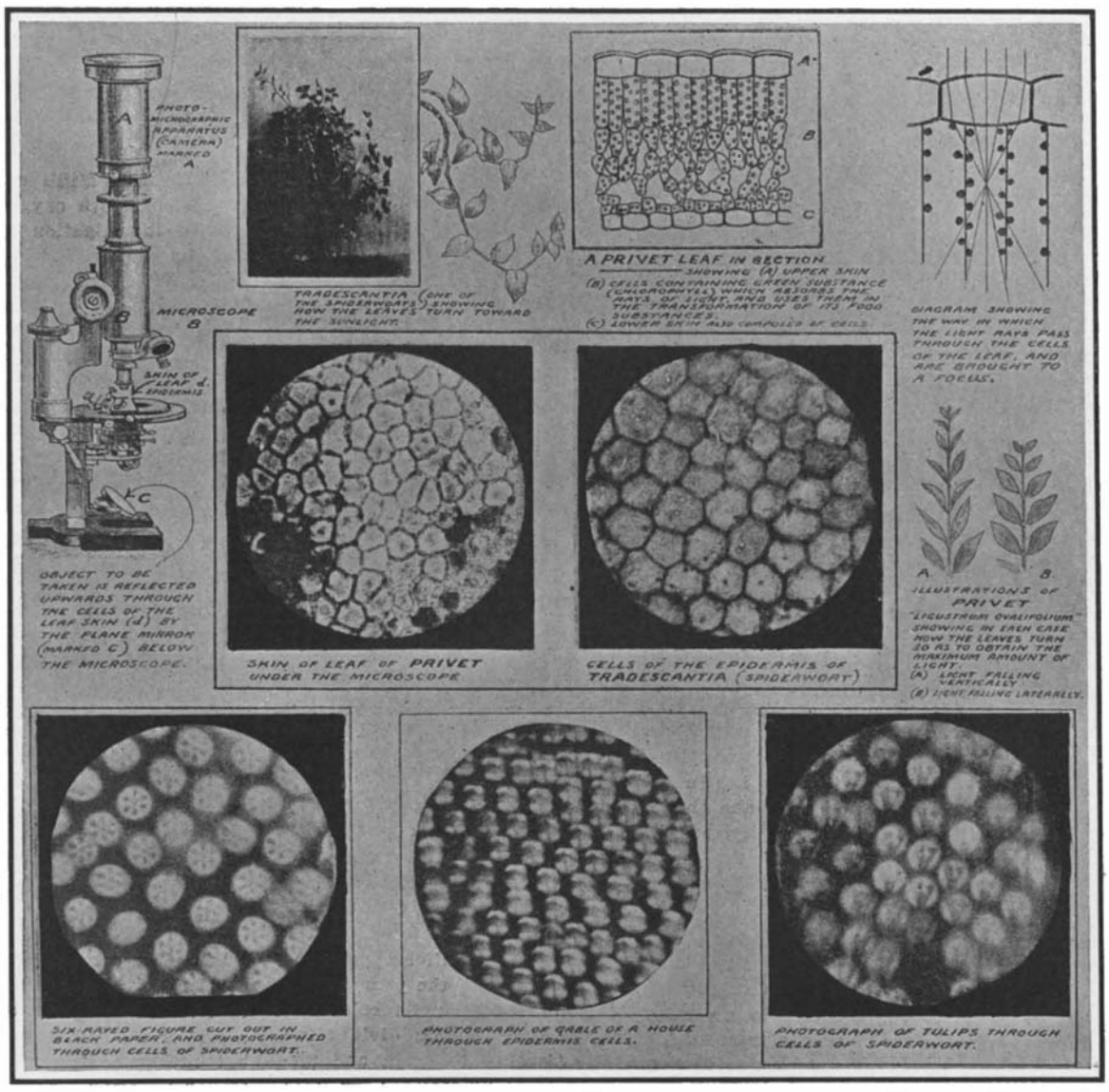
THE EYES OF PLANTS.

In our issue of September 12 we published an article by Dr. D. T. Macdougal, director of the Department of Botanical Research of the Carnegie Institution, in which he showed that plants are so sensitive to light, that we may well raise the question whether they do not actually see. He showed that if response to light stimulation by appropriate movements is equivalent to seeing, then plants certainly see. Even if nothing short of the formation and apprehension of a definite range of external objects may properly be designated as sight, the plant world may not be regarded as totally blind. While Dr. Macdougal's article was on the press, Mr. Harold Wager was reading a paper before the British Association for the Advancement of Science, in which were described experiments he and other biologists had conducted for the purpose of showing how much a plant really can see.

He exhibited photographs taken through the epidermal cells of the leaves of plants. The upper and lower surfaces of leaves are covered by a thin transparent skin, which can, in many cases, be very easily peeled off. When examined under the microscope, as Dr. Macdougal showed in his article and as Mr. Wager reiterates, this skin is seen to consist of innumerable compartments or cells, many thousands of which are found on a single leaf. They contain a clear watery sap, and their shape is such that they behave like ordinary convex or plano-convex lenses, the rays of light which fall upon them being converged and brought to a focus in the substance of the leaf. According to Prof. Haberlandt, a German botanist, these cells enable the plant to perceive the difference between light and dark, and set up a stimulus which results in the movement of the leaf into such a position that it can obtain the maximum amount of light; or it may be, as Mr. Wager is inclined to think, that these cells serve for the more efficient illumination of the green grains within the leaf upon which the effective food-supply of the plant depends. Possibly both play some part in aiding the leaf to perform its work more efficiently. These cells are found in practically all plants; but are most clearly seen in some shade plants. Prof. Haberlandt was able in one case to photograph a faint image of a microscope through the cells, and Mr. Wager has more recently obtained photographs of various objects some of which are here reproduced. In many cases these lens-cells may be compared with the corneal facets of an insect's eye, so far as their general appearance and power of causing a convergence of light are concerned. In addition to ordinary methods of photography, it has been found possible to obtain photographs of simple patterns in colors by means of the autochrome plates of Messrs. Lumière. In taking these photographs, whether in the ordinary way or in colors, the images formed by the leaf cells are magnified by the microscope from 100 to 400 or more diameters, and the photographs are obtained by an ordinary photo-micrographic apparatus; but the best results have been obtained with the Gordon photo-micrographic apparatus. It is not suggested that the plant can perceive the images which are thus photographed, but the fact that such images can be formed shows that these cells are very efficient lenses, and by means of them the plant may be enabled to take more advantage of the light which falls upon it than it would otherwise be able to do.

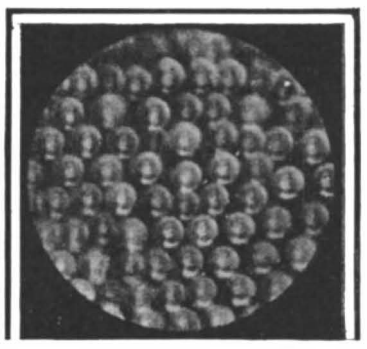


By courtesy of Illustrated London News. Drawn by Will B. Robinson from material supplied by Harold Wager, F.R.S.

THE EYES OF THE PLANT: THE LENSES OF THE LEAF.

Waste Wood and Veneer.

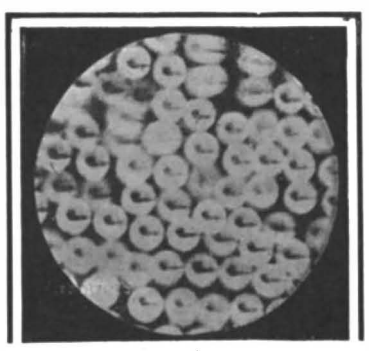
Five hundred manufacturers of explosives, pulp wood, and similar products, have been asked by the National Conservation Commission for information as to all possible uses of sawdust. From this it will be seen the Commission is going into fine details in its inventory of the natural resources of the country. Seven thousand lumbermen have been asked for their opinion as to the waste of lumber in sawmills, and more than two thousand lumber dealers and cooperage, veneer, furniture, box, vehicle, and implement manufacturers have been asked to point out striking



A much reduced copy of a portrait taken through epidermis cells.

features of waste in their respective lines. Yet all this is only one part of the general scheme of hunting down waste which the Commission is following in making its inventory. It is going after the little wastes here and there, which, added together, and put into dollars and cents, make an astonishing total.

For instance, take the making of veneer. At first blush it may not seem worthy of consideration with



Photograph of a pipe through the cells of spiderwort. A beetle would see the pipe in this way.

the manufacture of other products mentioned. Yet, the scarcity of the more attractive finishing woods in the last few years has led to the annual production of over 1,100,000,000 square feet of veneer. This, of course, has been made possible only by the introduction of new veneer-making machinery.

The use of veneer is generally regarded as exemplifying the scarcity of the finer woods and typifying the complete utilization of various kinds of woods, yet from one of the schedules of the National Conservation Commission it is evident that the Commission expects to discover great waste even in veneer manufacture.

Though the word veneer carries many meanings, from a glaze applied to pottery to the "polish" of a man of the world, it is most commonly employed as the name for the thin slices of wood now extensively used in the manufacture of all sorts of articles of use, such as wood plates, baskets, and the exterior finish of furniture and wood work. The manufacture of veneer in the last few years has advanced by leaps and bounds.

The best veneer is sawed, but a great deal is sliced and still more is "rotary cut." By the last named process logs of the desired wood are steamed until they are soft and then fixed in a lathe-like machine, in which they are turned against a wood knife. As the log rotates against the knife, veneer of the desired thickness is peeled off in a continuous slice, as if you should pare an apple, going deeper and deeper at each complete turn, until nothing is left but the core. The center of the log left after the veneer is cut is also called a "core."

The woods principally used for making veneer are red gum, maple, and yellow poplar, which together yield more than half of the total product. Red gum is largely used for baskets and maple for furniture. More valuable than these, however, are white oak and walnut veneer. Beech, which can be cut very thin, is used very largely for wooden plates. A number of other kinds of woods are used.

A good deal of waste occurs in the manufacture of veneer. It is always a problem, for instance, what use to make of the cores left by the rotary process. In many cases these are used for pulp wood, pillars, or panel headings, and they are largely used also for fuel, excelsior, crates, boxes, and baskets.

In the schedule of inquiries which the National Conservation Commission, through the Forest Service, is sending out, several questions are aimed to secure information as to the amount of waste in veneer manufacture and the possibilities of finding ways to utilize it.

Microscopic Tests of Wood.

A new line of work, consisting of the microscopic examination of wood after it breaks in a testing apparatus, has been started by the office of wood utilization in the United States Forest Service. The structure of wood is complex. Every species has several different kinds of cells, each of which has its own size and form. There is also a wide variation in the number and arrangement of the cells in different species. These differences in structure have their bearing on the strength of the wood. For some time past the Forest Service has been carrying on a large number of tests on many kinds of wood in order to determine their strength, stiffness, elasticity, and other physical properties. It is not expected that laymen will understand the significance of the proposed microscopic investigations as quickly as architects, builders, and other wood users.

The average life of an automobile does not exceed five years, according to the published statistics of automobilism in France. In January, 1903, there were in France 12,984 recorded automobiles. During the year 1903, 6,900 new cars of French make were sold, and 350 automobiles were imported. Hence there should have been 20,234 automobiles in France at the end of the year, but the number recorded in January, 1904, was only 17,107. From these figures and those of the following years it has been computed that the average life of an automobile is 4.99 years.