

found no difficulty in this, but despite the physiological improbability of the want of innervation to the muscular bundles, he declines to accept the fibrillar envelope of the chambered organ and its extensions into the stem and arms as belonging to the nervous system of a Crinoid. One ground for his objection lies in the presence of this fibrillar tissue in the axis of the stem and of the cirri that it bears, which contain no muscular tissue. This point, which supports Dr. Carpenter's view rather than opposing it, will be considered later.

The only explanation of the presence of this fibrillar tissue within the skeleton which Ludwig can suggest is as follows:—"Die Faserstränge sind zu betrachten als unverkalkt gebliebene Theile der bindegewebigen Grundlage der Kalkglieder, deren Aufgabe es ist, aus dem Blutgefässsystem, genauer aus den fünf Kammern, die ernährende Flüssigkeit aufzunehmen und den Arm- und Pinnulagliedern zuzuführen."¹

I have no doubt whatever that the axial cords are permeated by a nutritive fluid, which finds its way from the chambered organ into the substance of the organic basis of the skeleton. For I have frequently found coagulum, both in this last and in the axial cords themselves; but I should hesitate to speak of either of these as connective tissue. The closely set fibrils forming the axial cords are quite distinct from the nuclear network which interpenetrated the calcareous substance; and both are as different as possible from the connective tissue fibres of the articular ligaments, or the general connective tissue of the ventral perisome (see fig. 6 on p. 121). Simroth has given an excellent description and figures of the nucleated reticulum forming the organic basis of the skeleton in Ophiurids,² and nearly everything which he says is equally applicable to the Crinoids. The nature of this nuclear tissue is well shown in Pl. Vb. fig. 1, Pl. XXIV., and Pl. LVIII. figs. 2, 3; and its distinctness from the close fibrillar structure of the stem-axis is very apparent. The general aspect of the axial cords in thin sections is identical with that of the Ophiurid nerves as represented by Simroth, who finds the nerve-fibrils to be connected with bipolar cells. Fig. 32 on his pl. xxxiv., which shows the relation of the radial nerve to the organic substance of the under arm-plates beneath it, would serve, with very little alteration, for a part of a longitudinal section of the arm or pinnule of a Crinoid. The fibrillation of the axial cords and their marked differences from the organic basis of the skeletal plates is well seen in sections through the calyx of the Pentacrinoid. At this early stage the cords lie on the ventral surface of the flat calyx plates outside the organic basis of the skeleton altogether; and it is by an endogenous thickening of the calcareous substance of these plates that the cords come to lie in grooves which are subsequently closed into canals; while by a further continuance of the same process these canals are eventually so surrounded by calcareous tissue that they come to occupy the centre of the successive joints of the skeleton.

Ludwig's view of the nature of the axial cords is therefore not altogether in accordance

¹ Crinoideen, *loc. cit.*, p. 340.

² *Op. cit.*, pp. 433, 434.