AGRICULTURAL EDUCATION

ON THE TRAINING OF SCIENTIFIC OFFICERS FOR TROPICAL PLANTATION INDUSTRY.

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The Chairman (Mr. P. J. Burgess) read the following paper by Prof. J. B. Farmer, at the Rubber Conference held in Brussels in connection with the Sixth International Exhibition of Rubber and other Tropical Products, April, 1924.

The training of a scientific officer for tropical plantation industries must necessarily vary to some extent in relation to the duties which he is ultimately to be called upon to discharge. Broadly speaking, these duties or functions resolve themselves into three classes, and the requirements of each should be met by the appointment of correspondingly different classes of officers, viz :—

(A) Purely scientific officers, mainly engaged in research. Nearly related to these, and perhaps selected from their ranks.

(B) Men of scientific training and outlook, but whose main object is to disseminate information and to give advice by means of visits to different plantations and factories, and in various other ways.

(C) Agricultural scientific officers.

Men qualified to discharge the duties of any one of these three posts ought to have received a thoroughly scientific training at least up to the standard of a high honours degree at a University. An agricultural officer should, in addition to this, have had training in the principles of agriculture as practised in the field.

It will be convenient to consider separately the three main classes indicated above.

A. *Purely Scientific Officers.*—These will chiefly consist of chemists and biologists (including mycologists, plant physiologists, plant breeders, and entomologists).

(1) A chemist, in addition to having received a broad general scientific training, should have specialised at the close of his University career for at least a year in the particular aspects of chemistry and physics which bear upon the problems that will lie before him, and should have also had training in research. I do not mean by this that he ought to confine his attention to rubber, or to any other single tropical product. He will be continually faced by problems the solution of which will depend upon knowledge outside the range of his immediate subject, and for this reason it is necessary for him to possess a good all-round training. Moreover, it is not even desirable that he should have devoted his earlier research experience merely to the "getting up" of the technique of such a subject

as rubber. His time will have been better spent, from the point of view of the industry, in acquiring a knowledge of the methods and technique of physical and organic chemistry generally. Such training will be invaluable to him when he has to apply himself to the problems that will confront him in the laboratory and the factory. A man in a narrow groove is seldom or never an employee of the greatest value.

(2) Turning now to the biological staff, the training of these men should also, *mutatis mutandis*, be conducted on broad lines analogous to those insisted on for the chemists. It is essential that, in addition to their botanical acquirements, they should have had a sound training in chemistry, not to speak of other branches of science. It may be said generally that at least from two to two and a-half years are necessary to train a man properly for economic botany or entomology *after* he has received his general scientific groundwork. The particular line on which he is destined ultimately to specialise will appear during this period of his education. Thus a plant physiologist requires a much greater knowledge of chemistry and physics than a mycologist or entomologist who, on the other hand, needs to have at his fingers' ends a much more detailed knowledge of the actual plant diseases or insect pests and the technique for isolating and experimenting with them, than does the plant physiologist, and it is seldom that aptitude for both subjects is combined in one individual. A plant breeder, whose work is of a rather special kind, ought to have had practical training at one of the institutes that concern itself with this work, and he ought to have worked under the direction of a recognised leader in genetics.

From the point of view of usefulness to the industry, it is essential that every officer should be equipped with as wide a general knowledge as possible of the sciences bearing on his special subject, but it is important that during his course of training he should not be tied down in any way to the study of the particular kind of physiology or the kind of mycology or bacteriology which may appear most likely to be immediately useful to him on the plantation. In a word, a man's ultimate usefulness will depend more upon the *breadth of outlook* which he acquires during his period of training, rather than upon any *intensive knowledge of the problems which will confront him in the industry*. The latter knowledge will come soon enough when he gets to grips with the problems themselves, and the measure of success with which he is able to attack them will, other things being equal, chiefly depend upon the extent of general scientific knowledge which he is able to bring to bear upon them. Thus, I should entirely deprecate devoting a student's time to the study of rubber plantations problems. He will learn more about these problems, and learn it better (if his previous training has been what it ought to be), in two months on the plantations than he can possibly do in a year's work in Europe. As a student away from actual contact with the industry, his time will be far more usefully spent in laying a sound foundation of scientific knowledge and ideas, and of the technique and practice of research.

In addition, however, to laboratory experience, a good officer ought to have had, during his University training, some experience in the field, in order to enable him to grasp those fundamental principles which underlie so many of the reaction of plants to their environment.

For example, many problems of disease often resolve themselves into problems of nutrition, or of ration of the soil, or of water-supply, etc. When any of these conditions are defective the plant easily may—and experience shows it actually does—lose the curious quality of *resistance* to *infection*, and this is equally true whether one is dealing with the infection of a fungus or with the depredations of an insect pest. For example, it is known that inadequate aeration of the soil through deposit of silt, as a consequence of defective or deficient drainage, may so reduce the vitality of the plant by affecting the supply of oxygen to its roots as to render it an easy prey to the attack of pests and diseases which, under better conditions it would successfully resist. In making these statements I am quoting from personal observation and experience, and they can easily be verified and amplified by any one who knows how and where to look for appropriate examples.

It may be of very great advantage to a scientific officer, and still more, to his employers, if, after being selected for a post but before he is sent to take up the duties attaching to it, he is afforded an opportunity of working say for six months, at some tropical institution such as the Imperial College of Tropical Agriculture in the West Indies. There are other institutions which are also capable of affording similar advantages. The increased value of a man who has had this additional experience will be due to the circumstance that he has learnt, under skilled guidance and under specially advantageous conditions, to focus his knowledge upon tropical agriculture in the wider sense, and thus he will be enabled to short-circuit the gap between work in a European laboratory and practice in the Tropics. He will get a wider outlook on tropical problems generally, and he ought to be able thereby—and far more effectively—to concentrate on the particular ones which will face him in any individual district. I have no hesitation in saying that any expense incurred in giving an officer this additional training will be repaid to his employers many times over.

It is, of course, clearly recognised that the troubles which arise from the actual pests on the plantation are largely fungal or bacterial on the one hand, and animal—chiefly insect—on the other. But it would be unreasonable to expect that a man can qualify as a specialist fitted to be entrusted with the responsibility of serving a plantation industry in dealing with pests both of animal and of vegetable origin alike. The field of knowledge is too wide for any one man to cover. But I should like to record it as my opinion that the entomologists, like the Botanists, in addition to having a sound knowledge of entomology together with the remedial measures which such knowledge indicates, should at the same time be keenly alive to the influence of agricultural conditions upon the incidence of insect epidemics. This aspect of an entomologist's scientific training too often escapes attention.

B. When a trained scientific officer reaches the district to which he is appointed, there appears to be two main types of work which may lie in front of him—namely, either that of scientific investigation, or that of the dissemination of information by means of visits to plantations, factories, and the like. Some men have greater aptitude for one kind of work than the other, and it ought to be clearly understood that it is a waste of effort, as well as of money, to be continually asking a man whose mind is set on

investigation to leave his proper work in order to take over what might be described as "missionary work." By this I do not mean that a man whose main interest lies in research should be confined to his laboratory; some practical experience, such as visits to plantations or factories can afford, he ought certainly to have. What I do mean is that to take a man of the research type and continually to be calling him off from his proper work to visit plantations for the purpose of giving advice is to misuse him, and this means a waste of money. A good investigator is not necessarily a good adviser to a planter who wants quick results, and interruption of research too often involves unnecessary postponement, or even the loss, of results of far-reaching importance to industry. Naturally, it is not possible to lay down hard-and-fast rules, but the distinction I have here drawn is a real one, and wherever possible it should be kept in mind in organising a research staff.

It is also essential that a man whose time is mainly to be spent as a scientific adviser and in disseminating information should have had a sound preliminary scientific training similar to that already laid down for the investigator, but it will be turned to a different account. His material and point of view are different. His material is the plantation itself and the men who are employed in it, and he has to study both the one and the other. At the same time, it is necessary that he should be in close touch with the sources of that new knowledge which the scientific investigators are continually acquiring. Without this, and without an adequate initial training, his work may easily be worse than useless. With it, provided he has the necessary tact and possesses practical knowledge and sense, he should form an indispensable link between the research staff and the planter. The distinction I have here attempted to draw applies, though in somewhat different degree, to other cases. Probably the entomologist, more than any one else, can combine real research with advisory functions with least loss of general efficiency.

C. The higher agricultural officers will naturally be concerned mainly or entirely with administrative and advisory work, but in their case also a scientific foundation is absolutely essential. The kind of agriculturist who only has a "practical" knowledge of the land is not the kind of person, who in the long run, is at all likely to be of most use to the industry. There are already too many examples of mistakes in agricultural practice due to the lack of the right kind of preliminary scientific training. In a word, the agricultural officer must have been trained in the *principles* of agricultural *science*, as well as in the *practice* of agricultural *art*.

One further general remark I should like to make in conclusion. All scientific officers tied down to their own districts tend to become out of date, or at any rate "stale," unless they are given the opportunity at fairly frequent intervals (say, every four years) of coming into personal contact with the progress of work as it is going on in leading laboratories and institutes, whether in Europe or in America. It ought to be clearly recognised that it is of the greatest advantage to every employer to see to it that the scientific staff are sent at sufficiently frequent intervals to renew their acquaintance with men working at home, and thus to have an opportunity for acquiring experience of the new knowledge which is continually being made. "Study leave," as it is often called, is a first-class investment from the employers' point of view, whether that employer be an individual, a syndicate or a Colonial Government.