service was available. Recently, consultant work outside the group has been undertaken. The function of the occupational hygienist was: (a) to recognize environmental stress affecting health; (b) to evaluate the stress; (c) to prescribe control measures.

The occupational hygienist needed to have studied elementary physiology, industrial medicine and toxicology. Training in sampling and analysis, including dust, radiation and noise, detailed knowledge of heating, ventilating, air-conditioning and lighting, and a familiarity with statistical methods were desirable. Courses at a technical level, in addition to those for graduates, would be advantageous.

The deputy chief inspector of factories, Miss K. Crundwell, described a recent attempt to catalogue the facilities which at present exist for testing factory air. It was going to be difficult to convince industry of the need for testing to such an extent that they were willing to pay for it. Some employers were anxious to improve their working conditions but others might not take kindly to the suggestion that they should pay, as they might see it, for the evidence on which to hang themselves.

The last speaker in the morning session was Dr. S. G. Fortuin, director of the Philips Medical Services, Eindhoven, Holland. He explained that in every plant they tried to have a full-time medical man, whose services might also be shared by smaller firms in the same town. The checking of environmental conditions was the task of the medical department and there was no place for a more or less independent industrial hygiene department. The physician alone should be responsible for the evaluation of health hazards.

The industrial hygiene laboratory was part of the Medical Service; chemists and engineers were employed in this work and no university programme existed in the Netherlands for training them in the specific theoretical and practical problems of industrial hygiene; postgraduate courses should be organized for this purpose.

In the discussion which followed the first session it was generally agreed that a need for testing facilities existed, and this involved the training of occupational hygienists to carry out environmental measurements. The cost and method of paying for such services was debated and it seemed unlikely that small firms would be willing, or even able, to carry this individually, although trade associations might offer a way round the difficulty. Another problem was the cost of remedial measures, involving re-design of plant or exhaust equipment, which might be crippling to a small undertaking.

The afternoon session was opened by Dr. L. G. Norman. In a survey of courses related to occupational hygiene which are at present available, Dr. C. H. Wood said that very little was offered in Britain. British employers of occupational hygienists, when questioned, were unanimous in stating that the only training provided was in-service, augmented, occasionally, by short courses given, as a rule, by senior members of the staff.

It was difficult to find out what British teaching institutions gave in the way of special courses, as distinct from the comprehensive type in the United States, since no general list was published; nevertheless quite a number of subjects could be investigated in this way, lectures on radiation hazards being liberally provided.

Mr. S. A. Roach gave an account of a nine-month course in industrial hygiene engineering which was being planned at the London School of Hygiene and Tropical Medicine and which was to open in October 1961.

Prof. R. E. Lane, who is responsible for the teaching of occupational hygiene in the University of Manchester, stated that the current course for industrial medical officers lasted two years but required attendance for only a day and a half a week. The department also appointed research fellows who were post-graduate science candidates for M.Sc. or Ph.D. degrees.

Prof. R. C. Browne, who occupies the Nuffield chair of industrial health at the University of Durham, felt that the chemistry graduate was usually the best equipped for the work, followed, in order, by physicist, engineer and doctor, though special risks, such as radiation, clearly affected this. Such graduates were in short supply at present.

During the discussion on the afternoon papers the question of payment for training was raised. Several speakers thought that industry, while willing to send employees on short courses lasting a week or two, might not be prepared to lose their services for a year. The suggestion that Government bursaries might be paid drew the reply that all the students taking a somewhat analogous course in public health engineering had been from overseas for several years past, supported by the World Health Organization or their own Governments; no Treasury support was available for Britons. Other speakers considered it likely that bursaries would become available from industry.

The conference proceedings will be reported in full in the *Annals of Occupational Hygiene*.

C. N. Davies

CLOSED CIRCUIT TELEVISION IN THE MEDICAL SCHOOL

A SYMPOSIUM on the applications of television in medical research and teaching was organized at the London Hospital Medical College during May 10–11 by the Medical Committee of the Scientific Film Association in collaboration with the Association for the Study of Medical Education. Since the 2-hr. demonstration of a land-line colour broadcast by a team from Guy's Hospital in 1957 (*Nature*, 181, 91, 1958) no collective attempt had been made to evaluate and discuss the potential usefulness of closed-circuit television in medicine. This meeting is therefore a welcome sign that the universities are ready to concede that television need not necessarily be equated with mass entertainment. In fact, the conference was well timed, as many of the seventy senior representatives from British medical schools who participated are concerned with the planning of new buildings and the possible incorporation of closed-circuit television.

At least three schools are about to install such facilities and several others may shortly follow their example.

Apart from isolated *ad hoc* demonstrations by manufacturers of electronic equipment, and the somewhat elaborate presentations organized at congresses by a pharmaceutical firm, there is little practical experience in Britain. To ensure, therefore, that facts rather than opinions could be discussed, the organizers invited the co-operation of acknowledged experts in television engineering: on the use of television in a medical school in the United States, on research applications and on its uses in a military medical centre—both from the United States—and a surgeon in charge of television facilities at a German university.

While television has serious limitations, such as restricted resolving-power and relatively high cost, the conference has shown that television offers considerable advantages in a number of fields—with the obvious reservation that the usefulness of any device must depend on the ability and knowledge of the user, whether research worker or teacher. The main properties of television are: its ability to convert invisible radiation into visible images, its high sensitivity to light, electronically adjustable contrast, and above all, its ability to present instantaneously moving images, even of very small subjects, to an unlimited audience, while the camera may well be in a location too restricted or too dangerous for direct human observation.

Radiology makes full use of these properties. Small 'Vidicon' tube cameras can display enlarged pictures from the X-ray image converter. Similarly, large 'Orthicon' tube cameras equipped with systems of wide-aperture mirror lenses can reproduce the radiographic image from a life-size fluorescent screen with sufficient brilliance so that the radiologist need no longer work in the dark, and consultants and students can study simultaneously the same information on receiver screens in any number of different rooms. These methods make it possible to reduce the radiation received by the patient, so that the film records from the television screen can be used almost as a matter of routine for the study of processes within the human body. Image storage on special tubes, on ferro magnetic disks and on magnetic tape ('Video' tape) are now well beyond the laboratory stage, and the development in the United States of a really large television tube sensitive to X-rays will probably replace the use of the conventional fluorescent screen in the none too distant future.

Ultra-violet radiation, sufficient for direct photomicrography, will destroy biological tissues in a very short space of time, and similarily cine-micrographic studies of the retina would require an impracticable intensity of light. It is in these examples that the enlarging, intensifying and radiation-converting properties of television can be of value to research work. Camera tubes sensitive to ultra-violet radiation will produce images of the contents and behaviour of cells with greatly reduced radiation, and highly sensitive 'Orthicon' tubes can be used to record colour images of retinal blood vessels with light intensities which are well tolerated by the human eye. Tubes sensitive to infra-red radiation may be used instead of infra-red photography for the direct examination of the subcutaneous venous circulation.

A straightforward electronic method of superimposition makes it possible to display and record in accurate register on one receiver-screen two images from separate television cameras. Eye movements can thus be studied by superimposing the reflexion of a spot-light on an eye on to the image of the object which is being scanned by the subject.

Filming from the television receiver can also be used for selective studies of movements or behaviour. The television camera, with its automatic aperture compensation for changes in the intensity of light, can be operated from a distance by remote control. While the camera is in a relatively inaccessible or even dangerous location, the observer can aim and focus accurately by watching a television screen and record the action with a film camera in front of another receiver.

Applications in university teaching are obvious and numerous if it is remembered that television can ensure that every member of the audience can see equally as well as the demonstrator; the teaching of dental procedures is an outstanding example. The lecturer can use this enlarging device either in the classroom itself or in another room while he directs the demonstration with the help of a two-way communication system. The teacher can determine the area and degree of magnification of the subject to be displayed on a television projection screen or on receivers by adjusting the zoom lens on the camera from a small remote control panel. Chemical reactions, anatomical dissections or experiments under the microscope can be televised from within the lecture theatre itself, but other demonstrations, such as a psychiatric interview or a surgical operation, must take place elsewhere and are then relayed to the students and lecturer through closed circuit television.

Endoscopy, the exploration of body cavities, is perhaps a good example where television is equally applicable in both research and teaching. Here the television camera enables several research workers or a virtually unlimited number of students to study simultaneously what, until recently, could be seen by the endoscopist alone. Both in Britain and in the United States flexible bundles containing several thousands of very thin glass-fibres are being developed. Each fibre will, by internal reflexion, transmit a part of the image from a small lens to the television camera tube. The diminutive diameter and flexibility of these bundles make it possible to explore normal as well as pathological processes of organs inside the body which are not readily accessible to conventional optical endoscopes.

Like any other device, television should only be used where it is superior to other methods. It does not take the place of lantern slides or films, but there will clearly be occasions when an enlarged and detailed display of something which is happening now is likely to be more effective. Few films suit more than one teacher. They are too rigid, and it is impossible to modify what they present to suit the reaction of a particular audience.

Relatively inexpensive equipment, which is simple to operate and maintain, is now available, so that active experimentation should shortly replace the somewhat theoretical arguments on the assumed merits and demerits of television. Baylor University, where basic instruction on techniques in physiology are shown to students on television receivers in their individual laboratories, has demonstrated that television may contribute to better and more effective teaching, without in any way attempting to take the place of the teacher or individual practical experience by the student.

C. E. ENGEL