

note the early growth of the young plant, for which reason such manures should be well distributed, and amalgamated with a large body of soil, and not be placed in too close a proximity with the young turnips and mangel plants. I have made a good many field experiments on this subject, and find that, on moderately stiff soils, rotten dung, Peruvian guano, and sulphate of ammonia, and all nitrogenous manures, which later in the season sustain a vigorous and luxuriant growth, in a remarkable degree retard the progress of turnip and mangel plants in their earliest stages of development. It is not on highly-manured land, but on naturally poor and unmanured sandy soils, that turnips come soonest to the hoe. I have noticed repeatedly that on recently-manured land the fly destroys the young plants much more effectually than on soils dunged in autumn, and believe the explanation of this fact, which is well known to many farmers, is supplied in the circumstance that on the autumn-dunged land the nitrogenous constituents of the dung get more thoroughly distributed in the soil than is the case when the dung is put upon the land in spring, when the young turnip plants come into a more direct contact with the dung, in consequence of which the earliest growth of the young plants is retarded to an extent which gives the turnip fly ample time to clear off the plants. Nitrate of soda has the same general effect upon root crops as nitrogenous manures, but it appears to be more energetic in its action, and, on the whole, to be a useful addition to home manures, and to increase the produce in roots more considerably than salts of ammonia. Its effect is specially marked upon mangels, and to my knowledge heavy crops of mangels have been produced upon rather light land by  $1\frac{1}{2}$  cwt. of nitrate of soda, 2 cwt. of common salt, sown broadcast, and 4 cwt. of dissolved bones drilled in with the seed. With regard to the use of salt as a manure for root crops, I would observe that salt checks over-luxuriance in the tops, and prolongs the period of active growth. In consequence of this specific action it may be employed with benefit as an auxiliary manure for swedes and mangels upon light land; but, according to my experience, it does no good, and, in quantities larger than 3 cwt. per acre, rather diminishes than increases the root produce upon heavy land. Potash salts, in some field experiments which I have tried in different parts of the country, have shown that potash has a decidedly beneficial effect upon root crops on poor sandy soil; whilst on the majority of land, and notably upon clays or clay loams, or soils in a good agricultural condition, salts of potash do not increase the produce. The special effect of superphosphate, dissolved bones, and similar phosphatic manures, is to produce early maturity; and hence phosphatic manures are employed in practice very largely, and with much benefit, by root growers. In free-growing light soils it is desirable either to use dissolved bones, in addition to half a dressing of farmyard manure as a manure for roots, or to spread broadcast 2 or 3 cwt. of dissolved Peruvian guano, and 2 cwt. of salt, or 2 of guano and 1 cwt. of nitrate of soda and 2 cwt. of common salt, and to drill with the seed 3 to 4 cwt. of dissolved bones. On the heavier description of soils it is preferable to use mineral superphosphate for roots, especially if the land has been dressed in autumn with a moderate quantity of dung. The addition of ammoniacal manures to superphos-

phate has a tendency to retard the maturity of the root crop, for which reason mineral superphosphate, applied alone to the stiffer classes of soils, generally speaking, has a better practical effect upon the produce than dissolved bones, or mixed ammoniacal or phosphatic manures. On account of the valuable property of readily available phosphates to cause early maturity, neither turnips nor mangels, nor, indeed, any root crop, in my judgment, should be grown without superphosphates, 3 or 4 cwt. of which per acre are best drilled in at the time of sowing. Thus much with regard to the special effects of the principal fertilising matters upon root crops. It will appear that a knowledge of the rationale of action of the various manuring matters, and a due consideration of the variable character of soils, and the peculiarities of the prevailing climate in a district, will enable a root grower to compound for himself in the most suitable manner artificial manuring mixtures, or to confine himself to the use of purely mineral superphosphates, and to reap the benefit of his knowledge in the shape of heavy and sound root crops, at a more moderate expenditure than the farmer who, in the selection of the manures he applies to his root crops, is not guided by a proper consideration of the principles involved in the economic application of manures, and who depends, in a great measure, upon the recommendations of the local manure merchants and agents, who, naturally enough, are loud in praising their special compounds.

There remains for our consideration one more fertiliser upon which you will, perhaps, expect me to say a few words. I refer to town sewage, which, as you are aware, has been applied with more or less beneficial effect to roots, especially to mangels. Without doubt, town sewage is a most useful fertiliser for root crops, especially for mangels, provided it be applied to the land at the right time, and in proper quantities. Town sewage may be employed with great advantage repeatedly in large doses during the first two or three months of the growth of the root crops. In dry springs especially the liberal application of sewage cannot fail to be of the utmost utility to farmers who can command a supply of this liquid fertiliser. It then encourages an early, luxuriant, and healthy development of leaves, by which sugar is afterwards elaborated from atmospheric food, and stored up in the roots. Almost any quantity of town sewage may be applied to root crops during the first two months of their growth; but subsequently, and more especially when the bulbs have reached a considerable size, sewage should be withheld, or otherwise the crop will not properly ripen, and will not be worth much for feeding purposes. It is important to bear in mind that the more completely the supply of soil food is withheld during the late summer months, the more fully the roots will ripen, and the richer they will become in sugar in consequence. Town sewage is held in bad repute by not a few farmers, whose experience leads them to suspect that there is something or other in sewage prejudicial to the production of sound roots of good feeding qualities. I believe this is a mistake, for sewage contains nothing inimical to the healthy growth and development of roots; and the examination of mangels and sugar-beets has shown me that perfectly sound and nutritious roots can be grown with town sewage. At the same time I may state that some of the worst and

least nutritious mangels which have ever been analysed by me were grown with sewage; and I have therefore come to the conclusion that ill success with sewage as a manure for mangels in most cases is due to its injudicious use, and not to any inherent bad qualities which it has been supposed to possess.

#### INFLUENCE OF CLIMATE.

My remarks on the dependence of root crops upon the character of the soil upon which they are grown, and upon the composition of the various manures employed, have already occupied so much of the time that can be devoted to the subject appointed for our evening's discussion, that little or no time is left at my disposal to dwell upon the influence of the climate upon the quality of root crops. I regret this the less, because, under this head, with one exception, I have not any remarks to offer which are based on special and personal experience, and I hardly think it profitable to allude to matters of common observation, with which most agriculturists are familiar. The exception to which I allude has reference to the cultivation of the sugar-beet, not usually grown in England. Doubts have been expressed as regards the suitability of the English climate to the production of beets sufficiently rich in sugar to satisfy the demands of the manufacturer of sugar.—Having had a good deal of experience of beet-root culture, I have no hesitation in saying that our English climate, on the whole, is favourable to sugar-beet culture. Our summers are quite warm enough to ripen sugar-beets sufficiently, and to produce roots rich in sugar, in proof of which I might quote numerous analyses of sugar-beets, clearly showing that they can be grown of as good a quality in many parts of England as on the Continent. This crop does not require an excessive summer heat in order to come to perfection. Indeed, sugar-beets do not do nearly so well in central France as in Germany, nor in the South as in the North, where the summer temperature is much lower. It is not so much heat as a dry and unclouded sky during the autumnal months, which makes the sugar in the beet. A bright and dry August seems to do more for sugar-beet than almost any other condition, however favorable it may be to the luxuriant growth of this crop. Sugar-beet culture, therefore, is not likely to succeed well in a great part of Ireland and Scotland, nor in the Southern and South-western Counties of England, nor in localities in which the late summer and autumn are, as a rule, wet. On the other hand, the climate of the Eastern and Northern Counties, and of the east coast of Scotland, is by no means unfavorable to the cultivation of sugar-beets, so that in all districts where common mangels do well sugar-beets may also be grown successfully.

#### DISCUSSION.

Mr. J. K. Fowler said he had gathered from Dr. Voelcker's paper the superiority of sugar-beet to ordinary mangel wurzel as a cattle crop. Some years ago he had visited the Eastern counties, and was so struck with the beet culture that he saw there, that he determined to adopt it himself at Aylesbury. He had grown sugar-beet for the last three years, and found them a very valuable crop, though not so valuable in the mean time as mangels. But with larger experience they might do better. The best beetroot for cultivation he had found to be the white Sile-