that its neglect will be held an enduring reproach to the science of our time.

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THE NEW CHESTNUT BARK DISEASE

IN the latter part of the year 1904 Mr. H. W. Merkel discovered in the Bronx Botanical Garden a new and peculiar form of attack on the American wild chestnut tree, *Castanea dentata.* Prior to the finding of the cause of the infection, it had been noticed that this tree seemed to be in an abnormal condition.

A study of the infection was then undertaken and cultures were successfully made. It was determined, after its life history was better understood, that the attack was caused by a fungus, or a plant of fungoid nature, one of the Pyrenomycetes, a larger order of low-type plants, containing some of our most injurious fungi. The fungi in this order are known to attack not only other plants, but insects. Other well-known examples of this order of fungi are black knot of the plum and ergot of rye.

The chestnut blight has been identified by Professor Murrill as one of the genus *Diaporthe* named by him *parasitica,* and botanically described in *Torreya,* Vol. 6, No. 9, for September, 1906. Some doubt has recently been thrown about the genus to which it belongs. Because of its formation of ascospores within well-defined perithecia it is agreed that it rightfully belongs among the Pyrenomycetes. Its peculiar parasitic habit, however, is sufficient to cast some doubt upon the designation of the genus. No other well-known *Diaporthe* is parasitic. They are saprophytes. Because of its economic importance, almost vicious persistency and deadly habits with respect to its host, the wild chestnut, it might well be assigned to a new genus erected within the order. For a new generic name, the idea contained in the Greek Νικρωσις (nikrosis), a slaughtering unto extinction, would not be beside the fact.

The exterior appearance of this fungus first is numerous yellow pustules on the smooth bark of the tree. In the deep cracks of the oldest bark it takes the form of yellow or orange lines. Later the color turns to a much deeper yellow and finally brown of deepening shades. Within the pustules, the perithecia are found closely clustered, sometimes appressed. In outline they are not unlike the long-necked gourd, or a glass water-bottle. The walls of the neck of a perithecium are black, glistening, and, when cut across, have the sheen of anthracite coal. Within the perithecia are the elongated sacs or asci containing the spores, always eight in number, usually arranged in two rows, glassy and somewhat constricted across the short diameter. The largest of the asci will measure about 10×50 microns; the contained winter spores sometimes as much as 5×10 microns. Two forms of spores are found, as in many other fungi. The summer spores are produced in golden yellow threads protruded from the dome of the pustule, usually much twisted, and rarely found over a half inch in length. These summer spores, with dimensions not more than a fifth of those of the winter form, are exceedingly minute. By abrasion, action of rainfall, or other causes, they are scattered about continuously during the growing season.

It has been shown that the summer spores are of a sticky, gelatinous character. They are therefore peculiarly adapted to be carried about on the feet of insects, squirrels, or birds. Much of the heretofore inexplainable isolated spot infection must be attributed to such means of distribution, and less to wind action. But a spore covered with minute dust particles could just as easily be wind sown, as if it were originally of a scarious nature.

Entrance into a new host may be effected through slight wounds in the bark, broken twig ends or through insect tunnels, carried there by the insect itself. It was formerly believed that it entered only by these means. During the survey made along the main line of the Pennsylvania Railroad in the fall of 1910, by the Pennsylvania Department of Forestry, numerous instances were found where it seemed to have enacted through the lenticels of the bark, without insect aid or previous traumatism. It was also believed that the

fungus infects only the cambium of the bark and that the mycelium did not enter the cambium of the wood. During the survey just referred to, one well-defined instance was found where yellow pustules, plump and vigorous, *were growing upon freshly exposed wood.*

In this region the beginning of infection in a large number of cases was at a single point in the crown and in a few brown pustules in the deep cracks at the base of the tree. An exposed root running out horizontally for a foot or more was almost sure to contain pustules, no doubt washed down the stem by the rains, or brought by drip from neighboring trees with infected branches.

The appearance of the bark of a tree after an attack from this fungus is extremely characteristic. The bark will split, the surface within the lesion shows a sulphury-yellow tint, while numerous brown but minute wart-like excrescences will be found upon the unbroken bark surface. In the deep old bark cracks, it takes the appearance of reddish or orange-colored lines. The tendency of the disease is to encircle the branch or trunk. This produces another well-known mark, a depression or apparent sinking of the affected bark. In reality this is caused by the tree rushing nutriment to the spot and depositing it at the edges of the infected area, circulation being cut off within.

Another noteworthy fact respecting the life of this fungus is its great vitality. Unbarked chestnut rails made into fence and apparently well dried for a year or more have been found to contain active fruiting bodies. A pile of fence rails containing bark which was decayed to the point of falling from the wood by its own weight carried the blight in vigorous condition after two years. A specimen contained in a moist cell was found to be producing pustules after thirty-seven months. Just what amount of vitality will be retained by the dried spores and for how long is not definitely known. Certain it is, however, that the life within it is of unusual persistency and must be dealt with from that view point.

Prior to the year 1908 the chestnut bark disease was almost unknown in Pennsylvania. In the latter part of that year and in the early part of 1909, the attention of the Pennsylvania Department of Forestry was directed to its threatened invasion, by Dr. John Mickleborough, of Brooklyn, N. Y. Dr. Mickleborough pointed out the fact that the disease had probably entered the state and would continue its course westward were it not checked; also that it would be desirable to know to what extent it had entered Pennsylvania. Accordingly, the Deputy Commissioner of Forestry was detailed to accompany Dr. Mickleborough on a tour of inspection to determine the limits of the disease. This work was begun in the latter part of March, 1909, and was continued throughout that month and during the month of April, in which time many localities were examined. All of the southeastern counties of the state were inspected. At this time it was found that the main body of the disease was confined to the southeastern corner and that it had not crossed the north branch or the main river Susquehanna, except in the two instances discovered by the U. S. Department of Agriculture. Following this inspection, a report was prepared and printed, illustrated with drawings of the fungus in detail and accompanied by a print made by color photography, showing the appearance of the disease on living bark when developed to its fullest growth. Beside the articles appearing in botanical periodicals and the early reports of the U. S. Department of Agriculture, this report was the first to cover in detail any portion of country and the first report to be issued on the subject by any one of the states. Thus, within a short period, the disease developed from something unknown to a very decided and prominent attack upon one of the important wild trees of the commonwealth, and was rapidly extending itself to the western counties.

Somewhat prior to this time the officials of the Office of Forest Pathology in the U. S. Department of Agriculture were concerning themselves with its appearance in and around the city of Washington. They found it there rather numerously, and immediately applied the heroic remedy of cutting out and destroy-

ing every tree showing the infection. In this way it was possible to eradicate the disease for a distance of forty miles around the city, and to-day that area is believed to be almost if not quite free from infection. In this fact lies great hope, and it has a bearing of much importance upon future efforts to be made by any state for the eradication of the fungus.

As soon as its prevalence was proved in southeastern Pennsylvania, a determined sentiment arose looking to its destruction, or at least to staying its spread in such degree that it might not be communicated into new areas. Probably the worst infected portion of the state of Pennsylvania is that region along the main line of the Pennsylvania Railroad from the city of Philadelphia westward for a distance of fifty miles. The peculiarity of the infection in this region is that it seems to become more virulent the nearer one approaches the railroad, and is scattered in spots at distances therefrom. Whether this fact is sufficiently significant to point to railroad trains as vehicles of distribution, possibly remains to be proved; but it is a fact worthy of careful attention.

Along this portion of the railroad there exists a civic body known as The Main Line Citizens' Association, banded together for the good of the neighborhood. The chestnut tree forms a large proportion of all the wooded areas in this locality and is one of the best park, woodlands and lawn shade trees of natural growth in that region. Realizing that serious trouble has come upon the chestnut trees, this association appointed a committee to inquire into the trouble; and in the spring of 1910 this committee entered into negotiations with the Pennsylvania Department of Forestry for the purpose of making a proper inquiry into the situation. The result of the maturing of their plans was that a corps of inspectors consisting of foresters, students in forestry, and draftsmen, under the direction of the Deputy Commissioner of Forestry, located themselves at Ardmore in the midst of the infected region, and immediately began a detailed survey of the neighborhood hereinabove referred to, for the purpose of determining to what extent the disease had attacked the trees, and making report thereon. This work was continued throughout the fall and closed in the early part of December, with the coming of freezing weather. The plan adopted was to take a rough preliminary draft of each tract upon the ground. The approximately correct location of every chestnut tree on the premises was indicated on the draft and designated by numbers corresponding to a number upon a small wooden tag attached to the tree. At the same time a careful examination of the tree was made and a report noted in record books carried for the purpose, of the condition of the trees, showing the presence or absence of the infection, and in what portion of the tree it existed most prominently. The rough draft finished, it was returned to headquarters, re-drafted with care and accuracy upon tracing cloth, and blue prints made therefrom. A print together with a detailed report on the condition of the trees was then sent to each property owner. This gave him an accurate key to the situation, and it remained for him to decide what to do with respect to treatment, cutting the trees, or whatever else might seem to be called for. In this way nearly 300 properties were examined and reported upon, ranging in size from small town lots to areas of hundreds of acres. Over 30,000 tree groups, representing over 50,000 tree stems, were examined, reported upon, and recommendations relating thereto made to the owners. To prove that The Main Line Citizens' Association was really in earnest, it should be stated that they collected and expended for this work nearly $3,000, and the cooperation of the Department of Forestry represented an expenditure in time nearly equal in value to the expense of the committee.

The committee having this work in charge and representing the association consisted of the following gentlemen, property owners and residents in the immediate neighborhood: Harold Peirce, of the New York Life Insurance Co., chairman; Allen Evans, architect; Theodore N. Ely, superintendent of motive power of the Pennsylvania Railroad; Edgar

C. Felton, president of the Pennsylvania Steel Co.; Wm. Righter Fisher, attorney at law, of the Philadelphia bar; Alba B. Johnson, vice-president, Baldwin Locomotive Works; Robert W. Lesley, president of the American Cement Co.

When the work of inspection had proceeded, it was seen that the infection was of great extent, averaging more than fifty per cent. of all the trees examined. Under these conditions individual and unsystematic effort would and probably could avail but little against the progress of the infection. It was decided that the aid of the government should be called in to render the necessary assistance. The Department of Forestry of the state of Pennsylvania was without direct legislative authorization to do work of this character on a state-wide scale, and without appropriation if it had the authority. The national government was appealed to and word came back that the appropriation bills were all drawn, had passed the house of representatives and were on their passage through the senate, with little or no prospect of change or increase in appropriation. However, the active interest of Senator Penrose was enlisted, and an amendment was added by him in the senate to the agricultural appropriation bill, carrying $5,000 for the purpose of further study and investigation of this tree disease; and in the very last hours of the session, which ended March 4, 1911, the amendment was agreed to by both houses and shortly thereafter became a law by the signature of the president. Thus, it will be seen that through the activities of the committee representing the above association there was accomplished what at first seemed almost hopeless. With this success in mind, the committee and their friends and Pennsylvania state officials familiar with the situation turned to the legislature, then in session, for help and legislative authority to attack the problem in Pennsylvania. The governor of the commonwealth sent an urgent message to both houses of the legislature, a bill was introduced simultaneously in both, was passed without debate or a negative vote, and became a law by the signature of the governor, June 14, 1911. The same phenomenal good fortune attended this effort, and the law itself is looked upon as marking a great epoch in work of this kind. It provides for the creation of a commission of five persons, confers complete authority to attack and destroy this disease by whatever method they may adopt, and appropriates $275,000 for two years for the purpose of carrying on this work. The commission, only recently appointed by the governor, consists of the following persons: Samuel T. Bodine, Villa Nova, vice-president and general manager of the United Gas Improvement Co.; George F. Craig, Rosemont, wholesale lumber dealer and large lumber operator; Theodore N. Ely, Bryn Mawr, former superintendent motive power, Pennsylvania Railroad Co.; Harold Peirce, Haverford, of the New York Life Insurance Co.; Winthrop Sargent, Bryn Mawr, former president Standard Supply and Equipment Co.

The commission has effected an organization by choosing Mr. Sargent chairman, Mr. Peirce secretary, and Mr. Samuel B. Detwiler, a Minnesota forester, but a Pennsylvanian by birth, executive officer to have full charge of the work. Permanent offices have been secured in the Morris Building, Philadelphia.

In order that valuable time might not be lost while the organization was being perfected, the Department of Forestry of the state organized the outside work by sending men first to an instruction camp and then starting them out as scouts in lower York County, to locate infection and report on its prevalence.

Reports from these parties are now being received daily. With additional parties organized, York County will soon be covered and the work will then continue up the west side of the Susquehanna River and westward along the Maryland line. A large amount of preliminary work will be done this year in the hope that the winter work of taking down infected trees may accomplish the desired end, preventing further westward spread of the infection.

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