Our Scottish Letter.

THE USE OF FERTILIZERS.

One of the points in which the foreign, and especially the colonial, farmer has the advantage of the home producer is that the foreigner has no manure bill to pay. He is working with virgin soil, which willingly delivers up to him all that he demands, whereas the farmer in the realms where effete monarchies bear sway is compelled to expend lavishly on artificial manures, and indeed there is some reason to believe that the producer of these gets the best of the game. Between rent and expenditure of this kind, the British farmer has no pull at all with his foreign competitors; their expenditure for freight, which may be direct or indirect, is a bagatelle in comparison with his outlay for rent, rates and fertilizers. The efflux of time will, however, lessen the gulf between these competitors so far as this is concerned, and no doubt the Eastern farmer in Canada is already face to face with the unpleasant experience of having to compete with his more favored fellow citizen in the West and Northwest. He will be increasingly favored with the attentions of the salesmen of all kinds of manurial preparations; and if he be a wise man he will experiment abundantly before investing lavishly in any kind of manure. The special compound warranted to suit any soil and raise a good crop is specially to be avoided. There is no such manure in existence, and the best compounds are those which the farmer makes himself after having carefully studied the constituents of his soil.

WHAT IS MANURING?

There are three constituents drawn from the soil of arable land every time a crop is taken off. These are phosphoric acid, ammonia, and potash. Generally speaking, the first is drawn away most by the root crops, such as turnips and crops of that nature; all corn crops feed more or less on ammonia or nitrogen, and potash is especially demanded by potatoes and the Leguminosæ. Some soils are richer and some poorer in one or other of these elements, hence the farmer's problem is to adopt the applications of each in the form most desirable alike for the needs of the crop to be reared and the deficiencies of the soil. "Agriculture in old countries," it has been well said by Dr. Bernard Dyer, "becomes very largely the art of economizing the natural plant foods in the soil, and of judiciously supplementing them." Many chemical substances are needful for the growth of plants, and much of their food is supplied from water in the shape of rain and dew, and the gaseous carbonic acid which abounds in the atmosphere, but from the soil they must draw mineral substances and nitrogen, the latter by manure and clover growth. These every soil contains in some proportion; there is a certain amount of plant food bottled up, so to speak, in almost every soil, but much of it is only potential, and the expert agriculturist has to apply to that particular soil the proportion of other substances likely to render available the plant food so bottled up. Again quoting from Mr. Dyer, the aim of the farmer is "the economical supplementing of the land's own resources by means of well-chosen and skilfully-applied purchased fertilizers and feeding stuffs." To apply a phosphatic manure to wheat is in general a mere waste of money; to apply nitrogen in a quickly assimilable form is the very essence of successful wheat-growing. The ideal fertilizer is farmyard manure. It contains all the three constituents—nitrogen, phosphates and potash—in evenly-balanced proportions, and hence many old farmers believe in nothing but "muck," as they term it. They have arrived at this conclusion by experience, and their view is sound chemically, but it may

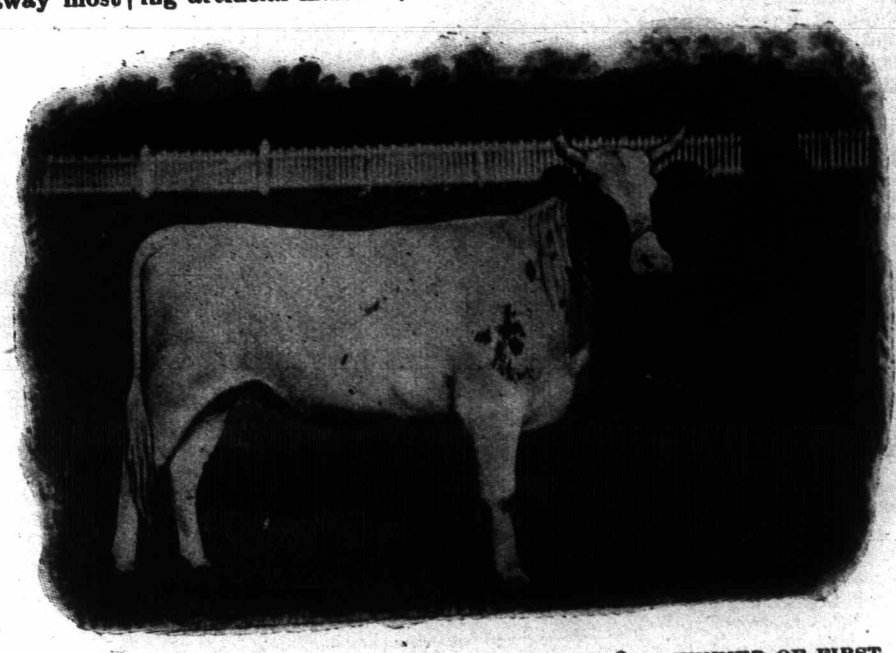
NOT BE SOUND COMMERCIALLY,

and in this important distinction lies the whole problem of the successful application of so-called artificial manures. Strictly speaking artificial is a misnomer. These manures or fertilizers should rather be characterized as concentrated. The value of farmyard manure depends chiefly on the feeding of the stock which made it. Generally speaking, foods which are rich in nitrogen are also rich in phosphates and potash, and *vice versa*, consequently the value of farmyard manure depends chiefly on amount of ammonia which it may contain. If a ton of farmyard manure be fairly rich it should contain from 9 to 15 pounds of nitrogen, 9 to 15 pounds of potash, and 4 to 9 pounds of phosphoric acid. It is quite possible, however, for the manure to contain a greater proportion of nitrogen than is needed say for a root crop, and hence experience has shown that the most economical manuring is attained by a partial application of farmyard manure, supplemented by a certain proportion of artificial manure, according to the nature of the crop proposed to be raised.

The chief forms in which phosphoric acid is applied in this country are superphosphate, bone meal, and basic slag. [NOTE.—The latter has been quite extensively introduced in Canada of late, being known as Albert's Thomas-Phosphate Powder.—ED.] Nitrogen is applied in the form of nitrate of soda and sulphate of ammonia, and potash in the form of kainit and sulphate of potash. Potash is seldom applied, except to potatoes and beans, clover or other leguminous plants. Hence in all experiments the quantity of potassic manure applied is generally the smallest. At present it can hardly be said that foreigners could learn much from Scottish systems of applying these manures. In connection with all agricultural teaching centers many experiments have been made, but little definite can as yet be predicted. To begin with,

THE CUSTOM IN SCOTLAND

has been to apply all the manure to the root crop in the rotation, except perhaps in the matter of nitrate of soda, which is usually added as a top-dressing to the hay crop. Land is laid down in pasture say for three years, and grazed by farm stock of all kinds. It is then plowed up, and an oat crop taken off without the application of any manure whatever. This is followed by a green crop, and to this all the manure is applied. Formerly the plan was to plow the oat stubble in late autumn—say about this time of year (October)—and leave it alone until spring, with the roots of the oats exposed and the stubble buried. In spring the land was harrowed, again plowed, again harrowed, and then drilled. The farmyard manure was spread in the bottom of the drills or furrows, and "the artificial," if any, was sown on the top of it, and then the whole was covered in. Now the practice is general of spreading the farmyard manure on the stubble in autumn before plowing, and burying it with the stubble. It is found that this is the most economical method, and nothing is lost by it chemically. Teachers and farmers are still experimenting on the best methods of applying artificial manures, and certain old-established



YEARLING AYRSHIRE HEIFER, NELLIE OSBORNE 2ND; WINNER OF FIRST PRIZE AT TORONTO, LONDON, OTTAWA, AND MONTREAL, 1897; FIRST AT TORONTO, OTTAWA, AND HOCHELAGA, 1898. OWNED BY D. DRUMMOND, PETITE COTE, QUEBEC.

theories are in consequence being rudely overturned. For example, in regard to the three forms of phosphoric acid—superphosphate, basic slag, and bone meal—it has long been a cherished conviction with Scottish farmers that superphosphate (that is, mineral phosphate) was the most evanescent, or, in other words, the most readily assimilated, and that its effects were exhausted by the crop to which it was applied; that basic slag was its superior in this respect, but that bones or bone meal was by far the most profitable, because the most enduring and effective of all phosphatic manures. On this basis many claims under the Agricultural Holdings Act have been settled, yet there is now reason to fear that the whole of these theories were wrong, that the value of bones or bone meal had been greatly exaggerated, and that claims had been made for basic slag which could not be fully made good. No one had apparently ever thought of testing the relative merits of the three forms, and yet few things of the kind could be more easily accomplished. The custom of applying the whole of the manure to the root or green crop in the rotation afforded an excellent starting-point for a thorough test. In the ordinary West of Scotland rotation the green crop is followed by a second corn crop, then a hay crop, and then three years pasture. Now, what is needed to establish the relative values of the three forms of applying phosphates is obviously

A SERIES OF ROTATION EXPERIMENTS

on different kinds of soil, say, for example, a clay soil, a sandy soil, and a peaty or mossy soil. Let the manures be applied according to use and wont, then let the results in each year be tabulated until the rotation be exhausted. The whole would prove invaluable, and light would be thrown upon a question which at present does not admit of a definite answer. Something, however, has been done in the desired direction, both by Professor Wright, in connection with the Glasgow College, and by Dr. Somerville, in connection with the Durham College of Science at Newcastle. In a rotation experiment conducted by the former it appeared that superphosphate is the most profitable form in which phosphates can be applied. As between basic slag and superphosphate, it has been shown that on turnips and rye-grass hay, and in respect to residual value, superphosphate is superior to basic slag, except on peaty or mossy soils. It is also superior in respect of residual value to bone meal, which has generally been regarded as the best form in which to apply bone phosphates. On peaty or mossy soils it does not appear that any kind of phosphatic manure surpasses basic slag.

[NOTE.—Dr. C. M. Aikman, Professor of Chemistry in Glasgow Veterinary College, in his work on manuring, issued in 1894, describes at length the elaborate experiments conducted by Prof. Wagner, of Darmstadt, which showed that the after-effects of the slag were better than those of the superphosphates, and the results obtained a few years ago in Scotland by Dr. Aitken, at the Highland Society's Stations, were especially favorable to the slag as a phosphatic manure. For turnips it was found superior, weight for weight, to superphosphate. The slag used was rich in phosphoric acid, and very finely ground.—EDITOR.]

Possibly the reader may be interested to know a little about this fertilizer, from which undoubtedly very remarkable results, especially in the way of renewing pastures on gray or mossy soils, have been obtained.

WHAT IS BASIC SLAG?

Basic slag is a by-product in the manufacture of Bessemer steel from phosphoric pig iron. "The phosphorus of the iron, which would otherwise render the steel manufactured from it of little use, is removed by lining the Bessemer 'converters' (in which pig iron is decarbonized) with a coating of lime and magnesia. The phosphorus is converted into phosphoric acid and attaches itself to the lime, but at the high temperature of the molten metal it forms not ordinary or tribasic phosphate, but a phosphate containing more lime and having peculiarly valuable properties." In its crude condition it is a most unpromising looking, dense, heavy material, but when finely ground it makes a readily available phosphatic manure. To put the foregoing popular explanation into scientific form, basic slag is a tetracalcic phosphate, having the composition $Ca_4P_2O_9$. Its value as a manure depends on two things: (1) The guarantee of its quality, which may vary from about 12 per cent. of phosphoric acid (equal to 26 percent. of tribasic phosphate of lime) to over 20 per cent. of phosphoric acid (equal to nearly 44 per cent. of phosphate); and (2) the fineness to which it is ground, and nothing should be looked at in this respect under 85 per cent. of "fine meal." This means that at least 85 per cent. of the "fine meal" to which the slag is ground will pass through a standard sieve of 10,000 meshes to the square inch. Without these guarantees no brand of basic slag should be purchased. It is a most disagreeable manure to sow with the hand, and the sowing of it has been suggested as an infallible test for a lad determined to be a farmer. If he will persist in his determination after two days' experience in applying slag he may be allowed to proceed. A sound general rule in

APPLYING PHOSPHATIC MANURES

is to use acid or dissolved manures (such as dissolved bones or superphosphate) on soils that contain a fair proportion of lime, and on soils deficient in lime to use non-acid manures, such as basic slag, fine bone meal, and Peruvian guano. That is to say, peaty soils, many clay soils and most granitic soils are favorable areas for basic slag, and hence its success on old pasture lands deficient in lime.

The rapid growth of white clovers after an application of basic slag is doubtless somewhat puzzling, but obviously it is not to be accounted for by the presence of clover seeds amongst the slag. The reason is to be sought elsewhere, but the action of the phosphates on the soil has the effect in many cases, especially on old hill pastures, of setting up a rich growth of white clover. Undoubtedly

THE SEEDS ARE IN THE SOIL,

but languishing for lack of food, which the basic slag, either directly or by combination with the potash in the soil, reinvigorates and brings to life. Dr. Somerville's experiments, I ought to say, are of a unique nature. He is trying to determine the residual value of phosphatic manures by the effects seen in the feeding of sheep on the experimental pastures. So far his findings confirm those of Professor Wright.

"SCOTLAND YET."

Our Efforts Appreciated.

G. W. A., Prince Edward Co., Ont.:—"Please accept my thanks for the very kind and obliging manner you have answered my enquiry about feed racks for sheep. It's entirely satisfactory. You take a great deal of trouble to place news and facts in an intelligent way before your readers."