and informed public alike how scientific achievements have and can impinge upon the life of mankind. Dr. Sherwood Taylor also indicated that were there a suitable demand he would be prepared to consider following the lead of the National Gallery and organize exhibitions of museum material outside London.

Dr. T. P. Colclough, of the British Iron and Steel Federation, showed how increased efficiency in the manufacture of steel depends upon the skilful use of the scientific worker, and that the industry, with its equipment costing millions of pounds, can only function successfully if science is applied at every stage and in every process; there is therefore a need and an opening for more, and for more highly trained, scientists.

The Departments of the Medical Officer of Health and of the County Engineer of the London County Council provided lecturers and demonstrations of the direct application of science in modern life. An informative lecture upon the drainage of London from the earliest times to the present day, with a discussion of the many problems involved, showed how life in a congested city can be maintained and also the risks to which those who are involved in the sewerage system are exposed. A colour film of this work was shown in the County Hall, London, after which the laboratories of the Chemist-in-Chief were inspected. In these laboratories more than twenty-five thousand samples are investigated annually, including samples of air from the London tunnels, water from the rivers, from the wells in the Council's institutions, from swimming pools and baths, paints and building materials, laundry materials and fabrics with their resistance to washing, and the control of all stages of sewage treatment. Time permitted only a brief inspection of the extensive display set out by the twenty-six graduate chemists and their twenty-eight assistants.

However, the most spectacular lecture of the meeting was undoubtedly that given by Dr. C. W. W. Read, director of education for West Sussex and chairman of the West Sussex Beekeepers Association, who showed how a method has been devised for inseminating instrumentally the virgin queen honey-bee while still in captivity. Hitherto mating has been done on the wing and therefore beyond human control. A special micro technique is involved, and this was demonstrated both by means of the apparatus and by a coloured film of all the processes involved. By suitable sized screens in the hives, the queen bees and the males can be separated from the 'workers'. The drones can then be marked for identification purposes, so that the males used may be those carrying known breeding characteristics. The virgin queen honey-bee and the drones are anæsthetized in carbon dioxide under suitable conditions, the semen collected from the males and, by the use of micro seekers and a micro pipette, 5 cu.mm. of semen is injected into the virgin queen bee. In this way complete control is exercised, and any type or strain can be bred. As five generations a year can be obtained, the purity of the strains produced can be recognized in a short time. The film which illustrated the lecture deserved all those adjectives that are often reserved for the commercial cinema.

As usual, one of the most useful features of the meeting was the display of apparatus and teaching devices made by the members, which extended from cotton reels and their uses in physics to "Nuclear Disintegration by Cosmic Rays". The programme for each afternoon consisted of visits to laboratories, institutions and works, all of which had a high scientific value. A reception was held in the County Hall, London, on the evening of January 1.

Nearly nine hundred signed the register of attendance, every part of the British Isles and many countries overseas being represented.

INDUSTRIAL CHEMICAL EQUIPMENT IN THE UNITED STATES

IT is an accepted fact that during the present century the chemical industry has developed at a far greater rate in the United States than it has in Europe. At the beginning of the First World War, Europe was the main centre for the production of chemicals, and the output in the United States was comparatively small; at present it is estimated that two-thirds of the world's supply of synthetic organic chemicals originates in the United States. It is to be noted, however, that Europe still excels in the making of original scientific discoveries; it is in the rapid development of these discoveries to industrial processes that the United States appear to show such marked superiority. Typical examples are detergents, penicillin, streptomycin, many plastics, silicones and chemicals made from petroleum, all of which could be bought in the United States before being made on the eastern side of the Atlantic. The main reason for this is usually ascribed to the very large number of chemical engineers available in the United States for development work, and the very small number trained elsewhere, the ratio being of the order 20 to 1 so far as Great Britain is concerned. During the past few years numerous reports and discussions have emphasized this state of affairs, and many recommendations have been made for training chemical engineers in much larger numbers.

The latest approach to the subject is wider in scope and is a report* entitled "Chemical Apparatus in the U.S.A." made to the Office of European Economic Co-operation by a group of experts who visited a number of American firms. The title is not a happy one, as it fails to convey the expressed object of the mission, which was to investigate so far as possible the reasons for the great development of the American chemical industry. It is obvious that such a task would be beyond the powers of any small body of men in a reasonable time, and consequently the mission has been forced merely to mention some of the causes of development and, after contact with some twenty manufacturing firms, to write more detailed accounts of a few selected operations. The result is bound to be unbalanced, but it is, none the less, very readable. Another difficulty with which the mission had to contend was the use of the term 'Europe' as the antithesis of 'United States'. Europe is still far from being one country, especially where chemical engineering is concerned, so that to state that a process or machine is not commonly used in Europe may be quite accurate where some of the component countries are concerned, but incorrect in other cases. This is particularly noticeable in the

* Chemical Apparatus in the U.S.A. Technical Assistance Mission No. 23. Report by a Group of European Experts. Pp. 224. (Paris: O.E.E.C.; London: H.M.S.O., 1952.) 20*s.* net.

case of chemical engineering training, the description of which in Europe can scarcely be taken to apply to Great Britain.

In Part 1 the authors discuss the factors which tend to give American manufacturers an advantage over corresponding firms in Europe. Some of these are as follows: more chemical engineers; superior natural resources; larger home market; stronger internal competition; more vigorous sales methods; greater interest in new processes, products and materials; breaking down of development projects into simple units each dealt with by specialists; greater use of sub-contractors; more standardization, internal and external; greater readiness of firms to publish process details; availability of much empirical information; superior methods of transport and storage; and more instrumentation and automatic control.

It seems probable that the rise of the chemical engineer in the United States was originally due to the requirements of the oil industry. His success in this department led naturally to a call for chemical engineers in other branches of the chemical industries, and the cumulative effect was to produce the present large numbers, many of whom are employed successfully in industries not directly connected with chemistry. It is interesting to note, however, a serious decline in the number of new graduates in the subject, the 1953 figure being estimated at only 36 per cent of that for 1950. This decline is common to other branches of engineering, and a similar trend may be observed in Great Britain.

Many of the advantages listed above are directly dependent on size; thus the larger the connexions of a specialist firm of equipment makers, the more designs can they hold from which to suit a customer and the more can they spend on research. The report emphasizes the attitude of American manufacturers towards new projects, but fails to mention the deterrents which exist, particularly in Great Britain, in the shape of restrictive regulations, insufficient obsolescence allowance, the risk of loss and, in the event of success, the confiscation by taxation of a large percentage or sometimes nearly the whole of any gains. It is surprising that, in these circumstances, development proceeds at all.

Part 2 contains articles on process instrumentation, catalytic processes, distillation and extraction, heat exchange, special equipment, materials of construction, and transport and storage. With the exception of the first, these savour somewhat of the text-book, although an attempt is made to direct attention to plant and methods which are more commonly used in the United States than in Europe. The twenty-six pages devoted to instrumentation give a clear picture of the extent to which automatic control is used in the United States, and thirty-five diagrams indicate the variety of ways in which it can be applied, as well as showing some of the most modern instruments. It is emphasized that automatic control is not merely a device for saving labour, but that the operation of many modern plants would be impossible without it.

The report itself is highly condensed and it is difficult in a brief notice to give an adequate idea of its contents. Few chemical or plant manufacturers, however, bearing in mind the limitations already referred to and reading the subject-matter in an inquiring rather than in a critical manner, will fail to find ideas or suggestions for which they may be grateful.

H. E. WATSON

ATOMIC ENERGY RESEARCH AT HARWELL

THE main research programmes of the Atomic Energy Research Establishment at Harwell since its inception in 1946 to the end of 1951 are described in a fascinating and connected story of the work and problems of the Establishment, which is the first of its kind to be published*. Some of the information has already appeared in scientific journals, but this new account is presented in a fashion which it is hoped will appeal to the more general reader. The subject, however, is far too technical to be appreciated and understood by any but those who have at least a background knowledge of the physics and chemistry of the atom.

Harwell is only a part, but an important central part, of the British atomic energy project. It has been given two main tasks: to conduct research into all aspects of atomic energy, and to advise the production organization and furnish it with the scientific and technical information that it needs. The atomic pile or nuclear reactor is obviously the primary requirement, and the two Harwell piles—'Gleep', the Graphite Low Energy Experimental Pile, which has been in almost continuous operation since August 15, 1947, and 'Bepo', the British Experimental Pile 0, which was started up on July 3, 1948—have proved invaluable research tools. Full descriptions of these reactors have been published previously, but, for convenience, these are reproduced in an appendix to the volume. Gleep operates at 100 kW., and Bepo, roughly of the same size, operates at 6,000 kW. with air cooling and is mainly concerned with the production of isotopes. These piles have been used to help solve problems in the design of the Windscale production piles, the main function of which is to produce plutonium. This branch of the work is briefly considered in the third of the nine sections into which the volume is divided. Other sections deal with the production and distribution of radioisotopes, perhaps the most widely publicized aspect of the work at Harwell; nuclear reactors and the production of useful power; particle accelerators, their purpose and the various forms in use at Harwell; methods of detection of radiation and of protection of atomic energy workers against damage to their health by exposure to radiation; the fundamental research programme involving chemical, physical and metallurgical investigations (engineering, biological and chemical-engineering work will be described in subsequent publications); and Harwell's extra-mural relations in the two important categories: collaboration through research and development contracts placed with academic, industrial or government laboratories, and exchange of scientific and technological ideas and information through published work, lectures, training schools and conferences.

To the general reader the sections on radioisotopes and on radiation protection will make most appeal. Present deliveries of isotopes, including those of long life which two years ago could be obtained only from the United States, now number eight hundred a month, and an increasing proportion is now made by air transport to many overseas customers. Various applications of radioisotopes in biological, medical and industrial fields are described. The use of cobalt-60 in place of radium is not so well known as

* Harwell: the British Atomic Energy Research Establishment, 1946–1951. Pp. 128+32 plates. (London: H.M.S.O., 1952.) 6s. net.