substance which is stirred or tilled by implements such as ploughs and spades. Below this is the *subsoil.* The soil through being acted upon by the air, heat, frost and other agencies usually consists of finer particles than those comprising the bulk of the subsoil. It contains more roots, and as a rule, is darker in colour than the subsoil on account of the larger proportion of decaying vegetable matter present in it: it is also looser in texture than the subsoil. The subsoil not unfrequently contains materials which are deleterious to the growth of crops, and roots descending into it may absorb and convey these poisonous substances to other parts of the plant or be themselves damaged by contact with them. On this account deeper tillage than usual, which allows of easier penetration of roots, or the carrying out of operations which bring the subsoil to the surface, must always be carefully considered.

At first sight few natural materials appear to be of less interest than the soil; yet its importance is manifest on the slightest reflection. From it, directly or indirectly, are obtained all food materials needed by man and beast. The inorganic materials within it supply some of the chief substances utilized by plants for their development and growth, and from plants animals obtain much of their sustenance.

*Origin of the Soil.—*It is a matter of common observation that stones of monuments, walls or buildings which are exposed to the air sooner or later become eaten away or broken up into small fragments under the influence of the weather. This disintegration is brought about chiefly by changes in tempera­ture, and by the action of the rain, the oxygen, and the carbon dioxide of the air. During the daytime the surface of the stone may become very warm, while at night it is speedily cooled. Such alterations in temperature produce strains which frequently result in the chipping off of small fragments of the material composing the stone. Moreover the rain penetrates into the small interstices between its particles and dissolves out some of the materials which bind the whole into a solid stone, the surface then becoming a loose powdery mass which falls to the ground below or is carried away by the wind. The action of frost is also very destructive to many stones, since the water within their cracks and crannies expands on freezing and splits off small pieces from their surfaces. In the case of lime­stones the carbon dioxide of the air in association with rain and dew eats into them and leads to their disintegration. The oxygen of the air may also bring about chemical changes which result in the production of soluble substances removable by rain, the insoluble parts being left in a loosened state.

These “ weathering ” agents not only act upon stones of buildings, but upon rocks of all kinds, reducing them sooner or later into a more or less fine powder. The work has been going on for ages, and the finely comminuted particles of rocks form the main bulk of the soil which covers much of the earth’s surface, the rest of the soil being composed chiefly of the remains of roots and other parts of plants.

If the whole of the soil in the British Islands were swept into the sea and the rocks beneath it laid bare the surface of the country would ultimately become covered again with soil produced from the rocks by the weathering processes just described. Moreover where there was no transport or solution of the soil thus produced it would necessarily show some simil­arity in composition to the rock on which it rested. The soils overlying red sandstone rocks would be reddish and of a sandy nature, while those overlying chalk would be whitish and contain considerable amounts of lime. In many parts of the country soils exhibiting such relationships, and known as *sedentary* soils, are prevalent, the transition from the soil to the rock beneath being plainly visible in sections exposed to view in railway cuttings, quarries and other excavations. The upper layer or soil proper consists of material which has been subjected swine, *sus. "*To sully,” to besmirch, to cover with “ mire ” (O. Eng. *sol.* cf. Ger. *sühlen)* is a quite distinct word. Lastly there is a form “ soil,” used by agriculturists, of the feeding and fattening of cattle with green food such as vetches. This is from O. Fr. *saoler, saouler,* mod. *soûler,* Lat. *satullus,* full-fed *(satur,* satiated, *satis,* enough).

to ages of weathering; the bulk of it is composed of finely comminuted particles of sand, clay and other minerals, among which are imbedded larger or smaller stones of more refractory nature. On descending into the substratum the finer material decreases and more stones are met with; farther down are seen larger fragments of unaltered rock closely packed, and this brash or rubble grades insensibly into the unbroken rock below.

In many districts the soil is manifestly unconnected in origin with the rock on which it rests, and differs from it in colour, composition and other characters. There are *transported* or drift soils, the particles of which have been brought from other areas and deposited over the rocks below. Some of the stiff boulder clays or "till ” so prevalent over parts of the north of England appear to have been deposited from ice sheets during the glacial period. Perhaps the majority of drift soils, however, have been moved to their present position by the action of the water of rivers or the sea.

As fast as the rock of a cliff is weathered its fragments are washed to the ground by the rain, and carried down the slopes by small streams, ultimately finding their way into a river along which they are carried until the force of the water is insufficient to keep them in suspension, when they become deposited in the river bed or along its banks. Such river-transported material or *alluvium* is common in all river valleys. It is often of very mixed origin, being derived from the detritus of many kinds of rocks, and usually forms soil of a fertile character.

*Quality of Soil.—*The good or bad qualities of a soil have reference to the needs of the crops which are to be grown upon it, and it is only after a consideration of the requirements of plants that a clear conception can be formed of what characters the soil must possess for it to be a suitable medium on which healthy crops can be raised.

In the first place, soil, to be of any use, must be sufficiently loose and porous to allow the roots of plants to grow and extend freely. It may be so compact that root development is checked or stopped altogether, in which case the plant suffers. On the other hand it should not be too open in texture or the roots do not get a proper hold of the ground and are easily disturbed by wind: moreover such soils are liable to blow away, leaving the underground parts exposed to the air and drought.

The roots like all other parts of plants contain protoplasm or living material, which cannot carry on its functions unless it is supplied with an adequate amount of oxygen: hence the necessity for the continuous circulation of fresh air through the soil. If the latter is too compact or has its interstices filled with carbon dioxide gas or with water—as is the case when the ground is water-logged—the roots rapidly die of suffocation just as would an animal under the same conditions. There is another point which requires attention. Plants need very considerable amounts of water for their nutrition and growth; the water­holding capacity is, therefore, important. If the soil holds too much it becomes water-logged and its temperature falls below the point for healthy growth, at any rate of the kinds of plants usually cultivated on farms and in gardens. If it allows of too free drainage drought sets in and the plants, not getting enough water for their needs, become stunted in size. Too much water is bad, and too little is equally injurious.

In addition, the temperature of the soil largely controls the yield of crops which can be obtained from the land. Soil whose temperature remains low, whether from its northerly aspect or from its high water content or other cause, is unsatisfactory, because the germination of Seeds and the general life processes of plants cannot go on satisfactorily except at certain tempera­tures well above freezing-point.

A good soil should be deep to allow of extensive root develop­ment and, in the case of arable soils, easy to work with imple­ments. Even when all the conditions above mentioned in regard to texture, water-holding capacity, aeration and temperature are suitably fulfilled the soil may still be barren: plant food­material is needed. This is usually present in abundance although it may not be available to the plant under certain