forth in search of food, having been stirred, is apt to admit the air freely to too great a depth. It is, however, in cultivating the summer-fallow and in growing root or other crops which admit of intertillage that a knowledge of the movements of soil water is of most value; and it should be borne in mind that a loose surface of two or three inches is essential to the economical saving of moisture. When a heavy rain has packed the upper layer, the harrow or cultivator should be applied as soon as the land is dry, else the capillary pores will become continuous to the surface, and the water which is so necessary to plant growth tend to become exhausted.

Soil Problems Discussed.

In the spring cultivation of land that has been summer-fallowed, use a cultivator that cuts all the ground, followed by plenty of harrowing both before and after drilling, and the weeder either just before the grain is up or when it is three or four inches high. If there is much couch grass or winter annual weeds, it may be necessary to gang-plow it.

Spring plowing should be four to six inches deep, followed by the sub-surface packer and harrows, if the weather is at all dry, seeding every day's plowing before leaving it at night. Harrowing five or six days after drilling is a good thing to give the grain the start of the weeds. The summer-fallow may be a good thing, but I think an occasional seeding to grass is better.

To follow any rotation with much advantage, it is necessary to have the farm fenced and divided into fields. There is nothing on the farm that will give better returns for what it costs than this. Seed with timothy or rye grass, or a mixture of both, along with a grain crop; take a crop of hay off the first year, pasture the second, and break up the third; then take off about three grain crops and seed down again.

The sub-surface packer is said to retain the moisture in new plowed land. I have used one for three years, but cannot say positively that I have seen any difference in the crop where it was used and where the land was given two strokes of the harrow instead of the packer; but the last two seasons have been so wet, and the one before that so dry, that it did not make much difference what was done. In a year that is moderately dry it would probably improve the crop, and it certainly settles the land down better than anything else I have tried, and rots the stubble and manure better.

A very good way to use manure is to spread it every day in the winter, as it is made, on land intended to be plowed for oats or barley in the spring, but it is apt to put a good many weed seeds into the land. If a grass rotation is followed, a much better way to use the manure is to spread it on the grass intended for pasture next summer. The cattle will tread weed seeds into the ground and make them grow, and afterwards eat the weeds off. The straw is also broken down, so that it does not bother while plowing.

CHAS. E. IVENS.

Wallace Municipality.

A Money Saver.

I am very pleased with the "Farmer's Advocate." I believe that a great many of us who came to this valley from Ontario would be worth $300.00 more to-day had we three years ago taken the "Farmer's Advocate," and gone by its advice.

Swan River, Man. WILLIAM H. SHAW.

Soil Fertility.

[Paper read by C. L. Strachan, Associate Ontario Agricultural College, before the Manitou Farmers' Institute.]

Our soil has been so richly supplied by nature with all the conditions favorable to plant growth, that the process of cropping thus far even has not exhausted its fertility sufficiently to cause the farmer any particular anxiety. But the fact nevertheless remains, that our soil is gradually

RESIDENCE OF D. W. McCUAIG.
Macdonald, Man.

becoming exhausted. This fact has been proved by Prof. Frank Shutt, chemist of the C. E. F. staff. He made analyses of soils that had been under cultivation for some twenty or twenty-five years, and compared them with the analyses of virgin soils from adjacent prairie land. The results show a decrease in the plant foods, but particularly in the available plant food. In view of this fact, even if we do not as yet feel the loss of fertility, I think we are justified in looking a little into this subject. Now, it is not my purpose to-day to advocate or to discuss at any length the use of manures; I just want to say in regard to commercial fertilizers that for general farming our soils have no need of them as yet. These fertilizers are always in a more or less soluble form, and if applied to our soils with their present fertility, there would certainly be a great loss through them leaking away with heavy rains. They may be used with profit, however, on a market garden, or such cases where the cropping is very exacting and intensive, and where rapidity of growth, earliness and high quality of produce are important factors, where plants require to be forced. But for general farming, for growing cereal crops when the growing period extends over a long season, we do not need to consider them. Lime may be profitably used in some cases, as we shall discuss later on.

In regard to farmyard manure, the right and proper thing to do is to make the best possible use of that we can. It is the very best general fertilizer that can be used. It not only supplies all the essential fertilizing constituents, but also supplies the soil with humus or decayed vegetable matter, which is an important thing in all fertile soil. Another advantage it has over commercial fertilizers is that while their value is only effective for one year, that of the manure extends over several years. The plant food supplied is not all readily available, but is gradually released as the process of decay goes on. I want to say just a ward regarding the manurial value of green crops which are plowed under before they reach maturity. These have all the advantages of the barnyard manures. It is usually some leguminous crop that is used for this purpose, such as clover, vetches and peas. This class of plants have the power to take the free nitrogen from the air and transform it into an available plant food. The power is due to the presence in the soil of myriads of micro-organisms or bacteria, which inhabit lobules or tubercles which become attached to the roots of these plants. It is these bacteria which have the power to take up the free nitrogen from the air and convert it into nitrate, and so supply the plant with nitrogen in an available form. Our soils in Manitoba do not naturally contain these bacteria, and that is one reason why clover and peas do not do so well with us. Our soils will have to be inoculated in some way with this class of bacteria. There is a prepared culture called nitrogen, which contains this class of bacteria, and which has been used successfully at the Brandon Exp. Farm and in several experimental stations in the Western States. Another method of inoculating the soil is by taking a quantity of soil from inoculated localities, as Ontario or Eastern States, and sowing in the drill with the leguminous crops. The results were in each case markedly successful, and the tubercles formed upon the roots of the plants. The knowledge of these facts is one of the most valuable additions to agricultural science of recent years. Nitrogen is the most expensive, as well as the most necessary, of the three essential fertilizing constituents which a soil is likely to require, if the farmer has to buy it in the form of commercial fertilizer, so it is a great saving to the farmer to have the plant get it free from the air.

By fertility of soil we mean its productiveness—its power to produce crops for us. This power depends upon the presence of the elements and conditions required by plants for seed germination and for plant growth and maturity. Experience and experiments have taught us that plants require in the soil, air, moisture, heat and plant food. The roots of a plant require air just as much as the leaves, and of course they require heat and moisture. If the soil lacks any one of these, or has a superabundance of any, it means death or, at least, retarded growth to the plants. We cannot do anything to supply the air, heat or moisture. These are always provided by nature. But we can do much to hold them where the plant can get them, by keeping the soil in a proper condition. A fertile soil must be in that physical condition or texture to admit air and hold moisture and heat, as well as contain the necessary plant food. You see, then, that the fertility of the soil is influenced by the cultivation as well as by the supply of plant food. Let us first consider the supply of plant food. Every fertile soil must contain the ingredients which plants take up through their roots and build up into tissues. Most soils contain an abundance of many of these elements, but there are three—only three—of those essential to plant growth of which soils are apt to become exhausted. They are nitrogen, phosphoric acid and potash. When we speak of a soil being run out or exhausted, we mean that it lacks one or more of those three elements. In their free or independent state, the phosphoric acid and potash are hard metallic substances, and the nitrogen is a gas. To be used by plants, the nitrogen must be united with other elements to form soluble nitrates; the phosphoric acid must be united with other substances to form soluble acid or phosphates, and the potash must be in some soluble form.

Every arable soil possesses its stores of plant food in two forms: 1st, the inert or locked-up form; and, 2nd, the available form. The former

A RICH FARMYARD. THE HOME OF JOHN HAWKS, MEDICINE HAT, ALTA.