BIOLOGY

Exploring Mother Earth

This summer is a good time to take soil apart and put it back together. There is a fascinating world underfoot that is too often taken for granted.

By HOWARD SIMONS

➤ THIS SUMMER tread lightly on Mother Earth.

Whether you are hiking through the woods, playing at a lakeside or green-thumbing in the back yard, there is an entire world alive underfoot.

Summer in the United States affords children and grown-ups alike a fine opportunity for exploring the world they live in, but rarely have time to take apart and put back together. There seems no earthly reason why a find-it-out-yourself course in something as "taken-for-granted" as earth cannot be fascinating and educational.

This is the direction two researchers of the New York State College of Agriculture at Cornell University, Ithaca, N. Y., have taken. Profs. Dora E. Worbs and Eva L. Gordon have found the world underfoot as fascinating as others have found the world overhead.

"Wherever you are now," they point out, "down underfoot there is soil or rock from which soil is being made. This soil is not just plain dirt. It is an exciting world which few persons really discover. It is a living world of plants and animals, some so small that they can be seen only with the help of a microscope, others as large as woodchucks and the roots of giant trees. It is a world of particles of different colors, sizes and combinations. It is a chemical world of air, water and minerals. It is a constantly changing world, a wonderful world to explore."

Surface Soil Is Mixture

A good place to start exploring, the New Yorkers state, is with a handful of soil. This will probably be surface soil, which is often a mixture of particles of many sizes. Good representative surface soil might contain pebbles, or even large stones; sand grains; fine silt and clay particles.

A handful of soil is actually small bits of rocks made up of various minerals and the remains of plants and animals that have lived and died in or on the soil.

This is surface soil. It is the richest of the soil layers in organic matter and the most familiar to man, who has plowed, tilled, dug and cultivated it for thousands of years. It is also the most weather-beaten. Just below the surface soil is the subsoil, an ever changing mixture that pushes itself upward, eventually graduating into the lower surface soil class.

The surface or topsoil is usually darker than the subsoil. This is so, the soil scientists state, because it contains more humus, made of decayed bits of plant and animal life and the waste products of living plants and animals. These substances are broken down by microorganisms in the soil, until they are no longer recognizable. The tiny dark-brown or black particles we call humus are so small that they cannot be seen even with the help of a microscope.

Topsoil containing humus is much desired by the farmer and the gardener, for humus soil holds more water and air than soil without it. And water and air are necessary to the life of soil.

Crumble a lump of moist soil from a plowed field or your garden and watch it break into smaller lumps. These crumbs of soil are called aggregates. Just how these aggregates are made and then held together is not fully understood by the scientists. Wetting and drying, freezing and thawing help to arrange soil particles as do the activities of plants, groundhogs, chipmunks, moles and earthworms.

Like human skin, soil has holes that are called pores. Through these pores, the soil receives its water and air. Lack of air in the soil is just as bad for it as a lack of water.

Soils on which trees or grass have grown for some time under careful management, the New Yorkers report, usually have many aggregates, which in turn means that air and water can move readily through them and in which roots and root hairs can push their way easily. Soils used to grow some crops often lose these valuable aggregates.

Raindrops falling on bare ground break them and water that runs off a field carries away humus, clay and silt. This is why soil conservation practices are so vital to the life of good soil.

Subsoil Also Important

Subsoil is important too, we are told, because plants with long roots often sink their way through the topsoil in search of water and minerals in the subsoil. Below the subsoil in a representative profile is usually found broken-up rock. And even farther down is often just rock.

Soil itself has character. It has color and a popular and technical name.

Anyone who has seen the red soil of

LIFE UNDERFOOT—This young lad, in search of worms for an afternoon of fishin' now that school is out, is surrounded by a world of underground dwellers. Life underfoot is fascinating and rarely given thought. The soil in which he found his worm probably harbors billions of microscopic plants and animals that contribute to the growth of soil.

Oklahoma, or the deep black soil of Iowa or the soft brown soil of upstate New York has first hand experience that soils can vary in color.

They are different in how they are identified too. Soil scientists often classify them into four general groups according to their recognizable mineral particle sizes. These are gravels, sands, loams and clays. A soil can be and usually is a mixture of more than one of these classes. Each has subdivisions too, such as clay loam, silty clay loam and silt loam. Soils are named by the scientist for their texture. To this is added the geographic name of the place where the soil was first studied, such as Ontario (N. Y.) silt loam.

Keystone to Soil Formation

A large part of the life of the soil is made up by the life underfoot in the soil. It is a keystone to soil formation. The numbers and kinds of living organisms in the soil can be staggering to the imagination. Soil scientists in one study, for instance, figured out that one gram of soil could harbor from 100,000 to several billion bacteria.

Or, as the New York study puts it, "a tablespoonful of fertile topsoil may contain more of these tiny creatures (microscopic plants and animals) than there are people in the whole United States."

Minute organisms, however, are not the only life beneath the surface of the earth. Many kinds of plants and animals, we are reminded, find ideal living conditions in soil: different kinds in different soils. Many live their whole lives among soil particles. Others live half under and half above the soil.

There are animals that live in the soil, chipmunks, woodchucks and prairie dogs, to name a few. They use the soil "as a cozy home, but go above ground to make a living." The mole, on the other hand, spends almost its entire lifetime burrowing in the dark underground.

Probably the most popular underground inhabitant is the earthworm, who not only contributes to the sport of fishing, but is man's valuable soil engineer. The earthworm passes soil through its body, feeding on the substances in it.

In addition to the larger animals and the earthworm, one can find slugs, snails, sowbugs, centipedes and millipedes, spiders and mites, ants, beetles and small animals called threadworms, eelworms or nematodes.

Plants too can be found under the soil. These are tiny plants that lack chlorophyll, the substance that makes plants green. These are mostly fungi and molds. Still others, the Cornell scientists report, are called thread bacteria or actinomyces, which are like molds in some respects and like bacteria in other respects.

Not all plants and animals are helpful. Some are considered harmful soil dwellers.

"Probably no animals or plants are harmful to the soil itself. A few soil dwellers may cause diseases of living things, including man. Some may injure plants that men wish to grow."

The mole, Japanese beetle grub and microscopic threadworms are in this category.

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GEOPHYSICS

North Pole Farther North 150 Miles Up

➤ THE NORTH POLE is one degree farther north at a height of 150 miles above the earth's surface, Dr. J. A. Jacobs, University of Toronto physicist, reports in *Nature* (July 7).

He calculated the gradual shift in the position of the North Pole with increasing altitude. Its position at ground level is 76 degrees north, 258 degrees east (102 degrees west) for the year 1942, Dr. Jacobs calculated. For the year 1956, he reports, the latitude must be increased approximately one degree, although there is no appreciable change in longitude.

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OCEANOGRAPHY

Scientists Studying Long Island Sound Sediment

➤ SCIENTISTS from the American Museum of Natural History in New York have begun a three-year study of the bottom of Long Island Sound.

The underwater explorers are seeking fossils, microscopic plants and animals and new knowledge of how oil is formed.

Called "Operation Triple S" (Submarine Sedimentation Survey), the project is headed by Dr. Brooks Fleming Ellis, chairman of the department of micropaleontology at the American Museum of Natural History and professor of geology at New York University.

Dr. Ellis calls the project "the first attempt at a thorough analysis of sediment deposition and distribution in Long Island Sound." He says the Sound is "a perfect place to carry on such a survey."

The Sound's bottom is made up of a wide variety of materials, from tiny invertebrates to large marine plants and animals, from black mud that may form oil millions of years hence to the waste products of civilization.

The survey will try to discover more about how these substances get where they are, their relationships with each other, how they become mud and even what that mud may become in several million years.

The project is being conducted jointly by the American Museum of Natural History and New York University, with the support of Abercrombie and Fitch. It will continue through October, 1956, and will resume during the summers of 1957 and 1958.

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