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SCIENTIFIC BOOKS.

Ueber die Organization und Physiologie der Cyanophyceenzelle und die mitotische Teilung ihres Kernes. Von E. G. Kohl. Jena, Gustav Fischer. 1903. Pp. 240, 10 plates. 20 mk.

This book, the result of several years of work on this interesting group of algæ on the part of Professor Kohl, will probably clear away definitely many of the clouds of doubt and contradiction over the structure of the cell of these plants. Professor Kohl applied his attention first to one species, *Tolypothrix latana,* until he had mastered the proper technique, and had acquired exact knowledge of its structure. Then he applied the same intensive study to *Anabœna catenula* and *Nostoc cœruleum,* afterwards testing his discoveries on a large series of the most diverse Cyanophyceæ.

Many points of structure, especially those bearing upon the shape and structure of the resting nucleus, as well as its behavior during division, were made the object of study in cells stained *in vivo,* as well as in cells fixed by various chemical reagents. The most important contribution to our knowledge is that in regard to the nucleus. The author confirms Bütschli's and Hegler's contention that the central body (Zentralkörper) is the nucleus. This organ occupies the center of the cell and runs out in numerous tapering branches into the surrounding cytoplasm, these processes often extending to the cell wall. As ordinary fixation methods cause their immediate retraction, they usually have been overlooked. The nucleus has no definitely staining delimiting membrane, nor does it contain a nucleolus. In it, and in it alone, are contained certain granules named by Kohl 'centralgranules (Zentralkörner) and thought by him to consist of reserve stuffs. The apparent occurrence of these granules in the cytoplasm is explained by their being often found in the processes of the nucleus. Similarly, granules belonging in the cytoplasm sometimes appear to be in the nucleus, when they are imbedded in cytoplasm between the bases of the nuclear processes. The central granules are identified by Kohl with Bütschli's red grains, Nadson's Chromatinkörner, etc., and with the Volutanskugeln of the bacteria.

The cytoplasm contains various inclusions, chief among which are the cyanophycin granules (protein crystalloids), fat drops and certain semi-fluid bodies in the heterocysts which are found to fill up the pits in the cell wall at the point of attachment to adjoining cells.

According to many authors, this blue-green cytoplasmic mantle between the nucleus and cell wall is the single, cylindrical chromatophore. Kohl, however, combats this idea and considers as chromatophores the very numerous minute, colored bodies about 0.6 μ in diameter scattered throughout the otherwise colorless cytoplasm. In their reaction towards stains they behave as do the chromatophores of higher plants. A study of the coloring matter of the cell shows that besides chlorophyll and phycocyanin, there is also always present carotin, the xanthophyll of many authors, which is never absent where chlorophyll is found, throughout the vegetable kingdom. It is the combination of these coloring matters in various proportions that makes possible the great variability of color of the different species, or even within the species of this group.

Instead of starch these algæ produce as carbohydrate the nearly related glycogen, storing it, apparently equally distributed, in the cytoplasm and not in granules.

The cell membrane consists of chitin with a very small amount of cellulose and pectin. In the heterocysts, however, a layer of cellulose is laid down when it (the heterocyst) begins to develop. In those genera with sheaths the filaments lie free in the sheath except the heterocysts, which are grown fast to it. Kohl sees in this the explanation of the function of these cells. They serve as points of resistance in the formation of hormogones, and in the branching of the filament. What the function can be in the forms without a sheath he does not clearly explain. They are evidently, however, not reserve cells, for they originate by the formation of stoppers for the pores through which alone the adjacent cells could furnish or receive reserve stuffs. They then build the cellulose wall and totally degenerate.

Here and there in the filament a single cell or several cells soften and degenerate, forming the points at which the filament breaks when it divides or produces hormogones. In the forms with false branching such degenerated cells are formed below the heterocysts and seem to help soften the sheath wall so as to enable the filament to turn out through the sheath when the resistance of the fast-grown heterocyst prevents its growing further in a straight line.

Normally the cells have no cell-sap vacuoles. They resemble meristematic cells in the size of the nucleus and density of the cytoplasm. Only in old or terminal cells and in the heterocysts do such vacuoles occur. The so-called gas vacuoles that Kohl mentions as occurring in some Cyanophyceæ have been proved definitely by Molisch and Brand, working independently, to be not of gas nature.

All cells are connected by a fine thread of plasm, which penetrates the center of the pore in the cell wall; even in the heterocysts where the pore is filled up the plasma thread remains, but it is unable to convey enough foodstuffs to keep the heterocyst plasma in good condition.

The nuclear division was made the object of especial study. By staining the living cells with methylene-blue Kohl was able to follow the process without subjecting himself to the criticism that his chromosomes were artefacts. The nucleus consists of a ground mass and a difficultly visible fine chromatin-bearing filament. This thickens itself and finally forms a spirem. This breaks up into usually six straight chromosomes which arrange themselves parallel to the long axis of the thread. They then begin to bow in somewhat, until they are much farther apart terminally than centrally. They then divide *crosswise* in the middle, *not lengthwise,* and collect at each end of the cell. At this point in the division a few achromatic fibers are visible, connecting the two masses of chromosomes, but no spindle in the proper sense is seen. The daughter chromosomes arrange themselves parallel, then form a spirem. As the chromosomes divide, the body of the nucleus which retains its distinctness from the cytoplasm begins to pinch in at the middle, and soon the separation of the two nuclei is complete. A cell wall separates the new cells at once.

The author also discusses the relationship of the Cyanophyceæ to the bacteria, holding that they are closely related and that the latter too probably have a nucleus similar to that described.

The book is, unfortunately, marred by an excessive number of typographical errors. The ten plates illustrating the book are finely executed and are very helpful to the understanding of the subject.

ERNEST A. BESSEY.

Geology of Economic Non-metallic Minerals. By FRANCIS MIRON, C. E.*

This little volume is published as one part of the 'Encyclopédie Scientifique des Aide-Mémoire,' issued under the direction of M. Léanté, member of the Institute of France. It is the fourth by the same author, the preceding volumes having dealt respectively with: (1) Mineral oils, (2) subterranean waters and (3) metallic minerals and mining. The general object is to furnish a series of brief hand-books describing the geological distribution, manner of occurrence and methods of procuring and utilizing of the substances treated of in each of the volumes. The pres-

* 'Gisements Mineraux; Stratigraphic et Composition,' par François Miron, Paris, Masson et Cie, pp. 157. (Part of 'Encyclopédie Scientifique des Aide-Mémoire.')