having three of the above points in its favor, namely, (1) structure, (2) water, (3) original oil. There are numerous favorable structural conditions in various counties of the state. The rocks contain plenty of water and there are some good beds of oil-bearing shale. The Devonian Black Shale is particularly a splendid carrier of original oil. The fourth factor is, however, as yet to be proved of sufficient importance to place Kentucky in high rank as an oil state; namely, "sand." In great oil fields there are large bodies of sand or retaining reservoirs in close proximity to beds of oil-bearing shale. There are frequently several such "sands" in the geological column in close relationships to oil-shale beds.

In Kentucky the "sands" or "porous beds" near the Devonian Oil Shale are carrying most of the oil so far discovered. In Wayne County these sands lie in the Waverly series above the Black Shale, but in other districts the oil is held below the shale in porous beds of limestone. This is true of the oil fields at Irvine, Cannel City, Campton, Menefee County and other districts of eastern Kentucky. In the coal basins of eastern Kentucky and western Kentucky there are a large number of beds of porous quartz sandstone; they lie in the Chester and Pennsylvania series, but in connection with these sandstone beds, oil shales must be proved to exist in order that any particular structure may be found productive. If, for instance, a bed of oil shale like the Devonian Black Shale could be found just above or below the Big Clifty Sandstone at the base of the Chester, then an anticline containing these beds at sufficient depth would most certainly make a big oil and gas field like those of Oklahoma; but it so happens that in a great many cases in Kentucky the oil shales do not lie near dependable porous reservoir rocks or else the porous sandstones in the higher portion of the geological column, such as those above enumerated, do not have near them any great amount of typical oil shale.

In conclusion the writer desires to state it as his opinion that Kentucky is not to rank high as an oil state in comparison with many other areas in the United States where the four factors work in harmony and there are numerous porous sands near beds of oil shale; however, the writer wishes to emphasize the probability that a number of structures in Kentucky will find the four factors working together and will furnish new oil pools that will be highly valuable to those who are fortunate enough to discover them.

Careful studies by geologists working in the state will serve to gather a great deal of important information in addition to merely mapping suitable structural conditions in any particular locality.

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OVERWINTERING OF THE APPLE-SCAB FUNGUS

THOUGH it is generally known that the scab disease of the apple, caused by the fungus *Venturia inequalis,* sometimes attacks the young twigs of susceptible varieties of the apple, yet not much has been published on this phase of the disease in North America.

Morse and Darrows[1] show that the conidia of this fungus survived the winter on apple twigs and germinated readily in the spring. They found no evidence, however, that the mycelium exists during the winter as a living stroma and produces conidia in the spring.

A review of the literature of this subject is given by Morse and Darrows. Wallace[2] also reviews the literature of the persistence of the stroma on the twigs and the hibernation of conidia and is convinced that twig infection is not of common occurrence and that conidia can not withstand winter temperatures.

The writer's attention was first called to scab disease on the young shoots of the apple in the fall of 1915, when a number of badly diseased twigs of a McIntosh apple tree were sent to the college for determination. They were forwarded by Dr. E. W. Henderson, of Mansonville, in this province. The twigs were defoliated for several inches from the tips, and the leaves that remained below showed a very severe attack of scab. The twigs were severely

1 *Phytopath.,* 3: 265, October, 1913.

2 *Bull. Cornell,* 335, 193.

injured, many of them being in a dying condition. The bark was studded with the pustules of the scab disease and abundant conidia were present. Another collection was sent by Dr. Henderson on request a few weeks later. Many of the twigs were now dead and few conidia remained.

Another collection of diseased twigs was received about the first of April from Professor Shaw, collected at Truro Agricultural College, N. S., also from a McIntosh tree. Many of these twigs were killed back several inches and in the dead and also in the living bark abundant pustules of the scab were present. The affected twigs showed the characteristics described by Morse and Darrows. The bark was more or less thickly studded with light brown spots which examination showed to be blister-like areas due to the death and pushing out of the epidermis of the twigs. Many of these light-brown areas were roundish or oval with a dark center. A number, however, lacked the dark central area. Pieces of the diseased bark were removed, embedded in paraffin and sectioned, and the sections and diseased twigs examined. A well-developed stroma was present, and many conidia beneath the raised epidermis. The dark center was composed chiefly of the conidiophores of the fungus, the exposed conidia having fallen away.

Dr. Henderson and Professor Shaw were asked to forward diseased twigs collected about blossoming time, and both generously responded. The collection from Professor Shaw was received about the first of June. A few inches of the tips of some of these twigs were dead, but the bark of the living parts and of the living twigs contained many scattered postules of the apple scab actively producing conidia, the pustules being olive green from the abundant conidia. The dead parts of the twigs were thickly covered with scab pustules of the previous season, but the stroma was dead or not producing conidia.

The fresh conidia were placed in hanging drops of distillated water and they germinated as freely and vigorously as conidia obtained a short time later from the young leaves of an apple in the orchard.

Pieces of the bark containing living pustules were fixed, embedded in paraffin and sectioned. The stroma was very well developed, reaching a maximum thickness of 200 microns, while the maximum thickness of the stroma on the fruit was about 55 microns. It was also evident that the stroma was actively producing conidia at the time of fixation.

Mr. A. G. Turney[3] describes the scab as being troublesome in the twigs of susceptible varieties and states that in one orchard all the twigs of the previous year's growth of the Fameuse were covered with scab spots. He also found the amount of scab on the fruit was much reduced by trimming off the diseased twigs early in the spring. He had previously failed to control scab in this orchard by spraying alone. However, he does not claim the results were entirely due to the spraying. He states in a letter to the writer that the scab is quite common in the coastal regions as a twig infestation, and it may be found also in almost any orchard inland, but rarely so bad as to be a serious hindrance to growth.

Professor Shaw in a letter to the writer states that he found severe twig injury from scab in several different regions in Nova Scotia. The twigs collected at Mansonville, Quebec, at blossoming time by Dr. Henderson did not show any living pustules, but as not many of them had been cut back into the living wood the negative evidence was not satisfactory.

The twigs that had been received from Truro, N. S., about the first of April were left about eight weeks in the laboratory under ordinary conditions. Conidia were then taken from the scabbed areas and were tested in hanging drops of distilled water for germination. A small percentage was found to germinate. A second test gave the same result. The spores were taken from beneath the blistered bark, so that they had a certain amount of protection from the cold and from drying.

The writer is convinced from these experiments and observations that in certain regions

[3] Report of the Horticulturist, Province of New Brunswick, p. 100, 1915.

near the coast apple scab may winter on the twigs of susceptible varieties such as Fameuse and McIntosh as a dormant stroma and produce abundant conidia in the spring. It also confirms Morse and Darrow's conclusion that under certain conditions and with certain varieties of apples diseased twigs and water sprouts may be an important factor in the propagation and spread of the disease.

Mr. J. S. Dash when a senior student at Macdonald College devoted some time to the study of apple scab and the results of his studies were embodied in an unpublished paper now in the college library. He collected scabby apples early in the spring that had lain under the snow all winter and found that about five to ten per cent. of the conidia germinated.

On November 27 of the present year the writer collected scabby apples that had lain under the trees after their fall without protection of any kind. During late fall and early winter the temperature fell below the freezing point fifteen times, rising above during the day. There were two periods of severe frost followed by mild weather, the minimum temperature of the first being 11° F. and of the second on November 26 being 1° F. Conidia were abundant on the scab spots and these were placed in hanging drops of distilled water. The spores germinated freely and vigorously and in twenty-four hours showed many germ tubes over 100 microns in length. By count of the spores present in a number of microscopic fields in several hanging drops it was found that over 26 per cent. had germinated. Only those with well-developed germ tubes were counted. The conidia were examined immediately after being placed in the distilled water, and there could be no doubt whatever that the germ tubes had developed while in the water.

It would seem from these observations that the conidia are more resistant to low temperatures than is generally supposed. As material is available it is hoped to carry on further experiments along this line during the winter and spring.

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SCIENTIFIC EVENTS

BARON DAIROKU KIKUCHI

BARON DAIROKU KIKUCHI died suddenly at his villa at Chigasaki, Japan, on August 19. Baron Kikuchi was graduated from the University of Cambridge, England, with the rank of "wrangler." He became professor of mathematics in the Imperial University at Tokyo and later its president. He was for a time the Imperial Minister of Education and a member of the Emperor's Privy Council at the time of his death.

He was active and influential in the organization of the Japanese National Academy of Sciences, the National Educational Association and in the development of all the scientific and educational interests of the empire. He was the author of many contributions to scientific journals and several books, including a notable volume on "Japanese Education," consisting of a series of lectures delivered at the University of London in 1907. Baron Kikuchi made several visits to the United States, lecturing in our principal cities and at several of our leading institutions of learning. He was looking forward to another visit to America in the very near future, and his many friends in this country will learn of his death with profound regret.

THE PRODUCTION OF POTASH IN THE UNITED STATES

MORE potash has been produced during the first six months of 1917 than was made during the entire year 1916. The reports received by the United States Geological Survey, Department of the Interior, have been reduced to terms of the commercial unit commonly used to measure the available or water-soluble potash (K_2O) in the product, and only material actually sold by the producer during this period is included. The weight of the materials handled was therefore much greater than represented by these figures.

This table includes practically all potash produced.

The Nebraska alkali lakes still lead, having yielded about one third the entire production. There are now at least four important operators in this field.