A DISEASE WHICH THREATENS THE AMERICAN CHESTNUT TREE.

BY G. G. COPP.

A new disease of remarkably destructive character has attacked the native American chestnut, and has gained a foothold and attained proportions which threaten the extinction of these trees in and about New York. The same disease is known to exist among the chestnuts of New Jersey, Maryland, and Virginia, but to what extent can only be ascertained by extensive and painstaking work in the respective fields.

The attention of George W. Merkel, forester and engineer at the New York Zoological Park, was first attracted by the immense number of dead and dying chestnuts in the park. He suspected the presence of a destructive fungus. He found that the disease was also creating havoc among the young chestnuts in the park nursery. He sprayed the young trees with Bordeaux mixture, and extended the treatment to the larger trees in the park. At best this treatment could be called only partially successful, and he appealed to Dr. W. A. Murrill, mycologist and first assistant in the New York Botanical Garden. This occurred last year, since which time Dr. Murrill has devoted all the time he could spare from other important duties to the careful study of the disease and to a long series of experiments as to its nature, cause, and cure. His investigations are not yet completed, but the ravages of the disease have now become so apparent that the subject is one of great economic importance.

As Mr. Merkel suspected, the disease is of fungous origin. Pure cultures were made by Dr. Murrill from affected chestnut sprouts in the Botanical Garden last autumn, and were transferred to agar and sterilized bean-stems and chestnut twigs. In each of these situations the fungus grew rapidly and fruited abundantly. Living chestnut twigs were infected and placed, with their ends in water, under bell jars for inspection and study of the fungous growth and action as a preliminary to experiments in the field.

This year, as soon as actual spring growth had begun, numbers of young chestnut trees in the Garden propagating houses were infected with active fungus transferred from bean stalks to the young trees. As Dr. Murrill had been led to expect by results obtained in his preliminary experiments, the fungus attacked the trees vigorously, and soon caused their death by girdling. The accompanying photograph illustrates some of these experiments. The tree shown on the right was inoculated April 3 in three different places. The small twig near the middle of the stem died on May 6, the larger one near the top on May 19. By August 26 the fungus had girdled the trunk at the lowest inoculation, indicated by the tuft of cotton, and had spread downward to the two lowest twigs.

Experiments with cut twigs, covered with glass tubes, were made on the tree in the center. Attempts were made to introduce the fungus into various buds and young twigs near the top of this tree without wounding the bark, but none of them was successful.

The tree on the left was treated on April 5 in the same way, several buds and young twigs from one to five inches in length being covered with the fungus for some time under glass; but all these attempts failed. The dead branch at the top was inoculated through a wound.

The work of observation was next carried into the open, where the ravages of the disease among the older trees throughout Bronx Park were watched, as they also were among young trees transferred from the nursery of the Zoological Park. In these instances infection had occurred naturally, and the fungus was found to be exceedingly active at the beginning of the season of growth, before the opening buds were able to utilize the large quantity of nourishment at hand.

The fungus works beneath the cortex in the layers of inner bark and cambium. Its presence is first indicated by the death of the cortex and the change of its color to a pale brown, resembling that of a dead leaf. Later the fruiting pustules push up through the lenticels and give the bark a rough, warty appearance; and from these numerous yellowish-brown pustules millions of minute summer spores emerge from day to day in elongated reddish-brown masses, to be disseminated by the wind and other agencies, such as insects, birds, squirrels, etc. In late autumn the winter spores are formed, which are disseminated from the dead branches the following spring. The present supposition is that infection takes place only through wounds or, possibly, through the lenticels. Wounds are, unfortunately, only too frequent, especially in the case of a tender, rapidly-growing young tree like the chestnut, which has the additional misfortune of attracting lumbermen and nut gatherers. If it escapes winter injuries to its trunk, the spring storms are sure to break the smaller branches and abrade the surface of the larger limbs; if it is not disfigured by the green fly and twig-bore during the summer, it is sure to be mutilated by savage hordes of small boys in autumn. Even the ubiquitous squirrel may spread the disease with tooth and claw while cutting off ripe burs and racing up and down the trunks; while every bird and insect that rests upon an infected spot is liable to carry the spores upon its feet or body to other trees.

Experiments With Young Chestnut Trees in the Propagating Houses.

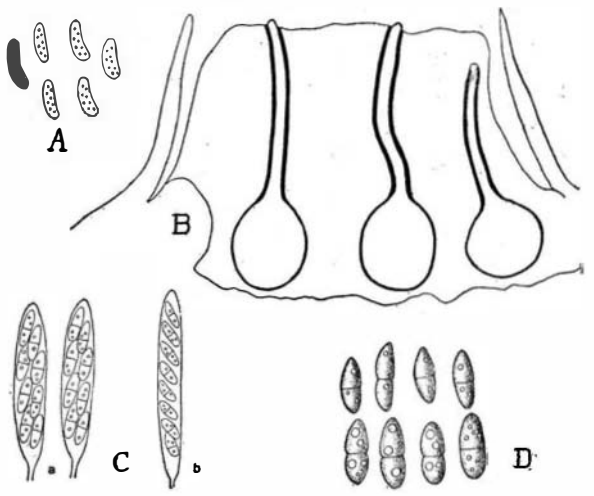

Fig. 3.

A, Summer spores; B, pustule in section showing perithecia; C, Asci with sporidia, *a*, usual form, *b*, rare; D, sporidia.

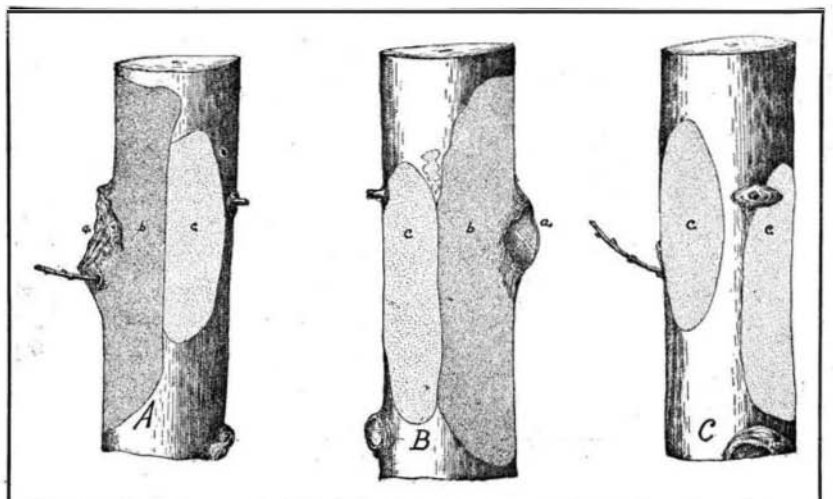

Fig. 1.—Trunk of an Infected Nursery Tree from Three Points of View.

a, Point of infection; *b*, area killed last year; *c*, development early last May.

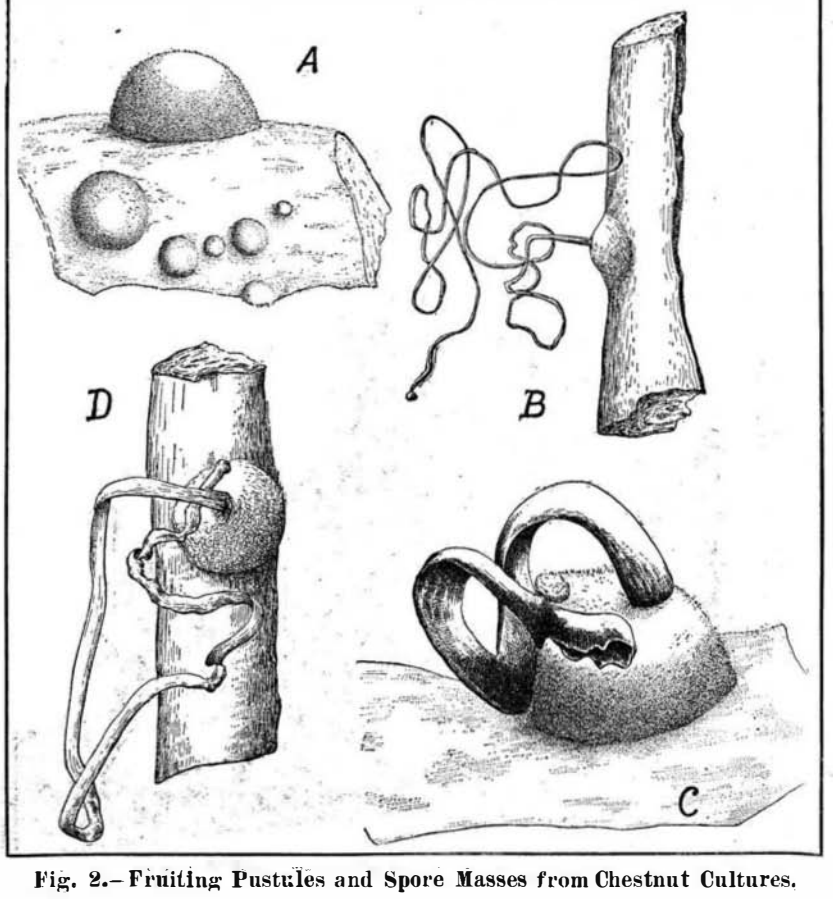

Fig. 2.—Fruiting Pustules and Spore Masses from Chestnut Cultures.

A, Pustules in stages of development; B, C, D, spore discharges in moist atmosphere.

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The treatment of a disease of this nature must, of course, be entirely preventive. When once allowed to enter, it cannot be reached by poisons applied externally, nor can the spores, which issue continuously and abundantly through eruptions of the bark, be rendered innocuous by any coating applied at intervals. On the other hand, no poisonous wash, even though covering every part of the tree, can prevent the germination of the disseminating spores when they fall into a wound, since the wound opens fresh tissues unprotected by the poison.

The spraying of young trees with copper sulphate solution, or strong Bordeaux mixture, in the spring before the buds open might be of advantage in killing the spores that have found lodgment among the branches during the winter, but the real efficacy of this treatment is so doubtful that it could not be recommended for large trees, where the practical difficulties and expense of applying it are much increased. Nursery trees should be pruned of all affected branches as soon as they are discovered, and the wounds carefully dressed with tar or paint or other suitable substance. Vigilance and care should largely control the disease among young trees. With the older trees all dead and infected wood should be cut out and burned, and all wounds covered without delay. Particular attention should be paid to water, soil, and other conditions of culture affecting the vitality of the tree, since anything that impairs its health renders it less able to resist fungous attack.

In conducting his experiments Dr. Murrill discovered that one or two of the older trees in the Garden are apparently immune. It is possible that careful study of such immune trees may disclose the cause of such immunity. Such discovery might readily prove an active agent in eradicating the disease. On the other hand, it may point to the securing of immune trees by selection, a process, however, which has the great disadvantage of being tediously slow and more or less destructive.

We are indebted to the New York Botanical Gardens for the loan of the accompanying illustrations.

Sir Oliver Lodge in the London Times gives the following *résumé* of our knowledge of radium: "The evidence for the generation of helium may be briefly summarized thus: Rutherford measured the magnetic deflection of the α-rays, or positively charged particles shot off by radium emanation at a certain stage of its disintegration (for it does disintegrate, it is not permanent), and inferred that the mass of each particle was comparable with twice that of an atom of hydrogen; consequently that the projected particles were material, and that the projected matter, if it were any single known substance, must be either hydrogen or helium, and most likely helium. Ramsay and Soddy then inclosed some of the emanation in a vacuum tube, and examined its spectrum. There was no sign of helium at first—as there would have been had it been merely an ingredient in a mixture—but the helium spectrum gradually made its appearance, in the course of a day or two, at approximately the rate to be expected on the disintegration hypothesis. The loss of much activity by radium when its emanation is removed from it and the gradual return of radio-activity when time is allowed for fresh emanation to be formed, are also facts to be remembered. The rest of the evidence for the slow disintegration of atoms is of a less direct kind, but it is voluminous and varied, and it seems to me that this evidence is extremely weighty."