

pods. The brachiopod is a bivalve, but with valves of unequal size. In the overwhelming majority of cases in the fossil form the valves are found united, and, as the valves are filled either with sediment or with crystallized matter, the interior is rarely visible. This involved a greater difficulty than that of merely ascertaining the marks of the attachments of the organs on the inner sides of the shells. The brachiopods have supports for the soft parts, the so-called arms, in the shape of loops or spirals, or other processes, and while in modern brachiopods these are not calcareous, in fossil forms they were. These spiral and other processes were occasionally but rarely exposed and separated valves showing the muscular markings were also found, but naturally the first attempts at systematizing the brachiopods were largely based on mere external characters. During the progress of Dr. Davidson's labours, however, the Rev. Norman Glass, assisted him materially. By the exercise of great ingenuity and delicate workmanship he removed the shells and exposed the delicate brachial supports referred to, in the case of many species, so that a greatly improved system was the result. It is but right to say that others were working upon the brachiopods in the same direction, notably Mr. Whitfield, of the American Museum of Natural History, New York. The number of known fossil species has, however, kept on increasing at a surprising rate, and we have also added largely to the known living forms. Dr. Davidson's work was, therefore, soon followed by important contributions from D. P. Oehlert, in 1887,⁽¹⁾ and by Professor Zittel in his Hand-book, already referred to. It was still maintained that we possessed no treatise in which "facts in regard to structure, function, habits, and distribution of these animals, the distinguishing characters and systematic relations of their genera," are included in one work. This Professor Hall and his co-workers have sought to do in the "Introduction to the Study of the Brachiopoda" and in the eighth volume of the *Palæontology of New York*. Here we can readily follow their history from the very minute and rudimentary brachiopods in the Lower Cambrian through their enormous development in the Palæozoic both in numbers of individuals and in variety of form and size, continuing in lessened though still great numbers through the Mesozoic, and gradually lessening until the present age, of which Professor Hall records only 147 species, many of which are mere varietal forms. Whether we consider the shapes of the valves as they have been influenced by the soft parts which are now gone, the microscopic structure of the shells, the systems of defence by spines, imitative surface markings or otherwise, the infinitely varied and very beautiful processes for supporting the arms, the muscular scars, the complicated nature of the hinge, the foramen, the evidence as to fixity of habit or the reverse, or any other feature which may leave its morphological evidence on the fossil; or the softer parts which may be seen in living forms and by the aid of which both the structure and habits of the fossil organisms may at least to some extent be understood, we must admit that the history of the Brachiopoda, as gathered from the study of both fossil and living forms has produced a result infinitely more satisfactory to the biologist and the geologist than could have been possible by the study of the fossil forms alone by the old-fashioned geologist and of the living forms alone by the old-fashioned biologist. And he would be a foolish man who undertook to say whether the fossil or the living forms had most aided in the final result. Both are absolutely necessary.

In almost any other branch of fossil remains quite as valuable evidence of the growth of palæontology on its biological side might be adduced. In the Protozoans, George Jennings Hinde by his microscopic work is carrying the evidence of the existence of Radiolarian remains farther and farther back in the Palæozoic rocks, and Messrs. W. D. and G. F. Matthew have found Globigerinidae in phos-

(1) Paul Fischer. *Manuel de Conchyliologie*, Paris, 1887, with an appendix on the Brachiopods by D. P. Oehlert.