

the stem immediately beneath the calyx, what appears to be the top stem-joint in a side view having one or two more smaller joints resting in its upper surface but not reaching the exterior as shown in Pl. XXXIV. fig. 9.

The top stem-joint—for the time being—of a specimen of *Pentacrinus wyville-thomsoni* is shown in Pl. XXII. fig. 2. Resting on its upper surface is a smaller stellate plate without any markings whatever, which in its turn would appear as the top stem-joint until it was replaced by the development of another above it. As these joints are relatively carried downwards from the calyx in succession by the appearance of younger ones above them, they also become separated from one another by the intercalation of new joints between them. Various stages of this process are shown in Pl. XXII. figs. 9–12, while fig. 4 shows an isolated young joint, and fig. 5 the depression in the next joint, which lodged it. Similar intercalated joints are shown in Pls. XXII. fig. 3, and Pl. XXIII. figs. 1, 2. The result of this process is that the growing part of the stem appears to consist of thick and thin joints alternating with one another (Pl. XIII. fig. 1; Pl. XIV.; Pl. XV. figs. 1, 2; Pl. XVIII. fig. 1, 2; Pl. XIX. fig. 2, 6, 7; Pls. XXV., XXVIII.–XXX.; XXXIV.–XXXVII.; Pl. XXXIX. fig. 1; Pl. XLIII. fig. 2; Pl. XLVIII. fig. 2). The former are the older, the latter being subsequent additions. These intercalated joints are always internodal, and the process goes on until the number of joints between any two nodes reaches a certain average, which is constant for each individual species.

There are many indications that the increase in length of the stem of the fossil Pentacrinidæ was due to the same process. Quenstedt<sup>1</sup> gives an excellent figure of a young concealed joint superposed upon an older and larger one, very much as shown in Pl. XXII. figs. 9–12; and others of his figures upon the same plate illustrate the different stages of growth on the stem of *Extracrinus subangularis*, as many as three or four concealed joints being sometimes found intercalated between two of the larger ones. In this species, too, with a stem which may reach 50 or 70 feet in length, the production of nodal joints at the top of the stem must have been very rapid. According to Quenstedt<sup>2</sup> forty or more succeed one another without any internodal joints being visible externally, though the presence of concealed intercalated joints is revealed by the examination of longitudinal sections of the stem. The final result of their growth was to enormously increase the total number of internodal joints.

Stem-fragments have been found by Quenstedt consisting of as many as eighty joints, all internodal, and it is impossible to say how many more there may have been; while he states that he finds traces of small intercalated joints in almost every part of the stem.

In most cases the new joints which have been intercalated between two older ones eventually reach the same size as their predecessors, so that it is difficult to tell the older from the younger joints in any mature stem. But in some species there appears to

<sup>1</sup> Encriniden, p. 298, Tab. 101, figs. 24a, 24b.

<sup>2</sup> *Ibid.*, p. 297, Tab. 101, figs. 16–19.