Third, the greater the initial pressure the greater the maximum pressure, although regularity and proportionality are not observed.

Fourth, the medium size capsule used in these experiments has a distinct tendency to decrease the maximum pressure and to retard combustion. The other capsules have a much less marked but similar effect.

Fifth, the pellet form of material in all cases markedly decreases the maximum pressure and retards the combustion.

Sixth, the incorporation of inert material is without appreciable effect on the maximum pressure, but markedly retards the rate of combustion.

Seventh, anthracite coal results in low maximum pressures, but the rate of combustion is extremely slow, sharply contrasting with results from bituminous coal.

SOIL ACIDITY IN ITS RELATION TO LACK OF AVAILABLE PHOSPHATES

Preliminary Report.

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Received February 4, 1907.

Experience has shown that a direct determination of the amount of the essential elements present in a soil does not show its fertility, since it does not consider the degree of availability. It is unquestionably true, however, that the processes by which these elements become available are chemical, and depend upon the conditions existing in the soil. A determination of the conditions which influence the rate at which the elements become available and which affect the accumulation of the available material would enable us to diagnose the needs of the soil more quickly and surely than by direct field and pot experiments.

It is a well recognized fact that a soil should be tested for acidity, whether this condition affects the physical, biological, or chemical reactions of the soil.[1] The general question of upland soil acidity has been discussed in considerable detail and with an excellent bibliography by Wheeler[2] and his associates of the Rhode Island Station.[3] The most interesting fact in this connection, however, is that investigations of the fertilizer requirements of soils during the past two or three years have shown that whenever a soil is acid it needs phosphates. The work of H. J. Wheeler[4] of Rhode Island, and C. E. Thorne[5] of Ohio, on acid soils has shown that these soils need phosphates, although neither author has commented upon the connection between acidity and lack of available phosphates.

[1] Snyder, Pr. Am. Assoc. Off. Agr. Chem., 1898, p. 60.

[2] Wheeler, R. I. Sta. Rept., 1900, pp. 293-327. Hilgard, "Soils," p. 322.

[3] R. I. Sta. Rept., 1895, pp. 232-280.

[4] U. S. Dept. of Agr., Farmers' Bull. No. 77; R. I. Expt. Sta. Bull. No. 68.

[5] O. Expt. Sta. Bull. No. 159.

This subject seems worthy of further consideration, for if a general statement can be made that phosphate fertilizers should be applied to acid soils, it becomes a simple matter to detect the lack of available phosphates by testing the soil for acidity with litmus paper. This method has been criticised as a sure indication of soil acidity,[1] but so far as experience in Wisconsin goes, considerable confidence is placed in it. The Rhode Island Station[2] has made some tests in this connection, which go to show that litmus paper is sufficiently reliable for all practical purposes.

Careful field and plant house tests were made during the summer of 1906, on nineteen soils, thirteen of them acid. A field test was made on a small plot with commercial acid phosphate. The crops were varied. The plant house test was made in two-gallon jars and sodium phosphate was the fertilizer. The crop was corn in every case, for experience had shown this to be an excellent indicator of crop needs. The soils tested were mostly clays from as many different localities in Wisconsin as possible.

All the acid soils showed the need of phosphate fertilizer. Three of the soils that were not acid also showed the need of phosphates, although rather slight in one case.

Hilgard[3] says that even relatively large amounts of phosphoric acid are not available unless there is considerable lime present, and acid soils must be low in calcium carbonate. A careful test for carbon dioxide from carbonates revealed the fact that all of the acid soils contain less than 0.05 per cent. of carbon dioxide, or 0.11 per cent. of calcium carbonate. Soils not acid contain considerably more carbonate except in two cases. It is possible that these two soils, which lie in a glacial region on limestone and sandstone, contain very small amounts of limestone and yet are kept neutral by diffusion of bicarbonate solution from the underlying limestone.

Although there is phosphoric acid present in these soils in sufficient quantity for many crops, it is not available, and hence the soils need phosphate fertilizers. The soil acids probably act upon the readily available phosphates, such as the calcium phosphates, at a more rapid rate than the normal, neutral or alkaline soil moisture, and when once in solution these phosphates are readily washed out by heavy rains, or are fixed by hydrated iron and aluminum compounds—that is, are precipitated and rendered unavailable as insoluble iron and aluminum phosphates. When there is sufficient lime in the soil to maintain the phosphoric acid in the

[1] Whitney, U. S. Dept. Agr., Farmer's Bull. No. 257, p. 33.
[2] R. I. Sta. Rept. 1895, p. 241.
[3] Hilgard, "Soils," p. 365.

form of calcium phosphate, the plant is able to obtain enough phosphorus for its use, since calcium phosphate is soluble enough to supply the needs of a growing crop.

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THE PREPARATION OF VINEGAR FROM KIEFFER PEARS

By H. C. GORE.

The Kieffer pear is a large, coarse fleshed variety of pear extensively grown in various parts of the United States, largely on account of the productiveness of the trees and their resistance to blight. In seasons when large crops of the choicer varieties of pears are produced, or when the apple crop is large, the prices obtainable for Kieffer pears are often too low to pay for marketing. It is desirable, therefore, to find some use for surplus Kieffer pears. At the suggestion of Mr. Wm. A. Taylor, Pomologist in charge of Field Investigations, of the Department of Agriculture, experiments were undertaken to determine if good vinegar could be made from the juice of Kieffer pears.

Experimental Work.

(*a*) *Preparation of the Juice.*—This portion of the work was carried on under the supervision of Mr. W. F. Fletcher, of the office of Field Investigations in Pomology. The pears were grown near Washington, D. C. The fruits were very ripe, many of them being quite soft. Six barrels of fruit were employed. These were ground at the mill of Mr. T. M. Whitney, at Washington, D. C., on October 16, 1905, at about 5 p. m. The juice and pomace were allowed to macerate over night in a wooden vat and were pressed on the following morning. The juice ran from the cheeses readily, a high yield being readily obtained from the large hand-power press which was used. From data secured by Mr. Fletcher at the time of pressing, the yield of juice was found to be 4½ gallons per bushel of fruit.

(*b*) *Preparation of Perry from the Juice by Alcoholic Fermentation.*—The juice was poured at once into two clean, 50-gallon whiskey barrels and stored in an unheated shed. As soon as received at the shed, a few gallons were removed from each barrel, in order to leave space for the formation of a head ; no such formation, however, was observed.

One barrel of juice was allowed to ferment spontaneously by action of the wild yeasts present. To the other barrel, dominant fermentation by a special yeast was secured by adding a small quantity of a pure culture of a cider yeast supplied by Mr. W. B. Alwood. Throughout the fermentation the barrels were kept closed with cotton plugs. Samples of