Bacteria—Chief Chemists of the Soil

Soil Science

Scientists Tell of Their Work at Congress in Russia

Russia, with the Great Bear's share of the land of two continents, is naturally a land (or rather a group of lands) of many soil types. With its great population dependent primarily on agriculture and the forest industries, it is to be expected that soil science should play an important part in the effort that is being made since the Revolution to place Russian living on a more comfortable material basis. Soil scientists in Russia are among the foremost in their field, and their colleagues in other lands are agreed that it is highly appropriate for the Second International Congress of Soil Science to be held in Leningrad and Moscow. Herewith are presented reports on a few of the many papers read there during the past week.

EVERY plant that sends its roots down into the soil gathers to itself a great crowd of microscopic hangers-on, like the vassals around a baron of old. It greatly promotes the growth of soil bacteria, and to a less degree it encourages fungi and other soil microbes. Studies of this condition were reported this week before the Second International Congress of Soil Science at Leningrad, by Prof. Robert L. Starkey of the New Jersey Agricultural Experiment Station.

Plants seem to produce a substance or substances through their roots, that bacteria find available for their needs, for the microorganisms grow thickest in immediate contact with the roots and are much scarcer a fraction of an inch away, Prof. Starkey found.

Rapidly Growing

BACTERIA are the chief chemists of the multiplex changes of material that are constantly going on in the soil. We have begun to understand their work, but our understanding so far is only a beginning, and soil microbiology is on the threshold of a development that will dwarf all present accomplishments in that field.

These were among the ideas presented by Prof. Selman I. Waksman of the New Jersey Agricultural Experiment Station. Prof. Waksman's paper summed up the present status of soil microbiology, with special stress on recent developments.

While soil microbiology is rapidly growing up into an independent branch of science, its future still depends on its continued contact with its parent sciences, Prof. Waksman emphasized. General bacteriology and the study of the fungi, on the one hand, and soil chemistry on the other, will both make large contributions to its development and recieve new growth themselves from the data which it will produce.

Desert Soil Bacteria

NITROGEN-FIXING bacteria are active even in the arid soils of the desert, Prof. P. S. Burgess of the Arizona Agricultural Experiment Station told his fellow soil scientists.

These nitrogen-capturing microbes are usually thought of as being active only in soils where higher plants leave something for them to feed on; but Prof. Burgess found that in the desert soils there were enough algae, free-living one-celled plants, to supply at least part of the foodstuffs needed by the bacteria. The bacteria are able to thrive also in the presence of rather high concentrations of alkali.

Rejuvenation

PROF. S. KRAVKOV, a Russian soil scientist, told his colleagues that he has developed a method for restoring fertility to apparently exhausted soils without the use of fertilizers.

It consists of keeping the soil to be treated under optimum physical conditions, especially as regards temperature, moisture and aeration, while the natural microbiotic population builds up and captures nitrogen from the air. Prof. Kravkov stated that he had increased the nitrogen content of "podsol," a poor, gray soil found in certain forest lands, approximately tenfold by his method.

Sulfur as Fertilizer

SULFUR must take its place on the list of approved fertilizer minerals, at least for certain types of land. Such is the indication of experiments performed by Prof. W. L. Powers of the Oregon Agricultural Experiment Station.

Prof. Powers has attacked the problem of black alkali, one of the most hopeless types of land ruin in the arid and irrigated West. He found that applications of sulfur, especially when used in combination with a nitrogen-rich organic fertilizer, will reclaim such land and make it yield good crops.

Even normal land is often benefited by sulfur application, he found. Sulfur-treated fields produced higher yields of alfalfa, which had a richer, greener growth than that of the unsulfured fields.

Antagonistic Iron

IRON in the soil has a constant tendency to break up aluminum compounds it finds there and set the aluminum adrift. This is indicated by experiments of Dr. J. S. Joffe of the New Jersey Agricultural Experiment Station.

Analyses of river waters showed that ordinarily they contain more aluminum than iron. In an endeavor to learn how this comes about, Dr. Joffe added a soluble iron compound to samples of soil, and found that in the solutions he got out again the iron had decreased in concentration, having been captured and held by the soil, accompanied by a release of aluminum. But when soil containing a good deal of iron had a soluble aluminum compound added, it did not lose any of the iron.

Showing Up Lime

TO find out how little lime there is in the soil, find out how much iron there is in the plants that grow on it.

This, in rough outline, is the field method of soil analysis used by Prof. Oscar Eckstein of Berlin, and described by him.

It is not of much practical value, Prof. Eckstein said, to determine by analysis the total calcium content of a soil. Not all the calcium in it is available to plants, and it is only the available calcium that really counts. But it has been learned that there is an antagonism between calcium and iron, and when a plant gets too little calcium it is very apt to take up an excess of iron. Iron in a plant stem can be detected very easily, by means of several (*Turn to Page* 62)

Moundbuilders—*Continued*

nations of the Plains and the northern portions of the present United States and Canada. With these, the purpose of this volume is not much concerned, for they seem to have had but superficial connection with the mound-building peoples.

"Whether or not the southerly trend of migration was numerically more important than that to the eastward, certain it is that in eventual development it was more significant. Hemmed in by mountain barriers on the left flank and enticed by the salubrious climate and never-failing food supplies of the Pacific Coast, the streams of immigrants from across Bering Strait came after a while into Mexico and Middle America. Here, in a semi-tropical setting unfavorable to the more advanced planes of human civilization but eminently encouraging to the development from primitive to higher culture stages, they prospered. From wandering nomads they became sedentary agricultural peoples, able for the first time to face the future with adequate stores of food supplies against famine and pestilence; able to exist in compact populous communities and thus to develop community enterprise and specilization of labor. The magic key which unlocked the door to progress was nothing more nor less than maize or Indian corn. . . .

Seek New Homes

"Equipped with the rudiments of agriculture and with the confidence engendered thereby, and carrying the germ of culture generated during their sojourn in the parental area in Mexico, the American aborigines again succumbed to the instinctive urge to seek new homes and to explore unknown lands. Once more groups and bands followed venturesome leaders across the visible horizon, some of them retracing, in a way, the old migration trails of the northward. To afford the reader an appreciation of the manner in which numerous highly diversified tribes and peoples, under equally diversified phases of environment, developed from a common source or stock, and to lead him, without further delay, to the objective of our inquiry, the Moundbuilder area, a somewhat hypothetical but highly probable series of movements may be assumed. From the nuclear area in southern Mexico the line of migration may be followed northward, finding its first materialization in the arid region of the Southwest. Here, influenced definitely by environment, may be envisioned the development of the Pueblo culture. Taking advantage of natural shelters in the cliffs and utilizing the native clays for making sun-dried brick for the construction of communal dwellings, the Pueblo peoples develop in due time a culture complex, distinctive and outstanding. This, it may be assumed, represents the first step outward from Mexican influence, and, as would be expected, it contains more elements of the parent nucleus than any other outlying region. The second stage of migration is found, not to the northward, as might be expected, but eastward in what is termed the Southeastern Woodland area, corresponding to the southern half of the general mound area. This second stage of removal from the Mexican cultural center brings us definitely into the country of the Mound-builders, and completes the hypothetical connection between the Asiatic migrants at Bering Strait and the peoples with which this volume is concerned. From this Southeastern region migration may be assumed to have extended, by still another step or stage, to the northern half of the mound area; and, ascending the Mississippi, it appears to have influenced to some slight extent the Plains area adjacent to the Southeastern Woodland, west of the Mississippi."

Cultures Differed

It must not be thought that after the great dispersal which Dr. Shetrone envisages the moundbuilders maintained any kind of uniformity. Though never so numerous as the peoples of Europe, they were spread over a territory nearly as large as everything west of Russia, and they achieved a diversity of culture as great as that of western Europe. Their most elaborate civilization was that of the so-called Hopewell people in Ohio and westward to the Mississippi. Their towns were the Paris and Vienna of the mound-builder world, and their ceremonial enclosures doubtless its Rome and its Canterbury. But there were at least two other distinct mound-builder peoples in Ohio alone, and when all the different types of burial, religious, and dwelling-site mounds have been counted up and correlated with the artifacts found in and around them, there are easily a score of different moundbuilder "nations" recognizable.

In spite of all that has been said and written about the moundbuilders, the real scientific investigation of their story is only beginning. There are thousands of mounds that have never been explored, including even the largest of all, the great mound of Kahokia, Illinois, opposite St. Louis, which is bigger than the pyramid of Cheops.

Some of these have been set aside as state parks or otherwise protected.

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Bacteria—*Continued*

different chemicals that cause a change of color when it is present. So by this indirect method it is possible to determine whether or not there is sufficient calcium in a given piece of land.

Increasing Nitrates

SOIL nitrates, one of the most important classes of plant nutrients, are materially increased by the addition of other fertilizers in proper amunts. This is the central idea of a paper presented by Prof. A. B. Beaumont of Massachusetts Agricultural College.

The American scientist added graded amounts of various types of fertilizer to different kinds of soils, and tested for increase or decrease in nitrates. Lime, he found, increased the nitrate concentration, in amounts up to six tons of lime to the acre. Beyond that amount lime was not beneficial; in some cases large amounts depressed nitrification. Green crops plowed under checked nitrification for three or four weeks, but after that time nitrates again accumulated rapidly.

The addition of nitrate fertilizers naturally increased the amount of soil nitrates; but in some instances it was found that the natural reactions and biological activities in the soil increased the soil nitrates over the figure allowed for even in adding the nitrogen fertilizers. Only one non-nitrogenous fertilizer element, phosphorous, had a consistent tendency to decrease soil nitrification.

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