

the case is the more necessary, inasmuch as the early division of the nucleus has no further influence upon the organisation. Just as in many other classes of the Protista there are monozootic (solitary) and polyzootic (social) forms, so also in the Radiolaria there are in addition to the ordinary monozootic or monobious forms certain families in which colonies or cœnobia are formed by the association of individuals; this distinction may be expressed by the terms "Monocyttaria" and "Polycyttaria."

The unicellular nature of the Radiolaria was first established by Richard Hertwig in 1879 (L. N. 33),<sup>1</sup> and brought into conformity with our present histological knowledge and the new reform of the cell-theory. Huxley, however, who was in 1851 the first to examine living Radiolaria accurately, declared *Thalassicolla nucleata* to be a unicellular Protozoon, and the individual central capsules of *Sphærozoum punctatum* to be cells, but, owing to the then condition of the cell-theory, he was unable to give a conclusive demonstration of this view. Later, when Johannes Müller in 1858 and myself in 1862 recognised the peculiar "yellow cells" which occur in large numbers in many Radiolaria as true nucleated cells, it appeared impossible any longer to maintain the unicellular nature of the Radiolaria; also the great complication which I showed to exist in the structure of *Thalassicolla* appeared to contradict it. Only after Cienkowski (1871) and Brandt (1881) had shown that the "yellow cells" do not belong to the Radiolarian organism, but are symbiotic unicellular algæ, was it possible to revive and demonstrate anew the unicellular nature of the Radiolaria.

12. *Morphological Individuality*.—From the morphological standpoint the individuality of the unicellular elementary organism is obvious in the ordinary solitary Radiolaria (Monobia), and is to be so regarded that the whole body with all its constituent parts, and not merely the central capsule, is to be regarded as a *cell*. Naturally the xanthellæ or yellow cells (§§ 76, 90), which as independent algæ live in symbiosis with many Radiolaria, must be excluded. The unicellular organisation of the Radiolaria is further to be distinguished from that of the other Protista, inasmuch as an internal membrane (capsule-membrane) separates the central (medullary) from the peripheral (cortical) portion. In the cœnobia of the social Radiolaria (or Polycyttaria), the morphological individuality persists only as regards the medullary portions of the aggregated cells (the individual central capsules), while the cortical portions fuse completely to form a common extracapsulum. Hence in these SPUMELLARIA polyzoa two different stages of morphological individuality must be distinguished, the *Cell* as a *Morphon of the first stage*, and the *Cœnobium* as a *Morphon of the second stage*.

13. *Physiological Individuality*.—From the physiological standpoint also the individuality of the unicellular organism is immediately obvious in the case of the ordinary solitary Radiolaria (Monobia); as in other Protista it fulfils all the functions of life by itself alone. This physiological individuality of the monobious Radiolarian cell is furthermore not influenced by the xanthellæ, which live as independent algæ in symbiosis with many Radiolaria; even though these often by the production of starch assist in the

<sup>1</sup> The numbers preceded by L. N. refer to the list of names of authors in the Bibliography on p. cxxxvi.