factor. The intensity of illumination by the electron beam is immensely greater than that for the brightest possible light source. Gabor estimates it as being in common practice 10^6 times as great as the intensity of the sun's image. Hence extremely small masses of matter containing a few thousand atoms scatter sufficient energy to produce an impression on a photographic plate.

The principle of the instrument is very simple. A co-axial magnetic or electric field acts as a lens for a beam of electrons of given velocity. By suitable design the focal length of such lenses can be reduced to a few millimetres. A first condenser lens concentrates 50,000-volt electrons on the object. After traversing it, they pass through an objective lens which forms an image magnified 100 or 200 times. This is viewed in a fluorescent screen with a fine hole at its centre, and a chosen portion of the image is brought over the hole. This portion is again magnified to a similar extent by a final lens, and viewed on a screen or photographed.

The objects must be extremely thin, less than 1,000 A. in thickness, and are of course in a vacuum. They may be deposited on a very fine pellicule of collodion which is laid on a plate pierced with fine holes. Focusing is achieved by adjusting the current in the magnetic lens. It is impossible to view the surface of a solid directly, since transmission must be used. It is possible, however, to examine the contours of a surface, such as that of an etched metal, by spreading a fine film of collodion over the surface and stripping it off, when it retains an impression of the hollows and ridges.

The War has retarded the applications of this instrument which would undoubtedly have otherwise been made, and we can confidently expect that it will open up fascinating new fields in future. On one hand, it gives greater definition to objects that can be seen under the microscope, and on the other it attains a resolving power in the 100 A. region, which is of the same order as that of the larger-scale structures studied by X-rays, so that we now have instruments capable of use in the whole range between the visible and atomic dimensions.

PRESENTATION OF SCIENCE TO A GENERAL PUBLIC*

By DR. ARNOLD RAESTAD

Formerly Minister of Foreign Affairs to the Norwegian Government

ALTHOUGH I am not a scientific man myself, it has fallen to my lot to be connected with certain aspects of the problem of the exposition of science. I have been engaged in examining the problem of how to organize better the presentation of the methods and results of science throughout the world or, in other words, the international dissemination of science. After three or four years of preparatory work, in 1938, the League of Nations, through the International Institute of Intellectual Co-operation in Paris, appointed a committee of scientific men, presided over by myself, to report on the matter. Before I say more about the committee and its work, it may be instructive to record, very briefly, the preliminary inquiries which led to its appointment.

The Assembly of the League of Nations had interested itself, in a couple of resolutions, in the use of broadcasting to promote the cause of peace and to familiarize nations with the culture of other nations. In 1936, an international convention for the use of broadcasting in the interest of peace was concluded. Later, the Institute of Intellectual Co-operation asked me to consider what subjects it might most appropriately pick out for an organized effort in this connexion. The Institute referred more particularly to the cause of peace and the work of the League, and to literature and culture generally, as promising objects for an internationally organized effort. I had to report that, in my opinion, neither the peace work of the League of Nations nor the knowledge of the literature of other peoples lent themselves very well to such a co-ordinated international effort.

But there was another field in which the practical broadcaster knew there was something to be done—science. For some reason or other, the attention of the statesmen of the League had not been focused on the need to disseminate more perfectly a knowledge of science—to publicize science. In most countries of Western Europe, despite the vastly increased effectiveness of the common media of information, the information at the disposal of the general public is less adequate, both as regards the progress of science and as regards current topics involving the existence of a scientific problem, than was the case thirty or forty years ago. The Press, filling its public to the saturation point with news and political views, has only a languid interest in the results and methods of science. The documentary film and the radio have not, in actual practice, filled the gap. As for the radio, it has no doubt rendered great services here, for listeners are easily attracted by great scientific names or fascinated by discoveries in biology or astronomy. But generally speaking, according to reports from many countries, the radio has not given what might have been expected, for a number of reasons. Outstanding men of science very rarely combine the qualities which make a good and attractive speaker on the radio; further, no single country has at its disposal first-rate men in all branches of science.

The Institute of Intellectual Co-operation, in view of the preliminary reports thus gathered, appointed in 1938 a committee of scientific men to consider means of improving, by organizational measures, the way in which the results and methods of science are now presented to a general public. The members of the committee were Dr. Julian Huxley, M. Henri Laugier, Dr. Clarence C. Little, my compatriot the late Prof. Sem Saeland, a Swiss, a Dutch and a Belgian man of science. All modern media of current presentation were considered in turn—lectures, Press, films, exhibitions, radio. The problem was approached from the point of view of science as well as from that of society, and from the point of view of the individual scientific worker as well as from that of organized and collective science. The committee was unanimous in stating as its opinion that the situation called for reforms of an organizational character, that these reforms would have to be carried out, if at all, by existing scientific bodies, and that the organization involved would have to be international in its scope and conceptions.

* Substance of a paper read on March 20 before the Division for the Social and International Relations of Science of the British Association at the Conference on "Science and the Citizen".

As for the content of the reforms, the committee, still unanimous, recommended the creation of an International Centre for scientific information, the efforts of which would have two main objectives: first, a continuous recording of the progress of science; and, secondly, the mobilization, as need and demand arise, of information on any scientific point of current interest. The material produced would, in principle, take the form of data, leaving the elaboration and the linguistic form to the journalist, the speaker, the film producer, the organizer of exhibitions, etc.

For its full achievement, therefore, a more satisfactory presentation of science to a general public will require the co-operation of three agents: the scientific specialist working to perfect his branch of knowledge and using the symbols peculiar to it, mostly mathematical; the intermediary man of science competent to grasp the symbolisms of a number of sciences and to assess the value of theorems and proofs offered by the specialists; and finally, the popularizer. Now and again, a specialist, and somewhat more often, the intermediary scientific worker, may also be a good popularizer; but the committee was unanimous in emphasizing that the great and urgent need of our time in this domain is for the development of a class of intermediary scientific worker having a very definite role in the life of science, a role important for science and for society alike.

A draft organization for the proposed International Centre was worked out. Besides the central secretariat, which might be reduced to modest dimensions to start with, there would be regional representatives of the Centre, and in each country, the academy of science or association for the advancement of science or corresponding body would appoint individual men of science or groups to carry on collaboration and correspondence with the Centre and its regional representatives and take initiatives. Otherwise, the initiatives would, to a great extent, come from the interested popular agencies themselves—Press, radio, film, theatres, etc.—as well as from the national bodies and authorities engaged in the work of spreading throughout the nation the knowledge and spirit embodied in organized science. Neither the central organization nor its regional or local subdivisions should constitute a barrier between the Press, the radio and other popular agencies and their direct access to scientific men. The news, comments and publications of the new organization should, on the contrary, be an additional help to them. The new organization being conceived as part of the house of science itself, there is no danger that it would develop intolerance and try to exercise a sort of birth-control of scientific ideas.

In 1938, the Rockefeller Foundation had instituted an investigation into the same problems in the United States. Conditions there differ to some extent from those in Europe; for example, greater efforts have been made to spread 'science news' in the Press, and to organize the production of documentary films. On the other hand, peculiarities of the broadcasting service react unfavourably on the attitude of the public to the news about science presented there. The first Rockefeller conference on Science and the Citizen in 1938 was followed by a second one in the summer of 1939. At that time, efforts were being made to formulate a practical programme that might be put before the leading scientific bodies of the world. The War interrupted these efforts. But in the light of recent experience, our aims of those days seem to me now to carry a more urgent appeal than ever.

To prepare for a lasting peace is to believe that we can have a new spiritual world. But there is no new spiritual world making for peace and progress unless it be centred in a greater proportion of willingness, and even habit, in high and low, to submit one's own judgment to the control of facts and to respect, in others, the supreme freedom to ascertain and assess facts. This submission to the control of measurement, and this respect for the truth of any assertion, constitute, if I am not mistaken, the spirit of science. When organizing the world, the United Nations have no more fundamental task, and no more urgent one, than to implement properly international co-operation for an adequate presentation to every people of the results and methods of science. In this co-operation, I do not propose to include nations subordinating scientific research to racial or other prejudices. Under the proposals put forward by the League of Nations Committee, international co-operation is automatically limited to such nations as respect the freedom of scientific thought and expression; and I believe it is best so.

I know that in Great Britain the better dissemination of scientific news by the Press and other popular agencies, and the establishment of a central organization to deal with the numerous international questions which inevitably arise, have frequently been discussed. Now that the United Nations are taking stock of their opportunities and their obligations, the opportunity should be grasped to make the realization of these purposes part and parcel of a remodelled and strengthened international co-operation.

SCIENCE IN INDIA*

By D. N. WADIA

Minerals in War

A GEOLOGIST'S work during war-time consists largely in mobilizing all mineral resources in his own limited sphere for munitions purposes. Free international movement of minerals having ceased, every country has to produce the full quota from its domestic mineral resources. Far-reaching questions will arise in the near future, if indeed some have not already arisen, as to how long minerals from accessible depths of the earth will be able to sustain man's wars.

Man's advancement to civilization from the hunter and peasant stage is due to his mastery over metals and minerals, but this advance has caused serious inroads on the world's stock of minerals and especially of metals. During the century and a quarter between the Napoleonic wars and the present War, the consumption of minerals has been more than a hundredfold of that consumed during the entire history of man on earth, and, so far as metals are concerned, man has used up between 1914 and to-day, between the two German wars, more metals than during any previous period of history. Metals such as tin have almost reached depletion stage, silver is being made to stand substitute for tin, while the extractable stocks of platinum, silver and gold left within manageable depth for the future needs of the world will be very meagre. The consumption of fossil fuels, coal and petroleum, has been at a far more serious

* General presidential address to the thirtieth Indian Science Congress meeting at Calcutta during January 2–4.