same source. Thus, through the action of these latter agencies, the rock particles which form the soil are further broken up, and the valuable plant-food constituents are brought into a condition to nourish plants.

These combined agencies which are at work decomposing the particles of rock are destructive, and especially tend to remove from the soil in drainage water the lime, magnesia, and, sometimes, the alkalies which it contains. Consequently, water taken from underground drains or from wells is "hard," because of the lime which it holds in solution. If the subsoil is of a sandy or gravelly nature the loss of potash may be considerable, but if clayey, very little will be lost. A surface soil is thus generally poorer in lime, and frequently in potash, than the subsoil beneath. The complete impoverishment of the soil is hindered by the presence of certain constituents which combine chemically with the liberated plant-food substances, and by the conservative action of vegetation. The plant is continually collecting from the soil and subsoil dissolved or easily soluble matter, storing these in its tissues, and at its death leaving them upon the surface soil. When natural vegetation has continued for ages, as in an undisturbed prairie or forest, a surface soil is produced rich in vegetable matter, and containing an accumulation of plant food in an available form.

The difference between the soil and subsoil is chiefly due to the amount of decaying organic matter found at the surface. The organic matter not only makes the soil darker, but, because of the acids liberated on the decomposition of the organic matter, the iron oxides, which color the soils, are removed. Another difference between the soil and subsoil lies in the fact that the soil is usually composed of coarser particles than the subsoil. This is due to the rain constantly percolating through even the stiffest soils and washing down the finer particles. Heavy rains may also wash the surface, carrying away the finest particles. To some extent this is counterbalanced by the work of earthworms bringing the fine mould to the surface; but, on light soils, constantly worked, and further opened up by the introduction of coarse manures, there is sometimes so complete a washing down of the finer particles that the soil proper loses its power of cohering, falls into dust when dry, and is said to be "worn out." The richness of the soil in humus, its greater warmth, and the freer access of air, causes it to be more abundantly supplied with organisms which play a very important part in preparing the food for plants. Because of the absence of humus, and of the organisms associated with it, the comparative poverty in available plant food, the presence sometimes of poisonous, unoxidized material, and, on stiff clays, the great change in texture, the subsoil is often unfertile. Therefore, if it becomes necessary to incorporate it with the surface soil, the mixing process should be a very gradual one.

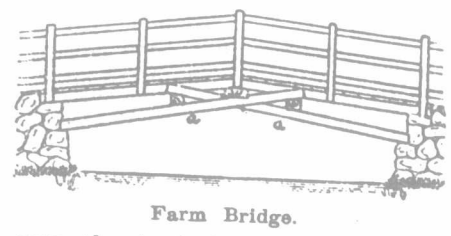
The size of the particles which make up a soil has an important bearing on its fertility. Pure sand is made up of practically indestructible silica, usually existing in fairly large grains, and is nearly destitute of plant food. Clays are composed of the finer particles derived from the more readily decomposed part of rocks, and, consequently, contain most of the lime, potash and phosphoric acid, so much required for the growth of plants. A sand is loose and open because its particles are too large to readily bind together. On the other hand, the tenacity of clays is largely, if not wholly, due to the fineness of the particles of which it it composed. As a matter of fact, the soils we have to deal with are not pure sands or pure clays, but mixtures of these. As sand or clay predominates, we style them sandy, sandy loams, clay loams, or clays, and the above-mentioned characteristics are prominent just in proportion as the sand or clay forms a large or small part of the whole.

The size of the particles in a soil, also has a very marked influence on its power of holding water. When a soil is saturated, all the spaces between and around the particles are filled with water—the soil is full of water. In a well-drained soil this water is drawn off, and only that remains which is held on the surface of the soil particles. The saturated condition may be illustrated by filling a pail containing marbles with water. All the spaces except that actually occupied by the marbles is filled with water. If the water is drained off, only that held on the surface of the marbles remains, and the open spaces between them will be occupied by air. The presence of this air in the soil is essential for the development of the roots of plants, for the oxidation of certain compounds, and for the life of the millions of organisms engaged in the breaking down of the organic matter in the soil. It is evident, then, that it is essential that these interspaces be kept open, and that the only way in which water may be held in a drained soil is on the surface of the particles. Anything that will increase the amount of the internal surfaces will increase the water-holding power of the soil. Small particles present a greater amount of surface than large, for it is a well-known fact that the total surface presented by a mass of spherical particles doubles when their diameter is halved. If the particles are irregular in shape, or are themselves porous, as particles of humus and limestone, and aggregates of smaller masses, the internal surfaces and, consequently, the water-holding power will be increased.

From the above it is evident that the soils retaining least water when drained are gravel and coarse sand. The amount increases as the particles become small, and reaches a maximum when the soil is rich in humus. The addition of organic matter, which in the process of decay forms humus in the soil, is thus the best means of increasing their power of retaining water. Moreover, an abundant supply of water, properly held, affords increased opportunities for the solution of plant food. Thus, good drainage to draw the water out of the interspaces and allow free access of air, thorough cultivation to open up the soil, and the presence of abundance of humus, with all its beneficial effects, are all important factors in tillage.

Bridge for Farm Use.

On a farm crossed by small streams which it is necessary to bridge, the form of bridge shown in the illustration will be found adaptable to almost any condition; and when it is built of good



Farm Bridge.

timber, says the Agricultural Epitomist, forms a lasting and serviceable structure. This bridge is especially valuable where a single log cannot be used as a stringer. Good timber of a size sufficient to sustain the weight the bridge must bear should be used for stringers.

Alfalfa in Rotation.

To the Editor "The Farmer's Advocate":

In reference to your editorial in "The Farmer's Advocate" of February 15th, would say: Rotation of crops is a very important factor in successful farming. Taking the average 100-acre farm as a basis, we will suppose 90 acres of it arable and divided in nine fields or lots. Clovers and plants of that family seem to be the best plant and soil improvers, and especially alfalfa or lucerne; then we should have one-third of our farm devoted to it, allowing 20 acres for meadow and 10 acres for pasture. If this were alfalfa it would, in an ordinary season, cut 50 tons of hay, and yield enough pasture to summer 30 head of cattle. Unlike the red clover, it grows on, no matter how often cut or eaten off, and dry weather does not effect it. It may have one objection, being hard to plow, but that is compensated by the enriching of the soil by its roots. Ten acres can now be profitably plowed from sod in spring and sown to peas, as there were no bugs last year, and with a light gang-plowing or disking the land is in fine shape for wheat; to be followed the next year with oats. After oats it has been the general practice here to follow with corn or roots, and on my own experiments would prefer it to sod, as the crop is easier managed if the ground after the oat harvest has been twice plowed and manured in the fall. After roots and corn, which we will suppose has thoroughly cleaned the soil, we should consider the best crop to seed down with. My choice is barley, sown not thicker than 1¾ bushels per acre; then with it, if land is rich clay loam, 15 pounds per acre of lucerne clover, with one or two pounds of timothy seed, for this reason, that the only thing that kills alfalfa or lucerne is ice, and should there be a spot or two in a field the timothy fills it, and the clover keeps the timothy in check on the remaining area. Our good Ontario farmers seem very slow in sowing this wonderful clover. I think one reason is the cost of seeding, as it is said by seedsmen that have it to sell that one-half bushel is the quantity, when by actual test for three years, one peck is all that is necessary on well-prepared land. Green fields greet the eye two weeks earlier in the spring, and much later in the autumn by its use, and it is the choice of cattle and all live stock among all the grasses. Much might be said about irregular crops sown after the other crops: such as rape, which does well after fall wheat. If sown about August 10th, it will usually be six inches high in October, and is much relished by all live stock, especially by sheep. A farm under regular rotation is much easier managed and worked, as it gives steady employment, and the products manufactured in winter into beef, pork, live stock or dairy, all will get and give the largest returns from proper rotation, at the same time leaving for those that follow richer and better farms than we came in possession of.

Oxford Co., Ont. H. J. D.

Reforestation Test Plantations.

Dr. Judson F. Clark, Chief of the Forestry Department of the Province of Ontario, whose contributions on that subject in "The Farmer's Advocate" have been stimulating, illuminating and helpful, has suggested that reforestation would not only provide employment for labor, but enrich the country at the same time. Just now older Canada is suffering from want of sufficient labor in the farming districts, but the lapse of time is destined to change that condition of things. During growth, forest plantations require constant care, and as the trees mature, cuting and manufacturing will begin, so that, whether by private enterprise, National or Provincial government, such plantations will involve much labor, and lay the foundations for large revenues, since the forests of all countries are rapidly disappearing and the value of wood is becoming enhanced. Dr. Clark's idea appears to have occurred some time ago to the corporation of Leeds, England. A large estate, on which the Leeds Reservoirs are situated, was selected, and the corporation engaged Professor Fisher, of Oxford, and another gentleman, to prepare a scheme for planting trees, to continue for five or six years, on the assumption that the annual expenditure would be about £1,200. Some forty men, citizens of Leeds, and most of them engaged through the unemployed bureau, were set to work. They are expected to plant this year 360,750 trees—spruce, cooseear pine, larch, Scots fir, beech, birch, sycamore, mountain elm, and alder. The nursery will be planted with 638,000 seedlings, and seeds will also be sown, so as to diminish the expenditure for purchasing trees. It is expected that in five years 851 acres will be planted.

There is a suggestion in the foregoing that Canadian municipal corporations might take advantage of in providing themselves with trees for purposes of shade and ornamentation, and in what may, at the same time, put to test or develop the larger idea of commercial plantations.

How Best to Apply Manure.

To the Editor "The Farmer's Advocate":

The object of your correspondent, W. A. Thompson, to bring out discussion on how best to apply manure is a good one. Under the heading, "When to Apply Manure," he gives you his plan, which I consider very wasteful. He finds fault with the spreading of manure broadcast in the winter, because the rains and melting of the snows send colored water from the high places to the lower. From what I can learn, he is one of those who clean out their stables daily, and take the manure to this big pile which he tells us about. I consider that method fifty years behind the age, from my experience of 60 years in farming, both in Canada and in Scotland. I have made two trips to the Old Land since I came first to Canada 44 years ago; Mr. Thompson's method of big piles was all the go in Scotland then. When I was home in 1884, the farmers were giving up that method; when home again in 1898, manure was mostly all applied "green," except by gardeners. The farmers here also are coming to see the advantage of green manuring. Now about the expense. Mr. Thompson handles his manure twice instead of once; he handles it a second time in the spring, when his horses and men should be putting seed in the ground. A few days' delay in the spring, when the ground is ready for the seed, means a great loss in bushels at threshing time. His scare about seeing the colored water is nothing to be compared with the leakage from his big pile by fermentation.

The difficulty about not knowing where to spread the manure when the snow has the ground covered is easily overcome. I have used the method of winter manuring for a good many years and had little trouble in putting it where it should be. A great many haul manure out and put it in small piles in the winter and spread it in the spring, when the frost gets out of it. That way may do for corn, but not for any other spring grain, because of delaying the putting in of the grain. I consider there is more waste in putting it in in small heaps than broadcast spreading.

Mr. Thompson may wish to criticise my way of handling manure; he is welcome to do so, and others of your readers who desire. Here is my method. My first object is to preserve both liquid and solid droppings from all stock. I have a division basement under my barn, 60x18 ft., where I store all my manure, with a trough for watering my cattle at all times. My cows are all tied up, other cattle are loose in box stalls; three-year-old steers in the manure division. I can hold all the manure from the whole stock for two months, but haul oftener when weather is favorable. If the box stalls get filled too much, and if the weather is not favorable, I dump it into the manure basement, and cattle, pigs and all have access to it when watering, therefore no fermentation. I have no hauling in the spring, except when the corn ground is not manured in the winter. My winter manuring is all for corn. Manure applied in winter on land intended for