SCIENTIFIC AND ENGINEERING MANPOWER IN THE UNITED STATES

THE report of the Committee on the Utilization of Scientific and Engineering Manpower in the United States*, which is discussed on p. 1101 of this issue of *Nature*, bases its recommendations and conclusions largely on the facts set forth in the second chapter of Part 1 of the report, "Needs and Resources". Between 1940 and 1960, the proportion of scientists and engineers in the working population greatly increased, and now, at 1·7 million, exceeds 2 per cent. Of this total, about 950,000 are engineers, 500,000 scientists and 250,000 teachers of science or mathematics at the secondary school level. By 1970, the total is expected to reach 2·8 per cent of the working population. About 40 per cent are engaged in private industry or commerce, 20 per cent in education, and between 20 and 30 per cent in work affecting national security and its position in the exploration of space. No major division of science includes more than 7·5 per cent of the scientists and no branch of engineering more than 15 per cent of engineers. Of those with doctorates, 29·2 per cent are scientists, 15·1 per cent being in the physical sciences and 7·4 per cent in the biological sciences. Secondary school teachers account for 14·7 per cent and engineers for 56·1 per cent; 6·7 per cent are psychologists or social scientists. Two out of three scientists and two out of five engineers are engaged in research and development. It is estimated that in 1963, of the total graduates in science and engineering, 57 per cent were employed in industry, 11 per cent by the Government, 12 per cent in colleges and universities and 15 per cent as secondary school teachers.

These figures and profiles are supported in Part 2 of the report by nine study papers. Mr. F. H. Harbison discusses measures towards the development of a comprehensive man-power policy; G. Colm and L. A. Lecht outline requirements for scientific and engineering manpower in the 1970's; and A. M. Ross considers how the United States uses its engineers and scientists. Proposals for development of an improved man-power-related information programme are detailed by A. O. Gamble, while P. W. Charington considers the impact of Government policy and action on the utilization of scientific and engineering man-power in the acquisition of weapons and space systems in a paper entitled "Systems-Acquisition and the Utilization of Scientific and Engineering Man-Power (Requirements and Programme-determination, Contracts and Grants)". In a further paper, he submits two case studies of the utilization of scientific and engineering man-power in the major military systems, *Titan II* and Naval Tactical Data Systems: this is summarized and its principal findings only are presented. In the last three papers, A. B. Kinzel presents an industrial view of the Government's impact on civilian research and development man-power, L. M. Hartman describes industrial practice affecting the utilization of scientific and engineering man-power, and R. H. Bolt takes a look ahead at man–machine partnership in intellectual pursuits.

* *Towards Better Utilization of Scientific and Engineering Talent: a Program for Action.* Report of the Committee on Utilization of Scientific and Engineering Manpower. Publication No. 1191, National Academy of Sciences. (Printing and Publishing Offices, National Academy of Sciences, Washington, D.C., 1964.)

FILM AND TELEVISION IN THE WORK OF THE UNIVERSITIES

A ONE-DAY conference on the film and television in the work of the universities was held at the Royal College of Art, London, on July 21. Mr. Michael Clarke, tutor in the Department of Television and Film at the College, deserves every praise and admiration for arranging the meeting. The interest and enthusiasm shown by his audience were a welcome indication that audio visual media may shortly emerge from their adolescence.

The British Universities Film Council conference at Senate House in March, 1963, set out to survey the field of closed-circuit television within institutions of higher education from the severely practical point of view of application, technique, instrumentation and cost. At the Royal College of Art, Members of Parliament, university vice-chancellors and professors, members of the University Grants Committee Sub-committee on Audio Visual Aids Facilities in Higher Education, directors and senior executives of the independent television companies and of the B.B.C., as well as a catholic selection of experts in the arts and sciences came together to hear and to discuss a wide-ranging and more general search for the present and future role of film and television in the universities.

In opening the morning's session on "Potential Functions of Film and Television in Higher Education", Mr. Clarke pointed out that the meeting was too large to achieve any concrete results and that the main aim should be to gain information from each other. The Television and Film Department within the Royal College of Art would accept up to ten students a year who had completed their art-school training. They would go through a three-year course on film and closed-circuit television to learn how to think in terms of moving pictures. From among these students, it was hoped, would come some of the producers and directors of the future. A one-year course exists for those who are already in industry but wish to experiment or enlarge their knowledge. The nucleus of an academic film unit has been created and has started to make teaching films in collaboration with Imperial College of Science and Technology, London.

Mr. Clarke claimed that film and television should be regarded as modes of communication in their own right. If they were to be fully exploited in this way, both users and producers would have to rethink and learn how to use visual concepts. This should apply not only to the professionals but also to the teachers; all should learn to think in terms of illustration.

Prof. Collin Cherry, Department of Telecommunication, Imperial College, and author of *On Human Communication* (John Wiley and Sons and Science Editions, Inc., 1961), spoke on his experimental use of simple closed-circuit television equipment as an enlarging device during his lectures on engineering, where this device enabled him to use small models to illustrate abstract concepts. He also recorded a twenty-minute summary immediately after each lecture, so that his students could listen to the tape-recording either to supplement their notes or to catch up on a lecture they might have missed.

Prof. Cherry emphasized that the academic lecture should impart a basic understanding and interest in the subject, not detailed information. He expressed the hope that television would cut its traditional cinema apron strings and make greater use of its essentially electronic genes. Future use of television in the lecture theatre might bring outside events and phenomena to the student to

enrich his understanding and visual experience. A great expansion could be envisaged as soon as the restricted availability of wave-lengths had been overcome.

As a complete contrast, Mr. Edgar Anstey of British Transport Films and vice-president of the International Scientific Film Association recalled that Percy Smith produced superb classroom films on biological subjects almost fifty years ago. While films had been produced ever since, lamentably little effective use had been made of them. This might possibly be explained by the lack of appreciation of their enormous potential and, particularly, by the ignorance of the film language and its ability to appeal not only to logic but also to the emotions.

Prof. David Daiches, Department of English, University of Sussex, recounted his experiences in mounting twelve experimental television broadcasts on English literature and how he attempted, and evidently most successfully, to impart a visual understanding of concepts which could not be explained by words alone. So, for example, he illustrated the concept of stylization by showing a photograph of a real lion followed by a drawing of a heraldic lion. This demonstration was followed by the reading of poems on Nature, some realistic recounts of what the poet had seen, others giving a stylized account of another poet's experiences. As a further example, Prof. Daiches mentioned the film of Dublin streets which was used as background illustration to the reading of part of Joyce's *Dubliners*.

Prof. Eric Crook, Department of Biochemistry and Chemistry, St. Bartholomew's Hospital Medical College, London, brought the meeting back from open broadcasting to the uses of television and film within the university. He outlined the vocational rather than academic nature of the medical curriculum and how his college was revising the sequence and manner of teaching the preclinical course. He emphasized that an effort should be made to exploit the visual aspects of the material to be learned, in order to help the student who was very largely visually orientated in his method of learning and retention of knowledge.

Mr. Peter Laslett, Trinity College, Cambridge, bridged the transition from the morning to the afternoon session on "Immediate Problems and Needs" with his account of the "Dawn University" experimental broadcasts from Cambridge and the television links between Cambridge and Norwich, and Cambridge and Imperial College, London. Mr. Laslett felt that few students would be able to proceed to a degree examination unless they were given a great deal of other help and guidance, and that the main bulk of the viewers would merely look for a "cultural uplift".

While such broadcasts could well train or retrain mothers who wanted to go back to teaching, a degree course of the air would require a new central national body. Television teaching could not be cheap. At an estimated cost of £2,000 per hour a degree course of 500–600 hours would cost £1,200,000; and yet every university offers not just one but many degree courses. To be effective each hour of television broadcasting would have to be accompanied by something like four hours of radio instruction, eight hours of correspondence course work and time when the students would actually visit the university to which they were attached.

Mr. Laslett made it clear that the subject was far too complex to be discussed satisfactorily in a short space of time. An organization had now been set up to discuss ways and means, and the University of Cambridge was prepared to mount a comparative experiment. Unfortunately, research into education did not appear to attract financial support, and no action could be taken at the present time.

Mr. S. Pitt Corder, Department of English, University of Leeds, gave a stimulating account of the important pioneering work now being translated into reality at his university. This University Television Centre will assist and stimulate the use of closed-circuit television as a visual aid and as a tool in research at department level. The central organization will develop television as a medium of teaching in its own right, and central studio facilities have been created for the distribution of instructional material to departments of the university. The Centre will also institute its own researches into educational television.

The staff is planned to provide a small team to advise on departmental uses and to offer a loan and repair service. Central activities will be carried out by a bigger team equipped with high-quality apparatus. The director, who will have an academic background, will probably be supported by a studio manager-producer, an assistant producer, two technicians, an art director and assistants, clerks, drivers and handymen to form a team of some ten to fourteen people. Naturally the Centre will wish to lean quite heavily on existing university film and photographic facilities. It may not prove easy to find suitably qualified and experienced personnel, and it is interesting to note that school teachers have already asked to be trained, so that they may be enabled to use television in their schools.

Mr. Thorold Dickinson, Slade School of Fine Art, University College, London, joined the discussion at this point to direct attention to the American and Russian trend towards smaller and more portable film cameras for more flexible documentary and dramatic recording. He advanced the argument that this would make filming rather less the preserve of the professional and that the teacher could acquire the necessary expertise within a short period of two to three months, and that this might apply equally to the use of television.

As a partial reply to the problem of selection, storage and availability of films and television recordings (video tapes), raised by Mrs. Eirene White, M.P., Mr. Dickinson pointed to the enormous amount of documentary film material stored by the various television companies. He had been able to obtain some interesting and valuable examples from the United States and from France on condition that these films remained under his supervision. Even with this safeguard of copyright it had not yet proved possible to secure the same facilities from British companies.

Mr. R. Postgate, deputy controller of educational broadcasting, B.B.C., gave a survey of the Corporation's past, present and future policy. He stated that it had always been thought desirable to appoint members of the teaching profession to lead educational broadcasting policy. Apart from the educational activities which were already well known, the Corporation was planning to use its second television channel during the day-time for educational programmes as soon as the channel had achieved wider coverage. Some twenty-four broadcasts were planned to assist those who were working for the social economics diploma of the University of London. On the whole, however, it was the policy of the B.B.C. to think in terms of a national service, and the main emphasis had to be on schools because of the extreme shortage of teachers.

Mrs. Mary Adams of the Television Viewers Council and the Mental Health Film Council made a strong plea for a national education television channel. She defended the point of view that schools and universities should formulate the purpose, nature and contents of educational broadcasting, instead of leaving the initiative to the broadcasting companies. Mrs. Adams proposed that an information centre be created, and that a fellowship might be financed to prepare a survey of present activities in instructional television.

The chairman, Sir John Newsom, chairman of the I.T.A. Education Council, in summing up the discussion, proposed that a further meeting be called early in the new year to concentrate on more specific topics. In the meantime, the conference on the use of film in teaching and research, to be held at the University of Birmingham in September, will serve as a further stimulus.

The conference at the Royal College of Art proved to be a useful forum for the exchange of information and opinion. The next meeting may accept the view expressed by a number of discussion speakers that film and television

should not be considered in isolation but in the wider context of all methods of learning and of teaching. Almost invariably the appropriate use of several methods in combination will produce the best results.

While film and television can be expressions of art in their own right, the primary usefulness will probably be as aids in communication. The selection of the most effective methods of communication presupposes a clear understanding of the end product, what the student is supposed to be able to do, and how he is expected to think and react at the end of his course of studies. An appreciation of the teaching situation and the context in which learning is to take place will be just as important. Furthermore the producer of audio visual aids should base his planning on a clear definition of objectives, on existing knowledge of the proposed audience, and on the purpose of the contents. Finally, students should be given an opportunity to learn how to learn from visual information. Visual literacy, a concept cited by Sir Arthur Elton, is essential for the effective construction, use and acceptance of information in visual terms by producers, teachers and students respectively. The literature on the effective construction and use of audio visual teaching devices, both for mass instruction and for individual learning, as well as the literature on methods of testing, is considerable and should be made more widely available. It is, therefore, a pleasure to learn that Lord Robbins will be concerned with a new journal on the technology of education, *New Education*, which is to commence publication in November of this year.

C. E. ENGEL

OXFORD CHROMOSOME CONFERENCE

AN international conference on chromosomes, attended by more than a hundred delegates from twenty countries, was held at Magdalen College and the Botany School, University of Oxford, during July 28–31. The deliberations of the conference were of five kinds: dissertations, demonstrations, business meetings, social functions, and extra-mural informal gatherings.

The proceedings began with an address of welcome by Prof. C. D. Darlington in which he recalled for the conference the content of Weismann's classic paper published in *Nature* (**36**, 607; 1887). This he saw as still a charter for those who examine chromosomes.

Thirty other papers were delivered in four sessions. The first, on plants, included a report by Prof. A. Müntzing (Sweden) on accessory (*B*) chromosomes in *Poa* and *Secale*. The latter was also the subject of an investigation by Dr. J. Sybenga (Netherlands) on the possible role of interchanges in determining selective pairing in polysomics. Preferential autosyndesis was not observed, indicating that interstitial changes in homology have no detectable effect on pairing which is localized near the ends. The control of pairing was considered also by Dr. R. Riley (Great Britain), who described work on wheat undertaken jointly with Dr. E. R. Sears (U.S.A.). It revealed a genetic condition which determined asynapsis but only under certain temperature conditions. Other polyploids were the subject of papers by C. J. Marchant (Great Britain) and Prof. J. K. Morton (Sierra Leone). A different aspect of chromosome mechanics, diplotene repulsion, was discussed by Dr. K. Pusa (Finland), who concluded that such a force exists. The chairman of this session was Dr. E. R. Sears and it also contained a paper by Mrs. E. R. Sansome (Nigeria), who presented evidence in favour of the diploid condition of the vegetative phase in the Oömycetes.

The second session was concerned with the structure of the nucleus and with chromosome abnormalities induced by mutagens. Prof. Müntzing acted as the chairman of this session, which included papers by Dr. H. Ris (U.S.A.) and L. F. La Cour (Great Britain), who considered chromosome organization as revealed by the electron microscope and nucleolar structure respectively. There were accounts also by Drs. H-G. Keyl (Western Germany) and B. A. Kihlman (Sweden), who discussed various aspects of DNA synthesis. Papers by Dr. R. C. von Borstel (U.S.A.) and Dr. G. R. Lane (Great Britain) reported investigations on X-ray chromosome breakage while Mr. C. J. Grant (France) discussed the delay in mitosis caused by chemical mutagens. This session included a report by Prof. G. Östergren (Sweden) on the effects on chromosome behaviour of induced point mutations, and he gave a demonstration on the same subject. Of special importance were his observations of chromosomes which entered pollen grain mitosis although they had not divided into chromatids.

Insects and mammals were the subject of the third session, which was chaired by Prof. H. Bauer (Western Germany). It began with a beautiful film of meiosis in *Pales* by Dr. R. Dietz (Western Germany), who also exhibited three other films at a supernumerary session held on the last day of the conference. These showed that the spindle could function in a normal way even in the absence of centrioles and they threw considerable light on the mechanical behaviour of the hereditary sex univalents of this genus. Other aspects of chromosome movement and their control were described by Dr. I. Geyer-Duszýnska (Poland), while the effects of α-heterochromatin on crossing-over were considered by Dr. B. E. Wolf (Western Germany). Gene action in *Drosophila* was the subject of two papers, one by Dr. O. Hess (Western Germany) and the other by Dr. H. D. Berendes (The Netherlands). Chromosome polymorphism in black-flies was considered from the taxonomic point of view by Dr. R. W. Dunbar (Great Britain), who also gave a demonstration, while intra-specific chromosome variation of the Robertsonian type was discussed by Dr. C. E. Ford (Great Britain) and Dr. J. Wahrman (Israel).

Prof. E. Battaglia (Italy) was the chairman of the final session which contained papers dealing with mammals and the recent, far-reaching, discoveries in man. Putative Robertsonian-type variation in humans was described by Dr. J. L. Hamerton (Great Britain), but there was a suggestion that the condition was better regarded as a monosomic one following unequal interchange between acrocentric chromosomes. Dr. M. Fraccaro (Italy) considered the occurrence of iso-chromosomes and deficiencies in the long arm of the X-chromosome in the same species. Attempts to identify the chromosomes of man individually by different methods were discussed by Dr. D. T. Hughes (Great Britain) and by Dr. C. H. Ockey (Great Britain), who supported his paper with a demonstration. Miss U. Mittwoch (Great Britain) reviewed the problem of the Barr-bodies in human females. This session also contained a very interesting account by Dr. S. Ohno (U.S.A.), who described a hitherto unique condition in mammals, namely, an *XO* soma as the normal state in females of the creeping vole. It is associated with mechanisms leading to the formation of only *X*-carrying eggs and *Y*- or *O*-containing sperm.

The thirty demonstrations included thirteen by members of the host department. They covered a wide range of organisms from microbes to man and a variety of techniques including experimental breeding, autoradiography and electron microscopy. Giant models of meiosis made at the Botany School were exhibited. The spiral structure of chromosomes was demonstrated on closed-circuit