PART B

Seventh International Soil Science Congress

(held at Madison, Wisconsin, U.S.A., August 1960)

(Report by C. K. N. NAIR)

Introduction :

THE INDIAN DELEGATION TO THE SEVENTH International Soil Science Congress held at Madison, Wisconsin, U.S.A., consisted of the following members :

1. Dr. N. P. Datta, Special Officer, Indian Agricultural Research Institute, New Delhi. (Leader).
2. Dr. A. Mariakulandai, Principal and Professor of Agronomy, Agricultural College & Research Institute, Coimbatore.
3. Dr. R. R. Aggarwal, Agricultural Chemist to the Government of Uttar Pradesh, Kanpur.
4. Dr. C. K. N. Nair, Professor of Agronomy, Agricultural College & Research Institute, Vellayani, Trivandrum.
5. Dr. C. T. Abichandani. Agricultural Chemist, Central Rice Research Institute, Cuttack.
6. Dr. S. Banerji, Research Officer. Agriculture Department, Government of West Bengal, Calcutta.
7. Dr. B. Ramamoorthy, Indian Agricultural Research Institute, New Delhi.
8. Shri S. Digar, Soil Correlator, All-India Soil Survey Scheme, Calcutta.
9. Shri C. M. Mathur, Agriculture Department, Government of Rajasthan, Jaipur.
10. Shri P. C. Ghosh, Agriculture Department, Government of Orissa, Cuttack (Joined the Delegation in the U.S.A.)

Professor N. R. Dhar, the distinguished Indian Scientist and a veteran leader in soil science (who was President of the Indian Science Congress, 1961) joined the Indian Delegation in New York as a special invitee to the Congress, and from then on virtually took over the technical leadership, almost until the end of the Delegation's visit to the U. S. A.

The participation of the Indian Delegation in the Seventh International Soil Science Congress was made possible by a grant from the Ford Foundation to the Government of India. The Delegation left Palam Air Port for London at noon on 2nd August 1960 and was scheduled to leave London for New York by a chartered flight the same night. But the air-craft in which the Delegation was travelling developed trouble at the Mehrabad International Air Port in Teheran and was delayed for well ovet 30 hours before it could take off for London. Consequently, the Delegation missed the chartered flight from London arranged by Professor F. A. van Baren, Secretary General of the Congress, for the Delegates of some countries

including those of India. The Indian Delegation left London on the afternoon of 4th August and after a brief stop-over at Gander, New Foundland reached New York's Idlewild Air Port at 5.00 P.M. the same day. They reached Governor Clinton Hotel, which was the centre where delegates entering New York were to assemble, well in time for the pre-arranged 1700-mile overland tour to Madison, Wisconsin, commencing the next morning.

The Tours :

Field study tours have always been one of the outstanding features of International soil science meetings. These provide an opportunity for the visiting soil scientists to see and study the soils of the host country in their natural setting. The field tours in connection with the Seventh Congress were masterpieces of perfection in regard to arrangements. The enormous and mighty resources of the United States Department of Agriculture were thrown into these. Dr. Charles E. Kellogg, Chief of the U. S. National Soil Survey had been working out details of these tours since 1956. There were three field tours arranged in connection with the Seventh Congress. Field Tour No. 1 was developed for those entering the United States at New York. Field Tour No. 2 from Madison to Washington through Southern States (1600 miles) and Field Tour No. 3 between Madison and San Francisco (3200 miles) were arranged as post-Congress tours in which the Indian Delegation did not take part.

Tour No. 1: New York to Madison:

There were about 200 delegates in this tour, representing 40 countries of the world. The tour commenced from Governor Clinton Hotel at 8 A. M. on August 5. There were five large air-conditioned buses equipped with loud speaker sytems each bus being placed under the direction of a competent guide. Professor M. G. Cline of the Department of Agronomy, Cornell University, was Tour Leader. Escorted by the New York State Police, the giant buses carrying the International Delegation moved out of New York City, passed through Lincoln Tunnel under the Hudson River and entered New York Thruway at Suffern, N. Y. Piloted by the State Police, the buses moved at an average speed of 60 miles an hour. Passing past Harriman State Park, the delegation could see Pre-Cambrian gneiss and schist formations, covered by a relatively thin mantle of glacial till. Entering an area that was dominated by medium textured *Orthic Fragochrepts*, the convoy stopped to examine a typical profile of this important group of soils of the North Eastern United States.

Orthic Fragochrept

The comprehensive Soil Classification system of the cooperative soil survey of the United States (the 7th. Approximation) was a new system which was introduced to the world for the first time at the 7th Congress. Several terras and words occur in the classification, which are new in soil science literature, The name "Orthic Fragochrept" is connotative. The ending *ept*, on the noun, is a formative element taken from the name of the order, "Inceptisol" which is derived from Latin "*inceptum*", meaning beginning. Hence the syllable *ept* indicates the class in the category of the soil order and signifies that this is a soil in the beginning or early stages of development of a genetic profile. The middle syllable, *ochr* combined with the ending *ept* gives the suborder name *ochrept*. *Ochr* is from Greek *ochros*, meaning pale, or in this case a light coloured surface soil. The soil has a fragipan in the lower layer. In the classification, a fragipan is treated as a feature additional to the characteristics

that are definitive at the suborder level. Thus the prefix *Frag,* from Latin *fragilis,* meaning brittle, is added to the suborder name to form the great soil group *Fragochrept*—a soil having a fragipan below a weakly expressed upper solum characterised by a light coloured surface soil, The adjective *Orthic*, from Greek *orthos*, meaning true, signifies that the soil has no aberrant properties. Supposing the soil had mottles or low chroma in the solum, in addition to the diagnostic criteria of the Fragochrepts, it would be considered an intergrade to the great group *Fragaquepts,* or wet Inceptisols. In that case, the adjetive would be *Aquic* implying water or wetness, and the subgroup would be *Aquic Fragochrept.*

More than an hour was spent in examining the profile of the typical *Orthic Fragochrept,* to a depth of 84 inches. The tour then continued along the eastern slope of Shawangunk Mountain, comprising of shales and slates. Then climbing the eastern edge of the Allegheny Plateau, with its broad, moderately sloping hill tops and steep sided valleys with level floors, the delegates were passing through regions of soils that developed in glacial till and belonging to *Fragocherepts* or their hydromorphic associates, *Fragaquepts* Past the famous Monticello Recreational Area and the Catskill Mountains, a predominantly forested landscape, the convoy moved through regions where privately owned forest plantations were common. The State of New York attaches great importance to the reforestation programmes. The total forested area in the State is 50 percent.

The Allegheny Plateau ;

This region occupies about 20 percent of the State of New York and contains 26 percent of the Farms. Dairying is the dominant type of farming, 40 percent of the milk supply of New York State comes from this area. The average size of farm is 244 acres, of which 85 acres is used for crops, 93 for pasture, and 56 for wood land. Hay yield is 1.9 tons/acre. Corn for silage yields 9.7 tons/acre. Oats is the principal grain crop and yields 54 bushels/acre. The average size of dairy herd is 28 cows, but ! 7 percent of the farms have more than 40 cows and the largest. 225. The average milk sold per cow is 7700 pounds, but 24 percent of the farms sell more than 9000 pounds per cow.

The average investment per farm was S 34,000. Total receipts averaged $ 13,000 per farm per year and operating expenses, $ 8,000. Farmers who use 100 lbs of plant nutrients per crop acre had average labour earnings of only S 1900 and those who used 200 pounds or more had average earnings of S 3500.

Past the flood control structures at Whitney Point built by U. S. Army Engineers the tour stopped at the Farm of E. B, Bick" ford, an outstanding young farmer of Cortland County, N. Y. Mr. Bickford, who heard a lecture in 1950 at the Cornell University Farm Programme, where it was stated that outstanding New York Dairy. Farmers of 1975 would produce 300,000 pounds of milk per man, considered this a challenge. In 1958, he has already produced 264,000 pounds of milk per man, though the average for the State was only 173,000 lbs. In 1960. he was approaching 300,000 pounds, achieving Cornell University's prediction target 15 years ahead of schedule.

From the Bickford Farm, the convoy moved through Cortland Valley, with its *Mollic Typudalf* soils (explained later), one of the most prosperous agricultural areas of New York, and arrived at Cornell University, Ithaca by 6 P. M. A distance of more than 300 miles from New York City was covered in 6 hours running time. Cornell University was the first overnight stop on the

Cornell University

Cornell is situated on the shores of Lake Cayuga. It is America's foremost Agricultural University, besides being also the leader in humanities and the sciences. Cornell is an outstanding example of public and private co-operation. The Agricultural and Veterinary Colleges, Colleges of Home Economics and Industrial and Labour Relations are State enterprises. There is an enrollment of more than 12000 students coming from every State of America and 78 foreign countries.

Professor Richard Bradfield, the President of the Seventh International Soil Science Congress, headed the Department of Agronomy at Cornell University until recently. Owing to his important pre-occupations as a Trustee of the Rockefeller Foundation, and his desire to devote more time and attention to world agricultural problems, Professor Bradfield has relinquished his position as Head of the Department of Agronomy, although he still retains his long associaton with Cornell by continuing his Professorship in Agronomy. The most outstanding American Agricultural Scientist of the day, Professor Bradfield is no stranger to India. As Director of the Rockefeller Foundation's Division of Agriculture, it was Professor Bradfield who, a few years ago, negotiated and succeeded in establishing the Post Graduate School in Agriculture at the Indian Agricultural Research Institute in New Delhi, with Rockefeller Foundation's financial assistance. It was Professor Bradfield again, who took the leading role in getting the FAO's Rice Research Institute in the Philippines established with Rockefeller assistance. A staunch friend of all under-developed countries, he has been responsible for extending to several such countries of the world many useful agricultural research programmes under the Rockefeller Foundation's financial support. One ol'the top agricultural policy makers of the U. S. A., Professor Bradfield's remarkable personality, his amazing, modesty, his friendliness to one and all, his sincerety and his superhuman patience were the contributing factors which made the Seventh Congress an unforgettable landmak in the history of soil science.

Professor Bradfield personally welcomed the delegates to Cornell. In an after-dinner reception to the delegates, Dr. Deane W. Malott, the President of Cornell University, addressed the gathering. A large number of Cornell's 1680-strong faculty members and their families were present at the reception.

The next morning, that is on August, 6, the delegates were shown round the Ithaca area. The profile of an *Ochreptic Fragaquept* (Low Humic Gley with fragipan) was examined. The term "*Ochreptic*" indicates that the intergrading diagnostic properties are confined to colour deviations.

The Mount Pleasant Research Farm of Cornell University :

The Mount Pleasant Farm, consisting of 1000 acres, is the Agronomic Research Farm of Cornell. It is seven miles away from the campus, and is at elevations ranging from 1550 feet to 1800 feet. The dominant soils are *Ochreptic Fragaquepts*. Experiments on drainage, liming, fertility, crop rotation, tillage, crop adaptation, grain crops, hay, pasture, silage, seed mixtures and crop improvement, have been laid out in this Farm. Space limitations do not allow to go into a detailed discussion of these experiments. The study of the interaction between the growing plants and their environments constitutes a fascinating experiment. Measurements of carbon dioxide exchange between plants, soil and the atmosphere under the ever-changing environment encountered in the field in the course of the growing season, were made using ingenuous devices. Inside sealed plastic canopy over the plants,

air temperature is regulated to match the temperature outside the canopy. An infra red carbon dioxide analyser monitors the carbon dioxide concentration of the air inside the canopy. CO_2 fixation is recorded as the amount of *CO,* that must be added to maintain the desired CO, level in the canopy. Transpiration is estimated by the water condensed by cooling coils of the refrigerating unit used to cool the enclosure. Fans control air turbulence.

An experimental technique for measuring carbon dioxide exchange in the photosynthetic process under natural field conditions, using aerodynamic theory, was explained to the delegates.

The Aurora Research Farm of Cornell University, comprising 450 acres is used for soil and crop research by the Agronomy and Plant Breeding Departments. The area is typical of the *Typudalf* (Grey Brown Podzolic) soils of western New York.

Mollic Typudalf:

In contrast to the *Fragochrepts* on less strongly calcareous and more deeply leached drift, silicate clays have been concentrated in the B-horizon of these soils, partly as a residual accumulation caused by loss of carbonates and partly by translocation. The entire solum is only slightly acid or neutral and free carbonates are present at shallow depth. Under these conditions, the surface horizon is relatively dark and thick. The formative element *alf* from the order *alfisol* implies the presence of the "Argillic", horizon a base saturation indicating relatively early stages of base depletion and an amount and character of organic matter more typical of forested regions than of grass lands. The syllable *ud* from Latin *udos,* meaning humid, implies that this is a soil of a humid temperate region. The syllable *Typ* indicates that the soil is the central great group of the suborder ("typical"). The adjective *Mollic* signifies that the surface horizon approaches that of the grass lands in amount and character of organic matter. *(Moll* from Latin *mollis,* meaning soft). The typudalfs are among the most productive soils of North Eastern United States. They are adapted to many kinds of crops and are very responsive to good management.

Leaving Aurora Farm, the convoy proceeded past Seneca Lake and the City of Geneva. Then past Rochester City, the home of Eastman Kodak Company, and through a region of flourishing agriculture, the delegates reached Brockport State Teachers College, the over-night stop for August 6.

The first stop on the morning of August 7, was at Gillard Muck Farm at Elba, New York. Professor Jeffery E. Dawson, Professor of Organic Soils at Cornell University who is an outstanding authority on Peat Soils in the United States, was at the Gillard Farm to explain the nature and character of New York's organic soils and peat soil agriculture. Organic soils occupy about 400,000 acres of New York State, of which 34,000 acres only are under cultivation. Onions and potatoes occupy the greatest acreages. The muck is underlain by calcareous alluvium or lacustrine material, commonly silt loam or clay loam in texture. The water that entered the bog during its formation passed through dolomite formations and the oxygen in this ground water oxidised some of the sphalerite present in the dolomite and the zinc sulphate thus formed was transported into the bog. By reduction and precipitation, it accumulated as zinc sulphide. Numerous areas of the soil are now high in zinc, causing toxicity and limiting crop production. In areas highest in zinc no crops can be grown.

From Elba to Albion, the convoy passed through an area dominated by *Typudalfs.* The St. Lawrence Valley and the Ontario

Lake Plain are among the most productive areas of the State. Fruit, mainly apples, peaches and cherries, is concentrated in this region. Vegetable growing is also most important in this region. The tour passed along the shores of Lake Ontario for several miles., and past Wilson and Youngstown, entered the city of Niagara.

Niagara Falls.

The point of pedological interest about Niagara Falls is that the resistant dolomite that caps the Falls is underlain by soft shales and as the shales are cut away, the river undercuts the dolomite which finally collapses in great blocks and fall into the gorge. It is estimated that the Falls have receded about six miles by this process since the last glacial ice left the St. Lawrence Valley ten or fifteen thousand years ago. It is estimated that the Falls is receding about 5 feet a year. A sketch by Father Hennepin in 1678 shows the Canadian Falls contiguous to the American Falls, which if correct, indicates that the Canadian Falls has retreated several hundred feet in the last 280 years.

From Niagara Falls, the tour proceeded to Buffalo, the second largest city in the State of New York, and then on to Cattaragus Creek. In the narrow belt from Cattaragus Creek westward, grape production is important. A combination of climatic and soil factors has contributed to the concentration of grapes in the area. Potassium and magnesium fertilisation for grapes is essential on many of these soils. The soils are gravelly and sandy varieties of *Typudalfs*.

The tour passed through the small town of Fredonia and came to the city of Jamestown, the overnight stop for August 7. Jamestown, is situated on the shores of beautiful Chautauqua Lake. This lake occupies an ancient glacial valley, 1400 feet above sea level, and is a famous recreational area.

On the morning of August 8, the tour convoy passed past Lake Erie and the lake plains constituting an important grape area and crossed into Erie County, Pennsylvania. At the New York-Pennsylvania border, the convoy was greeted by the Pennsylvania State Police which continued to provide route escort. Erie County is an area which was completely covered by the Wisconsin Glaciation. The broad valleys are filled with gravelly and sandy glacial outwash. On the way, the tour stopped at the Southwick Farm, a 113 acre private fruit farm. (Grapes and Cherries).

Grapes:

The Southwick Farm is representative of the fruit farms of the area. Grape is cultivated from Spring until about August 1, when a cover crop is seeded. 200 lbs. of ammonium nitrate per acre is applied in the Spring and 200 lbs of 5-10-10 before seeding the cover crop. The grape prunings are worked into the soil during the growing season. Year round labour is provided by two full time hired men for the entire 113-acre Farm. Casual labour is recruited for tying grapes and harvesting. The Farm is moderately mechanised. The average grape yield for the last 5 years was 4½ tons per acre.

At the Southwick Fruit Farm, the Pennsylvania State College of Agriculture is carrying out fertility experiments on grapes. Significant correlation between pruning weights and yields and soil organic matter has been observed. The number of buds left on the canes selected for the following year's growth and fruit production was based on a system of "balanced pruning" in which the following formula was used : number of buds equals 30 plus 12 (W–1) where W represents the total weight (in pounds) of the prunings.

The city of Erie is a fast growing lake port. Although vineyards are prominent west of Erie, agriculture generally is more highly diversified than east of the city. Vegetable crops are prominent. Crossing into Ohio State, the tour followed the northern edge of the Lake Escarpment Moraine, which consists of a 100-feet thick glacial deposit. Crossing the southern edge of the Moraine and travelling on the dissected Allegheny Plateau, the convoy stopped at Jafferson. The soils of the area are imperfectly drained *Fragochrepts*. They are strongly acid and low in fertility. Hay and pasture crops, small grain and corn are the major crops grown. Dairying is the most important agricultural enterprise. Along an area given to general farming, dairy farming and vegetable farming, the tour reached the city of Wooster, the over-night stop for August 8.

The Motels: At Wooster, the delegates stayed in Motels. These are remarkable institutions, typically American. A Motel is a Motorist's Hotel. The motorist drives in, spends a comfortable night, and proceeds with his onward journey when he pleases. Fifteen years ago, when the author of this article was a student in the U. S. A., the Motels were still there, but they had not attained the prominence and popularity seen in 1960. Today, the Motels are serious competitors to Hotels and along many important highways, the Holels are beginning to go out of business. The Motels are cheap, well-equipped (each room-unit with television and air conditioning equipment) and most Motels provide the guests facilities for making their own morning coffee in solitude and comfort.

On the morning of August 9, the delegates were taken round the Ohio Agricultural Experiment Station at Wooster. The main Wooster Station comprises of 1600 acres of land and 2500 acres in nine outlying Stations. The main Experiment Station alone has 85 officers of the rank of Assistant Professors or higher and more than 5 times this number of supporting personnel. More than 400 research projects are carried on by the Department of Agricultural Engineering, Agronomy, Animal Science, Plant Pathology, Entomology, Dairy Technology, Forestry, Horticulture and Veterinary Sciences.

Research work in Agronomy covers studies on the establishment and maintenance of forage crops, crop rotations, pastures, interplanting in row crops, crop varieties etc. Soil research includes extensive work on soil structure, water movement, effect of soil water, soil temperature, light intensity, air temperature and humidity on the uptake and translocation of nutrients in plants and extensive studies on the fertilisation of crops.

The annual budget of the Ohio Agricultural Experiment Station is approximately 3.5 million dollars (roughly Rs. 1,65,00,000).

The soils of the experiment Station are mainly *Udalfs*, of which *Fragudalfs* (gray brown podzolic soils with fragipan) are the most extensive Typical profiles were examined and studied by the delegates.

From Wooster the delegates proceeded to Millersburg, a town situated on the Wisconsin terminal moraine. The glacial deposits are about 100 feet thick. From Millersburg to Coshocton, the rocks are primarily sandstones and shales of the lower Pennsylvanian system. *Typudalfs* occupy the sloping hill crests. The tour stopped at the Soil and Water Conservation Research Station of the United States Soil Conservation Service at Coshocton. This Station is situated on agricultural land typical of much of southern Ohio, western Pennsylvania, West Virginia,

Kentucky and the southern parts of Illinois and Indiana. The soils are *Typudalfs* and *Dystrochrepts*. At this Station, detailed measurements of precipitation, run-off and soil moisture are made on natural water-sheds. Weighing monolith lysimeteres are used to evaluate accretion, depletion and storage of soil water as well as condensation-absorption and evapotranspiration. The distribution of soil water in the profile is determined by the neutron scattering probe and sealer. Soil moisture content in the 0-7" layer is determined by measuring the electrical resistance of the fiberglass-gypsum blocks left embedded in the soil. Flumes measure surface run-off from small water-sheds in rotation areas, pastures permanent meadows and farm wood land. Other water-sheds are used to study the effect of contour-strip cropping. Large water-sheds ofarea 30 to 300 acres are used to study run-off from mixed cover areas and forested areas. There is also a well-equipped soils laboratory attached to the Station.

The convoy moved along the Walhonding River Valley, the flood piains of which are occupied by *Hapludents* (Alluvial soils) and the terraces above the flood plains by *Typudalfs*. Near the town of Howard, the tour route left the Walhonding River Valley anp entered the glaciated uplands. Through areas of Wisconsin glaciation, the convoy reached the till plain of the Central Low-lands. *Orthic* and *Acquic Typudalfs* containing 10 to 20 percent calcium carbonate, predominate in this area. Following the eastern edge of the Johnstown morainic system, dark coloured *Argaquolls* are seen in depressions, in the till plain. The till of western Ohio is generally highly calcareous (20 to 50 percent calcium carbonate), and this is attributed to the extensive outcrops of limestones or shales of the Devonian, Silurian and Ordovician ages. In the evening the tour reached Delaware and the overnight stop was at the dormitories of the Ohio Wesleyan University.

On the morning of August 10, the tour passed through an extensive area of *Orthic Typudalfs*. The Maumee Beach deposits are also classified as *Orthi Typudalfs*. On the way, the delegates examined a profile of an *Orthic Ochraqualf*, an integrade between Humic Gley and Low-Humic Gley great soil group. Paulding Clay is a typical example of an *Orthic Ochraqalf*. The tour entered Indiana crossing the watershed of the Wabash River. Glacial drift along the route was deposited by two lobes of the Wisconsin Glaciation, the Erie lobe and the Saginaw lobe, which deposited series of recessional moraines in eastern and northern Indiana. According to C-14 dating, man was in this part of North America at least 10,000 years ago. In northern Indiana, large areas of organic soils have been drained and farmed for many years. Some of the largest farms in the State are on these soils. Corn occu-pies the largest acreage. In Indiana, at Terre Haute, is the world's largest vegetable green-house (30 acres). The important vegetables grown are tomatoes and leaf lettuce. The tour stopped at Fort Wayne on a morainic belt, marking a stand of the retreating Erie lobe. Gray Brown Podzols predominate in these areas. The delegates examined the profile of Morley Silt Loam, a typical Gray Brown Podzolic Soil. Proceeding further, the tour stopped at the Chamberlain Farm, a highly successful grain and livestock farm of 700 acres operated by father and son. The Chamberlains feed about 350 Hereford calves a year, produce about 3000 hogs, and keep from 800 to 1000 laying hens. The Farm has a five-man labour force only, indi-cative of the degree of mechanisation.

The tour passed through near the village of Lucerne and the Maxinkuckee moraine from the peat-filled depressions of which the bones of *Mammut Americanum* (American mastodon) had been recovered.

The overnight stop for August 10 was Purdue University, Indiana. Purdue is one of the most progressive Universities of the United States. The annual budget for agricultural research alone is of the order of 4.5 million dollars (Rs. 2.12 crores), contributed to the University partly from State funds and partly from public donations. The Memorial Building of Purdue University housing the Auditorium, Library etc. is a recently built structure costing 10 million dollars. This building is claimed to contain the largest auditorium in the world. The 470 acre Agronomy Farm serves the Departments of Botany, Pathology, Entomology and Agronomy. The soils of the Farm are developed on medium taxtured till of the Wisconsin Glaciation. On August 11, the delegates went round the Agronomy Farm visiting the various experiments.

Proceeding from Purdue, the tour stopped to examine the profile of a Brunizem. Entering Illinois State, the tour passed through glaciated country. Illinois was almost completely covered with ice at one time or another during Pleistocene time. The overnight stop for August i I was at the University of Illinois. Six years after Abraham Lincoln signed the Land Grant College Act in 1862, the University of Illinois was established with 3 faculty members and 50 students. In 1960, the enrollment was 30,282 students. The Agricultural Experiment Station Farms cover 1928 acres, including the Morrow Plots, famous all over the world. At Illinois University, the delegates broke into two groups on August 12, one group going on a local tour of the Agronomy Farm and the other on a field tour to examine profiles of *Albaqualfs* (Planosols) in South Central Illinois. Some of the more important experiments on the Agronomy Farm are on Lysimeter studies, use of water by crops, rotations and soil treatment, relation of sunlight to growth and yield of corn etc. In the afternoon, the delegates visited the Soil and related Laboratories of the University of Illinois. The work of the Department of Agronomy, headed by Professor M. B. Russell, one of the most distinguished Soil Physicists of the world, consists of soil survey and soil genesis, several absorbing lines of approach to problems of soil physics and physical chemistry such as bonding energy of chemical elements and compounds in soil materials, chemical nature of fulvic nitrogen, and chemical nature of humic acid; soil chemistry and fertility section dealing with soil test correlation, fertiliser trials on crops, lime-rock phosphate studies etc; crop physiology section dealing with hybridisation. herbicidal action, root development, effect of shade, crop breeding, weed control etc. The Agronomy Department also controls the Statistics and Biometry sections and the Soil Testing Laboratories. On the morning of August 13, the tour continued from Urbana to the Wisconsin border, along the Champaign moraine. The soil materials on the moraine are loess underlain by calcareous till. The soils are *Argudolls* (Brunizems) and *Haplaqualls* (Humic Gleys). On the way, a profile of an *Argudoll* was examined. Along the Illinois River Valley, famed for its beauty, the tour moved past the Starved Rock State Park, and through La Salle and Rockford reached the Illinois-Wisconsin state line at Beloit.

The route lay along the southernmost of the four large lakes close to Madison, Wisconsin. These lakes are, from south to north, Kengonsa, Waubesa, Monona, and

Mendota. The city of Madison is centered between lakes Monona and Mendota and another small lake named Wingra.

The tour which lasted nine days was indeed one of unusually useful experiences. The American towns and villages, the country sides of indescribable beauty, the farms, farm-houses and prosperous farmers, busy industrial centres, the fabulous corn-belt and above all, the American people with their genial hospitality and kindness, left an unforgettable impression in the minds of the delegates — the tour gave them the opportunity not only to study soil profiles and see the amazing prosperity of American agriculture for themselves, but view a cross-section of American life in all its resplendent glory.

The delegates could gauge the agricultural prosperity of the country during the tour. The more observant of them could also gauge the industrial and economic prosperity from what they saw on this 1900-mile tour. America is fast approaching a situation, where the number of automobiles in the country exceeds the number of people, and parking place for these is difficult to find. The *automobile grave yards* are becoming as typically American as the *Motels* are. There were few of these *auto-grave yards* in 1945 and the years immediately following the end of World War-II. Today they are seen in every State and along every important highway. The *auto-grave yards* are extensive acreages of land where abandoned motor cars are left. Literally, thousands of abandoned cars dot and cluster such grave yards. No one bothers to look at them. Many of the cars in a grave yard are good and serviceable with minor repairs, some of them are sparkling and new but may have met with aa accident, sometimes very minor and sometimes very major accidents. But by far, the category of cars abandoned are those which are perfectly in good condition, but which are more than five years old and therefore supposedly outmoded. When models change every year and some improvement is effected with every new model, questions of prestige do not allow the average American to continue to use a five-year old car. He will find no buyer for it either. Gladly, he takes it to the nearest *auto-grave yard,* abandons it there, buys a glistening new latest model and drives back home. This is the genesis of the fabulous auto-grave yards. And this is a measure of the great industrial and economic prosperity of the United States of America.

The University of Wisconsin :

This is a State land-grant institution which was founded in 1849. The University enrolls some 26,000 students. The operating budget of the University amounts to 70 million dollars per year (Rs. 40 crores). The main fcampus has 837 acres and the total land holdings of the University come to about 7160 acres. The State of Wisconsin, famous for its dairying industry, produces one-seventh the milk and one-half the cheese in the entire United States.

The Congress and the Conferences :

The University of Wisconsin was all in readiness to receive the great international gathering of scientists assembling at Madison for the Seventh Congress. By 14th August, more than 1500 delegates from all over the world arrived at Madison. All countries of the World, except the Peoples' Republic of China, had sent official delegations to participate in the deliberations of the Congress. All the delegations excepting those of the U. S. A. and Canada were accommodated

in the spacious, multi-storeyed Chadbourne Hall.

The coferences opened on the morning of Monday, August 15, in the large Auditorium of the Union Theatre of the University, capable of accommodating more than 3000 persons. Professor Richard Bradfield, President of the Congress, presided. Greetings on behalf of the Governor of Wisconsin were presented to the gathering by Robert Lewis, the Governor's Agricultural Adviser. Dr. C. A. Elvehjem, President of the University of Wisconsin, and himself a most distinguished Biochemist of the world, welcomed the international delegates to the University of Wisconsin. Officers of the International Society of Soil Science, Commissions and Chairmen of Organising Committees were then introduced to the gathering.

Shri. B. R. Sen, Director General of the FAO then addressed the gathering. Shri Sen spoke on the Freedom from Hunger Campaign of the FAO. Explaining the salient features of the Campaign, Shri Sen said that the campaign was not intended to replace any existing programmes for the improvement of food supplies and nutrition. It was intended to supplement the existing programmes and to created a better climate of opinion in which such programmes will work with greater effectiveness. It was intended to awaken the people of under developed countries and to encourage them to better effort. The campaign envisaged enlisting the support of people in prosperous countries for measures aimed at improving the condition of people less fortunate than themselves. The activities of the campaign fell mainly under three broad categories, (1) information and education, (2) research and (3) action programmes. Shri Sen then briefly outlined the role of soil science in the alleviation of hunger and malnutrition and what the FAO had been doing in the field of soil science in several under-developed countries.

After Shri Sen, Dr. Charles E. Kellogg, Chief of the United States Soil Survey, briefly reviewed the trend of productivity of the arable soils of the United States during the last three decades. Dr. Kellogg explained how from 1927 to 1960, the number of man-hours in U. S. Farms was reduced to half, at the same time agricultural production having gone up by 65 percent and the man-hour farm output by three times more than in 1927.

Presidential Address:

The Presidential address by Professor Bradfield was one of the most instructive delivered at the VII Congress and was of special significance to tropical and under-developed countries. Dealing with the problem of producing enough food for all, Professor Bradfield said that in areas where the population per unit of agricultural land is already high and where the rate of increase is also rapid, the problem of increased food supply at a sufficient rate becomes very formidable. In such situations, at least ways of slowing down the rate of population increase had to be considered. Professor Bradfield said that Agriculturists had more experience and more success in increasing food production than population experts had in population control. If the rate of population growth was not slowed down, eventually Malthus was sure to win, Professor Bradfield stated.

He then discussed the two principal ways of increasing food supply of the world, (1) increasing the area under cultivation and (2) increasing the yield on the land now cultivated. It has been estimated that about one thousand million acres of land in humid tropics and about 300 million acres of podzolic soils in the north temperate region can be brought under cultivation. Although the tropical regions with abundant sunshine,

growing period of 12 months and plenty of water had great potentialities, in many areas soils were depleted of plant nutrients and had acid surface soils which posed problems in fertiliser application. The problems of management of these soils were great. There were also many associated human problems in the tropical areas, such as movement of the agricultural population and their proper re-settlement.

Dealing with the necessity to produce more from the land now under cultivation, Professor Bradfield stated that the primary food of the masses consisted of cereals which furnished 75 to 90 percent of the calories consumed. Such diets were deficient in proteins and vitamins and the production of adequate amounts of fruits and vegetables to balance a cereal diet should not present many serious difficulties in most areas. The production of protein food was however a more serious problem. Professor Bradfield then discussed the effect of continuous cropping without fertilisers, on yield. Citing the famous Morrow Plot Experiments, he indicated how the yield of corn in the rich prairie soil had fallen to 23 bushels per acre in 80 years when no manure and no fertilisers were used. The average yield of wheat in England was 8 bushels per acre in the beginning of the 18th century. By 1840, after the introduction of the Norfolk rotation and before commercial fertilisers came to be used, the yield of wheat had increased to 20 bushels per acre. With the introduction of commercial fertilisers, today's yield has gone up to 40 bushels per acre. In the case of the Morrow Plots, after 80 years of no manuring, lime and commercial fertilisers were applied in 1955 and the first year of the treatment the yield of corn rose from 23 bushels to 86 bushels per acre. When the treatment was repeated in 1956, the yield was 113 bushels, which compared with 128 bushels on the plots receiving complete fertilisers during the 80 years. The low productivity soils in the older regions are therefore not " worn out" but are capable of responding quickly and generously to good treatment, Professor Bradfield stated.

Continuing, Professor Bradfield discussed the history of modern agricultural science which fell into two broad periods, (1) the period of analysis extending from about 1800 to about 1930, and (2) the period of analysis and synthesis extending from about 1930 to the present, that is, the early stages of development of the second period. Many of the less developed countries are only in the analytical stage at present. The history of development of agricultural research in the U.S.A. was then discussed, the Experiment Stations and their origin, and the coming into being of the Land Grant Agricultural Colleges, consequent on the Land Grant Act of Abraham Lincoln. In 1912, the Agricultural Extension Service was created in the U. S. A. to carry the results of researches into the field. In spite of the great success recorded in increased production in Experimental Fields, the average yields in 1933 were still low and had not shown any significant rise. This led to serious disappointment and scientists began to search for the reasons. Professor Bradfield then quoted the record yields of the world ever reported, for three most important food cereals.

Crop	*yield* *Bush/acre*	*Kg/Hc*	*Grower*	*Location*	*Year*
Corn (field)	304.38	19,100	Lamar Ratliff	Miss., U. S. A.	1955
Corn (Green House) (gravel culture)	390	24,400	H. G. M. Jacobson	Conn. U.S.A.	1948
Rice	266	13,400	K. Velliah Gounder	Madras, India	1950-51
Wheat	131	8800	Turrrel Bros.	Norfolk, England	1952
	144	9600		Soviet Union	1944

These yields were three to five times those obtained by the better farmers and are possible when the use of good management practices is accompained by a very rare and fortuitous combination of favourable environmental conditions. An integrated approach involving all of the most important factors affecting crop growth and their interaction upon each other are receiving considerable attention in many advanced countries of the world. Proceeding, Professor Bradfield explained the experiments being conducted at Cornell University with the object of finding the factors that limit the growth of principal field crops, even after incorporating into the systems of soil management all the best available information on individual factors. It was already brought out from these experiments that on heavily fertilised plots, water was seen to be the limiting factor for 5 out of six years, and that increases for irrigation ranged from 30 percent to 100 per cent. Varieties suited to higher fertitity levels had to be evolved, Even disease organisms and insects are found to react differently to crops that are grown at different fertilily levels. The yield as a function of the root and shoot environment (microclimate) was being investigated at Cornell, and such experiments may throw much light on the yield potential of any specific area.

Professor Bradfield then stressed the need in under developed countries for the soil scientists to concentrate their attention on applied problems, the solution of which would contribute towards more food production, than merely try to work on problems of no immediate benefit. Discussing the role of environmental conditions on crop production, Professor Bradfield explained how irrigation can change the entire crop-soil relations, necessitating a completely new system of soil management than what existed before irrigation could be given to a soil. Even in the case of hybrid corn, the yields depended to a very great extent on a proper combination of all the environmental factors.

Professor Bradfield then discussed the dangers of over-specialisation in soil science as in all other branches of science, and said that applied sciences are becoming increasingly more important in the modern world in the context of the solution of the many practical problems facing us. It was necessary to give the proper type of training to soil scientists, including training in the field where alone they would get practical contact with the soils which grow the crops. Professor Bradfield emphasised the necessity for team work in soil and crop management and said that although a single well trained agronomist can often find out how to increase the yield of corn from 20 to 40 bushels per acre in most environments, to go from 100 to 150 bushels per acre, it may require the combined efforts of a team of five or Six specialists for several years. He felt sure the job could be done, but it required a large investment in research which would eventualy lead to both more and cheaper food.

The AH General Sessions

The All General Sessions were addressed by men of eminence, on specific subjects relating to soil science. Through August 15 to 23, there were seven such sessions, attended by all the delegates. The subject of discussions were:

1. *The Petrographic Approach to the study of Soils* by Professor R. Brewer of Australia.

2. *The Contribution of Pedology to the Agriculture of the USSR* by Professor I. V. Tiurin, Leader of the Russian Delegation.

3. *The Influence of Soil Animals on soil Formation* by Dr. P. W. Murphy of the United Kingdom.

4. *Contribution of the Nutrio-Physiological Studies on the Fertiliser Application for Low Land Rice in Japan* by Professor Y. Ishizuka of Japan.

5. *Interaction of Inorganic and Organic Soil Constituents* by Professor H. Deuel of France.

6. *Haben Wir Ein Konzept Fur Ein-Wissenschaft Von Der Bodenbearbeitung.* by Professor H. Frese of Germany.

7. *Advances in Soil Physics* by Dr. L. A. Richards of the U. S. A.

(A summary of these addresses will appear n the September 1961 issue of this Journal)

Technical Transactions

The International Soil Science Congress transacted more than 400 original papers during the period August 15 to August 23. The Congress divided itself into seven Commissions on different subjects, the delegates attending whatever commission proceedings they were most interested in. The different subjects discussed by various commissions, along with the number of papers presented in each subject, are given below: (A brief summary of 57 papers is given in this report being part of the report of the Indian Delegation submitted to the Government of India. A summary of the remaining papers will appear in the September 1961 issue of this Journal.)

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Commission No.	*No. Papers*	*General Subject*
I	11	Physics of Soil Moisture
	9	Energy Balance of the Soil Surface and Moisture return to the Atmosphere
	9	Soil Structure
	8	Techniques of Measurements in Soils Physics
II	9	Modern Analytical Methods in Soil Research
	13	Chemistry of Soil Organic Matter
	13	Miscellaneous Contributions in Soil Chemistry
III	11	Soil Nitrogen
	10	Relationships of Soil Microorganisms and Higher Plants
	9	Nitrification and Nitrogen Fixation
	11	Microbiological Methods and Microbial Ecology
IV	6	Soil Fertility in Relation to Nutritive Value of Crops
	10	Diagnostic Tools - First Session
	10	Diagnostic Tools - Second Session
	7	Residual Fertility
	4	Root Development and Nutrition
	11	Miscellaneous Contributions in Soil Fertility
	12	Forest Fertilization
V	6	Classification and Geography of Soils of Great Regions
	10	Classification and Geography of Soils of Nations or Provinces
	11	Principles and Systems of Soil Classification
	4	Geomorphology and Time as Factors in Soil Genesis
	6	Genesis and Classification of Hydromorphic Soils
	10	Morphology and Genesis of Soils, Tropical Regions
	11	Morphology and Genesis of Soils, General
	11	Soil Survey and Its Applications
VI	10	Soil Physical Factors in Relation to Water Management - First Session
	5	Soil Physical Factors in Relation to Water Management - Second Session
	4	Management of Saline and Alkaline Soils - Firt Session
	10	Management of Saline and Alkaline Soils - Second Session
VII	7	The Effect of Parent Material and Environment on the Formation of Clay Minerals

Commission No.	No. Papers	General Subject
	1	Properties and Reactions of the Clay Minerals and Their Complexes
I–VI	7	Soil Management - First Session
	6	Soil Management - Second Session
	8	Water-Soil-Plant Relationships
I–IV–VI	8	Nutrient Availability as Related to Moisture and Other Other Soil Physical Factors
	7	Water - Fertility - Crop Growth Relationships
II–IV	10	Radioactive Isotopes in The Study of Ion Uptake by Plants
	11	Secondary and Minor Elements
II–V	11	Physical Chemistry and Soil Formation
II–VII	9	Clay and Oxide Mineralogy in Relation To Exchange Reactions and Electro-Chemistry
II–IV–VII	8	Phosphates in Soils and Their Availability - First Session
	9	Phosphates in Soils and Their Availability - Second Session
II–V–VII	8	Weathering and Mineralogy of Soil Genesis
III–V	10	Soil Fauna and Soil Formation ; Soil Humus
V–VII	2	Mineralogy and Soil Classification

SUMMARY OF SOME PAPERS

Soil Organic Matter

This subject was dealt with by Commission II, on the morning of August 2. There were 13 papers presented on the subject. Jose Maria Albareda presented a paper on "Micromorphologic and Chemical study of Humus formation resulting from different Vegetal Species". In this paper an effort was made to elucidate the correlation between cation content in the vegetation and exchange cations in the profile. The author also elucidated the dynamics of glucids, lypids and proteids through out the humic horizons. The influence of organic matter on pH values, on fertilising elements, on clay minerals formation and on the type of humus was also dealtwith.

A. M. Grinchenko and T. R. Shing presented a paper on the "Effect of prolonged crop cultivation on Dynamics of Humus Nitrogen and Phosphorus in soils of the southern Ukraine". They reported that periodical sowings under grass rotation system of perennial alfalfa in arid-steppe does not produce any effect on the accumulation of organic matter. Grassland farming on steppes resulted in a considerable decrease on phosphorus assimilation. Application of phosphatic fertilisers to leguminous grass in the grass rotation system was considered very important. In a paper on the "Biosynthesis of Humic substances and their Transformation in the course of Soil Formation", M. M. Kononova, I. V. Alexandrova and N. P. Belchikova stated that soil humus substances are a complex mixture

of compounds consisting of acid-soluble and acid-insoluble fractions and that the maturity of humus substances in the soil formation process is conjoined with the reduction of the acid-soluble fraction. The most mature acids are the "humic acids" and the youngest ones are the fulvic acids.

J. L. Mortensen, in a paper on "Physico-chemical properties of a Soil Polysaccharide" has stated that titration curves, ultracentrifugation, diffusion and light-scattering measurements provide information on the molecular size and shape of soil polysaccharides. Studies by N. Schnitzer and J. R. Wright on the oxidation of the organic matter of the Ao and Bh horizons of a podzol, have suggested that the organic matter of the Bh horizon contained more aromatic substances than that of the Ao horizon and that the organic matter of the Ao horizon contained alicyclic structures. The same authors in another paper on the chemical studies on humic acid from these horizons, reported that the functional carboxyl groups in the organic matter of the two horizons showed marked differences.

In a paper on "Chemical Studies on Humic Acid from a Podzol Soil", Alan Burges reported that separation of humic acids by paper chromatography or paper electrophoresis is not definitely indicative of variations in the chemical nature of the humic acids compared, but is due to the heterogenous diffusion of particles of different sizes. Continuous electrophoresis and light dispersion studies gave supporting evidence for such a conclusion. R. Ramlissa and H. Ramdi in a paper on "The Comparative Rates of Nitrogen Transformation in Some Natural and Synthetic Organic Manures" reported that Urea is the most quickly transformed and that Farm Yard Manure is the most slowly transformed. In descending order between these two came, dried blood, cotton seed cake and green manure.

Soil Nitrogen

The subject was dealt with by Commission HI on the morning of August 16. Eleven papers were presented at this session. In an interesting paper on "Nitrate Production Rate as a Soil Test for Estimating Fertiliser Requirements of Cereal Crops", R. A. Olson et al reported correlations of nitrate production rate with yield responses in wheat and oats. W. V. Bartholomew and Don Kirkham presented a paper in which they had derived a differential equation for describing the rate of change of soil organic matter and/or soil organic nitrogen. D. J. Greenland and P. H. Nye presented a paper in which they discussed the question whether bulky organic materials like straw would induce nitrogen deficiency in tropical soils.

Frank G. Viets Jr. in a study *of the recovery offertiliser nitrogen on the irrigated and dry land soils ofthe western United States* said that the mechanism of loss of fertiliser nitrogen such as leaching, erosion and inadequate aeration can be eliminated or reduced to a minimum on semi-arid land or irrigated land with carefully controlled irrigation. Studies on *losses of nitrogen in some Israeli soils under field conditions during the dry season of the year* by M. Winnick showed fluctuations in nitrogen content through out the various seasons of the year. *A* considerable decrease was observed towards the end of the dry period when short spells of dry hot winds blown from the desert caused conditions of high desiccation. W. H. Patrick Jr. in a paper on *nitrate reduction rates in a submerged soil as affected by redox potential* stated that the maintenance of redox potentials at constant level or control during investigations was difficult. He described a method where by the same could be maintained constant. The method is essentially

one of bubbling oxygen by the use of specific apparatus, through the suspension under study. *Influence of organic matter on volatile loss of nitrogen from soil* studied by F. E, Clark and W. E. Beard indicated that greater nitrite reactivity and greater mineral nitrogen deficiency were promoted in quartz sands by the addition of such organic amendments as peptone, alfalfa meal, glycine or arginine. Dextrose as an additive proved to be largely inert, providing there was no interval of pre-incubation prior to the addition of mineral nitrogen. Studies made by J. J. Lehr and J. Ch. van Wesemael on *ammonia volatilization from soils of different countries* (France, Belgium, Holland, Spain, Sweden, England) Egypt, India and Australia) indicated that volatilisation starts from pH values above 7 in the presence of calcium carbonate. There was a close relationship between volatilisation of ammonia and calcium carbonate content rather than of pH, the loss of ammonia with increasing temperature followed the temperature gradient of chemical reactions, the loss by volatilisation at constant temperature for a given period of time did not progressively increase with increasing calcium carbonate content, the variations noted in volatilisation even though wide were not specific to the countries from which the samples were collected and the loss by volatilisation is not only progressive with temperature but also progressive with time. F. E. Broadbent and T. Nakashima dealing with *the factors influencing the reaction between ammonia and soil organic matter* observed that considerable fixation of ammonia or ammonium ions with soil organic matter occurs under alkaline conditions with high concentration of ammonia. Presence of oxygen and oxidised soil organic matter were reported to be conducive to fixation of ammonia. Polyphenols also had a positive role in the fixation. The lignin fractions of soil organic matter had the bulk of fixation capacity for ammonia.

T. T. Chao and Wybe Kroontje in a paper on *ammonia adsorption phenomena* in soils stated that in acid soils there is an initial lag in the ammonia adsorption isotherm reflecting the possible neutralisation of acidity. Ammonia adsorption in neutral and basic soils is characterised by resistance to change in pH and the indications are that there is a high degree of buffering. Giampiero Baldanzi, in a paper on "Burning and Soil Fertility" adduced experimental evidence to prove that the practice of burning organic debris in the tropics had a beneficial effect and that no significant decrease or increase of carbon or nitrogen in the soils had been observed as a result of such treatments.

Nitrification and Nitrogen Fixation:

This subject was dealt with by Commission III, in session No. 3. In a paper on nitrogen transformation in soil according to the tests with application of Nitrogen-15 isotope, F. V. Turchin et all presented evidence to show that soils under crops contain little oxidised organic nitrogen, probably due to assimiliation by plants. Analysis of the bulk of soil organic nitrogen showed that the greater part of it consisted of proteins and nucleic acids. It was also established that during the course of nitrification, besides nitrates and nitrites, oxidised nitrocompounds are formed which are not soluble either in water or weak acids and alkalies.

Studying autotrophy and heterotrophy in nitrification, M. Alexander and others presented information on the activity of *nirosomonas* and *nitrobacter* along with a number of other autotrophic and hecerotrophic genera. Slight acidity suppressed the enzymatic oxidation by *nitrosomonas*, *nitrobacter* and also of *aspergillus flavus*.

Warren S. Silver, studying the enzymatic and non-enzymatic reactions of nitrate in

autotrophic and heterotrophic bacteria, presented data to show that the cellular cytochrome system of *nitrobacter* is in an oxidised steady state until the nitrate addition and that the transference of oxygen to this nitrate results in the cytochrome producing nitrate. In the case of the heterotrophs, the cytochrome reduction was reported to be much more extensive.

E. L. Schmidt, in his paper on nitrate production by the heterotrophic soil microorganism, *Aspergillus flavus* gave data to prove the ability of the organism to form nitrates on natural subtrates. A variety of nitrogenous compounds ranging in complexity from ammonium to casein resulted in nitrate accumulation so long as the reaction was favourable and the nitrogen content was in excess of the requirements forself-synthesis.

In a paper on survival degree in soil of nitrifying bacteria, A. J. Garbosky and N. Giambiagi reported the results of survival tests conducted by them with different soils and with additions of P, K, Ca Mg, N, and Cu. Modified plant responses induced by rhizobia cultivated in aminoacid media were reported by A. J. Holding et al. Those strains cultivated in glycine and valine media underwent greater loss of nitrogen fixing ability and plant response to these showed non-effective patterns by loss of vigour of growth, reduction in dry weight and paleness of green colour.

W. H. Fuller and others studied the fixation of nitrogen in desert soils by algae. Algal and lichen desert crusts were found to be four to five times as high in nitrogen as the soils a few inches deeper. These crusts increased in nitrogen when brought under controlled environmental conditions favourable for algal growth. Applications of phosphoric acid and free sulphur to the surface of irrigated desert soils favoured the growth of nitrogen fixing algae. The nitrogen fixed by algae was found to be as available to plants as an equivalent amount of nitratenitrogen.

Z. Saric, a paper on some traits of Rhizobium Sp. dealt with the cross inoculation specificity of different isolations from leguminous plants. All the strains isolated from Vigna were virulent to and effective on soybeans. With respect to morphological, physiological and cultivation traits, the strains isolated from nodules of vigna completely correspond to strains of Rhizobium japonicum.

Residual Fertility

This subject was discussed by Commission IV, in its session 4a. Seven papers were presented. J. F. Davis and others, dealing with the evaluation of residual fertility on some grey brown podzolic, humic gley and organic soils reported that the residual effects of applied nitrogen depended on the type of soil, time of application, amount applied and the carrier used. Heavy applications of P and K resulted in fast build up of phosphorus rather than of potassium. High potassium levels reduced response to magnesium and sodium applications. Copper had a lasting residual effect. Boron and manganese were fixed quickly in unavailable forms. while ammonia and ammoniacal fertilisers left an acidifying effect. Lloyd Dumenil et al, evaluating the residual fertiliser effects by chemical composition of plant parts, reported that the relationship between the changes in the N and P composition of corn leaves, below and opposite the primary ear, sampled at silking, could be used to estimate the equivalent levels of N and P fertilisers in the residual year.

N. G. Gokhale, in a paper on the long term effect of continuous cropping and

manuring on the nitrogen status of tea soils concluded that continued use of inorganic fertilisers actually benefits the nitrogen status of the North East Indian tea soils. In the case of totally unshaded lea, low rates of manuring results in deterioration in soil nitrogen status. Phosphate and potash applications had a pronounced effect on nitrogen status, possibility because of the better growth of the shade trees due to their application and consequent greater demand for nitrogen. John i'. Pesek et aJ, in their paper on the influence of residual fertiliser effects and discounting on optimum fertiliser rates, stated that the optimum rate of fertiliser application was defined as that rate at which the first derivative of the response equation is equal to the fertiliser-crop-price ratio. This rate returned the highest profit per unit area due to fertiliser use.

In a paper on the soil productivity study of the Sudan Gezira. the reasons for the large annual variation and a local variation in the yields of cotton under gravitational irrigation were presented by \ Finck. The local variations were attributed to local differences in clay contents of the soils. The causes for the annual variations were not studied. In a paper dealing with standardised responses to fertiliser trials carried out in Portugal from 1929 to 1958, A. K. de Oliveira and A. J. de Oliveira emphasised the need to formulate a fertiliser policy which would make the best use of national resources and the import of fertilisers.

In their paper on fertiliser nutrient uptake as related to root development in the fertiliser band, A. J. Chlrogge and S. R. Wilkinson stated that the immobile nutrients in the fertiliser applied in a band affected the soil in only a small part of the root zone of the crop. Efficiency in nutrient uptake from the band is in part dependent on the high nutrient concentration in the fertilised soil volume and the preferential development of roots in this zone. Other factors affecting nutrient uptake from fertiliser bands are the volume of fertiliser in contact with the soil, the active surface area of the roots developed in the fertiliser zone, the pH and osmotic properties of the soil-fertiliser band solution.

In a paper on root penetration and development of some common farm crops as related to soil morphology and physical and chemical properties. J. B. Fehrenbacher et al said that root studies of corn, soy beans, alfalfa, red clover and timothy in Brunizem, grey brown podzolic und Planosol soils in Illinois showed that proper soil fertilisation increased root penetration and development as well as crop yields. D. M. Huseinow presented a paper on the influence of organic compounds of petroleum origin upon the growth of roots and crop capacity of agricultural cultures. The naphthenic acids contained in the acid tar and alkaline wastes of petroleum industry were effective s substances in intensifying the growth of root systems and the above-ground part of the plants.

In a paper on the distribution and activity of roots in relation to soil properties, R. L. Fox and R. C. Lipps described methods developed for measuring the activity of roots at any desired depth for short or extended periods of time. Radioactive phosphorus was used for studies lasting more than one season.

Nutrient availablity as related to moisture and other Soil Physical factors:

This subject was discussed in a joint session of Commissions I-IV-VI on the afternoon of August 22. Eight papers were presented at this session. A. E. Erickson

and D. M. Van Doren presented a paper on the relation of plant growth and yield to soil oxygen availability. It was established that periods of oxygen deficiency in soils, although short lived had marked effect on the growth and yield of crcps. In a paper on the influence of moisture and temperature on phosphorus and potassium availability, S. A. Barker adduced evidence to show that the release of non-exchangeable potassium to exchangeable potassium was moisture dependent. Increasing temparature in the range of 2 to 23 degrees centigrade increased the availability of phosphorus. Moisture levels below field capacity had no influance. and above field capacity the status of iron in the soil was affected which in turn affected phosphorus availability.

D. A. Brown et al presented a paper on the effect of soil moisture upon cation exchange in soils add nutrient uptake by soy beans. Moisture reductions resulted in a greater decrease in the uptake of calcium and potassium from the coarse than from the fine textured soil. Nutrient uptake was correlated with the transpirational loss of water. The absorption of ions increased as transpiration increased up to the moisture equivalent, where ion absorption per gram of water transpired began to decrease and continued to do so to the saturation point The ion absorption was lowest both at the saturation point and at the wilting percentage.

F. S. Watanabe et al, in a paper on nutrient availability as related to soil moisture, reported results of studies made on phosphorus uptake, using P-32. The uptake of phosphorus by roots of plants decreased about threefold as the moisture tension increased from one-third to nine atmospheres. In a paper on ion up take under systems of moisture stress and moisture content, D. B. Peters and M. B. Russell stated that the concetrantion of ions in plant roots is a function of the effective concentration of the ions in the soil. The reduction in ion uptake was strongly influenced by the growth rate in plant roots, which in turn was affected by increased tension or reduced moisture content.

In a paper on the relation of plant growth and ion accumulation to soil moisture levels, H. J. Mederski and J. Stackhouse presented data showing increasing potassium content in the plant tissue with increasing soil moisture at all levels of added potassium. The response to moisture levels varied with the quantity of potassium added. At the zero level of potassium addition, the response was curvilinear while at 37 and 75 ppm potassium, the curves appeared to have inflection points at about 10 percent moisture level.

J. V. Lagerwerff and Gen Ogata, in a paper on plant growth, ion uptake and water consumption as functions of interacting activities of water and ions under saline-sodic conditions, presented data to show that the degree of salinity tolerance and sodium tolerance of dwarf red kidney bean plants are quantitatively interdependent. As to the consumptive use of water, it appeared that the uptake per unit weight of leaf strongly increased when the level of salinity and sodium in the nutrient solutions increased.

Other highlights of the Congress:

On August 18, a symposium on *Tropical Soil Resources* was held, being arranged and organised by the FAO, and presided over by Dr. Charles E. Kellogg. There were discussions on the Red and Yellow Soils of the Tropical and Subtropical Uplands," "Ground-Water Laterite Soils", "Alluvial Soils of the Tropics and their near Ralatives", Dark Clay Soils of the Tropics and Subtropics", "Cat Clays of the Ill Drained Coastal Regions", "General Aspects of

Soil Management for Improved Production".

The Problems and Potentialities of Areas under Shifting Cultivation and International Soil Correlation.

The Seventh Approximation :

The comprehensive new Soil Classification System, as released at the Seventh Congress, brief references to the terms in which have already appeared elsewhere in this Report, requires general approval of the world soil scientists before being accepted into soil science literature. A detailed publication by the United States Department of Agriculture on the Seventh Approximation was distributed to all the Delegates. (Salient points of the Seventh Approximation will appear in the September-1961 issue of this Journal).

Local Tours :

On August 18, local tours were arranged for the delegates, ap to 200 miles off Madison, to visit Research Stations and Experiments, and study Wisconsin soils.

Entertainment :

On Saturday, August 20, a complimentary barbecue evening meal was served to all the delegates in the Camp Randall Memorial Athletic Arena. Following the meal, an American Indian Troupe of about 35 Menominee Indians, dressed in full Indian regalia, put on a programme of dances and other Indian pageantry.

Conclusion of the Tour of the Delegation :

On the morning of August 22, one day before the Conference concluded, the Indian Delegation flew from Madison, Wis. to New York. The same evening, the delegation left New York for London. After a stay of two days in London, the delegation left for India. arriving in New Delhi in the early hours of 26th, August. 1961.