by a board of scientific directors whose members include Dr. Dean Burk, of the National Institute of Health; Dr. Leo Edelman, Dr. Leo Stieglitz and Dr. O. Alan Rose, all of New York City.

ACCORDING to the *Experiment Station Record,* a grant of $150,000 from the General Education Board for the conduct of a five-state regional study of land tenure and farm labor problems has been announced at the University of Arkansas. The university has been designated as fiscal agent. The research will include field studies of land tenure and farm labor problems in Arkansas, Mississippi, Louisiana, Texas and Oklahoma. A regional staff, headed by Dr. H. C. Hoffsommer, professor of rural sociology and sociologist at Louisiana State University and Station, will be employed, and a regional research laboratory will be set up at the university on a three-year basis. The project will be under the direction of the southwestern land tenure research committee, of which Dr. C. O. Brannen, head of the department of rural economics and sociology and assistant director of research, is chairman.

THE American Coordinating Committee on Corrosion is planning a revision of its confidential Directory of Technologists actively engaged in studies on corrosion and its prevention. The committee comprises delegates from the seventeen major technical societies together with representatives from the principal industrial research institutes and the National Bureau of Standards. Its directory lists some four hundred investigators in corrosion-preventive fields, selected on the basis of questionnaires circulated to the member societies of the committee. It requests that all those actively engaged in corrosion researches who have not received applications for information from the committee write to the secretary, Dr. G. H. Young, 4400 Fifth Avenue, Pittsburgh, Pa., for further details and application forms for directory listing.

DISCUSSION

SOIL FERTILITY AND MANURING IN CHINA

BEGINNING in 1935, the Soils and Fertilizers Department of the National Agricultural Research Bureau has been investigating the fertility of the soils of China, with especial reference to the limiting effect of plant food deficiencies, and to the possibility of increasing crop production by the use of fertilizers. The investigation is based in the first place on field experiments, chiefly "NPK Tests" consisting of modern factorial designs at two and/or three levels. The standard rate of application throughout is 8 *catties* per *mou* (about 0.5 cwt./acre), of N, P_2O_5 and K_2O. The experimental crops are rice, wheat, maize, rapeseed, cotton, millet, barley, sugar cane, Irish and sweet potatoes and mulberries (chiefly the first five). The experiments have been carried out either by this department directly, or in cooperation with provincial institutes, universities and other organizations. The field experiments are supplemented by laboratory, chemical tests for "available" nutrients in the soils of the experiments.

The results of over 170 of these field experiments, widely scattered through fourteen provinces of China, are now available. The work is still continuing, and yield results already obtained are still being analyzed, but although the investigation is thus incomplete, it is desired to put the broad results on record, in case the work should be interrupted. It is realized that the number of experiments is not large, in relation to the area covered (a consequence of the difficult conditions which have existed here since 1937), but none the less the general results are quite consistent within the various regions or soil groups, and it is believed that further extension of the work will not greatly alter the picture. It is thought that the findings will have some general interest to agriculturists and geographers, while the implications are important for the future of China.

Eighty-three per cent. of the soils tested in the field experiments gave significant responses to one or more nutrients: in other words, soil fertility is likely to be limited by plant food deficiencies in at least four fifths of the soils of China. (Early statements about the high fertility of Chinese soils were usually based on a superficial acquaintance with the rich soils of alluvial plains and deltas; much of interior China consists of relatively poor, hilly land.) Nitrogen deficiency was most general (74 per cent. of the soils); next came phosphate deficiency (38 per cent.); potash deficiency was uncommon (12 per cent.), probably because of the general use of ashes and local manures. There were clear relationships between the Great Soil Groups (as described by James Thorp), and nutrient supply or deficiency, which there is not space here to set out in detail. Briefly, the pedocal soils of north China (J. Lossing Buck's Wheat Region) were often deficient in nitrogen, but they were generally well supplied with phosphate and potash; the pedalfer soils of central and south China (Buck's Rice Region) were still more deficient in nitrogen, often seriously deficient in phosphate and sometimes deficient in potash. The red and yellow earths were the most seriously nutrient-deficient soil groups, and those on which fertilizers were most strikingly effective in increasing yields.

Estimates were made of the probable extent to which crop production could be increased in China, by using artificial fertilizers in addition to the present

supplies of local manures and fertilizers (which can not be much expanded). If artificial fertilizers were used only on soils where they were likely to be needed (on the soils which gave significant responses in these experiments), it would be possible to increase the total production of crops in China by between one third and one half, using the rates of application mentioned above. (The variability of the estimate depends on the weights to be applied to different crops and regions.) This estimate may be taken as applying to the part of China covered by Buck's "Land Utilization in China," with the exclusion of his Spring Wheat Area. The increase in production would be much greater in the Rice Region (about one half increase over present production) than in the wheat region (about one fifth increase).

Taking economic factors into consideration, and using the 1937 farm prices in east and north China as a basis, it can be said that if all farmers whose soils needed fertilizer applied what was necessary, at the standard rate, then on the average individual farmers would have a two-to-one chance of making a profit (*i.e.,* one farmer out of three would be likely to lose money). If only those farmers applied fertilizer whose soils were likely to give an economic response, on the basis of the field experiments, total crop production in China could still be increased by at least one quarter. Supposing that China developed her own fertilizer industry and that fertilizers could be sold at prices comparable with those in the United States in 1937, then these estimates would be considerably increased. If all farmers with deficient soils used the necessary fertilizers, then each farmer would have at least a five-to-one chance of making a profit from his expenditure; if only those farmers used fertilizers who were likely to secure an economic response, total crop production in China could be increased by at least one third.

The bearing of these results on the population, food and economic problems of China needs no emphasis. While it may not be possible to take much action on them under present conditions, for the future they are equivalent in increased production to adding four or five new provinces to the 17 or 18 provinces for which these estimates may be expected to hold good. In connection with the reclamation and resettlement of the poor soils of southwest China, too, the use of fertilizers is likely often to make the difference between success and failure.

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ON THE NATURE OF VIRUS ADAPTATIONS

FILTERABLE viruses are now generally recognized as highly specialized intracellular parasites. They not only are adapted to life within protoplasm, but also show specialized adaptations as to the kinds of cell that they invade and the species of animal in which they produce disease. The several adaptations appear to be distinctive for each individual virus and also to have a range of variation that is characteristic of each virus. Variations of the adaptations, within their ranges, are common in viruses occurring naturally; and by selection of the variations under experimental conditions, modified viruses of different kinds can be produced. Such terms as *neurotropic, dermatotropic* and *epitheliotropic* have been used to designate viruses that have special affinities for certain tissues. The term *pantropic* is used to describe a virus that invades a number of tissues without having a specialized affinity for any one of them.

There seem to be three fundamental adaptations of a virus as a parasite. The primary adaptation is to an existence within living protoplasm. It is this adaptation to growth within protoplasm that I have presented as basic to the transformation of visible microbes into ultramicrobes[1] by the process of retrograde evolution under conditions of parasitism. From the primary adaptation a virus obtains its fundamental characters in relation to a host-cell, such as growth only within the cytoplasm or the nucleus, the production of inclusion bodies before necrosis, the production of necrosis without inclusion bodies and stimulation of the host-cell to proliferation. This adaptation might be termed *cellular adaptation, protoplasmic adaptation* or *cytologic adaptation.* Inasmuch as the study of the cell is known as cytology, the most accurate term for adaptation of a virus to the cell would probably be the last named, *cytologic adaptation.*

Quite distinct is the adaptation of a virus to the type of host-cell[2] in which it grows. An expression of this specialization of a virus is seen in such terms as *neurotropic* and *dermatotropic.* The specialization does not seem to be an adaptation to a tissue or an organ, but specifically to a kind of cell which may, wholly or in part, make up a tissue or an organ. For example, the fox encephalitis virus produces a clinical encephalitis in foxes, but it is not a neurotropic virus, if this term indicates that the virus grows in nerve cells. It grows to the greatest extent in the cerebral vascular endothelium, to a less extent in the hepatic cells and not at all in nerve cells. In general, a virus appears to become adapted to grow best in one kind of specialized cell, but to a less extent it will grow in certain related specialized cells and also in more embryonic types of cell. This second adaptation might be called *organ-* or *tissue-specialization,* but this does not seem satisfactory because a virus grows in types

[1] R. G. Green, SCIENCE, 82: 443–445, 1935.

[2] R. G. Green, "Proceedings of the International Assembly of the Inter-State Postgraduate Medical Association of North America" (October 13–17, 1941, Minneapolis, Minnesota), pp. 80–85. 1941.