the long-term or basic research which is paying the highest dividends in practical results. This may seem paradoxical. The objectives of short-term or *ad hoc* research are those thought to be within reasonably easy reach, and the research itself usually covers a severely restricted field. The objectives of basic or long-term research are usually distant and the research itself is nearly always planned on a broad basis. It is precisely this planning on a broad basis that makes it valuable not only in science but also in practice, and in the light of the experience of the last three years I am almost tempted to believe that if provision is made for long-range research on a broad basis in which the closest contact is maintained with practice, much of the *ad hoc* work carried out in relation to the control of injurious insects might be dispensed with. That may, however, be to simplify matters too much, because there is often a gap between basic research and practice which can only be filled by *ad hoc* work. On the other hand, my own experience strongly suggests that it might be better if this necessary *ad hoc* work were carried out jointly by the practitioners and the research workers.

In recent years in applied entomology there has grown up a kind of investigation commonly called *ad hoc* research which has in my opinion little value. It is the kind of work which assumes that any kind of investigation, because it relates to an injurious insect or to the use of insecticides, is *ipso facto* of economic or applied scientific value. The literature of economic entomology is overburdened with accounts of work of that kind almost to the despair of the serious research worker and of the practitioner alike, because the work described is too often neither good science nor good practice. The possibility that in economic as in scientific work the discovery of new laws and principles may solve a problem cannot be overlooked, and in seeking to discover new laws and principles relating to insect behaviour or to the mode of action of insecticides it may be the simpler, if not the only, approach to study quite other insects than the injurious ones and then, having gained an understanding of principles, apply these principles to the solution of the practical problem.

I refer to this misunderstanding of research in applied entomology because recent experience has thrown it into high relief, and because the same experience has emphasized the value of a background of research as free and untrammelled by immediately practical considerations as is possible in a workaday world.

I favour, then, the freest basic research in the closest contact with practice, but I often meet with the view that free research aimed at the discovery of new laws and principles is incompatible with practice; that it is impracticable in war-time; that research and practice cannot run in double harness, and that their aims are totally different. That their aims may be different I do not for a moment deny, but that they are incompatible is demonstrably untrue.

So it comes about that in this field of work in the control of injurious insects there is and must be a continuous going to and fro between practice and research and between research and practice. They are not incompatible; they are complementary, and it may be some compensation for the sorrow and tragedy of war if in this and in other fields fundamental research and practice can continue to work together.

MUSEUMS AND EDUCATION

By G. F. WESTCOTT

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THE present world upheaval is partly due to the fact that man's control over his physical environment has advanced rapidly, while the ideas and methods which he uses for controlling his relations with his fellows have developed much more slowly.

One of the most important psychological features of man is his emotional and habit-forming nature. This nature has been essential to the development of civilization, by enabling the individuals of a nation to act together as a community with a common purpose. It is particularly valuable when reasoning cannot be used, whether for lack of intelligence or time or when the amount of evidence available to all is insufficient to produce logically a reasonable uniformity of opinion. No human being can be logical all the time: we all use many ideas, obtained by habit or suggestion or by previous reasoning, which are frequently emotionally reinforced and have become practically impervious to reason or suggestion in normal conditions. These ideas are often the guiding principles of our lives, which enable us to act quickly and help to give us our characters. They simplify our lives and save us from becoming choked by logical entanglements. It is an example of the small part reason plays in human life that these most fundamental ideas, particularly liable to emotional reinforcement, have received the least amount of study by scientific methods.

In the past, poor communications and the strong influence of tradition have been safeguards against the sudden rise over a large area of a new system of ideas. But to-day there is a loss of faith in tradition and, as we have seen only too clearly, the tremendous developments in our methods of communication and propaganda, especially when combined with repression and the destruction of all opposition (which can also now be organized and applied rapidly over a wide area), can change the purpose of a nation in a very short time, with disastrous results to the whole world. Emotions are so strong that they can be acted upon to reinforce almost any idea, whether right or wrong, and even against the balance of direct evidence. Repeated propaganda, especially if contradictions are suppressed, can also be used to form mental habits and so strengthen particular ideas.

In the past there has been a number of ideologies, sometimes on a national basis, and competition between them may have tended to ensure the survival of the fittest, even though this may often have meant mainly the ability to destroy its rivals by force or subterfuge; but the world seems to be approaching a time when, at least in certain directions, there may be only a few generally accepted views. It is essential, if development is not to be retarded, to provide for constant criticism and research, so that the best ideas may have a chance of coming into use. Perhaps a practical objective science of ideas and thought will be developed as a safeguard—indeed, work has already been done on these lines. This would result in further mental instruments being devised to enable man to transcend his natural abilities.

A practical ideology must satisfy at least two conditions: it must be expressed in such a way that it will communicate at least some acceptable meaning to many of the individuals concerned, and it must be

sufficiently in touch with reality on essential points to be workable. Many of the most important ideas on which our present civilization has been built, especially in the moral and political spheres, are upheld by the authority of tradition. This, owing to its strong power of resisting change, has probably provided the stability needed for the development of civilization in other directions. Tradition, however, in these spheres seems to be losing its power and also appears to be too resistant to change to keep pace with modern events, leading to the danger and actual occurrence of revolutions based on the authority of dominating individuals using all the modern methods of mass influence. It would be disastrous if civilization were to be left to the control of such ephemeral and fortuitous authorities, and it seems clear that there is an urgent need for some new kind of authority, more universal and stable and capable of rapid adaptation to new factors in the situation as they occur. The position is perhaps similar to that of several centuries ago, when the authority of tradition began to give way to the authority of knowledge based on experiment in the domain of the physical sciences. The rapid advances which have been made in science are mainly due to the use of methods which largely eliminate the effects of emotion, habit and prejudice; if we are to advance quickly and safely in the moral sphere, I believe we must use similar methods.

At the present time it may still be expedient that our conduct and ethical ideas should be guided largely by tradition, to prevent confusion and rash experiments, but I think that with an adequate historical background there would be little danger of trouble occurring even if people should be encouraged to think logically for themselves on such subjects. In the absence of emotional reinforcement the position would be similar to that in science, where a new idea, even if truer than previous ideas, meets with great opposition until it has been thoroughly tried out and assimilated into the main body of accepted theory.

The evidence on moral and political subjects obtained and presented by scientific methods is steadily increasing and may soon be sufficient to ensure a reasonable uniformity of educated opinion, if made readily available to all adults. Particularly since the beginning of the present century, new ideas and methods have been introduced into psychology and, though as yet psychology is apt to be regarded more as an art than a science and there is much conflict of ideas still to be resolved, our knowledge of human conduct has been considerably increased. The time is not far distant when our knowledge of how men do act will greatly influence our views as to how they should act. Such an ethic would increase our understanding and sympathy for others, whether nations, races or individuals.

It seems essential, especially if democracy is to survive and produce the best results, that as many people as possible should be taught how to think for themselves, and how to protect themselves from emotional exploitation for false or evil purposes. The individual must become more critical; though fortunately he cannot escape his emotional nature, and thus deprive life of much of its interest and drive, he can do his best to ensure that his feelings shall only be used to reinforce ideas, and particularly innovations, which conform with the best evidence available.

I would suggest that, among the objects of education in a democracy, the following are important:

(1) To provide the individual with a reasonably stable and dependable background for his mental development.

(2) To teach him how to think for himself and how to obtain reliable data, and to encourage him to use reasonable criticism and constant research.

(3) To help him to learn how to use his emotions and how to guard himself against their misuse by others.

(4) To discover and develop his abilities, so that he may become a useful member of the community.

Museums as an Educational Medium

In this particular connexion let us consider our national museums. The four selected objects are of the kind for which museums could be of the greatest assistance, and the following indicate some of the ways in which museums could help to attain these objects.

(1) For the later mental development of the individual a historical background is the most universal and stable. A knowledge of the past is a great help in understanding and dealing with the present and preparing for the future. Museums, by preserving the physical evidences of the past and by orderly arrangement, can do much to provide a common historical background.

(2) By examining examples of the work of men of the past, of the triumphs of critical thinkers and of scientific research, the visitor to a museum is bound to be impressed by the value of these methods and may be encouraged to try to use them himself. Museums and their associated public libraries would themselves be one of the sources of reliable data.

(3) Museums at the present time only help towards obtaining emotional control indirectly; for example, by inference from the insight they give into historical processes. To be more effective (a) there should be a museum (or part of a museum) devoted to psychology, and (b) an attempt should be made in museums generally to illustrate the influence of widespread (and consequently often emotionally reinforced) ideas on the development of civilization, so as to show which have produced permanent and which relatively fleeting effects. The evidential material thus made available in an interesting way would provide a stable background for judging the value of ideas.

The opportunity afforded by museums for studying the actual evidence on which authorities have based their theories, and the illustrations of the methods used to develop our understanding of the universe should help to produce a more rational attitude towards authority in general. Though we cannot be expert on all subjects, we can carefully examine the evidence in some small selected part of the field of knowledge and so obtain a better understanding of the foundations on which authority rests, particularly in the domains of science and history.

(4) By covering the whole field of man's thought, knowledge and activities, museums could help to discover to the individual (and his teacher) any particular interests or abilities which he may possess, and so enable him to decide in what way he could best serve the community and himself—that is to say, stimulate education rather than inject instruction.

Advantages of National Museums

Museums, especially the national museums, have advantages from an educational point of view over local teaching establishments in some respects. For

example, they contain unique examples of historical and evidential value; their material can be made to appeal to nearly all the human senses, and thus be made more interesting; expenses can be incurred for special exhibits which would be beyond the means of every local school or college; they can cover nearly the whole field of human knowledge and endeavour. As the educational possibilities of museums become more generally recognized, the time may come when visits to them will be included in the experience of all individuals (perhaps specially arranged tours to cover several weeks). The organization and display of museums would be adapted to increase their educational value.

One can visualize the time when the national museums will be organized to cover all the branches of knowledge systematically. For example, there would be a museum or museums illustrating what may roughly be defined as "Man's methods of dealing with himself and with his fellow men": this might include such subjects as government, laws, customs, warfare, religions, philosophies, education, psychology, physiology, anatomy and medicine.

These museums would deal with their particular subjects fairly fully and contain as much as possible of the important actual evidence available, such as historical relics. Descriptive labels would be attached to each exhibit: these should include sources of evidence and appropriate cross-references, and thus encourage the visitor to further research and self-education. Exhibits representing recent advances in our knowledge in the present or of the past would be brought particularly to the visitor's notice; in fact, it would be to museums that the public would naturally go for the latest information on such subjects.

Special Museums

In addition to these national museums dealing with limited and specialized subjects, I think there is another type of museum which would be of great educational value. This would deal with the development of civilization in general and as a whole, and form an introduction to, and a link between, the national museums. It would be integrative, and in it an attempt would be made to make the past live again. The ideas, politics, social organization, arts, crafts, and sciences, etc., of the past would be combined. It would be impossible to show the complete story of the development of civilization in the world as a continuous process, and so only certain important phases would be selected for treatment. For example, for a museum in Great Britain, a selection of periods such as the following might be made: early Egyptian; early Greek; Roman; Europe in Dark Ages; Italian Renaissance; and then, say, three periods of English history. The final period would be outside the museum—the actual present world. Of course, the periods, if thought desirable, could be extended backward in time to prehistoric eras.

In this museum actual relics of the periods would not normally be shown (unless large numbers in good condition happened to be available), but the reconstructions would be made as accurately as possible on the available evidence. Great care would be taken to provide suitable explanatory labels. Such a museum would not claim to represent final truth, but merely to be a careful attempt to reconstruct the past. It would invite criticism and would, of course, be modified as new evidence came to light.

Possibly, in suitable cases, the staff might be dressed in the costumes of the periods illustrated, and other means of adding realism adopted.

Mental instruments and methods have developed as well as material instruments, and it is most important to bring this out. Lecture theatres, cinemas and stages, where plays illustrating the life and ideas and demonstrations of the arts and crafts and instruments of the past could be given, might form an important part of the museum. There might also be rooms devoted to the great philosophers, and their philosophies, which influenced the periods concerned.

OBITUARIES

Dr. Cyril Crossland

By the death of Dr. Cyril Crossland on January 7 at Copenhagen at the age of sixty-four, zoology has lost one of its last explorer-naturalists of the Darwin type. He was educated in the Lake District, where his father was a well-known lake painter. During his whole life he suffered from deafness, but this did not prevent him from becoming a personality in Clare College, Cambridge, where he compelled its steward to provide vegetarian meals for him and his numerous disciples.

Wanting an assistant for his researches on the naked Mollusca, Sir Charles Eliot, Consul General and Commissioner, took Crossland to East Africa, where he developed a taste for small boat sailing, which enabled him to explore the coasts of Zanzibar, Pemba and the adjacent mainland. He compared the barrier reefs off the latter with those described by Darwin off Brazil, both series being formed by erosion. Zanzibar proved to be an enlarged portion of the continental barrier, whereas Pemba was an independent elevation; the coastal flats of the whole area were due to a recent lowering of sea-level. No reefs were found that could be considered as due to growth *in situ*. For comparison, he next visited the Azores, having been appointed fellow of the University of St. Andrews, discovering well-consolidated Dendrophyllia, Vermetus and Lithothamnion coastal formations.

In 1904, Crossland proceeded to the Red Sea on a year's biological exploration, in which he covered about five hundred miles of its western coast, collecting all the time. "Its shores are all composed of elevated coral and are fringed with its luxuriant growth, while Barrier and other reefs and patches fill the sea for miles from either shore." The Sudan was being opened up by the development of Port Sudan, and Crossland was given a commission for the economic culture of shell oysters, being allowed a free hand. He ran a farm for the next fifteen years at Donganab, about sixty miles north of Port Sudan, off which there was a maze of surface reefs and submerged banks with clear water between. Here he built a patriarchal settlement for his fishermen and he became a source of supply for Red Sea animals to nearly every school of zoology and museum in Europe. In 1913 he published his "Desert and Water Gardens of the Red Sea", descriptive of the lives of his people and reefs and of the sides of his fault line, more than 1,500 miles linearly of coral reef. In the War of 1914-18 his settlement was useful in policing the Red Sea, and his oyster farm was producing a crop of millions, for he had succeeded, where all his