

area as possible of the ciliated ambulacral grooves on their ventral surface in order to catch the minute organisms in the surrounding water which might serve as food, and send them down the ambulacra of the arms towards the central mouth. For this purpose, as for that of respiration, the repeated branching of the long arms of *Cyathocrinus* would be as effective as the development of pinnules on the successive joints of less divided arms in other Crinoids. The three great functions of these pinnules would thus have been performed without difficulty by the branching arms of *Cyathocrinus*. But for which of them are the covering plates of the arm-grooves at all adapted, and how far can these plates be considered as repetitions of the arms on a small scale? To each of these questions only a negative answer is possible.

The covering plates of recent Crinoids may be found closed down over the food-groove after death (Pl. XIII. fig. 16; Pl. XVII. fig. 7; Pl. XXVII. fig. 12; Pl. XXXIX. fig. 12; Pl. XLVII. fig. 10; Pl. LI. fig. 12; Pl. LII. fig. 6; Pl. LIV. figs. 4, 6); but they are just as often met with in a more or less erect position, thereby opening the food-groove to the exterior (Pl. Vc. figs. 8-10; Pl. VIIIa. fig. 5—*cp.* Pl. XVII. figs. 2, 8, 9; Pl. XLVII. figs. 4, 13; Pl. LI. fig. 11; Pl. LIV. figs. 7-9). Just in the same way the arms are frequently closed round the disk in the dead animal (Pls. XVIII., XIX., XXV., XXVIII., XXXI., XLV., XLIX., LII.); while in other cases they are more or less expanded, as they were during life (Pls. XXXIV., XL., XLII.). Messrs. Wachsmuth and Springer argue, however, (1) because the arm-groove of the fossil *Cyathocrinus* is closed by covering plates which could be opened and closed by the animal (as it is in the dried arm-fragment of *Pentacrinus asterius* which is shown in Pl. XVII. fig. 7), and (2) because the arm-groove of *Actinocrinus* must have been perfectly shut off from the surrounding water by the apposition of the pinnules *when the arms were closed*; therefore the covering plates of *Cyathocrinus* are homologous with the pinnules of *Actinocrinus*.

But what advantage is it to the animal to have its arm-grooves closed up, whether by covering plates or by pinnules, and so shut off from the surrounding water? It could not breathe properly in this condition, neither could it get its food. None of the food particles which one finds so frequently in the alimentary canal of a Crinoid, *e.g.*, Radiolarians, Foraminifera, Diatoms, &c., could enter the food-grooves of the arms if they were closed by covering plates or by the apposition of the pinnules over them. The habitual expansion of the arms is essential to the whole life of a Crinoid, and Prof. L. Agassiz has well described their movements in the living *Rhizocrinus*. "We had the Crinoid alive for ten or twelve hours. When contracted the pinnules are pressed against the arms, and the arms themselves shut against one another, so that the whole looks like a brush made of a few long coarse twines. When the animal opens, the arms at first separate without bending outside, so that the whole looks like an inverted pentapod; but gradually the tip of the arms bends outward as the arms diverge more and more, and when fully expanded the crown has the appearance of