SOIL FERTILITY AND PERMANENT AGRICULTURE

A SYMPOSIUM of Dr. Cyril G. Hopkins' work, "Soil Fertility and Permanent Agriculture," was read before N.D. Library Association recently by Prof. J. H. Sheppard. It is as follows:

The author is a South Dakota man and is now professor of agronomy in the University of Illinois. Soil at first thought seems sordid and uninteresting; in fact, it attracts us by its production, by the life and beauty which it supports, rather than by its innate features. Dr. Hopkins opens this book of 650 pages by simple explanations of the elemental compounds which constitute soil. Such an explanation seems tedious, but it is necessary; for strange to relate, two-thirds of the farmers of the Northwest would not comprehend his discussion if he had not made these simple explanatory paragraphs in the opening chapters. These explanations are followed by a statement of the nature of plant food and of plant growth.

The first portion of the book is discussed under the topical heading, "Science and Soil;" the second, "Systems of Permanent Agriculture;" the third, "Soil Investigation by Cultural Experiments;" fourth, "Various Fertility Factors." The composition and formation of the earth's surface or crust is given and this is followed by the basis of soil classification. All of the above is given in preparation for the discussion and it is well that the author has done so, for the amateur and the average practical farmer needs it as badly as the student needs his lexicon in translating a foreign language. You may or may not know that soil surveys, more or less complete, have been made or are under way in every state in the union, where a sample of the soil and subsoil is inspected on at least each forty acres of land and the soil areas are mapped.

The volume under discussion takes up the classifications and designates in map form all of the soil areas in the United States. The author next goes into a discussion and explanation of the difference between available plant food and similar material which is not available. If plant food is not soluble the plant cannot take it up. If it is too readily soluble, it may be lost by the leaching of water long before the plants constituting the crop on the field are ready to make use of it.

The chemist finds that the plant uses a large number of elemental plant foods—a dozen at least—and that they are all essential. This has been proven by leaving one out, and no matter which one it is fatal to the plant. If no iron is present, for example, the plant will be without chlorophyl—the green coloring matter—and will soon die. Fortunately iron has never been found lacking in any agricultural soil, and hence causes no trouble to the husbandman. The fact is that only three of these essential substances commonly run short from cropping. These three are nitrogen, potash and phosphoric acid. A system of cropping, therefore, which will keep up the supply of these three materials is a permanent system of agriculture. Temporary systems have been followed by some of the New England states, and to-day they are advertising abandoned farms as a state propaganda.

Connecticut, I think it was, sent out a pamphlet a few years ago, describing abandoned farms and inviting the citizens of America to occupy and redeem them. They used half-tone illustrations from photographs. I remember, as I ran, some of these farms they showed [illegible] pretty good-looking houses and fair barns and the descriptions read: "Three miles from market with good road, three-quarters of a mile from a schoolhouse, two miles from a church, etc., but these three elements were [illegible] or very low and had to be replaced before a crop could be grown on the land.

The addition of limestone is discussed, that is whether it should be burned by the farmer in a cheap way, or by the manufacturer on a large and expensive scale. Lime in itself is of no value to the crop, but among chemical substances there is frequently a contest for a common substance exactly like that which occurs between dogs when one has a bone which the other thinks he can take away from him. During the fight which ensues frequently a third canine gathers up the morsel and devours. In some soils lime will, in this way, free a substance which the crop will use promptly and to great advantage. Organic matter, humus—and nitrogen can be supplied by growing certain crops.

Dr. Hopkins is accused of being in part responsible for the high cost of meats in this country. He worked out two methods of cropping Illinois and on a basis of maintaining the soil fertility. One plan is grain and clover seed growing and the return of all the straw and clover hay—after the seed is removed—to the land, thus retaining the fertility of the soil. Except for the purchase of some rock phosphate which can be bought rather cheaply in the corn belt, this method of cropping retains the soil fertility without the addition of commercial fertilizers. The other plan of maintainence brought in live stock and by that means retained the fertility.

He shows how erroneous conclusions have frequently been drawn by experiments. For example, 300 years ago Van Helmont, a Flemish alchemist, planted a willow tree five feet high in 200 pounds of soil. In five years the tree had gained 164 pounds in weight and the soil had lost but two ounces. He drew the conclusion that plants live on air and rain water, not realizing that the tree would be removing a large per acre amount on the same basis and that the soil supplied very necessary ingredients to it.

Among the recent discoveries is that of the taking up of nitrogen from the air by the leguminous plants well presented by clover and the garden pea. I remember well that this was announced when I was a student in college, and that after spending three months in study of agricultural chemistry our teacher, an excitable Irishman, came into class one morning and said: "Boys it is all bowled over! Hellreigle has discovered that leguminous plants take their nitrogen from the air direct." We had spent the greater part of the term in a study of nitrogen supply and conservation because it was the expensive element to buy, twice as costly as either of the other two. Hellreigle had discovered that clover plants and a little bacterium had formed a co-partnership, known to botanists as symbiosis, by which the clover plant builds houses down on its roots in the form of little warts called tubercles and the bacteria live in them. They are pretty thick in these tenements, too, I can tell you—regular Rooseveltian families of them, and in some way not well understood. By this co-operation nitrogen is taken from the air either by the clover getting it from the air above the ground or the bacterium taking it from the air below the ground.

The chemist has never, in recent years at least, agreed for a minute that something has come from nothing. He well knew that a crop of clover removed a large quantity of nitrogen from a field and still left the soil richer than it was before the crop was removed. It had been observed that clover was deep-rooted and he had been satisfied with the belief that the subsoil had supplied the nitrogen to the clover and that the clover had left it in the surface soil.

The loss of fertility from leaching and weathering in these northern states and Canada is very small compared with that at the south. In travelling you may have noticed that southern soils are much lighter in color than northern. That is due to the fact that during some five months in the year northern fertility is locked up in cold storage, and hence the organic matter which gives the dark color is retained much more completely.

Dr. Hopkins has no patience with the toxic theory set forth by Prof. Whitney

(Continued on page 1879)