

originated from a uniserial form, even in those cases in which the arm structure at present is biserial, and diagrams are given illustrating how a uniserial arm might develop into a biserial one. It is well known that biserial arms frequently are uniserial at the base, and the arrangement here is regarded as more primitive. (See also Wachsmuth and Springer, *Revision of the Palaeocrinidea*, II, 1881, pp. 22-25; III, sec. 1, 1885, p. 14; III, sec. 2, 1886, p. 230.)

According to Austin H. Clark (*A Monograph of the Existing Crinoids*, 1915, pp. 184, 189, 350, 352, 354), however, the biserial arrangement is more primitive in crinoids; the biserial arrangement being the palaeozoic type, while the uniserial arrangement originated chiefly in post-palaeozoic times.

Clark's conception of the origin of the biserial arrangement of the ossicles of crinoid arms is so different from that commonly accepted that it is quoted here in full:

"The crinoid arms are primarily paired interfurcular structures which have become joined along their radial edges, forming a radial biserial appendage, the ossicles later slipping in between each other so that an elongate uniserial appendage results. The original arms were, therefore, primarily ten in number. Originally, before their union into five, the arms probably bore no ventral ambulacral structures, and had no function other than that of increasing the surface of the disk by increasing the distance between the points of attachment." (Loc. cit., p. 350.)

The following statement by Clark also is illuminating:

"In such fossil forms as have biserial arms it is to be remarked that at the arm bases the brachials become uniserial; this is not to be interpreted as indicating that the arms were originally uniserial, but quite otherwise; mechanical considerations have forced the amalgamation of the two primitive radials into one, and similarly have forced the uniserial arrangement of the first two, and partially of the third and fourth, brachials." (Loc. cit., p. 354.)

"It is probable that the pinnules represent the original type of crinoidal appendage, and that these appendages were arranged in five pairs, the two components of each pair being, so to speak, back to back; but the pinnules have become enormously reduplicated, while in addition (they) have come to lie along either side of long body processes (arms) of subsequent development." (Loc. cit., p. 274, but omitting all references to cirri.)

Since the pinnules of crinoids are uniserial, it is certain that Clark regarded the uniserial arrangement of ossicles as primitive among crinoid appendages. Even the primitive arms