

arms and also on the proximal pinnules. In both cases they open into that section of the body-cavity which surrounds the generative apparatus, and is known as the genital canal (Pl. LXI. fig. 5). In a few cases too, I have found water-pores on the middle and later pinnules of the arms. They open into the genital canal of the pinnule, close to the point where it arises from that of the arm.

D. THE BLOOD-VASCULAR SYSTEM.

The foundation of almost all our accurate knowledge of the blood-vascular apparatus of the Crinoids is due to the researches of Ludwig. The blood-vessels form a highly complex system, parts of which are entirely unrepresented in the unstalked Echinoderms (*Echinozoa*); while other parts of it, such as the oral ring and its radial extensions above the water-vessels, conform to the ordinary Echinoderm type.

The radial vessels (Pl. VIIIa. figs. 4, 5; Pl. LIX. figs. 1, 5; Pl. LX. figs. 1, 4, 6—*b*) vary considerably in size, and are often invisible if the section be at all oblique. They are large in *Antedon eschrichti* and in *Actinometra nigra*, and may frequently be found to contain yellow pigment-masses or coagula. In the latter type they are sometimes triangular in section, with the apex pointing downwards so as to be received into a strongly marked concavity in the upper edge of the water-vessel (Pl. LXI. fig. 6); but in *Antedon eschrichti*, *Pentacrinus decorus*, and in most other types their section is more or less lenticular. Sometimes, however, it is triangular with the apex projecting upwards towards the epithelial layer above, and so rendering the ambulacral nerve much thinner in the middle line than in its more lateral portions (Pl. LX. figs. 1, 6, *b*).

Its cellular lining is much more delicate than that of the intervisceral blood-vessels, and is not easy to make out. Ludwig¹ found that this radial blood-vessel in the arms of *Antedon eschrichti* is sometimes divided into two parts by a vertical septum, which has a distinctly cellular covering; and I have not unfrequently found in the disk of the same species that the lumen of the vessel may be crossed in various directions by delicate threads with nuclei upon them. These resemble the nucleated muscle-threads in the water-vessels, but are much finer and less refractile.

The oral ring which connects the radial blood-vessels, and resembles them in structure, extends somewhat beyond the inner edge of the water-vascular ring (Pl. LXII.); and its wall thus projects into that part of the body-cavity which is contained within the dense mesh-work of connective tissue supporting the lip (Pl. LX. fig. 4, *c*). Ludwig has described in *Antedon rosacea* a number of more or less branching tubules which are connected with the oral blood-vascular ring, and have a somewhat better defined epithelial lining than the intervisceral blood-vessels.² He thought it possible that they might be in connection with the ramifications of the upper (ventral) end of the plexiform gland,

¹ Crinoideen, *loc. cit.*, p. 267.

² *Ibid.*, p. 328.