FORMATION OF SOIL

--by Helen M. Martin

At first only granitic (the igneous) rock was the land surface of the earth. Cooling and contraction, heating and expansion, changes of temperature, cracked the rock. Ice formed in the cracks and broke it further. Rain and snow falling through the air gather carbon dioxide and become slightly acid and can then dissolve minerals. So the first rains helped to dissolve and change its minerals and to weaken the surface rock and break it into smaller and smaller fragments. Then pelted by rain, blown by wind it was further broken and weathered.

Broken fragments of rock and minerals in solution (then as now) were carried to the sea where they were sorted by waves and currents and deposited on shore and out to sea. Coarse material was on and near shore, deposited material was successively finer and finer farther out, and the mineral in solution was carried farthest from shore, and at times and in some places, some was deposited. In other words, coarse material is on shore (gravel), and deposits successively out from shore are coarse sand, fine sand, clay, silt, and chemical precipitates like lime.

Then life came into the sea, low forms of plant life at first – algae, fungi, bacteria. Chemical precipitation was hastened by bacteria. The bacteria and other organisms that followed, died, fell to the bottom of the sea, and were there incorporated with the muds. As time passed, the various sediments were compacted (that is, the water was squeezed out of them), consolidated, and cemented into firm rock. At times, these rocks--conglomerates. sandstones, shales, limestones, iron formations--became land surface and the process of weathering continued as before. Eventually, plants came out of the sea where their food had been minerals in solution, and on the land they found that food was to be found in the solutions that filled the cracks of the rocks, and so, lowly plant forms began to develop roots, higher plant forms evolved, and through the millions of years our flora was developed.

During the time the primitive plants were moving to a higher stage as land plants, animal life began to develop in the sea, having an abundance of plant food in the sea water for its sustenance. The plants on the land died. their organic matter mixed with the broken mineral matter and a primitive soil was formed. In time, the animals also came on the land--the lowly forms of worm and insect life that lived on decaying vegetation. When they died, they also became incorporated with the broken up rocks and produced a soil. During the lifetime of plants and animals, both produced various acids which were capable of dissolving more and more and greater varieties of mineral matter, thus producing more varieties of food and causing a development of higher and higher forms of plant and animal life.

In areas that have not been glaciated, the soils are formed from the bedrocks of the region and are known as residual soils. They were made by the weathering of the rocks, the freeing of mineral foods by solution, and the addition of organic matter with the activity of organisms. Thus, the rocks of a region might be considered the supermarket where unprepared foods are stored. The waters of the earth and air and the bacteria, angle worms, ants and others, are the cooks that prepare the minerals in a form suitable for nutrition of plants. Putting it simply, the soil is a combination of mineral matter and organic matter. The mineral matter is the true plant food.

In other areas, the winds carried fine dusts that were deposited in thick masses known as loess. Some of the most fertile soils are made of loess, as the mineral particles are so fine they go very readily into solution, becoming plant nutrients.

In the non-glaciated regions, the residual sails take on the character of the bedrock. They are sandy, limey, clayey soils and all sorts of combinations of the three. In glaciated areas, on the other hand, the bedrock is under a thick to thin mantle of glacial drift. Glacial drift is made up of all sorts and sizes of rocks. It is weathered as the original granitic rocks were weathered, organic matter is added to it in much the same way, but a complex variety of soils is developed on the glacial drift.

In places, ponds and lakes have developed. They are more numerous in the glaciated than in the non-glaciated areas, and as the water table lowered, vegetation has crept in and in dying, has “built up a mass of vegetative matter, which we know as our muckland soils. The muck itself is not a plant food. It is the kitchen in which plant food is prepared by water and organisms that provide acid for plants. It is also the spongy storehouse for storing plant foods in solution.

Mineral fertilizers added to our present soils bring valuable plant food when such fertilizers are dissolved by water. Organic matters added to soils provide plant food only when they are so decayed that the minerals which they have extracted from the soils are returned to the soils by the dead and decayed plant. Such organic matter breaks up clumpy, clayey soil and promotes its tilth, or promotes making plant food available. Since plants take minerals from the basic rock and animals live upon plants, both plant and animal (organic) fertilizers return minerals to the soil.

In any discussion of soil, it should always he noted that water is the most essential factor in producing and maintaining plants, plant food and thus soil, in the agricultural sense.

Engineers and geologists discuss “soils” with little reference to their organic content, meaning broken up or weathered rock--igneous or granitic; the crystalline rocks; the sedimentary rocks--conglomerates, sandstone, shale; the organic sedimentary rocks--limestone and coal; and the rocks we know as metamorphic. The agriculturist classes some soils as

mineral and organic but what is known as soil in the agricultural sense is weathered rock sediments plus organisms, both plant and animal, and the decomposition products of their living and dying, and always with water and air included.

A very interesting study can “be made of the work of plant and animal families in forming soil: i.e. grasses form soil faster and deeper than forests - contrast prairie and forested regions, insects, worms, burrowing animals help to break soil faster and deeper than the large mammals - horses, elephants.

Beneath the agricultural soil is a zone of more compact but weathered rock called the subsoil (known also as “parent material”). It contains a reserve of mineral nutrients and is changed into soil as it is penetrated by plant roots and by burrowing animals and insects and as air and water enter the gone. Under the subsoil in non-glaciated regions is the bedrock of the area. In glaciated regions the subsoil is compacted glacial drift which ranges from a few inches to hundreds of feet in thickness. Outside the glaciated area residual soils are old and thick, but within the glaciated areas, soils are young and thin.