

presence has not been certainly demonstrated. The extracapsular Xanthellæ are found most abundantly in the Colloclaria, both in the monozootic Thalassicollida and in the polyzootic Sphærozoida. They occur in smaller numbers in the Sphærellaria, and in many divisions of the latter they seem to be entirely absent. Also it sometimes happens that, though present in large numbers in some SPUMELLARIA, they are entirely absent in others nearly related to them; indeed, this has also been observed in the case of different individuals of the same species. This fact alone is sufficient to show that the Xanthellæ are not an integral part of the Radiolarian organism (as was formerly believed) but parasites or more correctly symbiontes, which live as inhabitants of the calymma. More recent investigations have shown, that besides the yellow pigment-grains they contain starch or an amyloid substance, that is to say, vegetable reserve materials, that their thin envelope contains cellulose, and that their yellow colouring-matter resembles chlorophyll and is related to that of the Diatomaceæ ("Diatomin"). Hence they are now generally regarded as unicellular Algæ, nearly related to those which occur as symbiontes in other marine animals (*Exuviella*, &c.). The starch, which they develop with the formation of oxygen, may serve as nutriment to the Radiolaria, while the carbonic acid yielded by the latter is also beneficial to the Xanthellæ. The form of the Xanthellæ is usually spherical and elliptical, often also spheroidal or discoidal. Their diameter is usually between 0.008 and 0.012 mm., rarely more or less. The differences exhibited by Xanthellæ which live in different groups of Radiolaria demand further investigation, which will perhaps lead to the establishment of several species of the genus *Zooxanthella*. At present *Zooxanthella extracapsularis*, in the calymma of SPUMELLARIA and NASSELLARIA, may be clearly distinguished from *Zooxanthella intracapsularis*, in the central capsule of the ACANTHARIA.

The "yellow cells" were first described in 1851 by Huxley, in the Colloclaria, and afterwards by J. Müller (1858) in many SPUMELLARIA and NASSELLARIA. In my Monograph (1862, pp. 84-87) I gave a detailed account of their structure and increase by division, and laid special emphasis on the fact that they are the only elements in the Radiolarian organism which "are undoubtedly cells in the strict histological sense of the word." Afterwards, in my Beiträge zur Plastiden-Theorie, I showed the constant presence of "starch in the yellow cells of the Radiolaria" (1870, L. N. 21). Shortly afterwards Cienkowski observed that the yellow cells live independently and reproduce themselves after the death of the Radiolaria, and in consequence first put forth the hypothesis that they do not belong to the Radiolarian organism, but that they are unicellular Algæ parasitic upon it (1871, L. N. 22). This view was ten years later more fully established by Karl Brandt, and elucidated by comparison with the symbiosis of the gonidia of Algæ, and the hyphæ of Fungi in the formation of Lichens, which had in the meantime become known (1881, L. N. 38). Brandt gave this unicellular yellow Alga the name *Zooxanthella nutricula*, and afterwards gave fuller details regarding its remarkable vital relations (L. N. 39), Patrick Geddes, who named it *Philozoon*, supplemented this account and showed experimentally that it gives off oxygen under the influence of sun-light (1882, L. N. 42, 43). In consequence