

social central capsules by gemmation and by cell-division, it would appear that the capsules produced by the former method afterwards produce anisospores, whilst those in the latter way yield isospores (§ 216).

The gemmules or capsular buds of the Polycyttaria were first accurately described by Richard Hertwig (L. N. 26, pp. 37–39), under the name “extracapsular bodies,” and their significance rightly indicated; earlier observers had incidentally mentioned and figured them, but had not seen their origin from the central capsule. Quite recently Karl Brandt has given a very painstaking account of them in the different Polycyttarian genera (L. N. 52, pp. 179–198). In the Monocyttaria such a formation of buds has not yet been observed. The basal lobes of the central capsule, which occur in many NASSELLARIA, are not buds, but simple processes of the capsule, due to its protrusion through the collar pores of the cortinar septum (§ 55).

215. *Sporification*.—Asexual reproduction by the formation of movable flagellate spores has been hitherto observed only in a very small number of genera; but since these belong to very different groups, and since the comparative morphology of the capsule appears to be similar throughout as regards the structure and development of its contents, it may be safely assumed that this kind of reproduction occurs quite generally in the Radiolaria. In all cases it is the contents of the central capsule, from which the swarm-spores are formed, both nucleus and endoplasm taking an equal share in the process; in all cases the spores produced are very numerous, small, ovoid or reniform, and have one or two very long slender flagella at one extremity (see §§ 141, 142). Since the whole contents of the mature central capsule are used up in the formation of these flagellate zoospores, it discharges the function of a sporangium. The division of the simple primary nucleus into numerous small nuclei, which usually (serotinous Radiolaria) takes place only shortly before sporification, but sometimes (precocious Radiolaria, § 63) happens very early; is the commencement of the often repeated process of nuclear division, which terminates with the production of a very large number of small spore-nuclei. The nucleolus often divides very peculiarly (§ 69, C). Each spore nucleus becomes surrounded by a portion of endoplasm and usually receives in addition one or more fatty granules, and sometimes also a small crystal (hence the “crystal-spores”). The size of the flagellate zoospores which emerge from the ruptured central capsule and swim freely in the water by means of their flagellum, varies generally between 0·004 and 0·008 mm. The extracapsulum is not directly concerned in the sporification, but undergoes degeneration during the process and perishes at its conclusion.

The first complete and detailed observations on the formation of spores in the Radiolaria were published by Cienkowski in 1871 and related to two genera of Polycyttaria, the skeletonless *Collozoum* and the spherical-shelled *Collosphaera* (L. N. 22, p. 372, Taf. xxix.). These were subsequently continued and supplemented by R. Hertwig (1876, L. N. 26, pp. 26–42, and L. N. 33 p. 129), and a general summary of these results has been given by Bütschli (L. N. 41, pp. 449–455).