THE TRAINING OF BIOLOGISTS

A DISCUSSION on the training of biologists, organized by the Institute of Biology, was held in London during April 21-22. The first session, under the chairmanship of Mr. J. F. Wolfenden, vice-chancellor of the University of Reading, was opened by Miss R. Hemmings (Girls' High School, Burton-on-Trent). She stressed the poor background from which the majority of the pupils at maintained schools come, and their ignorance, when they leave the primary schools, of any foreign language or mathematics, and of the principles of clear thinking. These deficiencies make the process of giving them a broad education both slow and difficult, and this in its turn reacts on the teaching of science. The careers which the girls follow vary widely; but teaching is not favoured. Mr. G. B. Hindle (King's Norton Grammar School for Boys) spoke of the great improvements that have taken place during the past twenty-five years in laboratories, text-books and the technique of teaching. This has been accompanied by a big increase in sixth-form numbers, and at King's Norton the use of the science sixth as a school of liberal education is encouraged. Mr. Hindle felt that professional biologists of the experimental type could be made if one started at the sixth-form level or even later, but that the training of field naturalists should begin much earlier. The shortage of qualified staff is an obvious difficulty, and while it was his opinion that pass-degree men were seldom of much use for sixth-form work, they could be helpful in the middle school.

Mr. W. H. Dowdeswell, describing conditions at Winchester College, said that biology is not begun until the sixth-form stage is reached, and this works well, at least with fairly able boys. Much emphasis is placed on field-work, about one-seventh of the total class-time being spent on this. A great handicap in making the subject live is that text-books, although so full of facts that they are difficult to read, do not treat the organisms as living creatures; they describe, for example, an abstract 'earthworm', in apparent ignorance of the fact that there are in Britain about a dozen species of different structure, habits and distribution. Mr. C. Bibby (College of St. Mark and St. John, London) balanced the wide range of initial knowledge of his students, from zero to degree standard, against the great freedom which the training colleges have to arrange their own courses.

The subsequent discussion ranged over a wide field. Points which were made by more than one speaker were that a chief duty of schools is to give a liberal education, and that many teachers keep much too closely to the syllabus and the text-book, in the mistaken belief that that is the only way to get their pupils through examinations. In answer to a question, Dr. G. E. Fogg said that the present over-production of pass-degree and third-class honours men unsuitable for teaching is not so large as had been predicted.

At the next session Dr. R. K. S. Wood (Imperial College of Science and Technology, London) gave a summary of the replies received to a questionnaire recently circulated by the Institute of Biology to heads of university departments. About two-thirds of the botany and zoology departments replied, and in nearly all there is some specialization in the final

year; but while in botany the number in which some choice is given is about the same as that in which all the special courses are compulsory, in the majority of zoology departments the student has some choice. A slight majority of the zoological heads think that this specialization ought to be reduced to a minimum; but nearly all the botanists accept it as inevitable and desirable.

Undergraduate courses in botany, plant physiology and zoology were dealt with by Dr. J. Heslop-Harrison (University College, London), Prof. F. G. Gregory (Imperial College of Science and Technology, London) and Dr. J. A. Kitching (University of Bristol), respectively. All three liked their students to have read chemistry, physics and mathematics instead of biology at school, although Prof. Gregory restricted this preference to those who would become research workers. Dr. Heslop-Harrison asked if it would not be better for future teachers and such-like to read pass degrees, so that all honours students could stay on and do postgraduate work. Prof. Gregory made a plea for the education of biological administrators—an important and increasing class. Dr. Kitching described the course at Bristol, where systematic zoology is compressed into one year and much attention is given to field-work and such special subjects as cytology and embryology.

Prof. J. F. Danielli (King's College, London) spoke on the other biological subjects and described the two ways of teaching biochemistry: as an undergraduate subject to students who have physics, chemistry and mathematics but know no biology, and as a postgraduate course for chemists or biologists. He said that the outstanding problems are the failure of the universities in general education and of the schools to attract outstanding teachers. A partial reason for the second of these was given in the subsequent discussion when Mr. D. A. Sturdy (Felsted School) said that if the universities do not want the schools to teach biology it is unlikely that the schools could attract good teachers. Prof. F. R. Winton (University of London) said that students must be allowed to study a subject when they are interested in it, a view which was applauded, and Dr. Wood that if biology were excluded from the schools there would soon be no biologists. Mr. W. B. Yapp (University of Birmingham) said that the trouble with insisting that future biologists should read chemistry, physics and mathematics in the sixth form is that the Advanced Level syllabuses in these subjects do not contain the material which they need.

The third session dealt with biology in technical colleges. Mr. S. A. Smith (London School of Hygiene and Tropical Medicine) described the courses for the examinations of the City and Guilds Institute and of the Science Technologists Association, and Dr. H. F. Steedman the special courses in biological technology which are run in the University of Glasgow. Both types of course were welcomed by speakers from the floor. Prof. I. A. Preece (Heriot-Watt College, Edinburgh) spoke on the need for a National Certificate in Biology, which would give a more theoretical qualification for such technicians as those responsible for routine testing in factories. Miss J. E. Heriot (Brighton Technical College) spoke on the difficulties and successes of technical colleges in

their degree work. In a lively discussion which followed, there was support for the idea of a National Certificate, and the difficulties in training isolated technicians, including those in schools, were stressed.

The final session dealt with postgraduate training. Summarizing the replies to the Institute's questionnaire, Dr. Wood said that few departments give any special courses in research methods, and that neither in botany nor zoology is it common for there to be concentration of the main resources of a department on a narrow field of inquiry. Dr. G. E. Fogg (University College, London) described a postgraduate course in microbiology, and Dr. G. Brownlee (King's College, London) a similar course in pharmacology. Both these consist of lectures and practical work. Prof. V. B. Wigglesworth (University of Cambridge) spoke on the Ph.D. and gave as his opinion that, in spite of its obvious disadvantages, this degree is on the whole worth while; but that employers should not insist on it. He deprecated the publication of theses, and Sir James Gray in the discussion went further and recommended their abolition. Dr. J. Y. Bogue (Imperial Chemical Industries, Ltd.) included, in his summary of the qualities which are desirable in the industrial research worker, a first-class education in the broadest sense, an ability to handle technicians and an ability to write English. The importance of the last was stressed by a number of speakers in the discussion, and other points that were made were that there might be scope for part-time postgraduate courses, and that workers who do not live in university towns are greatly handicapped by lack of library facilities. W. B. YAPP

MOLECULAR REARRANGEMENTS IN ORGANIC CHEMISTRY

ON April 6 a symposium was held by the Chemistry Department of Queen Mary College, London, on "Molecular Rearrangements in Organic Chemistry". Prof. D. H. Hey took the chair. The seven contributions covered those features of molecular rearrangements which are of current interest and stimulated a lively discussion.

Prof. S. Winstein described his investigations of 1:3 and 1:2 hydrogen shifts in carbonium ions. Roberts and Lee¹ had established the existence of a 1:3 hydrogen shift in the non-classical *norbornyl* carbonium ion; Prof. Winstein has found that the hydrogen shift does not accompany formation of the ion but occurs in a subsequent step. The first ion to be formed is the non-classical structure (I), and the subsequent migration involves as intermediate either the *nortricyclonium* ion (II), or the alternative structure (III). Prof. Winstein favoured the latter alternative. He then described experiments in the cyclohexane series which demonstrate the possibility of anchimeric assistance of ionization by adjacent hydrogen atoms, the ionization of appropriate cyclohexyl esters occurring more rapidly than would be anticipated and with a 1:2 shift of hydrogen.

In the subsequent discussion, Dr. H. Cardwell suggested that anchimeric assistance by adjacent hydrogen might be general in S_N1 solvolyses and pointed out that, if this were so, a statistical correction should be applied to observed solvolysis-rates, depending

on the number of hydrogen atoms able to participate. This idea was criticized by Prof. Winstein on experimental grounds. Prof. H. C. Longuet-Higgins gave theoretical reasons in support of the structure (III) for the *norbornyl* intermediate. Prof. M. J. S. Dewar emphasized that, although anchimeric assistance of solvolysis implies greater stability of the π -complex form of a carbonium compound with the classical form, the converse is not necessarily true. After further discussion, the consensus of opinion seemed to be that anchimeric assistance of solvolysis by hydrogen does not occur, except in special cases, but that the π -complex ions with hydrogen in the non-classical position are probably more stable than isomeric classical structures.

Prof. C. W. Shoppee discussed the stereochemistry of Wagner rearrangements in terms of the mechanism suggested by Ingold and Shoppee². In the rearrangement (IV), inversion should occur at both carbon atoms α, β , and retention of configuration in the migrating group R . Prof. Shoppee described a number of rearrangements in the sterol series, involving migrations of groups or ring contraction, where the products obtained depend on the stereochemical configuration of the starting materials and can be predicted on the basis of the theory.

Prof. Winstein pointed out that these conclusions are somewhat too rigid; while the configuration of R is invariably retained, and while C_α and C_β commonly undergo inversion, cases are known where retention of configuration can occur. He pointed out that the stereochemical course of the reaction depends on the timing of the individual processes; in particular, exclusive inversion at C_β occurs as a rule only when there is anchimeric assistance of the ionization of X .

Dr. W. J. Hickinbottom then described a number of investigations into the course of rearrangements of epoxides and related glycols. These were interpreted in terms of the current carbonium ion mechanism. Interesting new reactions are the formation of allylic alcohols from epoxides in the presence of acid, and the fission of highly substituted epoxides and 1:2-glycols into lower ketones and olefins. These reactions were interpreted as follows: