DISCUSSION

THE SPIRAL STRUCTURE OF PROTOPLASM

THERE is now fairly general agreement among certain cytologists that chromosomes or their essential parts, the chromonemata, maintain a spiral structure in all stages. The recent work of Koshy[1] is one example in which this view is maintained.

The writer has investigated the structure of the iron bacterium, *Leptothrix ochracea*. This bacterium was fixed and treated in different ways. It was found that the bacterium is composed of series of longitudinal spirals. Spiral structure has also been observed by the writer in his photomicrographs of fixed preparations of green, filamentous, fresh-water algae.

Five years ago Seifriz[2] stated that the spiral habit seems to be a fundamental heritable quality of protoplasm.

While recently looking through Seifriz's book on protoplasm I was arrested by his photomicrograph[3] of the quiescent protoplasm of a slime mold taken with a Spierer lens under dark-ground illumination. In some parts this picture shows complete spirals. Throughout the remaining parts of the picture structures typical of spirals in optical section are shown. For example, series of short parallel curves arranged one behind the other represent slightly obliquely placed spirals. Series of short, parallel lines arranged one behind the other represent spirals at right angles to the optical axis. A slight thickening at each end of the short lines shows the upward and downward coil in profile and results in slightly dumb-bell-like appearances. When seen end on, the spiral shows a comma-like appearance with the tail of the comma representing the spiral receding in depth. All these appearances are seen in Seifriz's photomicrograph and in the reproduction of it in his book. So it appears that this photomicrograph solves one of the major problems of protoplasm, for it shows the structure of the disperse phase to be spiral in the living state. Through Professor Seifriz's courtesy I have been able to examine the original photomicrograph.

With the spiral structure of Seifriz's photomicrograph as a guide the writer has examined living protoplasm microscopically with ordinary bright-ground illumination and conventional apochromatic lenses. The examination included living cells of stamen hairs of *Rhoeo discolor* and living epidermal cells of the bulb scale of the onion (*Allium cepa*). Spiral structure could be seen in each case. In the onion spiral structure was visible in the nucleus as well as the cytoplasm.

[1] T. K. Koshy, *Annals of Botany*, n.s., 1: 52, 56, 1937.
[2] W. Seifriz, SCIENCE, 77: 50, 1933; 78: 361, 1933.
[3] W. Seifriz, "Protoplasm" (McGraw-Hill), fig. 119, 1936.

The observations on the spiral structure of protoplasm, which are outlined above, bring the nucleus and the cytoplasm into the same structural class. The disperse phase of the nucleus and of the cytoplasm is evidently spiral in structure.

The remarkable elasticity of protoplasm is explained by its spiral structure. An example of protoplasmic elasticity is given by Scarth.[4] He showed that the nucleus of *Spirogyra* can be pushed by micromanipulation from one end of the cell to the other, but when it is released it immediately recoils to its original position.

The spiral structure of protoplasm can be correlated with several fundamental conceptions of life. One of these conceptions is that of crystalline character. The spiral is fundamentally a crystalline form with a screw-shaped axis. Accordingly, the spiral structure of protoplasm can be regarded as the basis of the crystalline conception of living material.

W. D. FRANCIS

BOTANIC GARDENS,
BRISBANE, AUSTRALIA

THE STING OF THE ANT, PARAPONERA CLAVATA

IN an article, "The Sting of an Ant,"[1] I gave the history of the effect of the sting of a worker of the ponerine ant, *Paraponera clavata* Fabr., in British Guiana. The ant stung my knee over the patella through heavy khaki and produced paralyzing symptoms, then a large and persistent blister. The well-founded reputation the sting of this ant has in South America for producing severe systemic symptoms in humans was described.[2]

In discussing the effects of the stings of this species with entomologists and other scientists I was puzzled by accounts of their experiences in Ceneral America, especially Panama. Several persons described being stung by these ants without incurring such severe symptoms as resulted from stings in South America. The stings, however, were always equal to a bad wasp sting. This past summer on Barro Colorado Island in the Panama Canal Zone I was stung by this species[3]

[4] G. W. Scarth, *Protoplasma*, 2: 194, 1927.
[1] *Am. Jour. Trop. Med.*, 17: 765–768, Fig. 1, 1937.
[2] In the "Medical Report of the Hamilton Rice Seventh Expedition to the Amazon, in Conjunction with the Department of Tropical Medicine of Harvard University, 1924–25," Harvard University Press, Cambridge Massachusetts, 1926, Dr. J. Bequaert has reviewed (pp. 250–253) the effects of the stings of this ant upon natives and whites in the Amazonian basin. The worker ant is well figured on page 253 (Fig. 8). The reputation this ant has among the natives and the effects of the sting upon whites recorded by Dr. Bequaert are added proof that I was not unusually susceptible or allergic to such poison in British Guiana.
[3] The ant is called "chacha" by the Panamanians and