BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE PRESIDENT'S ADDRESS.

In the Usher Hall, Edinburgh, on September 7, the Presidential Address of Sir T. Edward Thorpe, on "Some Aspects and Problems of Post-War Science, Pure and Applied," was read in his absence, owing to indisposition, by Sir J. A. Ewing, vice-chancellor of the University of Edinburgh. Among the more important topics considered were the relation of the State to scientific research, recent advances in the theory of the structure of the atom, and the ethics of chemical warfare.

The British Association owes its origin, and, in great measure, its specific aims and functions, to the public spirit and zeal of Scotsmen. Sir David Brewster, president in 1850, was its virtual founder, and Principal Forbes its chief architect. In 1834 the then president, the Rev. Prof. Sedgwick, indicated the great power which the Association is able to exercise in promoting the advancement of science by combination and united action, and contended that one of its most important functions is to further the "commerce of ideas" by holding joint discussions on subjects of kindred interest. This phase of the Association's activities is to be emphasised at the present meeting by the holding of many more joint meetings of allied sections to discuss problems of general interest; and another noteworthy change in procedure will be the introduction of discussions on the addresses of Presidents of Sections.

Brewster, who had a lofty ideal of the place of science in the intellectual life of a community, and of the just position of the man of science in the social scale, pleaded for the establishment of a national institution, possessing a class of resident members who should devote themselves entirely to science, and who should be "free alike from the embarrassments of poverty or the temptations of wealth"; such men should do more and better work than those who snatch an hour or two from their daily toil or nightly rest. This ideal was not attained in Brewster's time, nor has it been reached in our own. At the meeting of the Association in Edinburgh in 1871, Lord Kelvin pursued the same thought, urging the view that "experimental research should be made an object of national concern, and not be left, as hitherto, exclusively to the private enterprise of self-sacrificing amateurs, and the necessarily inconsecutive action of our present Governmental Departments and of casual committees." Lord Kelvin pleaded more particularly for the institution of physical observatories and laboratories, and it was not long before the Cavendish Laboratory at Cambridge and, thanks to the initiative of the late Lord Salisbury, the National Physical Laboratory were established. The achievements of these institutions bear remarkable testimony to the value of organised and continuous effort on the part of the British Association.

The fifty years which have elapsed since Lord Kelvin was president have been extraordinarily fruitful in physical and chemical discoveries. Probably no previous half-century has witnessed such momentous achievements. In pure chemistry, the discoveries of argon, radium, helium as a terrestial element, neon, xenon and krypton, the production of helium from radium, the isolation of fluorine, may be quoted as of outstanding importance, whose value is enormously enhanced by the theoretical and practical consequences which flow from them. In applied chemistry, the Gilchrist-Thomas process of iron-purification, the production of calcium cyanamide by the method of Frank and Caro, Sabatier's process of hydrogenation, a widespread application of liquefied gases, and Haber's work on ammonia synthesis, have revolutionised the industries with which they are concerned. In pure physics the past half-century has witnessed the rise of the electron theory, the discovery of electromagnetic waves, the investigation of cathode rays, and the elucidation of crystal structure. It has seen, moreover, the invention of the telephone, the establishment of incandescent lighting, the electric transmission of force, the invention of the kinematograph, of wireless telegraphy, the application of the Röntgen rays, and the photographic reproduction of colour. In physical chemistry it has witnessed the creation of stereochemistry, the formulation of the phase rule, the theories of solution, of ionic dissociation, and of the galvanic cell. Such a list is far from complete, but it is pregnant with meaning.

Another matter which Lord Kelvin urged the Association to take up was the more rapid dissemination of information concerning the results of scientific investigation; this, happily, has been accomplished. The timely aid given by the Association to the Chemical Society to enable it to prepare and publish monthly abstracts is gratefully remembered by British chemists, and the example has been widely followed by other scientific and technical societies. At the present time there is almost an embarrassment of riches in the sphere of chemical abstracts, and there is much need for co-operation among the various distributing societies, particularly in view of the greatly increased costs of publication.

All thinking men are agreed that science is at the basis of national progress. The industrial position of a nation, its wealth, welfare and stability depend upon invention, which in its turn depends upon research. The reiteration of this obvious fact was never more needed than now, for it is, unfortunately, only too true that in the past the industrial world has underrated the value of research. The establishment of the Department of Scientific and Industrial Research marks an epoch in our history, and is bound to exercise a profound influence upon industries where success depends upon discovery and invention. It has been so organised as to obviate many of the objections which have been urged against the endowment of research, and to be in harmony with the modern democratic view—and against that expressed by Brewster—that no institution should be created to which definite work is not assigned and from which definite results do not emanate. The Department has wisely left considerable freedom to the individual worker; it has created many new research associations, and has aided and co-ordinated the activities of both old and new.

Recent advances in the elaboration of the atomic theory of the structure of matter show that science advances less by fundamental alterations in its beliefs than by additions to them. The investigation of the inner mechanism of the atom has profoundly modified the basic conceptions of chemistry. The discovery of the electron, the production of helium in the disintegration of radioactive atoms, the recognition of the existence of isotopes, the possibility that all elementary atoms are composed either of helium atoms or of atoms of hydrogen and helium, and that these atoms in their turn are built up of the electron and a particle of positive electricity whose mass is practically identical with that of the same atom, are pregnant facts which have completely altered the fundamental aspects of the science. It is interesting to note that Graham, in his "Speculative Ideas respecting the Constitution of Matter" (1863) threw out certain suggestions which have a distinct bearing upon recent results. In this paper Graham

conceived of a lower order of atoms than the chemical atom of Dalton, and founded on this conception an explanation of chemical combination based upon a fixed combining measure, which he termed the "metron," its relative weight being one for hydrogen, sixteen for oxygen, and so on with the other so-called "elements."

The results of the work of Aston and J. J. Thomson on isotopes, including the existence of H_3, first detected by the latter, and Rutherford's work on the disruption of oxygen and nitrogen are of extraordinary interest as bearing on the question of the essential unity of matter and the mode of genesis of the elements, a subject which was considered many years ago by Crookes, Marignac, Schutzenberger, and Lockyer, who in many instances foresaw the results of recent workers. The comprehensiveness and sufficiency of the prevailing theory of the constitution of the atom are well illustrated by the explanation it affords of the Periodic Law, atomic numbers, and valency. In the light of recent researches, the term "atomic weight" has acquired a new and much wider significance. The existence of isotopes appears to have introduced greater complexity, but it may be found that greater simplicity will result. If the number and relative arrangement of the atomic protons and electrons be known, it may be possible to arrive at the atomic weight by simple calculation, on the assumption that the integer rule is mathematically valid; but, apparently, this is not so, owing to the influence of "packing." But the little differences may make all the difference, and it is in their determination that important new facts may be brought to light. In view of recent developments, it has become necessary to reorganise the work of the small International Committee on Atomic Weights which was appointed in 1903, and this has already been taken in hand by the International Union of Pure and Applied Chemistry (*cf.* J., 1921, 267 R).

The late war, which has so profoundly affected almost all human activities and relations, differed from previous wars in the extent to which organised science was invoked and systematically applied in its prosecution; but nothing shocked the conscience of the civilised world more than Germany's cynical disregard of her undertaking not to use lethal gas in warfare. Advocates of chemical warfare contend that poison gas is far less fatal and much less cruel than any other instrument of war, and that, as a method of conducting war it is more humane than preventive medicine, which by safeguarding the health of combatants renders possible the maintenance in the field of enormously greater armies, and thus provides greater scope for the destructive activities of other military weapons. This argument carries no conviction. The use of poison gas is not merely contrary to European military traditions; it is repugnant to the right feeling of civilised humanity. It in no wise displaces existing instruments of war, but creates a new kind of weapon of limitless power and deadliness. "Mustard gas" may be comparatively innocuous, but it was not intended to be so by the combatants; nor is it at all likely that the use of lethal gas will be confined to that of "mustard gas." To one who, after the peace, inquired in Germany concerning German methods of making "mustard gas," the reply was, "Why are you worrying about this when you know perfectly well that this is not the gas we shall use in the next war?" It is the legitimate business of preventive medicine to preserve the health of any body of men, however large or small, committed to its care, and it is not to its discredit if the numbers so maintained run into millions instead of being limited to thousands. The British Association could have no loftier task than to use its great influence in arresting a course which is the very negation of civilisation.

THE LABORATORY OF THE LIVING ORGANISM.

The continued recognition of the importance of that side of chemistry which deals with the elucidation of the processes of life is shown by its forming the subject of the presidential address to the Chemistry Section of the British Association, delivered by Dr. M. O. Forster, F.R.S., at the annual meeting in Edinburgh on September 8. In addition to a general survey of the present knowledge concerning some of the groups of chemical substances which are operative in the living organism, notable emphasis was laid on the æsthetic value of an acquaintance with the principles of chemistry, sufficient to enable the educated citizen to realise the intimate part played by the science in his daily life.

Whilst deprecating the selection of chemistry as an occupation without definite vocation (a pertinent warning at a moment when the profession is being entered upon by many more than can reasonably expect to find in it the inspiration which alone may bring an adequate reward), Dr. Forster insisted that appreciation of the general outlines of the subject would add to the mental equipment of our people a source of abundant intellectual pleasure, since every living plant, animal, and human being is a practical organic and physical chemist, conducting analytical and synthetical processes of the most complex order with imperturbable serenity.

The minute cells of which our bodies are co-ordinated assemblages, by the production and application of enzymes, possess a power of synthetic achievement contrasted with which the classical syntheses of organic chemistry are but hesitating preliminaries, whilst the carbohydrates, alkaloids or glucosides, complex as they seem from the standpoint of molecular structure, are but *débris* strewing the path of enzyme action and photochemical synthesis. Furthermore, whilst plants effect synthetic processes from carbonic acid, water and nitrogen, the animal system is powerless to utilise these simple starting materials until they have been assembled into more complex forms by plants.

Recent advances in the chief divisions of biochemistry were considered, and the work of R. Robinson in effecting syntheses of alkaloid derivatives from simple substances such as succinic dialdehyde, acetone and methylamine was mentioned. The structure of nucleic acids was discussed in some detail, with especial reference to the researches of W. Jones and P. A. Levene on the degradation of these acids by the appropriate phospho-nuclease and purine-nucleases through adenine, guanine or other purines to the ultimate product of purine metabolism—uric acid in man and apes, allantoin in other animals.

Willstätter's researches on chlorophyll and hæmoglobin show that these pigments are fundamentally related, since both can be converted into a substance, aetioporphyrin, composed of a system of condensed substituted pyrrole nuclei. The mechanism by which they act is not yet known, but Baeyer's "assimilation hypothesis," enunciated in 1870, and according to which formaldehyde is the connecting link between carbonic acid and sugars, still holds the field in spite of numerous criticisms. This view has received fresh support from the work of Willstätter and Stoll upon the assimilatory quotient (the relation of the carbon dioxide absorbed to oxygen liberated) obtained from many types of foliage under varying conditions of temperature and atmospheric composition.