

of soil. How long a time may have been required to effect the formation of a soil it is quite impossible to say, but the extreme slowness of the process points to its continuance through unknown ages, extending back far beyond the time when there was not yet a man to till the ground. Neither is it correct to entirely attribute the soil to the processes of slow decay, for they have been also formed by the direct wearing action of water, the more rapid grinding action of glaciers during the glacial period, and the transporting effects of rivers and the ocean. All the running water in the world is engaged daily in either making or removing soil, and every beach and river-course gives evidence of this effect. Soils are, then, the result of decay and attrition, or wear. In many cases the soil rests upon the rock from which it was derived, and partakes of its character. Such are chalk, limestone, and many clay soils, which rest upon a foundation of the same rock which has yielded them. These are called sedimentary soils. In other cases they have been brought from a distance by the action of water, in which case they are called transported soils. Every farmer who wishes to understand the nature of a soil should ascertain the geological formations from which it has been derived. He will find that one of the best keys to a knowledge of the variations of soil in his district is a study of the geological map, more particularly with reference to the surface geology of the neighbourhood.

THE CONSTITUTION OF SOIL.

There are, however, certain characters which are common to all fertile soils. They are, for example, all composed, although in varying proportions, of five very familiar substances. These are sand, clay, lime, vegetable matter, and stones. These form the bulk of every soil, and, as they predominate, the soil is termed sandy, clayey or argillaceous, limey or calcareous, peaty or "vegetable," and gravelly. Loams are mixtures of sand and clay in suitable proportions for cultivation, and may be heavy, medium, or light, according as the sand or clay predominate. Marls are mixtures of clay and lime, and vary from a distinctly calcareous to a pronounced clayey type.

THE BARRENNESS OF SAND, CLAY, LIME, AND VEGETABLE MATTER.

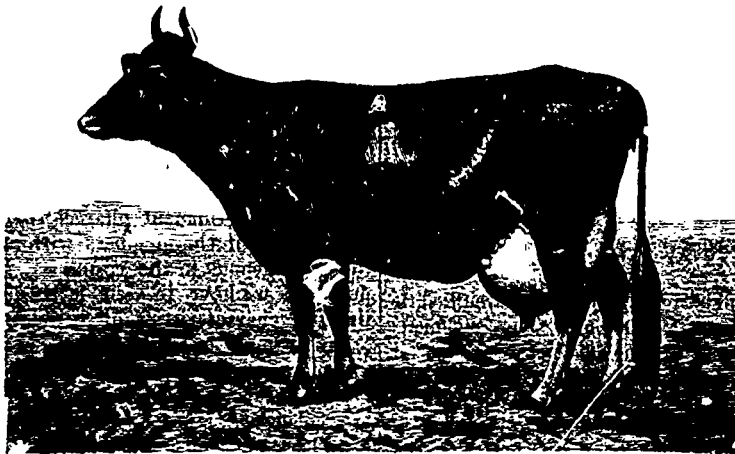
It is curious to note that in the pure or separate form none of these constituents of soil are fertile. Further, if even properly mixed, they would be far from giving us what we require, namely, a fertile soil.

The fertility of soils depends to some extent upon the happy commingling of these substances, but it is to the presence of certain substances which in nature are associated with them that the fertility is due.

By far the most striking example of this is CLAY. Chemically speaking, clay is a hydrated silicate of aluminium. Clay, as we understand the term, is, however, a substance

bound together by the silicate just mentioned, but composed largely of exceedingly fine, sandy particles, and it is generally red, owing to the presence of oxide of iron. Clay usually contains the important plant food potash, which originally existed in the granite or felspar from which it was derived. By virtue of the iron or ferric oxide which it contains, clay also has the power of retaining phosphoric acid, and, in a less degree, ammonia. Hence clay becomes a vehicle through which potash, phosphoric acid, and ammonia may be retained and presented to the roots of plants. It is always ready to seize upon and hold these substances when added in the form of manures, and hence clay soils are able to retain the most valuable fertilising materials much better than the lighter sandy soils. Clay is also retentive of moisture, and protects the soil in which it occurs from the effects of drought.

Sand is best described as small, hard particles of silica. Any small particles may be called sand, as, for example, calcareous sand or micaceous sand, and to these substances our description does not apply. We refer especially to quartzose sand, which is almost pure silica and is insoluble, and entirely useless as a plant food. The uses of sand are rather negative than positive. It prevents clay from being too retentive, and opens its pores so as to render the soil permeable to air, to water, and to the spread of the delicate fibres of roots. It is naturally warmer than clay, being a worse conductor of heat, and it has no power of absorbing moisture from the air, and small power to retain moisture. Sand, therefore, modifies the character of a clay soil, and renders it friable or easy to pulverise, dry, and warm.



Imported Guernsey Cow Select 2205, the property of Mr. Francis Shaw, New-Braintree, Massachusetts.

Lime differs from both the last-named component parts of soils in being a true plant food. No clay or sand enters within the frame of the growing plant, but lime is an invariable constituent of the ash or mineral part of all plants. It has other functions besides that of being a plant food. It is one of the most important instruments for preserving potash and ammonia in the soil. The chlorides, sulphates, or nitrates supplied to a soil are decomposed by lime, forming salts of lime, which wash through the soil, leaving the alkaline bases in combination with the silicates of aluminium, which occur in all, but in a special degree in clay soils. Hence lime assists in holding important fertilising materials, and applications of lime to a soil are useful in this respect.

We have now seen how clay, sand, and lime act in conferring certain important fertilising effects upon the soil in which they exist. They are intimately associated with the presence of phosphoric acid, potash, ammonia, magnesia, and, by implication, of lime in the soil, and these are by far the most important mineral ingredients of the food of plants.

The ORGANIC MATTER in soils gives the peculiar dark colour to garden mould and to rich agricultural land. It is partly composed of the roots, leaves, stubble, and farmyard manure, &c., applied to land. It may be divided into the recent and most actively fertilising additions of these substances and older matter, which is termed humus. The