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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

PROTOPLASM AND ITS HISTORY.[1]

IN the department of biology there are three subjects of transcendent interest; namely, protoplasm or living matter, development, and adaptation. In fact, the interest in some phases of these subjects is now so general and deep that the special students in this department feel that they have to a great extent the sympathy and co-operation of the public at large. This interest renders possible the construction of such commodious laboratories as this the latest acquisition of the University of Toronto, in which we are now permitted to meet. The generous halls and adequate equipment of this laboratory and other biological laboratories throughout our country and Europe testify to the existence of a widespread belief that the new natural history has very much to learn and much to teach in regard to many of the great problems of life.

In the annual gatherings of the members of our section for the exchange of views and for better fellowship, it has been found expedient for us to look at one or the other of these three subjects at the outset of our work in a somewhat broad and yet special manner.

Your chairman for the present year asks the privilege of selecting as his topic for the introductory address the first of the subjects mentioned. You are invited to examine the more recent additions to our knowledge of protoplasm, restricting the examination to discoveries in the field of botany.

[1] Address delivered by Professor George L. Goodale of Harvard University, as vice-president of the Biological Section of the American Association at Toronto, Aug. 28, 1889.

Whether we consider protoplasm, or the living matter of plants and animals, from the point of view of physics, of chemistry, of physiology, or of philosophy, we have before us a topic which has received, and which continues to receive, the most assiduous attention. Hence its literature, though comparatively recent, is appallingly voluminous; and any attempt to treat the subject, or any considerable part of it, exhaustively, within the limits properly imposed upon introductory addresses, would result in annoyance to you and utter discomfiture for me. Apropos of this, I am reminded of a series of experiments upon protoplasm, conducted in a German laboratory, which will illustrate the embarrassment which the case presents. The study to which I refer was with regard to certain organisms of very low grade. At a given period in the life of these organisms, their microscopic masses of protoplasm become confluent in such abundance that sufficient material can be procured for experiments on a large scale. In the special investigation referred to, a considerable quantity of protoplasm obtained in this way was subjected to enormous pressure. You can anticipate the result: there remained behind only a shrunken residue of what we may call, without figure of speech, the most juiceless and the driest of husks.

This natural result of extreme compression has stared me in the face during the preparation of the present address. A similar result is more than likely to follow my attempt to bring within very narrow limits the subject which I have chosen for your consideration.

The word "protoplasm" was coined by Hugo von Mohl in order to designate certain active contents of the vegetable cell.

We shall gain in clearness of vision by letting our glance rest first on the results of investigating vegetable cells and cell contents anterior to Von Mohl's time, in order that we may see some of the steps by which this term was reached by him. The compound microscope was not applied seriously to the examination of the structure of plants until about fifty years after its discovery by Drebbel. In 1667, Robert Hooke of England published an account of his investigations of minerals, plants, and animals under the microscope, and gave excellent illustrations of what he thought he saw. His first reference to the structure of plants is in his description of charcoal, and this is followed by a good account of common cork. In these brief and fairly accurate descriptions, the author makes use of the word "cell," applying the term to the cavities in charcoal and in cork.

Hooke's interesting treatise was soon followed by two remarkable memoirs, — one by an Italian, the other by an Englishman. Malpighi of Bologna sent to the Royal Society of London in 1670 a work entitled "Anatome Plantarum." The published volumes bear the dates 1675 and 1679. At the period these volumes were in the hands of the Royal Society, Nehemiah Grew, secretary of the society, was engaged in work almost identical with that of Malpighi; but there is no good reason to believe, as was formerly intimated, that he was indebted to Malpighi for any of the statements which he published as his own. It is, however, best for us to consider these two works together. By Grew the term "cell" appears to have been applied to the cavities in what we may term the softer tissues of the plant. It is certain that neither Malpighi nor Grew recognized, as we can now, the multifarious forms of vessels, fibres, long cells, and the like, as referrible to a common source. There is always a strong temptation to read in an old text some meaning which squares with our own notions; and one is greatly tempted to think that these assiduous investigators, Grew and Malpighi, detected the relationships which we know exist between the different elements of vegetable structure. But after giving them the benefit of every doubt, one fails to find in their writings any recognition of such affinities. On the contrary, these investigators were engaged in a study which naturally led them away from such conceptions. They were busy with descriptive work, outlining the arrangement of tissues in all organs of the plant which their knives could reach. They did not even break up the tissues into elementary parts, but they described and delineated with great skill the tissues as they were displayed in sections. Is it not incredible that these first works on vegetable structure, prepared only a few years after the earliest application of the compound microscope to the study of plants, should have remained for