and destruction, at rapidly growing ranges and on an ever increasing scale. The atomic bombs on Hiroshima and Nagasaki represent, of course, the proximate peak of this development, so far as it has yet been made known; but nobody can suppose them to be the climax of disastrous achievement, if the nations should persist in the desperate project of using further advances in this, or in any other department of science, to prepare in secret, each to excel or to anticipate others in perfecting the means of annihilation. Does the world need yet to be warned as to the end of such a policy? If so, we men of science must continue, against any reluctance to repeat and to insist, to proclaim the danger, and our hatred of the perversion of science to its creation.

Meanwhile we have our own problem of the effect of such a position on the prospect of science itself. For a devotion so complete to the service of war as that which was given in recent years has involved many men of science during its progress in obligations of secrecy entirely new to their experience; and there are important sections of scientific activity which have not yet been able to escape from these trammels. That concerned with the release of atomic energy, with all the side-issues into new lines of scientific progress which that gigantic war enterprise might have made, and will yet, we hope, make available, provides the most conspicuous case. This might, indeed, be regarded as epitomizing, or presenting, by way of an extreme example, the way in which science in peace may inherit opportunities from developments for which war alone could have set the scale and provided the momentum, and the threat to the freedom of science which may be entailed by the same inheritance. Though the scientific basis for its prediction was available in 1939, before the new War broke out, nothing but war, and the need to anticipate a danger of such magnitude in war, could have brought about an effort on the scale needed to convert the release of atomic energy by a chain-reaction from theory to practical reality in a few years. If peace had remained unbroken, the world might have had to wait for many decades to reach a point of such possibilities, for new departures and rapid advances in a whole range of fundamental sciences. War immensely accelerated the presentation of this opportunity to science; but, in doing so, compromised the peaceful use of it by the hideous threat of its further abuse in war. Science, then, finds itself facing a situation in which hope and frustration contend; the need to make the world safe, and the delay of agreement on the means of doing so, clog wheels of science which should now be turning freely for the enlightenment of mankind and the enrichment of human life, many years, perhaps many decades, before they could have done so if the War had not yet come.

How then are we men of science to deal with such a situation? With unquestioning loyalty to all our obligations—that first and foremost; but then also, I would urge, with a resolute watchfulness against any encroachment, on activities proper to peace, of a secrecy which we accepted as an abnormal condition in war, and with a determined effort to accelerate the liberation of science from its entanglement. In the universities in particular I hope that we shall be able to ensure that the men of science of the near future will grow up, as we their predecessors did, in an atmosphere of scientific freedom, and be ready to accept, in their turn, the duty of standing, at need, in the defence of science in its full integrity. And I hope that we can keep as the constant aim of our endeavour, in spite of all that might excuse discouragement, the revival of an intimate brotherhood of the men of science of all nations, working together in full confidence, once more as a world community.

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS

EARTH, STARS AND RADIO

DURING the year 1947 we are celebrating in Great Britain two important jubilees, one technological and the other scientific. It was in 1897, fifty years ago, that Marconi, the young Italian inventor, gave a decisive demonstration of 'telegraphy without wires' to Sir William Preece, who was then engineer-in-chief of the British Post Office. It was also in 1897 that the Cambridge professor of experimental physics, Prof. J. J. Thomson, made the first public announcement, at an evening discourse at the Royal Institution, of the existence of the electron as an independent entity. The technological development of radio from those early beginnings has had most important scientific consequences. Correspondingly, the scientific discovery of the electron, although important in the first instance because of its bearing on atomic theory, has had profound technological consequences. Indeed, it is scarcely possible to cite better examples of the mutual influence of fundamental science and technology than the developments which have sprung from those two great events of fifty years ago. These developments form the subject of the presidential address by Sir Edward Appleton to Section A (Physical Sciences).

The progress of radio as an agency for exploring the universe has followed directly from two electronic developments, namely, the thermionic valve and the cathode ray oscillograph. With the thermionic valve it is possible to generate radio waves of almost any wave-length. Moreover, such waves, if sufficiently short, can be emitted or received in any desired direction. It is also possible to arrange that their emission takes place in spurts, or pulses, which can be detected again if the waves are reflected by any natural agency in space. The cathode-ray oscillograph can, on the other hand, be used for the measurement of short radio echo-delay times, and also for the delineation of the wave-form of naturally occurring radio transients.

Using such radio and electronic techniques, the wave-forms of atmospherics, originating in lightning flashes, have been studied in some detail, and instantaneous methods have been developed for finding thunderstorm positions at a distance. Similarly, the use of centimetric wave radar echoes has led to methods of estimating the extent of rainfall areas.

During the War it was discovered that coastal radar stations sometimes received echoes from a ship which had passed well beyond the horizon. The detailed examination of this connexion between radio and the weather has led to the discovery that the lowest layers of the atmosphere may sometimes bend radio wave tracks with a curvature exceeding that of the earth. Such abnormal refraction is associated with temperature inversions and marked water-vapour lapse-rates.

The use of radio-wave exploration for investigating the electrical state of the upper atmosphere has been the subject of continuous experiment in Britain since 1925. It has been found that the ionosphere is subject to a marked solar control, there being a general waxing and waning of the ionization densities in sympathy with the trend of the sunspot cycle. Transient radio echoes have also been noted from the levels of the lower ionosphere, and these have been traced to reflexions from meteor trails.

Finally, the use of sensitive short-wave receivers has disclosed the terrestrial reception of radio noise from both the sun and the stars. Sunspots are found to be powerful emitters of 5-metre waves, the emission being specially enhanced at times of visual solar flares. A continuous radio noise has also been identified as originating in the Milky Way. It is not yet known whether such galactic radio noise originates in interstellar space or in sunspot regions on the stars themselves.

SCIENCE IN THE COLONIES

After reviewing some of the historical examples of the application of research to Colonial problems, Dr. J. L. Simonsen, president of Section B (Chemistry), emphasizes that only with the help of men of science could many of these be solved. While agriculture must continue to be a main industry of the Colonies, its maximum development will require research of a high order. The Colonies can, however, no longer be regarded solely as prime producers, and the introduction of other industries deriving their raw materials from agriculture will be essential. In 1942 the Colonial Products Research Council was formed to review the field of Colonial raw materials, and by research methods ascertain how fuller use could be made of them.

Large-scale industry based on plant products must look to the most abundant of these, namely, the carbohydrates, starch and sugar, as its raw materials. Starch already finds an extended application in industry, and the methods devised at Birmingham for the separation of its two constituents, amylose and amylopectin, have now rendered these products readily accessible. A detailed survey of the little-known starches of tropical Colonial countries is urgently needed. Although sucrose is the organic chemical produced on the largest scale, it has been little used as an industrial raw material apart from fermentation processes. The sucrose molecule is complex, and rapid progress of research into the production of substances of increased industrial value which is now being carried out in Great Britain and the United States cannot be expected, although some of these have been shown to have useful antifreeze, plastic and chemotherapeutic properties.

Recognition of the importance of microbiology has resulted in the decision of the Colonial Products Research Council to open a Microbiological Research Institute in Trinidad. Among the problems it is hoped to attack are those associated with soil fertility and the control of the Panama disease of bananas.

Synthetic organic chemistry has replaced many drugs previously obtained from plants; but this does not, however, diminish the need for a study by modern technique of the constituents of plants with which medicinal properties have been associated. Furthermore, it has been shown that the botanist can no longer disregard the nature of the chemical constituents in his classification of plants.

The value of improved methods of agriculture and the control of soil erosion will be neutralized if steps are not taken to prevent the large losses of the world's food supply incurred through pest infestation. If the new synthetic insecticides, D.D.T. and 'Gammexane', can be shown to be used with safety on foodstuffs, a weapon will be available which should largely eliminate this destruction by insect attack.

Of even greater importance is the control of two of the foremost insect enemies of man and animals, the mosquito and the tsetse fly. Experience with the new insecticide sprays against the mosquito indicates that the problem is not insoluble, and if by a co-ordinated attack on malaria in conjunction with the use of prophylactics, such as paludrine, meets with success, science will have made an outstanding contribution to Colonial prosperity. The control of tsetse, the transmitter of trypanosomiasis, presents a problem of far greater difficulty. The fly can be killed if brought into contact with insecticides, but it is not yet known how best this can be done. Possibly the use of smoke or smoke bombs from aircraft may be a solution; but the problem must be vigorously attacked on a scale commensurate with its magnitude.

GEOLOGY IN THE DEVELOPMENT OF THE COALFIELDS

In conformity with the general theme of 'swords into ploughshares', the presidential address to Section C (Geology) by Dr. Murray Macgregor deals with the place of geology in the development of the coalfields. The transference of the coal mines of Britain from private to public ownership has created an entirely new set of conditions, bringing with them their own complexities and hazards and demanding vigilant and unsparing service from all concerned. The unified industry will certainly require the best scientific and technical assistance that the country can give. Scientific research applied to the numerous problems that arise in connexion with the exploitation and utilization of the coal resources of Great Britain must be more directive and more closely integrated than in the past. There are the problems connected with occurrence, distribution, structure and correlation; with vertical and lateral variations in the number and thickness of seams, in the lithology, and in the fossil content; with the size and direction of faults, the amplitude and pitch of folds, the occurrence of suites of contemporaneous igneous rocks and of intrusions, etc. There are the chemical and physico-chemical problems connected with the composition and classification of the coals, and the problems related to their preparation for the market and their economic use.

The fact that the geologist is the first link in this chain of concerted effort is too often overlooked or forgotten, and it must be emphasized that all development schemes, short-term and long-term alike, depend upon a proper and thorough knowledge and