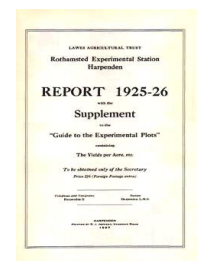


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# Report 1925-26 With the Supplement to the Guide to the Experimental Plots



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## The Soil

### Rothamsted Research

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### III. THE SOIL.

(Chemical, Physical and Statistical Departments.)

#### (a) MECHANICAL ANALYSIS.

- XXII. A Sub-Committee of the Agricultural Education Association. "*The Mechanical Analysis of Soils: A Report on the Present Position, and Recommendations for a New Official Method.*" *Journal of Agricultural Science*, 1926, Vol. XVI., pp. 123-144.

This paper condenses the results of over two years' investigations at a number of centres, including Rothamsted. The work of the Sub-Committee was co-ordinated from Rothamsted by Dr. Keen. A thorough examination has been made of the function and significance of mechanical analysis in the light of recent advances in our knowledge of soil, and a comprehensive trial has been made of (a) a new method of dispersion, and (b) an improved single sedimentation method of analysis. These new procedures have been compared in detail with the original beaker method adopted by the Association in 1906, and, on the recommendation of the Committee, have been officially adopted in place of the older method.

Treatment of the soil with 20 vol. hydrogen peroxide prior to addition of hydrochloric acid is shown to effect a much better dispersion of the compound particles than that obtained with acid alone. The efficiency is due to the action of the peroxide on the cementing organic matter, some 80 per cent. of which is removed as gas or rendered soluble. There is at the same time a small chemical action largely confined to the finest mineral particles, a loss of 1 per cent. to 2 per cent. being usually found.

The dispersed material was submitted to mechanical analysis both by the old beaker method and the new method, which depends on taking samples with a pipette from the sedimenting column of material at specified depths and times.

The complete set of tests involved four series representing the combination of the two methods of dispersion with the two methods of analysis, and the full set was done on each of eight carefully chosen typical soils.

A complete set of experiments was carried out at Rothamsted, Leeds and Bangor, so that comparisons were available of the same methods in the hands of several different workers. Thus very adequate data were obtained on which to base the recommendation of the new method, full details of which are given in paper No. C.

- XXIII. J. R. H. COUTTS and E. M. CROWTHER. "*A Source of Error in the Mechanical Analysis of Sediments by Continuous Weighing.*" *Transactions of the Faraday Society*, 1925, Vol. XXI., pp. 374-380.

In the determination of the size distribution curves of suspensions by the method of continuous weighing of the sediment accumulated on a balance pan hung near the base of a column of suspension, all previous workers have tacitly assumed that the course of the sedimentation is unaffected by the presence of the pan. This assumption has been examined experimentally and found to be incorrect. The pan shields the liquid below it from



the entry of particles from higher levels, whereas the liquid in the annular region between the pan and the walls of the vessel experiences no such effect. Hence, the lower density of suspension immediately below the pan after the sedimentation has proceeded for a few minutes, inevitably sets up a flow of liquid which interferes with the free vertical fall of the particles. With the large, narrow-rimmed pans hitherto used, the observed yields are appreciably below the theoretical values. In extreme cases, with about 1cm. between the pan and the base of the cylinder, the observed yields may be as low as 70 per cent. of the theoretical yields. With the pan close to the base, the error is smaller, but there is a rapid change of yield with very small changes in the position of the pan. The extent of the disturbance varies with the size of the particle, and thus produces a distortion of the distribution curve.

(b) PHYSICAL PROPERTIES.

XXIV. B. A. KEEN. "*The Physicist in Agriculture, with special reference to Soil Problems.*" Lecture to the Institute of Physics, November, 1925. From "*Physics in Industry*," Vol. IV. (1926).

A connected account of the properties of soil from the viewpoint of the physicist, and based very largely on the work of the Soil Physics Department at Rothamsted. Among the subjects dealt with are particle size and its measurement, the soil colloids, the mechanism of water movement in soil, soil tilth and soil cultivation.

XXV. B. A. KEEN, E. M. CROWTHER and J. R. H. COUTTS. "*The evaporation of Water from Soil. III. A Critical Study of the Technique.*" *Journal of Agricultural Science*, 1926, Vol. XVI, pp. 105-122.

Experiments on the evaporation of water from a soil paste spread in shallow pans, showed that the drying proceeded very irregularly over the soil mass. Considerable portions became almost completely dry, whilst other portions remained very wet. There was a rough relationship between the form of the dry patch and the shape of the corresponding evaporation rate curves.

An improvement in technique was effected by exposing the soil in thin layers below glass plates. Under these conditions, reproducible results were obtained. Soil and kaolin, but not sand, gave considerable linear portions over the region of decreasing rate of evaporation. Tests on soil exposed as central discs, or peripheral rings, and on partially covered full plates, showed that, owing to the type of air currents set up, the drying was largely confined to the outer edges during the early stages.

The establishment of a moisture gradient in this way was subsequently opposed by the lateral movement of water by capillarity.

By interposing a barrier to the lateral spread of the air currents, the rate of evaporation was reduced to one-quarter and the resulting curves approximated to the limiting case of slow evaporation, *i.e.*, vapour pressure curves.

The evaporation of water is controlled by two groups of



factors depending on (1) the soil-water relationships, and (2) the environmental conditions. The latter group includes such factors as diffusion of water vapour from the soil to the acid, and bulk air movements set up by (a) the temperature gradient from bottom to top of the evaporating chamber, (b) the cooling of the soil by evaporation, (c) inevitable disturbance in the weighings, (d) the lower density of moist air. Thus the environmental conditions are very complex and liable to irregular changes from one experiment to another. Differences in the rate curves for various materials cannot, therefore, be attributed solely to the water relationships of the material. Where the results are obtained by a carefully controlled and reproducible technique, certain comparisons can be made, but caution must be exercised at present in associating precise physical explanations with the shape of the complete rate curves.

XXVI. W. B. HAINES. "*Studies in the Physical Properties of Soils. II. A Note on the Cohesion Developed by Capillary Forces in an Ideal Soil.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 529-535.

In this note an approximate calculation is made of the forces due to surface tension of water-films distributed through an "ideal" soil consisting of an assemblage of uniform spheres in regular packing. An expression is obtained for the value of the cohesion or shrinkage pressure produced, which shows that, although the cohesion rises toward zero moisture, it approaches a finite limit. If moistures are expressed in percentage by weight (as is usual in soil work), then the calculation is only valid below moisture values of 3—8 per cent., according to closeness of packing. For higher moistures a general inference is made that the cohesion again rises, which is supported by a very rough single value calculated for saturation.

The main conclusion reached is that the magnitude of these capillary forces depends almost wholly on the size of the particles. For any one particle size the range of cohesion for all moisture values is not large. On the other hand, the cohesion may be made to assume large values by making the particle size sufficiently small.

An attempted experimental verification is described in which a sample of ignited silt was taken as an approximation to the ideal soil and measurements of cohesion made with Atterberg's apparatus. This instrument measures the force required for the penetration of a wedge into the sample under test. The results agree well enough with the theoretical value at saturation, but not with the values at lower moistures. (See also papers XXVIII. and XXIX.)

XXVII. W. B. HAINES. "*Studies in the Physical Properties of Soils. III. Observations on the Electrical Conductivity of Soils.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 536-543.

The change of electrical conductivity with variations in moisture content has often been advocated as a convenient method for making soil-moisture measurements. This paper describes some tests made under laboratory conditions to investigate the



validity of such a method. The technical difficulties concerned with unspecified variations in soil packing, or the nature of the electrode contact were eliminated in order to trace the exact changes in conductivity with changing moisture. The curves showing these changes for several different soil types, indicate that in most cases and above the hygroscopic point, the electrical conductivity could be used as a measure of the moisture. As the curves vary a good deal in shape from one soil to another, a preliminary examination of the soil would be necessary.

On the other hand, in the four cases of heavy clays examined, the conductivity was constant over a great part of the higher moisture range, so that exact inferences of moisture content could not be made from the conductivity measurements. It was also noticed in these cases that a close relationship exists between the critical point where the electrical conductivity begins to fall and a similar critical point in the shrinkage behaviour of the clay, thus providing an interesting connection between the electrical and mechanical behaviour of clay.

Measurements made on an ignited soil led to an interesting verification of earlier work on the capillary behaviour of water in soils, and in particular of the moisture contents at which the film continuity ceases. The shape of the conductivity curve for ignited soil gave clear proof of the values arrived at earlier. Results of previous workers using sand are shown to bear out the same conclusion.

XXVIII. R. A. FISHER. "*On the Capillary Forces in an Ideal Soil; Correction of Formulæ given by W. B. Haines.*" *Journal of Agricultural Science*, 1926, Vol. XVI., pp. 492-505.

The statical treatment of the capillary action between adjacent soil particles is reworked, and certain corrections introduced into Haines' formulæ (Paper No. XXVI.). It is suggested that the discrepancy between theoretical stress and the experimental values reported may be removed by the supposition that the measurements were better designed to measure the work needed to cause rupture than the static stress of the system. Finally, the limitations of the geometrical approximation adopted are removed by recalculating the volumes, pressures and stresses from the true capillary surface.

XXIX. W. B. HAINES. "*Studies in the Physical Properties of Soils. IV. A Further Contribution to the Theory of Capillary Phenomena in Soil.*" *Journal of Agricultural Science*, 1927, Vol. XVII., pp. 264-290.

This paper develops further the theory outlined in Paper No. XXVI., and deals with certain criticisms (Paper No. XXVIII.). In order to clarify the points at issue a more complete treatment is given of the ideal case for that part of the problem which has not received precise mathematical treatment. The pressure deficiency produced by capillary forces in the soil water has been directly measured for several simple materials approximating to the ideal case. The results are shown to be confirmatory of the theory and to throw considerable light on the problem of capillary rise in soils which has received so much attention from soil physicists.

E



(c) SOIL CULTIVATION.

- XXX. B. A. KEEN and W. B. HAINES. "*Studies in Soil Cultivation. I. The Evolution of a Reliable Dynamometer Technique for Use in Soil Cultivation Experiments.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 375-386.

This paper is the first of a series representing attempts to apply exact measurement in various ways to questions of soil cultivation. It presents the results of a critical examination of the technique of dynamometer measurements when applied to cultivation processes. A description is given of the dynamometer used, which enabled simultaneous and continuous records to be obtained of draw-bar pull, and depth and speed of ploughing. Data are then given for the effect on the drawbar pull of variations in speed, depth of ploughing, slope of land, and other possible alterations in ploughing conditions. The results of the speed tests were most important in the economic aspect, since the increase of pull is only slight for considerable increase in speed. Hence there should be a great saving in costs where it is possible to increase the normal ploughing speed. The advisability is also discussed of making dynamometer comparisons, not on drawbar pull alone, but on the basis of power factor, which includes this question of the time occupied.

The other main conclusion which is established by this critical survey is that if the implemental factors are kept constant, then the values of drawbar pull during ploughing are closely related to the locality of the field. In other words the soil variations are reflected in the drawbar pull, so that the records for the ploughing of two contiguous furrows show a close similarity in outline.

- XXXI. W. B. HAINES and B. A. KEEN. "*Studies in Soil Cultivation. II. A Test of Soil Uniformity by Means of Dynamometer and Plough.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 387-394.

Following up the main conclusion reached in the last paper, the idea was developed of using the dynamometer and plough as a soil surveying instrument for field use. The drawbar pull is taken as a measure of the physical properties of the soil at the point concerned, so that by properly spacing the measured furrows across a field, a complete soil map can be prepared showing the variations in the physical properties of the soil. The map is best prepared by drawing lines through regions of equal drawbar pull, similar to contour lines of height in an ordinary map. The name "Isodyne" has been adopted for lines so drawn. An isodyne map is shown for a field at Rothamsted which had not previously been under experiment and was chosen for a test of uniformity. The area of some six acres was sub-divided into plots of one chain square, and the mean drawbar pull calculated from a series of measurements. The values varied between 1,200 and 1,700 lb. at different places, with perfect definite gradients in these values between the light and heavy places. Assuming a division of the field into strips, as would be done for a competitive implement



trial, the average pull along the strips varied by about 12 per cent. Thus such a competition would be subject to a heavy unknown handicap unless the field had first been explored and the handicap assessed.

Preliminary measurements are also discussed, which show that the drawbar pull has a positive correlation with the clay content of the soil, and that there is a negative correlation with the number of wheat plants which were growing on the plots in early spring.

XXXII. W. B. HAINES and B. A. KEEN. "*Studies in Soil Cultivation. III. Measurements on the Rothamsted Classical Plots by Means of Dynamometer and Plough.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 395-406.

This paper presents and discusses the isodyne maps which have been obtained for the permanent wheat, barley and mangold plots at Rothamsted, viz., Broadbalk, Great Hoos, and Barnfield.

The most intensive work has been done on Broadbalk, and the results for various years, when compared together, show complete permanence in the features brought out by these maps.

The measurements show that the drawbar pull is related to the clay content of the soil and also to the drainage rates. On a particular occasion the rate of efflux of drainage water was measured for each plot, and a high positive correlation was shown with the average drawbar pull for the plots. Thus the drainage was largest in amount for the heaviest plots, showing the greater need for artificial drainage on those plots having the heaviest soil.

The isodyne map for Great Hoos permanent barley has no special feature except that it has greater uniformity than any other area yet examined on this farm.

The map for the permanent mangold plots on Barnfield shows large variations in the soil, and opens up a new problem in the high values obtained on the farmyard manure strip. It is contrary to all other measurements and experience that a plot having this treatment should be heavy to work. Part of the reason was found to lie in a high moisture content, but in the main the explanation of this anomalous behaviour must be sought along physico-chemical and biological lines.

XXXIII. E. M. CROWTHER. "*Some Aspects of the Gezira Soil Problem (and Analysis of the Influence of Rainfall on The Yield of Cotton at the Gezira Research Farm.*" Report of a Meeting in the Sudan Gezira, in December, 1925, for the discussion of certain problems connected with cotton growing. Sudan Government, Khartoum, 1926, pp. 18-28.

This contribution to a joint discussion on the problems arising in the cultivation of cotton by irrigation on the heavy alkaline soils of the Gezira, is based on physical and statistical investigations made whilst the author was working temporarily at the Gezira Research Farm, Wad Medani, Sudan. The soil of the Gezira has a hard layer at a depth of about 3 feet, and it is known from field studies of water movement after irrigation,



that but little of the added water percolates below this depth. Cotton roots, exposed by washing away the soil with a jet of water, did not penetrate this layer but were confined to the first two feet of soil. Measurements of the apparent specific gravity of soil by the waxed block method were made at a series of depths down to 4 feet. The density of the moist soil increased from 1.65 gms. per cc. at the surface to a maximum value of 1.80 gms. per cc. at about 3 feet (the weight of dry soil in gms. per cc. increased from 1.29 to 1.49). The high value at 3 feet shows that the closeness of packing of the soil particles is one factor in the hardness and impermeability of this layer. But even when this factor is removed by uniform packing of sieved soils in columns in the laboratory, there are marked differences in permeability in samples taken from different depths. The rate of movement of water decreased steadily from the surface to very low values in soils taken from the third foot; below this depth the rate of movement increased owing to the flocculating action of the sodium sulphate present. The possibility of increasing the permeability of the field soils by cultivation methods was discussed and attention drawn to the desirability of investigating the effects of delaying the cultivation of the fallow preceding the cotton crop.

Data for the yields of cotton on the older experimental areas in the Gezira were subjected to a statistical analysis. In any one year the yields of cotton grown under miscellaneous rotations at Tayiba from 1911 to 1922 decreased steadily for each additional crop of cotton previously grown on the plot. It has been suggested that this deterioration may arise from the intrinsically bad effect of water on a saline soil. Except in the earliest years the yields were not diminished by the previous growth under irrigation of other crops, chiefly lubia and dura. These crops appear to counteract the deleterious effect of irrigation, probably by the introduction of organic matter or the fixation of nitrogen. In rotation experiments at the Gezira Research Farm, the deterioration is least in the rotations including the leguminous crop, lubia. The correlations between the monthly distribution of rainfall and the yields of cotton in five rotation experiments at the Gezira Research Farm for the period 1918 to 1925, were investigated. For the normal three year rotation, lubia, fallow, cotton, there was a striking agreement between low yields and high early (May and June) rainfalls. ( $r = -0.94$ ). Two year rotations and continuous cotton did not show this effect, but the yields were connected with the rainfall at other periods. Thus late rains (September and October) had a bad effect, which increased in magnitude for the rotations in the order, fallow—cotton, dura-cotton, lubia—cotton, continuous cotton; the bad effect of late rains increased as the duration of the fallow preceding the cotton crop decreased. This probably indicates the importance of the fallow in increasing the permeability of the soil to water.

Some support was given to the conclusions from the three course rotations by the results from three course rotations at Tayiba and Barakat. Each of these estates had 2,000 acres of cotton annually during the six years for which the local rainfall data were available. The correlation coefficients between yield and May and June rainfall were  $-0.81$  and  $-0.50$ . No satisfactory explanation of this effect could be offered, but the hypothesis



was advanced that the bad effect of early rains arises from a loss of available nitrogen from soils containing very little decomposable organic matter during heavy rains in July and August when these have been preceded by an early rainfall sufficient to allow nitrification during May and June. In two-course rotations the presence of decomposable organic matter would probably reduce this loss just as in humid climates the introduction of bulky organic matter and stubbles reduces the loss of nitrate during the winter months.

It was concluded from a consideration of the rotation and manurial experiments at the Gezira Research Farm and from general observations that, after the water supply, the most important soil factor in the growth of cotton in the Gezira was the nitrogen supply.

(d) PHYSICAL CHEMISTRY AND INORGANIC CHEMISTRY.

- XXXIV. A. N. PURI. "*Some Experiments on the Interaction between Soil and Dilute Acids.*" *Journal of Agricultural Science*, 1925, Vol. XV., pp. 334-342.

The conditions of equilibrium between soil (free from carbonates and absorbed bases) and dilute acids, was studied, and also the degree to which soil can remove anions from solution in conditions which render improbable the formation of insoluble salts.

The equilibrium between the soil and each of several dilute acids employed, can be expressed by Freundlich's equation, and it may be concluded that the interaction is a surface phenomenon.

The soil was capable of removing chlorine ions from hydrochloric acid solution.

- XXXV. H. J. PAGE. "*The Nature of Soil Acidity.*" *Transactions of the II Commission of the International Society of Soil Science*, Vol. A., Groningen, 1926, pp. 232-244.

A discussion of the nature of soil acidity in the light of modern views on the ionic exchange relationships of the soil colloids. The views of Kappen, who distinguishes four different types of soil acidity, are criticised. It is maintained that the conception of the absorbing complex of the soil as consisting of an insoluble colloidal acid, or "acidoid," with which are associated surface-active hydrogen and basic cations, brings into line the majority of the known physico-chemical properties of the soil. The different types of acidity postulated by Kappen can all be regarded as manifestations of the same property of the complex, namely, the tendency of metallic cations to exchange with hydrogen ions as well as with other cations.

- XXXVI. C. E. MARSHALL. "*Some Recent Researches on Soil Colloids. A Review.*" *Journal of Agricultural Science*, 1927, Vol. XVII., pp. 315-332.

A critical review of recent work on the nature and physico-chemical properties of the colloids of the soil.



XXXVII. H. J. PAGE and W. WILLIAMS. "*The Effect of Flooding with Sea Water on the Fertility of the Soil.*" *Journal of Agricultural Science*, 1926, Vol. XVI., pp. 551-573.

The flooding with sea-water of land around the Humber in 1921 spoilt a considerable area of arable land.

The effects of the flooding, which consisted chiefly in an entire destruction of the tilth of the soil, are described, and compared with the recorded effects of similar floods in Holland and in Essex.

The results of an examination of the exchangeable bases in the flooded soil are considered in the light of modern work on the relation between the nature of the exchangeable bases in the soil and its physical condition. It is shown that the observed effects can be explained by replacement of a considerable proportion of the exchangeable calcium of the soil by sodium.

Dutch experience on the reclamation of flooded soils is discussed. It is shown that in the first few years after flooding, the land should be cultivated as little as possible.

The use of lime or gypsum for the treatment of flooded soils, in order to hasten the restitution of calcium to the clay in place of sodium, is discussed. From an examination of the soil from plots which had been treated with these materials, it is shown that, although both produced in some degree the desired effect chemically, the action did not proceed far enough in 12 months to produce a noticeable improvement in the tilth.

It may be possible under favourable conditions to grow certain arable crops on flooded land, among which crucifers appear to be specially suitable.

However, the most satisfactory and promising means of hastening the recovery of tilth and fertility by flooded land appears to be the establishment of a ley of lucerne, clover, or "seeds" which can be left down for several years.

(e) BIOCHEMISTRY AND ORGANIC CHEMISTRY.

XXXVIII. H. J. PAGE. "*Studies on the Carbon and Nitrogen Cycles in the Soil. I. On the Nature and Origin of the Humic Matter of the Soil.*" *Journal of Agricultural Science*, (in the press).

This paper is the first of a series dealing with investigations carried out in the last few years by or under the direction of the author. It is shown from the results reported in detail in the next four papers of the series, (1) That the humic matter of the soil is of a similar character in soils of widely different organic carbon content brought about by different manurial and cultural treatments. (2) That this can be explained on the assumption that humic matter is derived from one common constituent of plant residues, the remaining constituents not contributing directly to the formation of humic matter. (3) That the quantitative study of the humification of plant materials and the comparison of various artificial "humic acids" with humic acids isolated from natural sources, are both in favour of the hypothesis that this common constituent of plant residues, the parent substance of humic matter, is lignin.



These results support the lignin hypothesis of the origin of humic matter and coal, put forward by Fischer and Schrader. This hypothesis and other recent rival hypotheses on the nature of the humification process, are discussed.

XXXIX. C. W. B. ARNOLD. "*Studies on the Carbon and Nitrogen Cycles in the Soil. II. The Fractionation of the Organic Matter of the Soil.*" Journal of Agricultural Science, (in the press).

By treatment of the soil from the plots on Broadbalk and Barnfields receiving dung artificials and no manure respectively, with cold 2 per cent. caustic soda, and with the same reagent at 100°C., it is shown that the organic carbon can be fractionated into three parts thus: (1) Material soluble in cold dilute alkali; (2) material which will not dissolve in dilute alkali until it is heated; (3) material which is insoluble in cold or hot dilute alkali. The quantitative distribution of the organic carbon among these groups is practically the same for all the soils examined.

XL. M. S. DU TOIT and H. J. PAGE. "*Studies in the Carbon and Nitrogen Cycles in the Soil. IV. A Quantitative Study of the Humification of Certain Plant Materials.*" Journal of Agricultural Science, (in the press).

The rate of disappearance of the chief organic constituents of some plant materials: straw, maize cobs, sawdust, and clover hay, during their rotting under the influence of soil organisms, has been studied. It is shown that the formation of humic matter is more closely related to disappearance of lignin than to that of the other constituents. Moreover, pure preparations of those other constituents (cellulose, starch, xylan, xylose, glucose and protein) were wholly or largely destroyed by the microorganisms of the soil, without the production of any humic matter.

XLI. M. S. DU TOIT and H. J. PAGE. "*Studies in the Carbon and Nitrogen Cycles in the Soil. V. On the Preparation and Properties of Various Natural and Artificial Humic Acids.*" Journal of Agricultural Science, (in the press).

The preparation and purification of humic acid from various natural sources is described. The products were compared with preparations of the various types of artificial humic acid by conductometric titration with ammonia. All the natural products behaved as true acids, producing a definite increase in the conductivity of added ammonia. The artificial humic acids from lignin and from hydroquinone, and to a lesser extent, from cellulose, resembled the natural products in this respect, but those produced from sucrose and from furfural behaved differently, causing a reduction in the conductivity of ammonia. Quantitative studies of the humification of furfural and of w-hydroxymethyl-furfural *in vitro*, and of the interaction of glucose with glycine and various related bodies, are also described.



- XLII. V. SUBRAHMANYAN. "*The Biochemistry of Water-logged Soils, Parts I. and II.*" Journal of Agricultural Science, (in the press).

The work described in these papers constitutes the first portion of a systematic investigation into the chemical processes occurring in water-logged soils. This is a subject of great importance in relation to tropical agriculture, in particular, for rice growing. Part I deals with the influence of water-logging on the different forms of nitrogen, on the reaction, on gas production, and on bacterial numbers. The only prominent change in the nitrogen compounds is an increase in the ammonia, which causes a slightly more alkaline reaction. The absence of appreciable carbon-dioxide production, and the lack of any increase in bacterial numbers under aerobic or anærobic conditions, suggests that the ammonia production is due to enzyme action.

Part II describes work confirming this hypothesis. It is shown that ammonia production is not hindered by the presence of an antiseptic, and that the aqueous glycerine extract of toluened soil contains an agent which is able to produce ammonia from simple protein derivatives. An active deaminase preparation, of a protein like nature was isolated. The presence of this deaminase in cultures of soil organisms was demonstrated, and its action on a number of amino-acids was studied. It is concluded that this enzymatic deamination may play an important part in plant nutrition on waterlogged soils.

(f) CHEMICAL ANALYSIS.

- XLIII. C. W. B. ARNOLD. "*Studies on the Carbon and Nitrogen Cycles in the Soil. III. The Determination of Organic Carbon in Soils and Soil Extracts.*" Journal of Agricultural Science, (in the press).

A description of the methods of analysis developed for use in the work described in the paper, No. XXXIX.

- XLIV. V. SUBRAHMANYAN. "*An Improved Method for the Determination of Dissolved Oxygen in Water.*" Journal of Agricultural Science, (in the press).

This paper deals with methods which have been specially worked out for use in the investigations on waterlogged soils, described in paper No. XLII.

IV. THE SOIL POPULATION & ITS BEHAVIOUR.

(Bacteriological, General Microbiology, Mycological Departments.)

(a) BACTERIA.

- XLV. P. H. H. GRAY. "*A Method of Staining Bacterial Flagella.*" Journal of Bacteriology, 1926, Vol. XII., pp. 273-274.

A simplified method that has proved of great value in a procedure, usually attended with much difficulty, essential in bacterial diagnosis.