subsists between the character and chemical composition of the land, and the root produce grown upon it. Turnips affected by anbury, I may observe in passing, I find are much richer in nitrogen and in mineral matters than sound roots, as will be seen by the following results, which I obtained in the analysis of a turnip attacked by this disorder:

Composition of a Turnip Attacked by Anbury.

Water	88.02
*Albuminous compounds	3.56
Sugar, pectine, and digestible fibre	3.67
Woody fibre	3.27
Mineral matter (ash)	1.48
	100.00
*Containing nitrogen	.57

On an average, sound nutritive turnips contain about 91 per cent. of water, and not more than 1½ to 1¾ per cent. of nitrogenous compounds, and much less than was found in the diseased roots; and it appears from these, and numerous other results to which I shall have to refer presently, that a high per-centage of nitrogen and of ash in roots rather indicate immaturity, and by no means superior feeding quality. Roots grown on peaty soils, it is well known, frequently are spongy, and of a low feeding quality. Peaty land often is greatly deficient in lime, and in that case the turnip crop is liable to finger-and-toe. Such is the character of two soils from Shropshire, analysed many years ago with the following results:—

Peaty Soils.

	No. 1.	No 2.
Moisture	2.77	4.03
Organic matter	21.15	37.92
Oxides of iron and alumina	5.15	1.91
Carbonate of lime	.80	.52
Magnesia and alkalies	.88	.25
Insoluble silicious matter	69.25	55.37
	100.00	100.00

On No. 1, white turnips grow well up to a certain time, and then die off, and on No 2 soil they suffer from finger-and-toe. Here, then, we have some further examples, which show that the deficiency of lime and probably of other mineral matters in the soil, and the excess of organic matter, greatly effect the character of roots grown upon such land. The preceding examples amply illustrate the intimate relation which exists between the character of the root crops and the nature of the land upon which they are grown.

INFLUENCE OF MANURES.

Before speaking of the next subject, the influence of various kinds of manures upon roots, it appears to me desirable to a clear understanding of the remarks which I shall have to make on this head, to refer, as briefly as possible, to the average composition of the principal root crops, and to consider the various conditions which regulate their nutritive value.

The following table, founded on numerous analysis, shows the average composition of different root crops:

Average Composition of Roots.

	Turnips.	Swedes.	Mangels.	Sugar Beet.	Carrots (white Belgian.)	Parsnips.
Water	91.5	89.5	88.5	84.5	87.0	82.0
Albuminous compounds	1.1	1.5	1.5	1.5	.7	1.3
Fat	.2	.2	.1	.1	.2	.5
Pectine, &c.	1.5	1.0	1.0	.9	1.2	1.2
Starch	..	..	..	..	..	3.5
Sugar	3.0	5.0	5.5	9.5	6.5	3.0
Cellular fibre	2.0	2.1	2.4	2.5	3.5	7.5
Mineral matter (ash)	.7	.7	1.0	1.0	.9	1.0
	100.0	100.0	100.0	100.0	100.0	100 0

The amount of dry feeding matter, it will be seen, is largest in parsnips and smallest in white turnips. In the former we have as much as 18 per cent. of dry substance, and in the latter only 8¼ per cent. If we arrange the different root crops according to their per centage of water and dry substance, we get the following order:—1, parsnips; 2, sugar-beets; 3, carrots; 4, mangels; 5, swedes; 6, turnips. As regards the nutritive or feeding values of these different root crops, I am inclined to place them in the same order, and the least to turnips. The amount of solid matter in equally matured root, it strikes me, may be fairly taken as the measure of their comparative feeding value. Well matured roots, it will be seen, contain a considerable amount of sugar. The largest proportion occurs in sugar beets, the smallest in turnips. Upon it the feeding value of roots greatly depends. Excepting parsnips, in which a certain proportion of sugar is replaced by starch—a constituent which serves the same ends in the animal economy—the per centage of sugar in roots affords a good means for judging of their comparative feeding values. Thus we have in

Sugar-beets	9½	per cent. of sugar on an average.	
Carrots	6½	"	"
Mangels	5½	"	"
Swedes	5	"	"
Turnips	3	"	"

The order, based upon the per centage of sugar, it will be noticed, coincides with that based upon the per centage of dry matter in roots. Whether we judge of the nutritive value of well ripened roots by either standard, the practical result is the same. The proportion of sugar, as a rule, rises or falls with the per centage of water and dry matter in the roots. Starch occurs in considerable proportion in parsnips, and in small quantities in unripe mangels, carrots, and swedes. With the maturity of the last mentioned crops the starch disappears and becomes converted into sugar. The per-centage of albuminous compounds and of ash constituents in different root crops on the whole do not vary in well-matured roots in the same degree as the per-centage of sugar. The case is different in immature roots. Such roots, according to their comparative state of maturity, exhibit a much greater range of variations in nitrogenous matter and ash. I find invariably the per centage of nitrogen and of ash much larger in roots at the earlier stages of their growth than at a later; a high per centage of nitrogen and of mineral matter in roots, therefore, are indications not of their high feeding value, but the reverse. Briefly stated, the nutritive value of different root crops depends largely upon their state of maturity, or, in other words, upon the per centage of dry matter, and the proportion of sugar in the dry substance of the roots. Unripe turnips and mangels not only are poor in sugar, but they contain organic acids, which, together with an excess of imperfectly elaborated nitrogenous substances, appear to be the cause of the unwholesome properties of unripe roots. Mehay found .22 per cent. of oxalic acid in sugar-beet, .43 per cent. in the stalk, and as much as 1.86 per cent. in the leaves. In passing, I may notice that the leaves of root crops contain much more nitrogen than the bulbous roots; and as turnip or mangel tops, in regard to nutritive properties, are not to be compared with the roots, we have here positive proof of the fact already pointed out, that the feeding value of root crops is by no means proportional to the nitrogen which they contain. That this is not merely a theoretical proposition is clearly shown by some direct feeding experiments which Mr. Lawes made in 1848, and fully described in a paper published in vol. viii., p. 495, of the *Journal of the Royal Agricultural Society of England*, with a view of testing practically the feeding value of four lots of white turnips, grown with different kinds of manures. Mr. Lawes determined the amount of dry organic matter which was consumed to produce 100 lb. of live weight in sheep fed upon white turnips from his experimental field. The following tabulated statement explains itself:—

Effects of Manuring.

	Mineral Manures only.	Minerals with Ammonia	Minerals with Rape-cake	Minerals, Ammonia and Rape-cake.
Dry substance in the fresh turnips	9.37	8.42	7.78	7.88
Ash in dry roots	6.69	7.48	8.21	8.92
Nitrogen in dry roots	1.50	2.08	2.36	3.20
Dry organic matter consumed to produce 100 cwt of live weight	lb. 2288	lb. 1321	lb. 2371	Thesheep lost live weight.

The turnips grown with minerals only (superphosphate and alkalies) were over-ripe and pithy; the second lot, which gave the best result, were fully ripe; the third and fourth lots were unripe. The most unripe turnips, containing the highest per-centage of nitrogen and of ash, it will be seen, gave the worst result when employed as food. These interesting experiments strikingly exemplify the influence of manures on the composition and feeding qualities of turnips. Let us now examine a little more minutely the modifying influence of different kinds of manuring agents on root crops. Land highly manured with rich dung from the fattening boxes or stalls induces luxuriant and vigorous growth in root crops, and, as is well known, has a tendency to develop over-luxuriance in the tops. This is the case more particularly if the dung is derived from fattening beasts, liberally supplied with oilcake and artificial food rich in nitrogenous constituents. If the autumn turns out fairly dry and warm, the roots in highly manured lands continue to grow vigorously, the bulbs swell to a large dimension; and if the weather in September and October continues warm and dry, a heavy weight and fairly ripe roots result from the liberal use of rich dung. But should the autumn be cold and wet, too liberal an application of good, well-rotten dung is apt to maintain the luxuriant tops in a vigorous, active, growing condition, at a period of the year when the crop has to be taken up, and the result is an immature root crop of a low feeding value. Although the bulbs may be of a good size, they turn out, when grown under such conditions, watery, deficient in sugar, and not nearly as nutritious as they would have been had a more moderate dressing of dung been put upon the land. The main cause of the immature and low feeding quality of mangel grown with an excessive quantity of rich dug is the comparatively large amount of ammoniacal and nitrogenous constituents in the dung, for numerous field experiments have shown that the peculiar tendency of ammonia salts, and of readily avail-