

*THE UNDERSTANDING OF RESEARCH

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The problem stated by the Editors of the "Tea Quarterly" in the June 1962 issue is of widespread interest and importance and deserves an active response from all those concerned with it. It is a particular case of the much more general question of effective communication in our increasingly complex society, in which the development of language to meet specialist needs has raised new difficulties of understanding. It is perhaps most acute in the field of the application of scientific research to the problems of industry and agriculture, but it is by no means restricted to it. The search for satisfactory solutions to the problem is urgent and requires a co-operative effort both by those who have information to give and those who hope to benefit from it.

The establishment of a research organisation by an industry implies a recognition that the scientific method of examining the facts of experience offers exciting possibilities of improving the efficiency of the industry. It has not always been so readily recognised that to realize that promise demands a good deal more than the provision of funds to support research. The benefits of expenditure on research require an active effort of understanding on the part of those responsible for production to match the effort of the research worker to discover new knowledge.

Let us examine the sentence which provided the text for the discussion—"Polymerisation beyond the dimer stage is unlikely on steric grounds". First of all it is important not to be frightened. Scientific workers do not invent words to mystify the uninstructed; they do so in the interests of clarity and precision when describing their results. It is true that some effort is needed to learn the language but it is not necessary to master all its intricacies to get a general idea of its meaning. It is surprising how much can be understood with a little courageous self education.

There are three technical terms in the sentence, one of which is to be found in any modern standard dictionary and the other two are fairly readily derived from related words. The Concise Oxford Dictionary defines polymerization as "formation of a polymer by simple chemical addition of a number of identical smaller molecules", having previously defined a polymer as a "compound formed by simple chemical addition from a number of identical molecules, each of which consists of a number of identical units". Polymers play such an increasingly large part in our daily life, from the rubber in our car tyres to the nylon in our shirts, that some acquaintance with their nature could well be assumed amongst educated people. The same dictionary defines the word 'dimerous' as 'with two parts' and it should not be very difficult to infer that dimer refers to the stage of a polymer involving only two molecules.

'Steric' presents rather more difficulty, though if its relationship to "stereoscopic" and "stereophonic" is realised, an association with arrangements in three dimensional space might be inferred. With this information, the sentence could be translated as—"the joining together of these units is unlikely to go beyond two units because their relations in space would not permit"—over twice as many words and for the specialist much less precise.

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This is admittedly an extreme case taken from a paper which was clearly prepared for a different kind of audience, but it will serve to illustrate the kind of effort which is required if the full benefits of research are to be obtained. The potentialities offered by a growth in informed understanding of the methods and language of the research worker by those directly concerned with production policy are immense. The waste that defects in communication have imposed will be obvious to anyone familiar with the history of the planting industry. It is against this background that the problem must be considered.

In my opinion the primary object of the Tea Quarterly is to inform the industry and other interested people of what is going on in the Tea Research Institute. If the material in its pages can be considered as advisory or as a record of research, that is incidental to the main purpose. The use to which the material is put will depend on a variety of factors, not least of which will be its intelligibility to the readers and the extent to which they are responsible for technical policy in any section of the tea industry.

The purpose of the work of the Institute is to afford the basis for the more efficient production of tea in Ceylon and at length its results must form part of the corpus of advice. The passage from research result to practical application is far from simple and the difficulties have been admirably outlined by the Editors. It may help the discussion to carry that analysis a little further to cover the work of a research institute as a whole, in its relation to the industry it serves.

It is convenient to think of this work in three stages, (1) Investigation; (2) Presentation; and (3) Application. At each stage there must be an interaction between research workers and the industry if progress is to be maintained and confidence and trust built up.

Investigation is clearly the province of the research worker but there must be subjects for investigation and it is here that close co-operation between the scientist and the producer begins. There are two sorts of subjects for investigation—those which are recognised by the producer and those which are recognised by the research worker. There is naturally a considerable coincidence amongst the two groups, but it would be quite incorrect to assume their identity. The first group includes the obvious problems such as those presented by diseases and pests and the most efficient use of fertilizers. To the producer these are specifically the province of the research worker and any recommendations involving something new in practical methods normally receive a ready acceptance, provided they clearly afford an economic return. Given this satisfaction the producer is rarely seriously concerned with the techniques by which the results were achieved.

The situation becomes more complex when a problem is recognised by the research worker which is unseen by the producer because it involves practices so sanctioned by custom and usage as to be accepted as fundamental. Such a situation may arise in the study of problems in the first group when the effective control of a pest may require some change in time honoured cultural practices rather than, or in addition to, the use of some entirely new method. It may also arise from the recognition by the research worker that traditional practice has developed from outdated theory and is therefore ripe for a critical re-examination.

In such cases, the producer is much more reluctant to accept a recommendation for change and is much more concerned with the nature of the evidence on which it is made. Unfortunately, there is a widespread suspicion of the validity of evidence derived from modern agricultural field experiments. It is by no means uncommon to hear scornful references to pocket-handkerchief-sized plots and affirmations that

no evidence on a scale less than a whole field is of any value. References to the statistical interpretation of experimental data is still more likely to elicit the cynic's remark about "lies, damned lies and statistics" than a serious appreciation of its utility. This is so, in spite of the very excellent exposition of the nature of modern field experimentation which Dr Eden wrote in the early numbers of the "Quarterly".

This is an unfortunate situation since it must delay the incorporation of valid results into general practice, thus reducing the return on the resources devoted to research. The difficulty is not one of understanding the results because of the way in which they are communicated, but one of trusting their obvious implications. Provided he has clearly stated the nature of his experiments, the research worker can do little to bridge this gap. It is necessary for the producer to place his trust in experimental methods which have been developed and tested by scientific workers in all parts of the world. The trust may be an act of faith but the principles are simple and there is no reason why the faith should not be firmly based on knowledge.

There is a sense in which the second stage of presentation is a no man's land. To many research workers the task of presenting the results of their work appears as a tiresome necessity—time taken away from following up the ideas which the work itself has opened up. If the presentation requires the additional labour of popularisation, the task becomes still more burdensome, demanding gifts that are not at every scientist's command. Even if they are, it is not easy for one who has wrestled long with a problem, devised experiments to test ideas and brooded over the results, to know how much or how little can be assumed to be known to his audience. It is more usual to assume too much with a consequent failure to convey any useful information at all. Yet the issue is a crucial one, for the transfer of knowledge from the research worker to the understanding of the producer can alone justify the expenditure on research.

The record of the Institute in this matter is a very good one, as a study of the files of the "Quarterly" will confirm. It has been fortunate in the number of its staff who have been able, over the years, to communicate their results with style and lucidity. The cost of this in terms of time and effort is perhaps not fully realised by the majority of the beneficiaries, but there is no doubt that it was considerable and a search for means to lighten it would be worth while.

The admitted need for a considerable simplification in the presentation of the results of research suggests that there is a strong case for some consideration of the training of planting staff. The traditional method of "sitting next to Nellie" is still the basis of most initiation into the mysteries of planting. This system has much to commend it where the production pattern is stable or where the worker is called upon to carry out established techniques. It can be highly dangerous in a developing industry anxious to use every resource to improve its competitive efficiency. Nothing is better adapted for the perpetuation of the errors of our forefathers. It is the worst possible way of ensuring the early appreciation of the possibilities which research offers to the industry and which must be made known largely through the written word.

This is only a particular instance of a general problem which has been exercising both Government and Industry in Britain—the neglect of technological education and the shortage of technologists—people "who, as a result of broadly based studies and wide practical experience, have acquired a real understanding of scientific principles and can apply them to the development of industrial processes in diverse fields". It is pertinent to ask how many technologists in this sense are available to the planting industry and I am afraid the answer would hardly be reassuring.

This is in no way to decry the very real progress that has been made by both past and present generations of planters brought up in the old way. Nevertheless, with the accelerating progress of research, it would seem that the time has come to leave less to chance and try and ensure that in the future the background of those who will determine policy in the field and factory will be closely in accord with that of the research worker in the laboratory and experimental plot. With such an accord, the problem of the presentation of results by the scientific worker and the appreciation of their significance by the producer will be facilitated. The present relationship savours too much of the magician conferring benefits on the somewhat mystified client, instead of the marriage of two minds, with all the associations of differences, conflicts and co-operation that matrimony implies.

A wider understanding of scientific principles among producers will not absolve the scientific worker from the necessity of a sympathetic appreciation of the complexities of production problems. In many ways, the problems of the research worker are simpler than those of the planter, who is called upon to keep a productive organisation running, synthesizing his appreciation of the requirement of the crops with the resources of men and money available to him. He has to use his judgment with the knowledge at his command, imperfect and incomplete as it is, and he has to reconcile his purposes with the independent and often conflicting purposes of a considerable community of workers. A technical innovation which to the research worker is the consummation of a successful investigation may be an infliction upon the planter who has to incorporate it into the estate routine.

The close association between the research worker and the planter which the policy of the Institute has encouraged and its situation facilitated has done much to smooth the channels between research and practice in both directions. It must always be recognized that these relationships require careful nurture if they are to be a natural expression of mutual respect and of ultimate common aims. While formal occasions—symposia, planters' association meetings and the like—are valuable, the opportunities for informal relations are perhaps still more important. It is in such relations that the planter's observations and experience are most likely to stimulate the perceptive investigator and the planter is most likely to acquire an appreciation of the aims and methods of the research worker. It need hardly be said that these contacts can also do much to reveal the difficulties of communication and so lead to improvements in the presentation of the results of research.

There are dangers of course, and in particular, the wish of planters to see more of their scientists can be a serious impediment to the continuous concentration which research demands, if it is not firmly controlled. The dangers are not unavoidable if their nature is recognized and will disappear with the growth of understanding. Nothing can take the place of the growth of understanding and it requires effort on both sides. If the emphasis has been placed mainly on the effort needed by the producer, this is because it has generally received less attention than the need for the scientist to explain himself and his works to the practical man.

The final aim of the processes of investigation and the presentation of the results is their application to production. Whether they can be applied depends on a number of considerations not all of which are of a technical nature. Over-riding them all in the first instance is the question of whether and how far the results of an investigation, which must of necessity be carried out under a limited range of conditions, can be generalised to cover the variety of conditions encountered in the industry. Naturally, the answer will vary with the problem and with the conditions on individual estates. Clearly, the application of research results is a specialized task in which the planter has a major role. His efficiency in that role will depend both on his experience and the deductions prompted by that experience,

Sound deductions require a basis of knowledge. It would be both incorrect and unjust to generalise but many scientific workers in the plantation industry would echo from their experience the comment of R. H. Stoughton, reviewing a book by a farmer—"He has obviously thought deeply and observed closely, but lacks the background of knowledge correctly to interpret his observations". In the light of the variety of responsibilities which fall upon a planter it is too much to expect a high degree of specialized knowledge concerning any one of them, nor is this necessary provided there are sources of advice to which he can turn. It is true that the effectiveness and efficiency of an advisory service depends to a considerable degree on the ability of the adviser to count on a broad understanding of his particular speciality amongst those he is called upon to assist. It is this requirement for which the training of newcomers to the industry should provide.

In the early stages of a research organisation, the working out of the practical application of research has usually been left to the planter and the research worker himself. In the past, there have been a number of remarkably successful instances where research and advice have been combined. However, these successes usually occurred when there were still many relatively simple problems to be solved and when the agricultural research worker was more often "a practical farmer with a bent for research" than "a scientist with a concern for farming". There are natural advantages where such a combination of functions can be achieved, but there is a point when it becomes an intolerable burden on the research worker and gives inadequate help to the planter.

It is impossible for the research worker to carry on with his proper job if he is constantly called upon to adapt his results to the requirements of individual cases. Often enough, they raise questions which are unanswerable without an acquaintance with local conditions impossible to obtain without devoting an amount of time to travel and discussion which can only be at the cost of research. In the interests of efficiency, the establishment of an advisory service becomes essential and this service must have a status not less than that accorded to research. The qualities required in an advisory officer are different from, but in no way inferior to, those of the research worker, and in some respects more difficult to find. There are times when the degree of respect accorded to the specialist may endanger the usefulness of his contribution to industrial development by undervaluing the part played by the less specialized technologist in incorporating new discoveries into the processes of production.

There is no doubt of the need for the strengthening of the advisory services for the industry and the problem should be considered from a wider angle than that of the Institute itself. The planting industry has not made as great an effort to engage its own scientific advisory staff as might be expected from the importance and complexity of the biological problems presented by its productive assets. It is true that the industry includes a large number of small independent units which individually could not support a specialist staff. For these the advisory service of the Institute is the obvious solution. There are, however, some larger units and Agency houses responsible for the care and supervision of groups of companies where the provision of scientific advisers would be practicable. In the past, there have been considerable difficulties in finding suitable men, since the essence of an adviser is not only scientific training but also experience and this may be one factor in limiting the number of such appointments. The present time offers possibilities of securing men of experience uprooted by political developments in newly independent areas who possess just the sort of background required. There might, of course, be some difficulties with the Immigration authorities, but the advantages which such appointments would confer on the industry should carry considerable weight.

The existence of scientific officers in the industry, independent of the Institute would greatly strengthen the whole scientific effort devoted to the crop. Apart from the contribution they could make to extending trials of new methods and materials arising from research and adapting them to local conditions, they could provide a source of informed criticism which would be a most valuable stimulant to the Institute. The Editors point out one aspect of need for criticism in their emphasis on the desirability, wherever suitable, of the publication of research results in international journals where they will be exposed to such critical appraisal. The presence of independent scientific workers in the industry itself could perform a similar constructive function, with immense advantages both to the workers at the Institute and to the industry as a whole.

There has been a great deal of discussion in recent years on the question of whether scientists should be "on tap" or "on top" in industrial affairs. The problem is far more complex than this simple antithesis would imply. Whether men trained in scientific disciplines and developed in specialist departments make better managers or policy makers than others trained in other ways depends on qualities of personality and character largely independent of either background or experience. What is certain is that the future of any industry based on technology is in jeopardy if an informed appraisal of the contributions which research can make is not associated with the decisions at the highest levels of policy making and direction. This may seem a long way from the point at which this discussion started but it is highly relevant to the question of making the best use of research in the service of the tea industry in a highly competitive world.