salts from Dead Sea water and Indian brines. Research of a more general character was concerned with the infra-red spectra of many substances, including diamond. This led to the discovery of two 'types' of diamond.

The Laboratory has always been a pioneer in the use of physical methods in chemical analysis. Extensive use was made of the microscope and of the hydrometer and refractometer in the very early years of the Laboratory's existence. A little later the versatile dipping refractometer was brought into use. Qualitative use of the spectrograph and the spectrometer became a matter of routine before the War of 1914–18. Under the present Government Chemist, Dr. J. J. Fox, C.B., O.B.E., who succeeded Sir Robert Robertson in 1936, the quantitative use of the spectrometer in the analysis of metals and alloys has been greatly developed as well as that of the polarograph, which has been found particularly useful in the accurate determination of very small quantities of elements in metals of a high degree of purity.

At the present time the energy of the Laboratory is naturally being devoted to other activities. In happier circumstances, it is hoped to publish a full account of the origin and development of the Government Laboratory and of some of the more important investigations undertaken there.

EDUCATION AND TRAINING OF PHYSICISTS

A DISTINGUISHED gathering, including representatives of the universities, technical colleges and research institutions of Great Britain, and many societies interested in the teaching of science, assembled in the theatre of the Royal Institution on October 12, at the invitation of the Institute of Physics, to discuss a memorandum on "Post-war Education and Training of Physicists", prepared by Dr. H. Lowery on behalf of the Planning Committee of the Institute. The principal speakers at the morning session, dealing more particularly with educational problems, were Dr. Lowery, Sir Lawrence Bragg and Dr. K. E. Grew (Heriot Watt College). The afternoon session, dealing with the training of physicists for industrial and technical research, was addressed by Dr. A. P. M. Fleming (Metropolitan-Vickers Electrical Co., Ltd.), Mr. F. Brundrett (Admiralty Department of Scientific Research and Experiment), Mr. J. Wilson (British Rubber Producers' Research Association), and Mr. D. A. Oliver (William Jessop and Sons, Ltd.). At both sessions many valuable contributions also came from members of the assembly, and the number of communications received by the Institute of Physics since the meeting shows that the interest in the subject would have sustained a much more prolonged discussion if time had permitted.

Introducing his memorandum, Dr. Lowery set a high tone for the discussion by his insistence on the primary importance of education: the development of the whole personality of the individual as opposed to technical training, which merely fits him for earning a living. This was a note which recurred again and again throughout the whole discussion. Sir Lawrence Bragg, who followed, was obviously more immediately concerned with the necessity of producing potential leaders for industry, and brought forward again the suggestion which he pressed in a recent discourse at the Royal Institution that potential physicists should have a definite break between their school and university courses, which should be spent in industrial surroundings in order to familiarize them with works conditions and the workers themselves. It was on this proposal that the widest divergence of opinion was shown in the subsequent discussion. Some members of the conference were very doubtful as to the desirability of any prolonged break in the systematic training of a student, while others felt that if a break were necessary there were alternative methods of spending the time which might produce better results. Division of opinion did not follow the division of interest between pure and applied physics, as supporters and opponents of the idea were found in both groups. Apart from this single question, the conference revealed a substantial measure of agreement on the steps which should be taken to improve what faults there still are in the education and training of physicists.

It was generally agreed that apart from the physicist who is fortunate enough, usually owing to his appointment on a university staff, to be able to pursue his subject for its own sake, physicists employed in a technical capacity fall into three classes: those employed mainly in pioneer research; those engaged on the development of mechanisms; and those employed in process control. For the pioneer physicist the present course of training through secondary school and university is on the whole very satisfactory, though there is a discontinuity, often involving loss of energy, at the transition stage between the secondary school and the university. It was generally agreed that at present the physics teaching in schools tends to be both too intensive and too extensive, some parts of the subject being taught in schools which could more profitably be left to the subsequent university course. The main cause of the trouble is the present competitive scholarship system whereby, in order to pick out the few scholars from the large number of applicants, the standard of the scholarship papers, particularly at Oxford and Cambridge, has been raised to an unjustifiably high level. A substitution of the system of State bursaries, initiated for special purposes during the War, whereby bursaries are granted without a means test to all students who reach a definite fixed standard of attainment, would do much to relieve the present undue pressure on schoolboys of scholarship age. There was some support for the suggestion that the Higher School Certificate examination be made less specialized in character, so that a science candidate who has the interest and ability might offer literary subjects along with his sciences.

With regard to the university course a strong preference was expressed, particularly from the industrial side, for the wider type of degree such as Part I of the Natural Sciences Tripos in Cambridge and the General Honours degree at London, in which three or more science subjects are studied to a good general level, and an extended knowledge gained of the great body of scientific knowledge. A specialized course in physics alone should follow the general honours degree for those who show the necessary interest and ability. Another criticism, rather forcibly expressed, was that there is a tendency for university physics courses to become seriously biased in the direction of the special interest of the individual professor in charge. It was emphasized that the standard classical physics, particularly that portion of it known as 'general properties of matter', is still

the essential basis of most work in industry. Still dealing with potential leaders of the profession, there seemed to be agreement that the present arrangement by which the student who hopes ultimately to pass into industry remains in the university for one or two years for research work has much to commend it. The novice in research is bound to make mistakes (that, of course, is the way in which he learns), and it is much better that he should make his mistakes in the friendly company of his professors and fellow students than in the research department of a large works or research institution, where mistakes are not regarded as an inevitable part of the general order of things.

Side by side with the training of the pioneer research physicist, there must be suitable provision for the education and training of the no less important class of men with practical ability who, whether from their turn of mind or personal interests, do not fit suitably into the university scheme of things; men, for example, who will occupy the posts of physicists of the second and third classes, carrying the ideas from the research department into actual production and overcoming the difficulties which occur when the article gets 'on the belt'. For these, it would appear that a course through the junior technical schools leading to more advanced courses in the technical colleges would prove most useful. Some of these courses might very well be part-time courses, after the man has actually joined industry. In that case, however, it was strongly urged, a youth could not be expected to make adequate progress unless his employers are prepared to grant him very appreciable facilities in the firm's time, corresponding at least to one full day a week. Teachers in technical colleges spoke very highly of the ability of men of this type to master subjects connected with their daily work, and one head of a large industrial research laboratory went so far as to describe them as the salt of the earth. It was pointed out that many of these men, owing possibly to not having reached intermediate or even matriculation standard before leaving school, would not be able to take an external university degree, and in fact a university degree might not be their most suitable aim. There was strong support for the suggestion that the time has now arrived when one or more National Certificates in Physics should be instituted, and that if possible the highest of these should be of such good standing that it might be accepted for associate membership of the Institute of Physics.

The characteristics demanded of a candidate for industrial work were stated in very much the same terms as in the conference held by the Institute in 1936: "Honesty and integrity of outlook, intelligence and quick-wittedness, co-operativeness, tactfulness and charm of manner, drive, good health and energy, and a sense of real values which is the antidote to swelled head or side". Presumably some knowledge of his subject is also desirable. This is a formidable catalogue, and clearly implies that the candidate must have had a wide education for living, in addition to his specialized studies. In fact, the need for broadening the education of the physicist might be described as the dominant note in the Conference. This broadness of education and wideness of outlook are equally essential whether the man goes by way of the university or the technical college, and it was gratifying to hear that the more modern of technical colleges of Great Britain are in fact providing the necessary facilities in ever ampler measure.

One final point. It was strongly urged that at no stage in his career should the physicist feel that his education is complete. There was a very steady and unanimous demand for more and more postgraduate courses both in pure and applied physics; some perhaps part-time and others perhaps short refresher courses of from two to three months. Both the universities and technical colleges can, in fact must, play their part in providing such facilities; and many of these courses could with mutual advantage be given by men who have made their mark on the industrial life of the country.

The discussion as a whole reached a very high level and showed a considerable consensus of opinion on some extremely practical points. It has provided a valuable compendium of suggestions and evidence on which it is hoped the Planning Committee, which arranged the Conference, will be able to base a report for presentation to the Board of the Institute of Physics in due course. J. A. CROWTHER.

OBITUARIES

Prof. Carl Oppenheimer

ON December 24, 1941, Prof. Carl Oppenheimer died in exile at The Hague, after a prolonged illness. The second son of a liberal rabbi, he was born on February 21, 1874, in Berlin. His elder brother Franz is the well-known economist. Carl Oppenheimer was educated in Berlin, where he obtained the Ph.D. in chemistry in 1894 and the M.D. in 1898, and also spent a short time at the University of Erlangen. He worked as assistant to the famous physiologist, R. Zunz, at the Landwirtschaftliche Hochschule in Berlin and became a university teacher. He married in 1904 and had two sons. The elder, Chanan, is now at Rehovot Agricultural Research Station in Palestine, and the younger, Ernest, has joined the South African Army.

Carl Oppenheimer was one of the most prolific scientific writers, whose everyday language made the most difficult problems of science easily understandable. While still a student, he wrote a little text-book on inorganic and organic chemistry which was to become the most popular chemistry text-book for medical students all over the world; it went through many editions and was translated into several languages, but not into English. His comprehensive text-book of chemistry, written in 1923 in collaboration with Matula, is a good example of Oppenheimer's presentation of the problems of science to a wider public and of his desire to show the connexion of chemistry with natural science and industry.

This connexion between the various branches of science, and still more the central importance of the study of the living organism, was one of Oppenheimer's leading ideas through all his life. By his research in chemistry as well as physiology, he was soon led to see that a study of the living organism could not be successful from the medical point of view only, but that the more exact branches of science would have to be called upon for this purpose. He may thus justly be claimed to be one of the founders of biochemistry. This is to-day a generally accepted branch of science—a fact mainly due to Carl Oppenheimer. The conception of these ideas and their continuous propagation through all his lifetime must be regarded as Oppenheimer's greatest contribution to science and human progress. In