Earth Will Support Eight Billion People

On this page, Dr. Frank Thone gives a few of the high-lights of the First International Congress of Soil Science, which met at Washington, June 13 to 22.

Eight thousand million souls. That is the size of the population the world can sustain, if all of its lands are utilized to the full. So said Dr. Albrecht Penck, noted geographer of the University of Berlin, at the meeting of the First International Congress of Soil Science.

Dr. Penck has surveyed the peoples of the earth and considered the present and potential food-supplying power of the fields they till and yet may win from forest and desert. And he refuses to bow to the ghost of Malthus at any mere two and one-half billions, which is the limit allowed for world population by many of his colleagues.

If this latter estimate is true, he says, our politico-economic problem is indeed acute, for we shall reach the two-and-a-half billion mark within a century. A hundred years ago, when Malthus first expressed his fears of world misery through over-population, and proposed birth restriction to avert it, there were nine hundred million people in the world. The centennial of his gloomy prediction, 1920, saw the world population doubled, with at the same time a marked advance in the standards of living of many races.

The failure of Malthus' prophecy to be realized, Dr. Penck pointed out, has been due partly to the winning of new lands through the clearing of forest areas in the temperate zones, and partly to improved methods of cultivation applied to older lands. If comparable advances can be made in the yet untapped but immense resources of the tropics, the one and three-quarters billions of people now on this planet have only begun to fulfil the ancient injunction to multiply, and replenish the earth, and subdue it. To the objection that the white man can not become acclimated to the moist tropics, Dr. Penck opposes the reply that he has not yet made a really serious, scientific effort to do so, and that if he will descend gradually from his higher, cooler border lands he may yet be able to conquer the jungle and make it into a country he can live in.

But even if the tropics can not be made permanently habitable for the white race, there are other peoples who can fill them if they are properly guided. Dr. Penck pointed out the example of the natives of Java, who under the benevolent despotism of the Dutch rule have increased until now the fifty thousand square miles of the island support a population of thirty-five millions, or nearly seven hundred persons to the square mile. The Javanese have only an Oriental standard of living, it is true; yet the condition of their swarming millions now is better than that of the sparse scores of thousands of their ancestors before the science of the white man showed them how to improve their lot. As a comparison, we may vision the state of Iowa, which is somewhat larger than Java, supporting a quarter of the population of the United States, instead of its present two and one-half millions.

Brazil is to be the great nation of the future, if our grandchildren can make good the dream of Dr. Penck. It depends on whether the lowlands of the Amazon can be settled, he said. The conquest of the tropics, he emphasized in concluding, depends on a close and careful study of all factors affecting human life in them, and especially on an accurate knowledge of their widely various soils.

Science Has Stabilized Agriculture

Science has changed agriculture from an occupation that in past ages has had to choose between moving on to new and unexhausted fields, and staying at home to starve. This was the keynote of the presidential address of Dr. Jacob G. Lipman. Ancient Rome, he stated, knowing nothing of modern methods of preserving permanent fertility of the soil, literally ate up the fields of Italy, and then ate up Sicily, Sardinia and the lands of the coast of Africa. The medieval world did no better. The Germanic migrations that upset the whole world were due largely to crop failures following uneconomic primitive agriculture. Our own Indians moved frequently, apparently for the same reason. But modern science has shown the way to keep farm lands permanently productive. None the less, he added, we have still to learn to think of soil problems in world terms.

"As students of soils and soil resources we must think not only of plant-food but of its mobilization," he told his hearers. "We must consider the soil solution not alone in its local relations, but as a part of a great mass of fresh water moving to the sea. We must consider the cubic miles of sediment deposited at the outlets of great rivers as a toll upon the land and as a tax upon those who till it. We must think, finally, of ancient plants and animals, as well as of those now living, as possessors of something that in the workshop of creation must be used over and over again. We are the technical advisors to the nations who are trustees of precious raw materials. These must be used wisely and conserved effectively in order that human kind may travel with the least pain and sorrow on its road of destiny."

Terraces to Check Floods

Flood relief figured in the discussions of the Congress. Not merely stronger and higher levees to keep the Mississippi within bounds, not forests and reservoirs in the headwaters region, should be the only reliances of river control engineers, declared Dr. A. F. Woods, director of scientific work of the U. S. Department of Agriculture. The way the hills are farmed nowadays permits spring rains and melting snows to run straight off their steep sides and into the valleys, swelling the creeks and small rivers and piling the water up at last into disastrous floods. Terraces, he said, are imperative in hillside farming, if repetitions of this spring's tragic events are to be averted.

"Failure to build terraces on sloping fields generally and to plant grass and trees on the steeper lands highly susceptible to rainwash accounts for much of the excess of water now sweeping down the Mississippi," he said. "Practically nothing is being done about this phase of flood prevention. There are no hillside terraces north of the Arkansas River. Eighteen inches of topsoil has been removed from the youthful fields in some parts of northeastern Kansas. The entire topsoil is gone from hundreds of thousands of acres in western Virginia, western Pennsylvania, eastern Kentucky and southeastern Ohio. Not only will terraces and other soil-binding measures slow up the run-off water, but they will save the most valuable part of the soil, and will reduce the clogging of streams, which cuts down their carrying capacity and adds to the flood danger."

(*Just turn the page*)

Soil Science Congress

(*Continued from page* 401)

CO^2 in Soil Solution

The breath of bacteria, the carbon dioxide discarded by them as a by-product of their life-processes, comes to man's table as his daily bread. We live on the exhalations of billions of tiny beings which we never see. This, in brief paraphrase, was the revolutionary doctrine laid before the Congress in a paper prepared by Dr. Julius Stoklasa, of the Technical Institute and Experiment Station of Prague.

The old theory that plants build their food out of carbon dioxide which they capture from the air by means of their leaves, Dr. Stoklasa said, is entirely inadequate. The supplies of this gas in the air, according to his measurements, are not sufficient to account for the sugars, starches and other substances formed by plants with the assistance of the sun's energy. But the soil solution contains a great deal of carbon in the form of bicarbonates, and this carbon is taken into the plant along with the other soil minerals used by the plant, and borne by the sap to the green parts where carbohydrate manufacture is going on.

Of course not nearly all of the carbon dioxide given off by soil bacteria gets into the plants. A great deal of it escapes upwards, into the air. But here the leaves are waiting for it, and it passes into the plants through the channels hitherto taught as orthodox according to the accepted doctrines of plant physiology.

Furthermore, according to Prof. Stoklasa, fertilizers added to the soil are by no means entirely for the direct benefit of the corn or clover or other crops. A large share of these plant condiments fall to the share of the bacteria, stimulating them to greater activity in the production of materials eventually used in the production of foods by the higher plants.

The Usefulness of Fungi

Mushrooms, moulds and other fungi, neglected plants usually regarded as nearly useless or even dangerous, have their place in the complex underground processes that eventually make our farms and forests.

Sir John Russell, director of the great British agricultural experiment station at Rothamstead, told how fungi are being used on horseless farms to make fertilizer out of the otherwise wasted straw. The new "manureless manure" is made simply by adding to straw water and certain chemicals, especially phosphates, ammonia and lime, and letting the fungal spores that float in the air do the rest.

The importance of fungi to trees was stressed by a number of speakers at a special session on the problems of forest soils. Many of our most important timber trees, including pines, spruces, larches and oaks, live in a sort of mutually parasitic union with mushrooms and other kinds of fungi. These fungi receive nourishment from the trees and in turn supply other kinds of food material to the roots. Such fungi are known as "micorrhiza," which means "fungous roots." Micorrhiza thrive best, it was stated, in soils rich in raw humus, while trees in older soils have less of them. They seem to be jealous of their root-inhabiting privileges, for they keep away from their hosts the growths of harmful and wholly parasitic fungi, that would otherwise infest them.

The Versatility of Peat

Peat, or "turf" as old Irish people call it, is a material whose agricultural and industrial value is not properly appreciated in America, according to Dr. A. P. Dachnowski of the U. S. Department of Agriculture. Dr. Dachnowski showed samples of German-made cloth, woven largely from peat fibers, and sheets of thick, corky material used for heat insulation. He also had with him a vertical section cut from a peat bog, in which there are roots, leaves and the remains of insects and other forms of animal life, dating back ten thousand years or more, yet all perfectly preserved. At one level he pointed out plants that grew when Tut-ankh-amon reigned, at another, leaves that were green when Christ was born.

Physiological "Missing Links"

Creatures that seem to be a sort of missing link between the world of independently-living green plants that can build their own food out of inorganic material, and the world of dependent plants, including the fungi and bacteria, that must have ready-made organic food to live on, have been studied by Dr. B. Muriel Bristol-Roach of Rothamstead. These between-world soil dwellers belong to the plant group known to botanists as algae, familiar examples of which are the green pond-scums that swarm in stagnant water. Most of these are as completely free-living as corn or cabbage. In the soil-inhabiting group, however, there are some species that can grow in this normal fashion at the surface, but below ground, where the light is cut off, they apparently are able to take hold of dead organic material and feed on it as fungi do, thus hastening its return to the dust from whence it came.

Poison Stimulates Bacteria

Small amounts of chemical substances in the soil, many of them poisonous to bacteria, seem to have a stimulating effect on these microscopic organisms as well as on the bigger plants whose lives they affect, according to Dr. J. E. Greaves, of the Utah Agricultural Experiment Station. In his studies on the rise and decline of soil bacterial populations he has found this stimulating effect followed the use of arsenic, of sodium sulphate and of sodium chloride, all of which are poisonous to bacteria in stronger concentrations.

The explanation which Dr. Greaves offers for this phenomenon is that the effect of the poison is not a direct one. He inclines to the opinion that there is in the soil, along with the bacteria, a destructive substance or principle allied to the bacteriophage, prominent in recent medical research, and that the poisons cause increases or decreases in its activity, thereby causing the fluctuations in the numbers of bacteria.

Bacteria Founded Steel Trade

The vast iron mines of Minnesota, of Alsace, of Silesia, and the roaring furnaces of Pittsburgh, of Sheffield, of Essen, all owe their existence to the activities of humble bacteria that swarmed in unimaginable billions in the swamps and pools of long past ages. This vision was conjured up by the paper of Dr. Rudolph Lieske of the great German agricultural and forestry experiment station near Berlin.

According to Dr. Lieske, iron is an essential of life to the bacteria that cover the surfaces of wayside pools with rusty films. "Have you had your iron today?" is neither a jest nor an advertisement to these humble creatures. They get the life energy that keeps them going by changing one kind of iron rust into another. And the slow accumulation of their iron-loaded bodies, piling up through multitudinous leisurely millenia, filled the hollow places of the earth with what we now call iron ore.