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NEW YORK, MARCH 23, 1894.

THE IMPORTANCE OF STRUCTURAL DETAILS IN THE STUDY OF PLANTS.

BY W. W. ROWLEE, ITHACA, N. Y.

IF there was any one thing more than another that led the ancient herbalists into serious and often amusing errors in regard to plants, it was their ignorance of the structure of vegetable tissues. Their minds were not in a condition to be attracted by natural phenomena, and, further, they were without lenses and other appliances which are so indispensable as aids to workers of the present day.

It is, moreover, but recently that some important advances have been made in methods of treating tissues in order that their structure may be more thoroughly and exactly studied. With the exception of those which are lignified or sclerenchymatous, all vegetable tissues are too soft and yielding to be cut even with the sharpest knife without undergoing displacement and distortion, and especially is this true of that part of the tissue most important of all from a physiological point of view, i. e., the protoplasm. In its normal condition in the vegetable cell, protoplasm resembles in texture and consistency the white of an egg. No one would expect to cut this substance in its natural condition into sections to be examined with a microscope. The cell-walls also are displaced when unfixed tissue is cut, especially if the tissue be from delicate organs. If fresh material could be cut and examined without any distortion it would be highly desirable to do so, as all parts would be unchanged, but not only is this impracticable on account of the firmness of the tissue, but, moreover, certain parts are in nature colorless and must be stained before they can be seen.

Fixation of tissues consists in hardening and preserving the pliable and perishable parts of tissues, especially protoplasm and its primary modifications. This is accomplished by replacing the water in the tissue by some preserving fluid. The tissue must be killed immediately, and the elements must remain *in situ* through the process of infiltration if the fixing is properly done. Professor Gage in his "Histology" recommends picric-alcohol (25 p. c. alcohol + .2 p. c. picric acid) for fixing tissues, and it has given us entire satisfaction so far as fixing material is concerned. The stain made by picric acid, however, is not altogether satisfactory. Professor Campbell (*Bot. Gaz.* Feb., 1891) found chromic acid very effective as a fixing agent in his work upon the delicate tissues of fern prothallia. We have been satisfied with results attained from using alcohol, always being careful at first to apply only sufficient to kill the tissue and then gradually to increase the strength of alcohol until the tissue is completely dehydrated. The most satisfactory method of accomplishing this we have found is by the modification of Schultze's apparatus devised and described by Professor Thomas (Proc. Am. Micro. Soc., 1890). If the fixing has been properly done all the tissue elements will be *in situ* and normal except in so far as the alcohol produces changes. The tissue after fixing has been accomplished instead of being flexible is exceedingly brittle and must during succeeding manipulations be handled with the greatest care. As a general rule it is safer to pour pieces of delicate tissue from one vessel to another rather than to handle them with forceps. In this condition, protoplasm and cell-walls are firm enough to withstand the knife without displacement, providing proper support is afforded.

This support may be gotten by infiltrating the tissue with some liquid which under changed conditions will become solid. Here, too, the agents used should be such as modify the tissue as little as possible. Paraffin and collodion have been most used. Both will penetrate not only the intercellular spaces and cell cavities but will also infiltrate into the cell-walls and protoplasm, preventing the former from tearing and holding the nucleus and plastic bodies of the latter in position during sectioning. The effects of alcohol and other reagents upon tissues should be determined carefully by experiment, and such changes as occur should be considered before conclusions are drawn.

The importance of exactness in structural studies can scarcely be over-estimated. Confirmation or modification of new systems of classification (and there are plenty of them at the present time) must depend for their permanency quite as much upon accurate observation of structural details as upon the ingenuity of any systematist. A single illustration from a discovery made in our laboratory may not be inappropriate. The nodding bidens (*Bidens cernua*) differs from its congeners of the northeastern United States in having the hypocotyl of the embryo in the seed before germination possessed of large and numerous intercellular spaces. The occurrence of large intercellular spaces in an embryo is of comparatively rare occurence and is probably of assistance to the plant in aerating its tissues during germination. This seems the more probable when one considers that the first structural modification attending germination is the enlargement of the intercellular spaces. In species in question the provision of intercellular spaces has been provided before germination. If this organ had been cut fresh the knife would have displaced the cells so as to render uncertain the relation of the cells and spaces.

Fixed and properly imbedded, the cells retain their normal condition and position; the intercellular spaces are just as they were in the living plant.

The embryos of other plants afford quite as distinctive structural characters and often as interesting functional adaptations.

The correct interpretation of tissue modifications in plants has led to the conclusion that plant diseases may be caused by improper conditions of moisture, etc. Dropsy in plants has been caused by too great activity in the root-system of the plant, and thereby unbalancing the equilibrium between absorption and transpiration. This disease was first discovered by a careful examination of the structural details, and the fact that the disease was so discovered leads to the opinion that much light may be thrown upon the diagnosis and cure of plant diseases by a careful study of the minute structure of the plant.

NATIONAL PARK PROTECTION.

BY GEO. BIRD GRINNELL.

THE recent slaughter of twenty or more of the National Park buffalo has excited widespread comment and calls attention anew to the fact that, although the Yellowstone Park was established twenty-two years ago last March, no law for its protection has ever been enacted.

The organic act by which the Park was set aside says that the Secretary of the Interior shall make rules and regulations for its protection and the preservation of its natural wonders, but nothing in this act nor in any other provides any form of government, gives jurisdiction to any court, appoints any law officers or defines and fixes penalties for any crimes or misdemeanors committed within the boundaries of the reservation.

There are now pending before Congress—in the House of Representatives and in the Senate as well—several bills which provide for the cutting off from the area of the Park about 1,200,000 acres of land, largely forest covered, and one or two which contain some needed government and police provisions. It is of the utmost importance that one of these last named bills should be passed. No matter how efficient and energetic the commander and his troops, to whom the care of the Park has been given, it is impossible for him efficiently to protect it so long as no punishment awaits the man who violates the regulations established by the Secretary—shoots down the buffalo or fires the forests. As things exist to-day no such punishment can be meted out. Government scouts may capture a poacher red-handed, having just slain some of America's largest wild animals, but it is certain that soon after the prisoner has been brought to the guard house, he will be set free, because no law takes cognizance of his crime and provides that he shall be given a trial and punished if found guilty. The Yellowstone Park has been set apart from the states in which it lies, and put under the authority of the Secretary of the Interior. The laws of those states, therefore, do not apply to crimes committed within its borders, and Congress has given the Secretary of the Interior no authority to punish crime.

No class of men comprehend better than the readers of *Science* the importance of preserving the Yellowstone Park and all it contains as nearly as possible in a state of nature. Nor is there any class among our population who can exercise more influence toward inducing Congress to pass the much needed laws. It is earnestly to be hoped that each reader of *Science* will do his part toward bringing influence to bear on Congressmen and Senators, so that a proper police bill may be passed for the Park.

Some of the objections to the passage of the segregation bill are that such segregation would establish a very bad precedent, since if one corner can be cut off to-day another may be cut off to-morrow, and by continual whittling the area of the Park may finally be reduced to nothing. Segregation by reducing the area of the Park brings skin hunters nearer to the herds of wild game and to the forests, and increases the danger to both. Segregation also absolutely destroys large herds of wild game and considerable areas of forests at present existing in the country proposed to be segregated. Segregation reduces the area of the National Park by nearly 1,200,000 acres, restoring to the public domain land which is utterly valueless for purposes of settlement. It is high, rough, mountain land, unfit for agriculture or stock range, overgrown with timber which is at present too far from a market to be of vulue, and probably without any mineral deposits that are worth working. This land will be vastly more useful as a forest reserve than it can be for any other purpose.

THE SEMBLING OF A LARGE NATIVE MOTH, *TELEA POLYPHEMUS*.

BY H. GARMAN, LEXINGTON, KY.

THE collection of males of our larger Bombycid moths has sometimes been practised by confining newly matured females so that the males attracted could be secured, but I am not aware that it has been made a matter of careful observation and record, or that the source of the attracting secretion has been made out. I have often secured a limited number of male *T. polyphemus*, and of *Platysamia cecropia*, by this method, but a recent experience is, for myself, out of the ordinary, and may be worth reporting.

In the latter part of July, 1893, a fine female *T. polyphemus* emerged in one of my breeding cages. She came from her cocoon in the afternoon, and by night her wings were pretty well expanded. I thought when I went home at five o'clock that her wings were not sufficiently firm for a good cabinet specimen, and so she remained in the cage till next day. In the evening of the following day cage and moth were taken to my home, and mosquito-bar being tacked over the front of the cage the latter was placed in the open window of my bedroom. In the night I was awakened by the fluttering of wings against the window and curtains, and getting up secured the two first males that had appeared. It was then just 1.30 A. M. From this time till daylight the males continued to come, sometimes two or three arriving about the same time, but oftener one at a time. All that appeared were captured, and in the morning I found I had twenty males, most of them nearly or quite new in appearance.

The next night the same story was repeated, the first moths appearing at about half-past one, and the rest scattering along between this and morning. This night I secured twenty-three males.

The third day was rather cool, and the night following was cool and breezy. The female had now laid most of her eggs. No males appeared. I thought no more would come, but concluded to leave the cage in the window a few nights longer.

The fourth night five males appeared, and on the sixth, four were secured. In the former case the first moth appeared at fifteen minutes of one, and in the latter at two o'clock.

On the sixth night no males were secured, and the