

plates on the arms of *Gissocrinus*, which he described in his generic diagnosis¹ as “pinnulæ brevissimæ verrucæformes.” They do not correspond to the “assulæ ambulacrales” of *Gissocrinus*; for these, as pointed out by Wachsmuth and Springer,² are the joints of the arm-bases which are recumbent upon the vault, being raised above the general level, and “covered by small alternating plates like the free arms.”

Thus, then, the expression “pinnulæ” was used by Angelin for three different types of structure in *Habrocrinus*, *Crotalocrinus*, and *Gissocrinus* respectively. The first of these represent the true pinnules of recent Crinoids; while, as was first recognised by Zittel,³ the plates on the arms of *Gissocrinus* represent the “Saumplättchen” which Müller had described on the ambulacra of *Pentacrinus*. He takes the same view of the plates which Angelin called “rudimenta pinnularum semiglobosa” in *Cyathocrinus ramosus*. The corresponding plates in *Cyathocrinus longimanus* have indistinct cross markings; and Messrs. Wachsmuth and Springer have interpreted this as indicative of segmentation into pinnule-joints;⁴ for they speak positively of “two rows of five successive plates each, one row being given off from the right, the other from the left side of the furrow, and perfectly covering it.” The arms of *Cyathocrinus*, however, are only single-jointed; and they state elsewhere⁵ that “in double-jointed arms every joint at each side bears a pinnule, while in those with single joints the pinnules are found only on alternate sides.” But Angelin’s figures show that on five arm-joints there are twelve of these rudimentary pinnules, six on each side, while in *Gissocrinus* there are from four to six on each arm-joint. In spite of these facts, however, Wachsmuth and Springer give it as their opinion that these plates which cover in the ambulacral groove in the arms are the homologues of the pinnules, though too rudimentary to be ranked as such.⁶ [See p. 84.]

The chief point of their position (and they make the most of it) is the apparent segmentation of the “rudimentary pinnules” into five joints, as shown in Angelin’s figures of *Cyathocrinus longimanus*. It would be very desirable if this could be verified on the actual specimens. The presence of two rows on each side of the ambulacrum in *Cyathocrinus*, *Gissocrinus*, &c., is nothing unusual; for they represent the side plates and covering plates of Neocrinoids, of which there may be from five to seven to one arm-joint. Precisely similar plates occur on the pinnules as well as on the arms; and they also form part of the skeleton round the radiating tubes beneath the vault of *Actinocrinus* “which connect with the ambulacral furrows in the arms.”⁷ But I think that Wachsmuth and Springer would hesitate before considering the two upper rows of plates in these radiating tubes as “rudimentary pinnulæ.”

¹ Iconographia Crinoideorum, p. 10.

² Revision, part ii. p. 91.

³ Paleontologie, pp. 338, 354.

⁴ Revision, part i. pp. 24, 82.

⁵ *Ibid.*, part ii. p. 24.

⁶ *Ibid.*, part i. p. 82.

⁷ *Ibid.*, part ii. p. 28.