regular members of the staff the work has been supplemented by the following visiting lecturers: Dr. Charles F. Brooks, of Harvard, in meteorology; Arthur Robinson, of the Cartographic Division, Office of Coordinator of Information; Richard Edes Harrison, cartographer for *Life* and *Fortune;* George B. Cressey, Syracuse University; Earl B. Shaw, Worcester State Teachers College. The work has been under the immediate direction of Wallace W. Atwood, Jr., associate professor of geography, who has taken charge of cartography, photogrammetry, field work and map interpretation. President Wallace W. Atwood, Dr. Samuel Van Valkenburg, Dr. Clarence F. Jones and Guy H. Burnham have also contributed to the program. Special attention has been given to economic geography, the geography of the war zones and to training in geographic research. Several of those who have taken this work will soon go into active service. On September 21, a new group will be admitted for similar training for war service in geography. The demand for experts in this field is far beyond the present supply.

DISCUSSION

MODERN VOCATIONAL AGRICULTURE

"FORTY Years of Helping the Farmer with Knowledge," published in SCIENCE for June 5, is a frank and challenging article with much of which I can agree. However, it is distinctly misleading at certain points, particularly as it deals with agriculture in our secondary schools.

Modern vocational agriculture does not aim at holding all farm boys on the land. It assists in providing sound guidance regarding opportunities in farming and other agricultural occupations and then helps to train those who apparently will fare best if they follow these occupations.

Teachers of agriculture in the secondary schools do not confine their efforts to the teaching of boys. In 1940–41, the latest year for which I have data available, teachers of vocational agriculture in the United States taught 253,691 adults (exclusive of those enrolled in defense education classes) and 332,612 persons of high-school age. Enrolments in classes for adults are growing at a much more rapid rate than enrolments in high-school classes. Thus teachers of agriculture are already extensively engaged in working with people who are established in farming.

We recognize in vocational agriculture, as Dr. Chandler does, that experience in farming is the basic preparation for farming. We have found, however, that school instruction closely correlated with farming experience and some school supervision of farming experience make that experience much more valuable than farming alone can be. This combination of science with practice has proved most acceptable to the farming people of America, as shown by the rapid growth in the number of schools providing it and in the enrolments in the classes in agriculture in these schools. Approximately 9,000 high schools in the United States now offer vocational agriculture.

Teachers of agriculture are, in general, eager to keep in touch with the colleges of agriculture and their extension services. Often it has been made very difficult for them to do so. These teachers want graduate courses in agriculture as well as in education, but they are not always able to get appropriate courses. They want other types of assistance, but some colleges of agriculture have chosen to give nearly all their help to the county agents, ignoring the teacher group.

Here at the University of Illinois three eighths of the graduates of the College of Agriculture go into the teaching of vocational agriculture. This group is regarded by the college as a very important group, both before and after graduation. Through this group, the college has one of its most important outlets to the state. Two men are employed full time in liaison work between the college of agriculture and the teachers of vocational agriculture to determine the subject matter needs of these teachers and to secure from the college the services they desire. County agents and teachers of vocational agriculture have grown up together, have been educated together and work together in their counties in the spirit of a large but closely knit family. This is to a considerable extent the situation in most states.

It is unfortunate that California, in which the relations between vocational agriculture and the college of agriculture are probably the poorest in any state, should be held up as an example. Vocational agriculture in California has from the beginning been so nearly ignored by the College of Agriculture of the University of California that it has been considered necessary to set up a completely separated program for vocational agriculture whose isolation from the college of agriculture Dr. Chandler deplores. In spite of the indifference of the College of Agriculture, vocational agriculture has thrived in California. Several other colleges of agriculture started out in the direction in which California's College of Agriculture has gone but have retraced their steps, so that California is now unique in its relationships between the agricultural college and vocational agriculture.

Dr. Chandler seems not to be concerned with the effects on the public schools of removing from them an important branch of education. If agricultural education were to be turned over to agencies outside the local public schools, it would be easy to argue for turning over other types of education until little would be left of these schools. I am not at all concerned that this is going to be done. We may as well reconcile ourselves to the idea that agricultural education is to have an increasing part in our public schools and begin to work out more satisfactory relationships between this type of agricultural education and that sponsored by the agricultural colleges.

Some of Dr. Chandler's conclusions seem to trace to the limited conception of education implied by the title of his article. If we are only to "help farmers with knowledge" we shall go about the job one way; if we are to provide education in agriculture as a part of a general education, our procedure is quite different. Certainly agricultural education is much more than getting the newest sound facts about agriculture to the farm people.

Dr. Chandler's article provides further evidence that increased contacts between agricultural scientists and educators would be desirable. Perhaps, as one result of these contacts, the educators could answer the question: Why do scientists who reason well in their own fields often become inexact and unreliable when they stray outside them?

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ANTS AS PROBABLE AGENTS IN THE SPREAD OF SHIGELLA INFECTIONS

ANTS have not been incriminated as vectors of pathogenic bacteria affecting man, though medical entomology abounds with citations of flies as carriers of many species of bacteria. Even cockroaches have been suspected, but ants have not been mentioned. No reference is found in the available literature as to their role in this respect.

Theoretically, if flies can convey pathogens mechanically from infected to non-infected material, other insects should be able to do likewise. For some reason, ants, in tropical or subtropical regions where they abound, are prone to be accepted rather as a harmless invader to be combatted solely on an esthetic basis. They are driven from sugar, candy or other foods which are then consumed with little thought of contamination.

Recently in this laboratory, in the course of experiments on native food as a culture medium for Shigella, ants were found to carry these organisms. The original observation which led to this limited series of experiments was purely accidental. Portions of the native food, rice and beans cooked together with onions and tomato sauce, were inoculated with various strains of Shigella to determine whether this food was a favorable medium for the growth of the pathogens and thus a source of the dysentery so common in Puerto Rico. Following a 24-hour incubation of the plates streaked from this food, which had been inoculated with Flexner strains of Shigella, they were read, covered and left inverted on the laboratory table until the next morning. At that time unusual growths of non-lactose fermenting colonies, later identified as Shigella, were observed in a pattern similar to miniature rabbit tracks. Examination revealed a few ants on the table, leaving the plates. These were caught and allowed to walk on sterile MacConkey and S.S. agar plates which, on incubation, produced a growth pattern similar to the original.

Since it was impossible at the time to produce a laboratory ant-hill for control purposes, it was necessary to rely on those entering from the hidden colony. Many were caught as they made their first appearance in the laboratory, about six feet from the inoculated plates. They were allowed to walk across sterile plates and then were placed in large vaseline-rimmed pans. Others leaving the infected food were caught three to five feet away and, on exposure to sterile plates, produced pure cultures of Shigella. Since the MacConkey and S.S. agar are selective media, inhibiting *B. coli* as well as some Gram-positive organisms, the plates made from the entering ants were sterile 24 hours later. From this it was concluded that ants, placed in this container, were free from Shigella or Salmonella.

Food inoculated with *Shigella flexner* V was placed in one container. The ants fed readily during a period of four hours, when the food was removed and sterile plates introduced long enough to allow ants to walk over the surfaces. These plates produced *Shigella flexner* V. Twenty-four hours after feeding on the infected material, sterile plates were again introduced. These, too, produced the typical growth of Shigella marking the footprints of the ants. The process was repeated in forty-eight hours, but on these last plates no colonies appeared. About twenty ants of this group were then macerated and inoculated on plates; others placed in nutrient broth, which again failed to produce Shigella. This work was repeated with like results.

From these simple experiments it may be deduced that ants may carry bacteria on their feet from one place to another for at least 24 hours after feeding on or traversing infected material.

The ants used in this experiment were kindly identified by M. R. Smith, of the U. S. Bureau of Entomology, as tropical fire ants, *Solenopsis geminata* (F.).