

monuments, defensive ramparts, standing stones and wattle-and-daub houses could be mentioned, but the present article emphasizes the experimental techniques involving the functions of actual or duplicated artefactual material. A considerable amount of experimental work has been carried out on the casting of copper and bronze products, and on the firing of Romano-British pottery, but these have been concerned mainly with production techniques, while it is the functional aspect that is particularly relevant at the moment. Recent work on this aspect has included the testing of the capabilities of sheet metal and leather shields to stand up to sword and spear blows, the determination of the range of musical notes obtainable from both Danish and Irish Bronze Age horns, the function of Upper Palaeolithic and early Mesolithic harpoon-heads, and, most recently, two papers in *Man* (65, 1965) which advance new interpretations of the function of well-known Palaeolithic artefacts. In one (No. 148) Dr. M. D. W. Jeffreys attempts to show that the handaxe, that characteristic tool of the widespread African Chelles-Acheul and European and western Asian Abbevillian and Acheulean industries, was not in fact a handaxe, but was a handbolt or missile. He defines a handaxe as an elongated tool with a pointed and a blunt end, bifacially worked with a cutting edge all the way around which shows no sign of wear. Because of the cutting edge, Jeffreys believes that such axes could not have been held in the hand, and he argues that these objects were hurled, the blunt end aimed at the quarry and thrown with the cutting edge horizontal to the ground. The weight distribution he thinks would cause the missile to revolve in such a way that the sharp-pointed end would move at great speed. In my opinion, experimental throwing of handaxes seems to disprove this theory; handaxes exhibit immense variation in their form, and many

of the type with one pointed end have a rounded butt deliberately left untouched, presumably to provide a safe grip. That different shapes and sizes of axes were designed for different functions seems without question, but it is incorrect to call all these tools handbolts.

The second paper (No. 143) is a contribution by Leon Underwood and is concerned with Upper Palaeolithic perforated batons. These, often decorated, have been interpreted in the past as leather-working tools, arrow straighteners, or generally as emblems of authority and ceremony. Underwood argues that these batons were used as spear-throwers on the basis of analogous forms in Eskimo throwers. The latter have a prepared grip and a nipple to engage the end of the spear shaft. On not a single Palaeolithic baton has the end survived sufficiently to provide the slightest hint of a nipple or hook, and apart from this hypothetical appendage, there is really no point of comparison between the batons and the Eskimo throwers other than the hole or holes. That such batons, if provided with hooks, would function as spear-throwers is not disputed, because Underwood has provided models to show this. But there are a few complete Palaeolithic batons, and these show no sign of the hook nor of a bound-on hook. In any case it would seem strange if the development of the baton as a spear-thrower, from Aurignacian times through the Magdalenian, did not become abruptly altered by the apparently quite rapid appearance of the true spear-thrower in mid-Magdalenian times; in fact, there is a high degree of consistency in baton development over some 15,000 years. Underwood has made a number of provocative statements in his paper; although some of these are improbable, his ingenuity may nevertheless stimulate further work of this experimental kind.

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THE TEACHING OF PARASITOLOGY

PARASITOLOGY is taught in schools, in agricultural and biological departments of universities and technical colleges and in schools of medicine and veterinary medicine. Parasitologists are employed in a wide range of research establishments and many people trained in parasitology have found employment outside this field. The British Society for Parasitology felt that a meeting on the teaching of this subject would bring together those who taught and those who employed parasitologists and that all would profit from an informal discussion of common aims and problems. Accordingly, a colloquium was held at the Imperial College of Science and Technology, London, on January 10.

The form of the colloquium itself was an experiment as a large number of people were expected to attend and the usual formal meeting was quite unsuitable as a basis for the informal discussion which was envisaged. It was eventually decided that four speakers should briefly discuss particular topics of a general or controversial nature and that the participants should then divide up into small groups to discuss the papers and a list of topics prepared by the organizers. Each group was to be led by a rapporteur and at the end of the group discussions the participants would reassemble and listen to summaries from the rapporteurs and discuss them. In advance, each participant received a summary of the replies to a questionnaire which gave some idea of how much and what kind of parasitology was being taught in Great Britain. Questionnaires had been sent to biology or zoology departments of universities, schools of medicine and veterinary medicine and certain colleges of technology. Forty-one biology or zoology departments in

universities were approached; thirty-five replied, and of these twenty-nine ran some sort of course in parasitology and twenty-three of these planned to expand their courses during the next 5 years. Eighteen of the twenty-two medical schools replied and twelve of these ran parasitology courses, three of which will be expanded. All six veterinary schools replied and four of these ran courses, one of which is to be expanded. Seventeen technical colleges were sent questionnaires and twelve replied; of these, nine ran courses and all planned some expansion. In all, fifty-four separate departments run eighty-three courses in parasitology each year and a considerable further expansion is envisaged. These courses are very varied and range from one or two lectures to postgraduate courses lasting a whole academic year. The content of the courses is also varied but, in general, the parasitology taught to the veterinary students is applied, while that taught to all other students ranges from wholly systematic to wholly experimental, although most courses cover all aspects of the subject to some extent. Other information obtained from the questionnaire dealt with the nature and content of parasitology courses and was intended to act as a stimulus for discussion.

Eighty-six people attended the colloquium, which opened under the chairmanship of Prof. B. G. Peters, who outlined the nature, aims and procedure of the meeting. Prof. W. E. Kershaw spoke in general terms about the teaching of parasitology and more particularly about the M.Sc. course at the University of Liverpool. The second speaker was Dr. H. D. Crofton, who discussed the different problems involved in teaching science and veterinary students. The latter, he said, regarded

any course as an interruption in the path of their chosen career and thought they could obtain most of the parasitology they needed from the publications of the pharmaceutical firms. The method of teaching different types of students should vary considerably, and scientists could benefit from an ecological approach. D. A. Denham spoke from the point of view of someone who had recently been taught parasitology. He criticized the tendency to teach this subject as an extension of a course on systematic zoology; in other words, parasites rather than parasitology. Nothing was more disheartening to a student than boxes of stained slides, and many must have been put off the subject by this approach. The parasites of parasitology, he said, were those who used this easy way of teaching. The last speaker was Dr. S. R. Smithers, who spoke as one working in a research establishment as a 'consumer' of parasitologists. Dr. Smithers argued that a parasitologist ought to be something else as well, an immunologist, a pathologist or a taxonomist, for example. Specialization ought to be something that came after an undergraduate career. An ideal situation would be one in which an undergraduate received instruction in a number of interlinked disciplines including parasitology.

The meeting then broke up into five groups in order to discuss the teaching of parasitology informally, and reassembled at the end of the day to summarize the findings.

The topics discussed and the views aired in the discussion groups were many and varied and it would be impossible to summarize them all in a short space. It was generally felt that something about parasites ought to be said at schools, but that there was no need for a separate course in parasitology. The use of parasites other than those in the standard text-books was desirable especially as many are easily obtained from animals used for dissections, whereas few schools have the facilities to show pupils the living parasites required by most syllabuses. Plant nematodes are a particularly good introduction to experimental parasitology as their use requires no licence. The teaching of undergraduates was discussed at length and the only common conclusion reached was that there are many ways of teaching parasitology and this variety cannot do anything but good for the subject.

It was felt that veterinary students required a course which was vocational in nature and that, unless they were being specifically trained for work in the tropics, parasites such as trypanosomes need only be mentioned in passing. During such a course a student should be introduced to the wider field of parasitology, but this should not be the main object of the course. Medical students receive very little training in parasitology and it was generally agreed that a short course is useful and even one lecture is better than none, but that long courses would serve no particular purpose. The requirements of science students are quite different from those of medical and veterinary students, and the various opinions expressed ranged between wide extremes. General agreement was reached that parasitology ought to be mentioned early on in an undergraduate course in order to stimulate interest in the subject. This need not take the form of specific lectures but could be incorporated into zoology or physiology courses. Parasitic examples could be used to illustrate a variety of biological principles, and the way in which this was done could encourage interested students to look further into the subject.

What was generally agreed was that a sound biological background was necessary before parasitology could be studied in depth. The general feeling was that formal courses in parasitology should be left until the final undergraduate or first postgraduate year, by which time the students would have covered the necessary background. The type of course offered to final year students varies considerably from university to university, and this variation provided the basis for further discussion.

No single type of course could equally be applicable in all departments and it was felt that a student needed instruction not only on the parasites and their interactions with their hosts but also on the disciplines which impinge on parasitology. A number of courses run at present take the form of a review of the parasitic protozoa, platyhelminthes, nematodes and arthropods, with brief mention of their physiology, biochemistry and ecology. It was regretted that only too often a parasite is regarded as something in a taxonomic key rather than as a living organism. It was agreed that some systematics must be taught and the more that is covered in the pre-parasitology years the less needs to be done in the final year. Students of parasitology should be able to use keys, and some training in this was thought to be necessary, although no agreement as to the extent of such training could be reached. Some felt that emphasis on difficult but basic characters, such as the bursae of nematodes, would be preferable to a general coverage of a number of taxonomic points and others felt the reverse. What was agreed, however, was that there is, and always will be, a need for people who can identify parasites.

Considerable discussion ranged around other possible approaches to the teaching of parasitology, especially the experimental approach, although few participants actually had much experience of such courses. The main difficulty seemed to be a lack of possible experiments, but most people were willing and able to devise suitable exercises based on their own first-hand experience, so the difficulty is really one of communication. It was agreed that the British Society for Parasitology would provide a useful service if it collected together a number of tried experiments and exercises and distributed them to those involved in teaching. Individual projects undertaken by students were also thought to be useful in the teaching of the subject and difficulties which might arise could be overcome by the exchange of information.

Postgraduate courses were discussed by all the groups and the opinions expressed varied considerably. The general feeling was that such courses were useful but that they could easily become white elephants. The courses really needed were those which brought several disciplines together and were of a vocational nature. There seemed no point in beginning a postgraduate course simply to assimilate material pushed out of an undergraduate course, nor was there any point in such a course if it was merely an expansion of one given to undergraduates. The problem of financing students for such courses was raised and difficulties had been encountered. The general feeling was that the initiation of postgraduate courses should not be undertaken lightly but that well-planned courses of a high standard and of a vocational nature could contribute much to the field of parasitology.

Other aspects of the teaching of parasitology discussed included the merits of sandwich courses, which were regarded as being very useful and in some ways better than the usual undergraduate courses. The expansion of this type of teaching might have a considerable impact on the future of the subject. The training of technicians should be mainly vocational but it was felt that those hoping to work in the tropics should be taught some basic science and, in particular, the use of keys.

All the participants at the colloquium had the opportunity to learn and to preach, and most did both, so the meeting served its purpose. Among the concrete proposals which arose were suggestions that the British Society for Parasitology should consider collecting not only the experiments in parasitology already mentioned but also lists of teaching materials and teaching aids such as films and film strips. It remains to be seen whether or not this meeting will have any impact on the teaching of parasitology, but there is no doubt that the subject will continue to be taught and no pessimism was felt concerning the future employment of the students in these courses.

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