to the calyx of *Encrinus liliiformis*, at that time the only Crinoid in which a crown had been found in connection with the stem." This is the intensification of an error already bad enough. It was Harenberg who, in 1729, thus misapplied Agricola's term *Encrinus*, which originally bore the same relation to *Pentacrinus* as *Entrochus* bore to *Trochites*, i.e. *Encrinus* meant a series of star-shaped columnals. What Agricola and the rest really did say is set forth in my recent paper, "*Pentacrinus: a name and its history*" (*Natural Science*, vol. xii, pp. 245-256).

The next paragraph says that "Rosinus . . . was the first writer to show that the Crinoids were not plants, as before then generally supposed, but were closely related to the Asterids." Rosinus was a writer of much merit, but the date of his "*De Stellis Marinis quondam nunc Fossilibus Disquisitio*" was 1719, whereas Llbuyd had published even more correct views in his "*Lithophylacii Britannici Ichnographia*," issued at London and Leipzig in 1699 (see *Natural Science*, loc. cit., also vol. xii, pp. 292 and 431). Wachsmuth and Springer's error, copied from De Koninck, was long ago corrected by W. B. Carpenter.

Guettard next receives some praise that is far too faint. The name "Palmier marin" was not his invention; the animal to which it was applied has been more correctly known as *Pentacrinus asteria* than as *P. caput-medusæ*; there are three misprints in the reference to his paper.

Blumenbach (the date of whose "Handbuch der Naturgeschichte," Ed. 1, is 1779, not 1780) obtains "the credit of having been the first writer who ranked them [crinoids] with the Asteroids and Ophiurids among the order 'Vermes crustacei,' which corresponds approximately to our present Echinoderms." He may have been the first *post-Linnæan* writer to do this; but he was only following Lihuyd in both arrangement and terminology. Moreover, in the edition of the "Handbuch" cited by our authors, Blumenbach referred the Echinoderms to 'Cartilaginea,' associating the crinoids with various Hydrozoa. It was not until 1788 that he placed them under 'Crustacea.'

J. S. Miller's definition of a crinoid is turned into nonsense on p. 12. Miller wrote as follows, but Wachsmuth and Springer have quoted only the italicized words: "*An animal with a round, oval, or angular column, composed of numerous articulating joints, supporting at its summit a series of plates or joints forming a cup-like body containing the viscera, from whose upper rim proceed five articulated arms, dividing into tentaculated fingers, more or less numerous, surrounding the aperture of the mouth, situated in the centre of a plated integument, which extends over the abdominal cavity, and is capable of being contracted into a conic or proboscal shape.*" The omissions can scarcely be intentional.

On p. 14 "Heisinger (1837)" no doubt refers to Hisinger's "Lethæa suecica," which was published in that year, and not to Heusinger, who also was an early writer on crinoids.

On the same page it is said that Joh. Müller's paper "Ueber den Bau des *Pentacrinus caput-medusæ*" appeared in 1840. The first part of it was read in that year, but none was published till 1843. In this paper Müller wrote as an anatomist rather than as a systematist, and it is not easy to understand what his precise views as to the classification may have been. Probably he wrote thus of set purpose, recognizing that the time for a formal classification of crinoids had not arrived, and intending only to give names to certain plans of structure. Nevertheless, my interpretation of Müller is so different from that of Messrs. Wachsmuth and Springer that I can only suppose they have not referred to the original paper, incredible though such an inference may seem. "Müller," they write, "divided the Crinoids into three great groups: the '*Crinoidea Articulata*,' the '*Crinoidea Tessellata*,' and the '*Crinoidea Costata*.'" And again: "The Tessellata were subdivided by Müller into two groups: *Crinoidea with arms*, and *Crinoidea without arms*. To the former he referred all true Crinoids and the Cystid genus *Caryocrinus*. . . . The armless Crinoids comprise the '*Pentremites*' (Blastoidea) and '*Sphæronites*' (Cystidea)."

Instead of criticizing these statements in detail I will contrast



with them my interpretation of Müller's intentions. Müller's 'Crinoidea' included all Pelmatozoa then known. His first division was into those with arms and those without, the former group being the 'Crinoidea brachiata' of writers who preferred a Latin terminology, and the latter including 'Pentremites' and 'Sphæronites.' Among crinoids with arms, the stalked forms were always distinguished from the unstalked; but it is not clear that Müller intended this as a prime classificatory division, although the point should not be omitted from any account of his views. Apart from this he noted, not three, but five divisions in the Crinoidea brachiata, viz.: (1) the Articulata, both stalked, as Pentacrinidæ, and unstalked, as Antedonidæ; (2) the Tessellata, both stalked, as most Palæozoic crinoids, and unstalked, as *Marsupites*; (3) the Costata, unstalked only, and not to be described as a "great group," since it included only the small genus *Saccocoma*; (4) the Testacea, erected for the reception of *Haplocrinus mespiliformis*, and defined thus: cup and tegmen form a firm, connected test, with five ambulacra running up to the mouth; (5) *Holopus*, "eine ganz eigenthümliche Abtheilung der festsitzenden Crinoiden" (p. 210), with sessile cup and, apparently, no anus (p. 229). "The stalked crinoids without arms," writes Müller (p. 229), "form two Families. Both are most probably [unlike the Tessellata] provided with distinct mouth and anus." The first Family is further distinguished from Tessellata by having a star-shaped arrangement of ambulacra on the ventral surface of the calyx: "these are the Pentremites." The second Family, which may be described in Müller's words as "Die Tessellata dieser Abtheilung, ohne Stern von Tentakelfelder," are the Sphæronites "with their genera as established by Mr. von Buch (1840)." It was probably this phrase "Die Tessellata dieser Abtheilung" that led Messrs. Wachsmuth and Springer to suppose that Müller really meant to class the Cystidea in the Tessellata; surely he merely meant to imply that they followed in this one respect the 'tessellate' type of structure. In any case the phrase shows that he did not place the Blastoidea with the Tessellata; in fact, on the previous page he compares them, much in the same way, with the Testacea.

It results from the above that the statement on p. 23, that Zittel in 1879 followed Müller in his classification, is also incorrect. For Zittel really did divide the Crinoidea brachiata, or Eucrinoidea as he called them, into three suborders, merging *Holopus* and the Testacea in the Articulata.

I do not know what is meant by "Roemer's classical memoir on the Cystidea," but everybody knows his memoir on the Blastoidea, and knows that it was published in 1851, not in 1855 as would follow from the remarks on p. 17 of the present monograph. The reference to Pictet's Paléontologie on the same page should not be "Tom. v" but "2<sup>e</sup> edition, tom. iv."

The account of the successive classifications proposed by Wachsmuth and Springer themselves is clear, and will be welcomed by many who have not mastered all the previous

writings of these authors. But in the account of P. H. Carpenter's views is a curious omission. The division of the Crinoidea by Wachsmuth and Springer into Palæocrinoidea and Stomatocrinoidea was accepted by Carpenter and Etheridge, jun., in 1881 (*Ann. Mag. Nat. Hist.*, [5,] vii, 281–298); the latter authors, however, laid more stress on the asymmetry of the posterior interradius in Palæocrinoidea than on the condition of the tegmen, and therefore suggested the names Irregularia and Regularia.

It is personally gratifying to gather from this history that the first rejection of the division into Palæocrinoidea and Neocrinoidea must have been independently and synchronously published by these eminent American authorities and by myself (February, 1889); further, that in applying the logical consequences of the tegmental structure of *Taxocrinus* to all Crinoidea, I actually preceded them by half a year (April, 1890). No one will suffer from the absence of all allusion to this in the present monograph, which certainly does not err in the direction of underestimating any contributions that I have so far been able to make to our knowledge of the Crinoidea.

Such errors as have been pointed out do not materially detract from the value of the monograph, and we can readily forgive a few such slips when we remember the age and ill-health with which the senior author had to struggle, and the constant pressure of other occupation that must have made his colleague's revision of the proofs a task of no ordinary difficulty. These circumstances will, I hope, always be borne in mind by any who read the present or future chapters of this review.

F. A. BATHER.

(To be continued.)

## REPORTS AND PROCEEDINGS.

### GEOLOGICAL SOCIETY OF LONDON.

I.—April 20, 1898.—W. Whitaker, B.A., F.R.S., President, in the Chair. The following communications were read:—

1. "Note on an Ebbing and Flowing Well, at Newton Nottage (Glamorganshire)." By H. G. Madan, Esq., M.A., F.C.S. (Communicated by A. Strahan, Esq., M.A., F.G.S.)

This well lies in a direct line drawn north and south from the church of Newton Nottage to the sea, about 80 yards south of the church and 500 yards from the sea. Sand-hills about 20 or 30 feet high lie between it and the sea. A range of Carboniferous Limestone cliffs runs east and west to the north of the church, while the same formation crops out in the sea at half-tide level. Between the two there is a band of Keuper conglomerate covered in one place at least by 7 feet of brown loamy clay with pebbles. At the shore-junction of conglomerate and limestone numerous springs occur, and it is in the conglomerate that the well is sunk, its bottom being 8 feet above ordnance datum.

A series of about forty observations made at intervals of an hour (and in many cases at the intermediate half-hours) during three