charge of the cells. There are three types of these; and one of them, which is of no use to the worm, is digested and disappears.

The other two types of stinging cells, which are well adapted to *Microstomum's* defensive uses, are carried to the surface layers of the body, and there arranged into a formidable defensive armament by cooperation between the white blood cells and the fixed cells of the body.

Thus *Microstomum* is given a complete borrowed armament, which aids in repelling its enemies.

This armament, moreover, is useful not only to the worm that first captures it, but can be passed on to its offspring even to the third and fourth generations.

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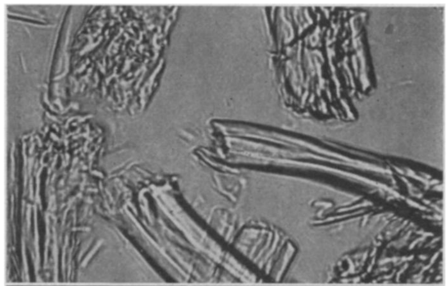
PLANT PHYSIOLOGY

Plants Builds Walls With "Bricks" Made of Cellulose

Chains of Particles, Joined Together in Matrix Of Pectin, Demonstrated Through Use of Weak Acid



CELLULOSE "BRICKS"

Made visible for the first time through the technique of Drs. Farr and Eckerson, are units of structure of cotton, linen, wood and manifold other useful substances. Above are cotton fibers broken down by hydrochloric acid. Below are the individual cellulose particles magnified more than 1200 times

PLANTS build their walls in much the same manner that masons build brick walls. But plants are so skillful that when their walls are finished you cannot distinguish the bricks from the mortar. The first persons to see the bricks in plant walls and to learn the character of the mortar used in their construction, or indeed, to know that the walls were made of materials comparable to bricks and mortar, were Mrs. Wanda K. Farr of the U. S. Department of Agriculture, working at the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., with Dr. Sophia H. Eckerson, a staff member of that institution.

Since man first utilized fibers of the wild cotton plant, he has assumed that he was handling a uniform substance—cellulose. He has built up the huge cotton textile industry on this asumption. There are large numbers of workers throughout the world known as cellulose chemists and they have been working on this basis. True, cellulose chemists knew little enough about the stuff they worked with. They were unable to crystallize "cellulose," tell its melting point, dissolve it with any ordinary chemical solvents, give its structural formula or determine its molecular weight; but still they produced many important results. Botanists, too, have been assuming that cotton fibers were uniform and homogeneous.

At a round table discussion held at the American Institute in New York City, Mrs. Farr and Dr. Eckerson showed that in the protoplasm of the young cotton fibers as they develop there are large numbers of elliptical particles, remarkably uniform in size, separate or in bead-like strands lying approximately parallel to the long axis of the young living fiber. Separate particles and short chains are found in the central part of the cell. In the outer portions the chains are longer, and often the particles are so closely compressed end to end that they have lost their separate identity. It is in this fashion that the cellulose spiral structure comes into existence. The final step in the process consists of the close appression of the fibrils to one another and to the outer membrane of the cell.

The final thickness of the cellulose wall depends upon the extent to which this formation and deposition takes place. Another interesting fact is that from its earliest stage each of the tiny particles is enveloped in a viscous film which serves to hold the particles together with an almost irresistible force; and once the fibril is formed, the points of juncture defy the strongest microscope. It is as if a brickmason had been so skillful that in his wall it were impossible to see where the bricks left off and where the mortar began.

The film about the particles is soluble in weak acids and alkalies, and its other chemical and physical properties led the speakers to believe that the cement which holds the particles together is composed largely of pectic or jelly-forming substance, though coming as it does from the living cell protoplasm it probably has traces of many other materials. The weight of this "cement" is probably not more than two per cent. of the weight of the whole fibril.

If the process of cellulose membrane formation takes place as described, the mature membranes should break down into fibrils and the fibrils in turn into particles identical with those seen in the living cytoplasm. This was successfully accomplished by the use of strong hydrochloric acid. The cementing substance was almost instantly destroyed in this treatment and the cellulose particles fell apart.

The resulting particles were identical in size, shape, and properties with those which previously had been observed in the living protoplasm. X-ray pictures of the particles in the young cotton fiber and the particles obtained by the breakdown of the mature cotton fiber are conclusive evidence of their identity with pure cellulose. Now research workers know that cotton fibers are made up of two separate substances; cellulose particles and cementing material.

The speakers brought out the fact that they know nothing of how the protoplasm actually makes the cellulose particles but they are sure that "cellulose membranes" are not pure cellulose but particles of cellulose held together laterally and longitudinally by a pectic or jelly-like substance and that the cellulose particles can be separated from the pectic substance so that each in turn can now be studied.

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A silkworm's cocoon may unwind to a length of 600 yards.

The Euphrates River is nearly a mile wide where ancient Babylon stood.