

extremely susceptible of irritation. When they are touched in the living animal, the whole circlet of arms is suddenly and simultaneously coiled up over the disk; while irritation of one of the ordinary pinnules is simply followed by the flexion of the arm which bears it.

The structure of these "oral pinnules," which in *Antedon rosacea* and allied species are borne by the second brachials, differs very considerably from that of the pinnules on the other arm-joints. For not only are they sterile, but they have neither tentacular apparatus nor ambulacral groove. Their ventral surface is slightly convex, instead of being concave, as in the ordinary arms and pinnules; while the ciliated ambulacral epithelium, together with the subjacent nerve and radial blood-vessel, are also absent. This appears to be the case with the oral pinnules of almost all Comatulæ; while in some species of *Actinometra* whole arms, with all the pinnules which they bear, are in the same condition.

In the Pentacrinidæ, however, the lowest pinnules of the rays are usually all grooved like their successors, and not devoid of the ambulacra with all their accessory structures, as in the Comatulæ (Pl. XXXIV. fig. 2). In fact the pinnule-ambulacra of *Metacrinus* often start directly from the peristome or from the five primary groove-trunks of the disk, instead of from the particular branches corresponding to the arms which bear the pinnules (Pl. XXXIX. fig. 2; Pl. XLIII. fig. 3; Pl. L. fig. 2).

The fact that the pinnules are only arms in miniature is very well shown by the process of their development at the terminal growing points of the young arms. The first indication of a pinnule is the formation of a fork at the growing point, the two limbs of which are at first almost equal (Pl. XXXV. fig. 1). "One of these rami, however, grows faster than the other, and soon takes a line continuous with that of the axis of the arm, from which the other diverges at an acute angle, so that the former comes to be the proper extension of the arm, while the latter soon takes on the characters of a pinnule. Ere long, however, the growing point of the arm again subdivides; two branches are formed as previously; and whilst one of these becomes a continuation of the arm, the other is soon to be distinguished as a pinnule given off from it on the side opposite to that of the first formed pinnule."¹

In all the Neocrinoidea, with the exception of *Hyocrinus*, the pinnule borne by any joint is small in comparison with the arm of which that joint is a part. But in this aberrant genus (Pl. VI. figs. 1, 2) the pinnule-bearing joints have rather the appearance of axillaries. For the pinnules are large in proportion to the arms, and are nearly equal in length to the parts of the arms which are beyond the joints where they originate, so that the outer ends of all the pinnules, as well as those of the arms, meet nearly on a level. Hence the pinnules of *Hyocrinus* have some resemblance to the "armlets" or small and undivided but pinnule-bearing arms which come off from the inner faces of the axillaries of *Extracrinus*. But their function as pinnules is shown by the way in which they are

¹ *Phil. Trans.*, 1866, p. 734. See also *Trans. Linn. Soc. Lond. (Zool.)*, ser. 2, vol. ii., 1877, p. 40, pl. ii. figs. 4, 6.