

ments which have led him to the following conclusions:—"1. The central capsule and its prolongations, the axial cords and their branches, constitute the main nervous system of *Antedon*. 2. The central capsule is specially connected with the complex co-ordinated movements of swimming and of righting when inverted. 3. The axial cords act as both afferent and efferent nerves. 4. The subepithelial bands are probably also nerves, but their exact function, probably a special and subordinate one in connection with the ambulacral tentacles and epithelium, is not yet ascertained."

These conclusions are the result of a long series of experimental investigations, in which Dr. Carpenter's fundamental observations were repeated and largely extended.

Marshall's paper concludes with a valuable discussion of the morphological aspect of his results. Starting from the generally accepted doctrine that the Asterids are the most primitive group of the Echinoderms, he shows how this character is well illustrated by their nervous system. Hamann's observations have demonstrated that this "is in the form of a continuous nerve-sheath enclosing the whole body, and directly continuous with the external epidermis of which it forms the deepest layer. This nerve-sheath is thickened at certain places, notably along the ambulacral grooves, where it forms the five radial or ambulacral nerves." Marshall points out that the analogies of the Coelenterates, Chaetognatha, and Palaeonemertines all tend to show the primitive nature of the Asterid nervous system.¹ There is no difficulty about the relation of the nervous system of the remaining Echinozoa to that of the Asterids; but the case is different with the Crinoids, on account of the antambulacral position of their principal nerve centre and its radiating extensions. Marshall, however, is inclined to consider them as "descended from forms which agreed with the recent Asterids in possessing a complete nerve-sheath (though possibly very unlike Asterids in other respects);" and he is therefore "disposed to regard the antambulacral nervous system of a Crinoid, *i.e.*, the central capsule and axial cords with their branches, as being derived from the antambulacral part of the primitive nerve-sheath, and not as an entirely new set of structures possessed by no other Echinoderms."

He endeavours to show that the relations of the axial cords which lie in grooves on the surface of the radials of the Pentacrinoid larva (a permanent condition in some Palaeocrinoids) are "very similar to those of the ambulacral nerves of an adult Ophiurid or Echinid, and as the latter have certainly acquired their adult condition by becoming detached from the epidermis and shifting inwards, so also may the same process be supposed to have occurred in the Crinoid." Too much weight must not be laid upon this point, however, for the supposed inward movement of the radial nerves of an Ophiurid or Echinid would be from the outer or ambulacral surface of the plate towards the inner one, *i.e.*, that next to the body-cavity.

On the other hand, in the developing Crinoidal calyx the axial cords are at first on the walls of the body-cavity, which are formed by the *inner* surfaces of the radials; but they

¹ Compare Chapter VI. pp. 113, 115.