SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ISSUE RAISED IN "A NEW TYPE OF LYSIMETER AT THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION"

UNDER the caption, "A New Type of Lysimeter at the New Jersey Agricultural Experiment Station," SCIENCE, 70: 147, Dr. J. S. Joffe describes the Russian type of lysimeter and enumerates what he considers to be its distinctive advantages. The statement, "The only rational method of studying the drainage of each horizon is to install a series of lysimeters at the depth of the respective horizons *without disturbing the natural position of the soil profile.*"[1] is one that raises an interesting issue. If this unqualified statement be true, it means that during the past twenty years the properties of the several profiles of different soils have been studied by an irrational method at the Tennessee Station, and with three types of equipment.[2] The same fallacy would apply to similar studies at several other stations in this country, as well as in England, Germany and Switzerland. The writers believe that the above-mentioned article offers a timely occasion for the presentation of the two view-points that have been considered in a previous contribution.[3]

Lysimeter researches have for many years been based upon these two view-points. One of them calls for a built-up enclosure around an area of undisturbed soil for each lysimeter unit. This postulates homogeneity in the soil and subsoil of the area chosen for study. This homogeneity can be proved only by physical and chemical examination when the enclosed area shall have been disrupted after the termination of the experiment; hence periodic reports of different phases of the studies can not be made with safety. The other view-point demands homogeneity as the first prerequisite, and this is assured by a premixing of the soil required for each experiment. With assurance of initial uniformity, periodic reports of the progress of the main objectives and by-product findings may be offered as the investigation proceeds. In both conventional types the retaining walls extend above the surrounding surface, so as to preclude the effects of surface washing.

Our concept of the value of the lysimeter is that it serves as a means of establishing fundamental principles that relate to *cultivated* soils and their subsoils. Most of the cultivated soils in our humid regions receive some manurial treatment. The fate of such additions is of academic interest, as well as practical importance. The lysimeter is of especial value in this connection.

Our own opinion is that homogeneity in the soil mass is the paramount essential in lysimeter experiments. This can be assured at the beginning of an experiment only by a thorough mixing of the body of soil that is to be divided among the several containers. Initial uniformity in the soil systems in the different units is imperative when supplementary laboratory studies of residual effects and causative factors are to be made.

When properly carried out, we believe preliminary screening and mixing constitute a treatment that is hardly more severe than a thorough field preparation for a common farm crop. To contend that the prescribed mixing materially alters a given soil is equivalent to contending that the repeated field cultivation of that soil results in its being converted into a series of materially different soil systems. Extended observations have shown that the initial acceleration in biochemical activities and the enhanced outgo that may result from the preparatory handling is followed by years of uniform outgo, under normal climatic conditions. The close agreement obtained in the outgo of nutrients from replicated lysimeters has further justified the efforts to insure the uniformity that is attained by premixing. The practicability of the premixing plan also permits the economic installation of a large number of filled units, instead of a restricted number of built-up enclosure units, for the same expenditure.

The new, or Russian, no-wall type of lysimeter that is advocated by Dr. Joffe requires further and even more optimistic postulation than that called for by the built-up enclosure type. Homogeneity is hoped for, or assumed, and this assumption is burdened by the further assumption that the percolation follows a definite perpendicular direction in the absence of the side walls that are used in the two older types. With increase in depth of profile, this assumption becomes more hazardous, especially in gravelly soils and those of glaciated regions. The assumption as to perpendicular movement of percolates in the absence of retaining walls also minimizes the variations that may be introduced by ducts that result from decayed plant roots, as well as worm channels. Under some conditions and with certain types of soil and terrain, the major portion of the gravitational movement probably is directly downward. Nevertheless, the lateral seepage that causes trouble in perpendicular concrete walls tends to create skepticism concerning this point. The question of the direction of gravitational water movement through a soil column has been controversially considered by Greene and Ampt, and Thorpe and Roger, and by Leather, who states:[4] "But the passages

[1] Italics are ours.
[2] Tennessee Sta. Bul. 111, 1915.
[3] *Jour. A. O. A. C.*, 7: 16, 1928.
[4] *Jour. Agr. Sci.*, 4: 304, 1912.

through the soil are not straight or of uniform diameter for any measurable distance, in fact they are wholly irregular, which Greene and Ampt recognize, for they describe them as 'irregular in area, length, direction and shape.'" Furthermore, exactness in the increment of rainfall per unit of soil surface is not assured in the Russian type, since no control of surface run-off is provided. Certain studies at the Tennessee Station have required separate collections of percolates and the surface run-off from rainfall within lysimeter walls, and from observations made in these studies we are convinced that the factor of run-off can not be disregarded.

The Russian type of installation has economy as a point in its favor, but it will not prove economical unless its operation affords dependable results. The requisite expenditure of time, money and scientific labor will have been made before the validity of the results is determined.

Dr. Joffe states, "It is well to remember that such an outfit may be installed anywhere and if the data obtained were either unsatisfactory or *(in)complete*[5] for any particular purpose, the lysimeter funnels might easily be dug out and placed elsewhere." The implied uncertainty carried by this statement will hardly appeal to those who have labored to perfect types of containers that have proved to be dependable for study of soil and subsoil horizons to a depth of six feet.

The suggestion of a new type of equipment for the study of fundamental objectives arouses interest, and an *a priori* criticism would not be advanced by us if the Russian equipment were not offered as essential to a "rational" procedure in studies made by us and others through the use of related types of equipment. We readily concede that individual workers are entitled to the prerogative of choosing the apparatus that they believe will best serve their respective needs. We do not concede, however, that the introduction of a new and comparatively untried type of lysimeter justifies the inference that the use of an extensively tried and proved type is irrational.

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SPECIAL ARTICLES

TRANSMISSION OF EXPERIMENTAL TRACHOMA BY CONTACT

DR. NOGUCHI'S work, already confirmed in the United States and Europe, associates etiologically *Bacterium granulosis* with human trachoma. This association is based, first on the frequent, probably constant, presence of the bacterium in the lesions; and also on the fact that when *Bacterium granulosis* is inoculated into rhesus monkeys and chimpanzees by subconjunctival injection, corresponding granulomatous lesions are produced. Experienced ophthalmologists have identified the experimentally produced lesions with the typical lesions of human trachoma, and there are great similarities between the two shown by the microscope.

The usual course of the development of the lesions in inoculated monkeys, as described in Dr. Noguchi's monographic article,[1] is, first the appearance of the granular lesions on the upper inoculated conjunctiva; then on the lower membrane, and later the extension of the lesions to the upper and lower conjunctivae of the opposite, uninjected eye.

This succession of events indicates quite unmistakably that while for the initiation of the lesions in apes a subconjunctival injection of the culture may be necessary or is the surest way of establishing infection, the subsequent processes depend on the contact of the lesions, or the secretions from the lesions, with the uninjected conjunctivae.

In order to procure this contact infection beyond doubt, four rhesus monkeys were caged together. Two of the four had advanced granular lesions produced in the one case by the injection of Albuquerque strain No. 1 isolated by Dr. Noguchi in 1926, and in the second by the injection of the same strain recovered in 1928 (Tyler) from the eye lesions of a monkey previously injected with the same Albuquerque strain. The remaining two monkeys were normal, with entirely smooth conjunctivae, at the time of exposure.

The animals were placed together in a roomy cage on November 8, 1929. They were examined eighteen days later, or on November 26. The two monkeys already affected showed, of course, advanced lesions. The two exposed monkeys, which had normal conjunctivae on November 8, now showed in each instance granulomatous lesions affecting the upper and lower conjunctival membranes of both eyes.

There seems, therefore, no doubt that *Bacterium granulosis* can be carried to and made to infect the uninjured conjunctiva of *Macacus rhesus* through ordinary contact. This possibility, already shown by the extension of the lesions from the injected to the uninjected eye by Dr. Noguchi, is now shown to be

[5] In a communication to the writers, Dr. Joffe requested that this word be corrected to read "complete."

[1] Hideyo Noguchi, "The Etiology of Trachoma," Supplement No. 2, *Jour. Exper. Med.*, 1928, xlviii.