phytopathology is therefore a timely and serviceable contribution. The subject is treated by Professor Whetzel in an attractive and perspicuous manner, and covers from the most ancient times to the present. Both the development of concepts regarding the nature and treatment of diseases as well as the dominating influence of phytopathological writers are taken into consideration in dividing the time into eras, and again into periods.

Scarcely thirty pages are given to the three incubation eras, called the Ancient, Dark and Premodern Eras, but they are most readable pages, and clearly point out the course of the early development of the subject.

The Modern Era, extending from 1853 to 1906, was one of great activity in all scientific lines. During this time phytopathology became a distinctive science. Many investigators of forceful personality and marked ability gave direction to the work of discovery, and in consequence the boundary of knowledge in the field of plant diseases was enormously extended. The center of pathological activity in its academic aspects was at first in Germany, and in its practical and commercial aspects in France, but in both aspects the foremost advance began to shift to America in the eighties, and soon this country became the leader in initiative as well as in the amount of investigation.

The present era, now just entering its second decade, has seen the establishment of chairs of phytopathology in many universities, the rise of the American Phytopathological Society and of the journal *Phytopathology*, the enactment of effective quarantine measures against the international and interstate movement of diseased plants, a new class of fungicides with sulphur in place of copper, the discovery of the canceroid nature of crown gall, and in general the recognition by men of affairs as well as by the cultivator of the vast importance of the utmost detailed information regarding plant diseases and of cooperative and efficient means for making such knowledge available in protecting all sorts of crops and plant life.

This orderly presentation of the evolution of a science destined to play an increasingly wider and more important part in the affairs of human well-being and achievement is particularly timely. Professor Whetzel has compressed into the hundred and thirty pages of his book a well balanced and helpful outline of the historical aspects of the science. It is a valuable addition to botanical literature.

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SPECIAL ARTICLES

RESISTANCE IN THE AMERICAN CHESTNUT TO THE BARK DISEASE

During the past summer, in connection with the Office of Forest Pathology, U. S. Department of Agriculture, the writer investigated conditions in the American chestnut looking toward immunity or disease resistance to the well-known bark disease. A thorough search was carried on, which, for obvious reasons, was restricted mainly to the immediate neighborhood of New York City. The results are deemed of sufficient importance to warrant publication here in advance of a more detailed account.

No immune trees were found, but a considerable number of resistant trees were located, some of them on the island of Manhattan itself. The following points are considered evidence of a resistant quality in these trees.

1. The result of inoculation tests. The average lateral growth of the fungus in 289 inoculations was 0.6 cm. for a period of from 5 to 6 weeks—mainly in August. This is about one fourth the figure (2.2 cm.) given by Anderson and Rankin for normal trees during the month of August at Napanoch, New York, and about one fifth the figure (2.83 cm.) given for the same month by the same investigators at Charter Oak, Pennsylvania.[1]

2. The occurrence of the trees in a neighborhood long subject to the disease, and the presence among the trees of individuals long since dead.

[1] Anderson, P. J., and Rankin, W. H., "Endothia Canker of Chestnut," Cornell Univ. Agric. Expt. Sta. Bull. 347, pp. 574, 575, 1914.

3. Evidence of the long period the disease has been present in the trees themselves; *i. e.*, bare, weathered tops; *healed* cankers; thrifty branches, with bases diseased and hypertrophied, but living, etc.

4. Peculiarities of the bark; such as extensive development of a callus tissue, and the presence of a peculiar substance which is constantly associated with, and particularly conspicuous in cases of marked resistance.

5. The natural grouping of the trees in well-defined areas or "pockets," pointing to a genetic variation.

6. The manifestation by members of the same coppice group; and by branches, trunk and basal shoots of the same individual; of similar degrees of resistance, indicating an inherent condition.

If these facts and inferences are correct, they point the way clearly toward a reconstruction and a revival of our American chestnut. Many of the trees bloomed well, and this fall bore good fruit. A large number of nuts have been gathered and planted by Dr. Van Fleet, of the U. S. Department of Agriculture, at the trail grounds near Washington, D. C. If the resulting seedlings substantiate the inference that the disease resistance is a heritable character, the way lies open, both by inbreeding, and by crossing with the resistant oriental species (not good timber trees themselves) to develop an extremely resistant or perhaps practically immune strain of timber tree for the reforestation of our devastated chestnut woodlands.

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THE OCCURRENCE OF AZOTOBACTER IN CRANBERRY SOILS

SEVERAL papers have appeared recently in SCIENCE and elsewhere[1, 2] concerning the fact that the aerobic non-symbiotic nitrogen fixing organisms, namely the *Azotobacter* group, occur in the soil, when the concentration of the hydrogen-ion is not more than 10^{-6}, or the limiting exponent is 6.0.

Investigators[3] have gone so far as to use the presence of *Azotobacter* in the soil as an indication of the soil reaction. Gillespie,[2] interpreting the results of Christensen,[3] stated that they are in accord with those obtained by Gainey,[1] namely the limiting hydrogen-ion exponent for the presence of *Azotobacter* in the soil is 6.0.

The methods previously used in determining the soil acidity conveyed only a very indefinite idea about the true nature of the reaction of the soil. But only recently [4, 5] methods have been suggested which, either using the electrometric or an improved colorimetric method, have enabled us to get a better insight into the extent and nature of soil acidity. These studies have brought out the facts referred to above concerning the reaction limit for the existence of *Azotobacter* in the soil.

In the study of the microbial population of cranberry soils some interesting observations were made and of these only the occurence of *Azotobacter* will be reported here.

The cranberry soils are so distinctly different from ordinary soils that it was thought for a long time that no very large number of bacteria can exist in them and that the microbial population consists predominantly of molds. These soils are known to have a distinctly acid reaction and contain large quantities of undecomposed organic matter, namely the roots and the stubble of the dead plants. The existence of *Azotobacter* in cranberry soils would be of great practical importance, since the nitrogen of the air would thus be fixed and made available to the crops, which have to grow in soils rather poor in available nitrogenous constituents (particularly is this true of sandy bottom bogs). The undecomposed roots and stubble would supply the carbohydrates necessary for the activities of *Azoto-*

[1] Gainey, SCIENCE, Vol. 48, pp. 139–140, 1918; *Jour. Agr. Res.*, Vol. 14, pp. 265–271, 1918.

[2] Gillespie, SCIENCE, Vol. 48, pp. 393–394, 1918.

[3] Christensen, *Soil Science*, Vol. 4, pp. 115–178, 1917.

[4] Gillespie, *Jour. Wash. Acad. Sci.*, Vol. 6, pp. 7–16, 1916.

[5] Sharp and Hoagland, *Jour. Agr. Res.*, Vol. 7, pp. 123–145, 1916.