MEDAL AWARDS OF THE ROYAL SOCIETY*

Copley Medal

THE Copley Medal has been awarded to Sir Robert Robinson, Waynflete professor of chemistry in the University of Oxford.

Sir Robert Robinson is recognized in all countries as one of the world's leaders in organic chemistry, and is one of the greatest and most versatile of investigators in that department of science. His researches, with a long and notable succession of pupils and collaborators, have covered a remarkably wide range of problems in this field, and his approach to these has been distinguished by brilliance in conception and a genius for the selection of methods leading to the desired solutions. Robinson's investigations have been particularly concerned with the chemistry of natural substances, products of the life processes of plants and animals. His work has thus been a potent factor in the tendency of organic chemistry to return, in recent years, to an objective nearer to that of its origin, and to make contacts of growing intimacy and value with biochemistry, a more recent development in response to the stimulus of functional biology.

This occasion does not permit any attempt at a complete or detailed survey of all the different fields which Robinson's work has illuminated and opened to further exploration. Special mention must be made, however, of his long series of fundamental investigations on the constitution and relationships of the plant alkaloids. His theory of the biogenesis of plant products seems rather to have inspired than to have resulted from his own early and elegant synthesis of tropinone; and it has revealed an unforeseen and coherent relationship between the constitutions of different groups of alkaloids, and given a great stimulus to work on their synthesis. The work published from Robinson's laboratory has been fundamental to understanding of the isoquinoline and the indole series of alkaloids, of morphine and its allies, and of the structural formulæ of strychnine and brucine, which formed the subject of his Bakerian Lecture.

Of at least equal scientific rank is the work which Robinson carried out and inspired over many years on the anthocyanin and, more recently, on the anthoxanthin pigments of plants, culminating in the synthesis of the actual colouring matters of flowers, and forming as a whole one of the most brilliant achievements in the whole range of modern organic chemistry.

Robinson's mastery of synthetic resources, and his penetrating instinct for clues to organic constitution, have been further demonstrated in a more recent approach to the synthesis of the steroids, in the production of series of compounds of interest for chemotherapy, and in notable studies of individual natural substances of a range of other types. He is, moreover, a philosopher as well as a master of experimental possibilities; and his theory of organic reactions, in the modern, electronic terms of valency bonds, has had a great influence on the development of fundamental conceptions in organic chemistry.

The Copley Medal is the highest recognition of scientific achievement in the Royal Society's gift, with no limitations of subject or nation; and the Society may well find cause for satisfaction in the knowledge that the award of its premier medal, this year for achievement in organic chemistry, after an interval of many years, finds among its own fellows a recipient of such unquestioned pre-eminence as Sir Robert Robinson.

Rumford Medal

The Rumford Medal has been awarded to Dr. G. M. B. Dobson, reader in meteorology in the University of Oxford.

The Rumford Medal awarded by the Royal Society was established for the recognition of important discoveries made in Europe, especially on heat or on light. These conditions appear to be met with a special fitness in the award of the Medal this year to Dr. G. M. B. Dobson, for his meteorological researches and discoveries. For Dobson's work has, in recent years, greatly extended knowledge of the linkage between the behaviour of ozone and cyclonic disturbances, in that complicated heat engine which is the earth's atmosphere; while light may be said to have provided the basis of measurement for Dobson's spectrographic studies of the distribution of ozone, in time and in height above the earth's surface.

Light had also a major concern in earlier researches on meteors in which Dobson collaborated with Prof. F. A. Lindemann (Lord Cherwell); in these, the study of the heights between which meteors become luminescent enabled them to draw conclusions as to the density, and from these as to the temperature of the atmosphere at great heights from the earth's surface. But it is especially on Dr. Dobson's own studies of the ozone of the atmosphere, continued over many years, and producing results of outstanding importance for meteorology, that the award is based.

Royal Medals

A Royal Medal has been awarded to Prof. W. N. Haworth, professor of chemistry and director of the Chemistry Department in the University of Birmingham.

Haworth's great claim to distinction arises from the revolutionary change which has been produced by his own investigations, and by those of his immediate pupils, in the whole aspect of an important section of organic chemistry, dealing with the structure and the relationships of the carbohydrates. The ring structure of the simple sugars, first proposed by Tollens and supported by the work and the authority of Emil Fischer, had been generally regarded by chemists as firmly established. Detecting insecurities in the arguments which led to this formulation, Haworth developed the methylation technique, first used by Purdie and Irvine, and applied it systematically to the monosaccharides. He was thus able to show, by unequivocal methods of organic chemistry, that the accepted ring structure of these sugars was incorrect, and that, in their normal and reactive forms, they were derivatives of pyran and of furan respectively.

Later, Haworth further developed his methods in application to sugars and carbohydrates of increasing complexity. By his work, and that of others who have followed his lead, the detailed structures of many disaccharides and of some trisaccharides have been established. Progress has further been made in his attack on the structural complexities of the polysaccharides, and a simple chemical method has been evolved for determining their minimal molecular

* Remarks made by Sir Henry Dale, Pres.R.S., in presenting the medals for 1942.

weights. Prof. Haworth's work, in the field which he has thus made his own, has received the high international recognition of a Nobel Prize, and will assuredly take rank as a major achievement of permanent significance in chemical history.

A Royal Medal has been awarded to Dr. W. W. C. Topley, formerly professor of bacteriology and immunology, University of London, now secretary to the Agricultural Research Council.

Dr. Topley is one of the most distinguished of the British bacteriologists of recent years. The most important of Topley's contributions to bacteriology and experimental medicine has been the experimental study of epidemics, which he initiated and of which the methods have been largely his own creation. Much had been learned by the statistical analysis of observational data, dealing with the origin, spread and development of natural epidemics, under conditions largely out of control. Topley conceived the idea of applying such methods to the investigation of epidemics started artificially in populations of healthy mice, kept in the laboratory under conditions which could be exactly controlled and deliberately varied. Thus the factors conducive to the rise, culmination and decline of an epidemic, to its revival or its final subsidence, could be experimentally determined. In a long series of such studies, the important results of which were reviewed in his Croonian Lecture for 1941 on "The Biology of Epidemics", Topley had the statistical co-operation of Prof. Major Greenwood, in both planning and interpretation.

On this firm basis of knowledge concerning the incidence and mortality of a naturally transmitted infection in untreated stock, the efficiency of prophylactic measures could be put to a controlled test. Under Topley's guidance and inspiration, accordingly, substantial progress has been made by his chemical colleagues towards the isolation from various species of pathogenic bacteria of highly purified and stable antigens, and the practical trial of some of these was interrupted by the outbreak of war.

Dr. Topley's researches have had a great and lasting influence on the study of bacteriology, immunology and epidemiology in relation to human medicine. His recent change of the focus of his interests may be expected to give an important stimulus to advance in many cognate fields of agricultural research.

Davy Medal

The Davy Medal has been awarded to Prof. C. N. Hinshelwood, Dr. Lee's professor of chemistry in the University of Oxford.

The award has been made for Prof. Hinshelwood's work on the kinetics of chemical change, characterized by its pioneering quality and by the varied new lines of research which it has opened up. An experimental investigator of great skill and achievement, Hinshelwood has also enlarged the theory of the subject by able mathematical analyses and descriptions based on the concepts of collisions and of activation energy.

Hinshelwood took a leading part in the early study of homogeneous gaseous reactions. As the result of the examination of a number of bimolecular examples, he was able to show, with reason, that these are confined to molecules containing few atoms, and that the actual rate was given by the product of the total collision rate and the probability of a molecule possessing the experimental energy of activation. Unimolecular reactions were found to occur with polyatomic molecules and to show more complex features. In association with Prof. F. A. Lindemann (Lord Cherwell), Hinshelwood put forward the mechanism, now accepted, whereby a reaction fundamentally dependent on collisions may nevertheless have unimolecular kinetics. This theory he was able to verify by showing that the rates of such reactions diminish at low pressures and that the kinetics then become bimolecular.

In the field of chain reactions Hinshelwood opened up new lines of advance by studying the thermal reaction between hydrogen and oxygen. Thus he discovered, and offered clear explanations for, the curious phenomenon of 'explosion limits', confining explosive reaction, at any fixed temperature, sharply to a particular pressure region. Elaborate studies of the effects of nitrogen peroxide and other foreign gases on the hydrogen–oxygen reaction brought to light the very great kinetic complexities of an apparently simple type of chemical change. In this work Hinshelwood directed attention to the influence of the container surfaces on chain reactions, and also clarified the confusion of evidence concerning the effects on reaction rates of the intensive drying of gases. His discovered the inhibition of certain gaseous reactions by nitric oxide and interpreted the effect as due to the removal of radicals from, and the suppression of, 'chains'.

Hinshelwood has also carried out a large number of experiments on heterogeneous reactions and shown that their differences in kinetic behaviour can be explained by the application of the concepts of Langmuir.

Throughout all these researches, carried out with the utmost economy and directness, though with full experimental precautions, and interpreted in the most lucid manner, Hinshelwood has never lost sight of the essential complexity of chemical reaction mechanisms. He has always been ready to modify his views in accordance with new experimental evidence, and to make the fullest use of the more recent developments of wave-mechanics and of statistical mechanics. Summarized by their author in two well-known treatises, Prof. Hinshelwood's distinguished researches furnish abundant ground for the award to him of the Davy Medal.

Darwin Medal

The Darwin Medal has been awarded to Prof. D. M. S. Watson, Jodrell professor of zoology and comparative anatomy at University College in the University of London.

Prof. Watson is pre-eminent among palæontologists for his contributions to knowledge of the course of vertebrate evolution. His researches have been concerned mostly with the origin of the land vertebrates, with the fishes most nearly related to them, and with the main line of evolution leading to the mammals.

It will not be possible to survey here Watson's work in all its aspects, and mention must be restricted to some of the major lines of advance which it has opened. His Croonian Lecture, in 1925, summarized the conclusions which he had reached by that date as to the evolution of the Amphibia, demonstrating for the first time the relationship of the Stegocephalia to the Osteolepid fishes. In addition to tracing the descent of land vertebrates thus from Amphibia back to fishes, Watson followed the line of the evolution of the mammals, through early, primitive reptiles, the Cotylosaurs, to the mammal-like reptiles, in a large series of valuable papers. He related this work on the reptiles to that on the amphibians in a paper on the evolution of the shoulder girdle of the Tetrapoda.

In this work on the fossil vertebrates, in its relation to the course of evolution, Watson has not confined his attention to morphological details, but, with an enterprise remarkable in a palæontologist though characteristic of his outlook, has considered where possible the functional significance of the structures preserved in the rocks; thus he has considered the mode of action of the shoulder girdle and deduced the nature of the musculature of a group of marine fossil reptiles.

Pursuing his study of mammalian origins, Watson was led to study the most primitive of living mammals, the oviparous Monotremes, and to discover that characters in which their skulls differ from those of other mammals can be regarded as extreme developments of features observed in the skulls of certain fossil, mammal-like reptiles.

Watson's work has continued in full vigour into recent years, and has brought two further contributions of major importance to the study of evolution in the vertebrates. One is concerned with the origin of the frogs from more primitive amphibian types, while the other shows that a group of fishes from the Old Red Sandstone constitutes a separate class of vertebrates, equal in rank to and ancestral to the remaining fishes.

Tracing, in this brilliant series of researches, the main stages of the descent of the mammals from their earliest fish-like ancestry, Prof. Watson has certainly performed "work of acknowledged distinction in the field in which Charles Darwin himself laboured".

Buchanan Medal

The Buchanan Medal has been awarded to Sir Wilson Jameson, formerly dean of the London School of Hygiene and Tropical Medicine and since 1940 the chief medical officer to the Ministry of Health and the Board of Education.

In both capacities Jameson has shown himself to be a man of stimulating influence and leadership, determined and persistent in his efforts to ensure that advances of medical knowledge in the laboratory, the clinic and the field shall receive prompt application in administrative practice.

Largely to Jameson's vigorous policy is due the hope that active immunization against diphtheria, which has banished the disease from many large communities of North America, will at length find systematic and effective application in Great Britain, where many of the discoveries were made which have rendered it safe and practicable. In the prompt official adoption of methods using modern technical resources to deal with the recent increase of tuberculosis under war conditions, and in the recognition of adequate and scientifically planned nutrition of the people as a central item of an effective health policy, Jameson's active and enlightened influence can again be discerned.

Of the grounds on which the founder of the Buchanan Medal desired the awards of it to be made, Sir Wilson Jameson's high claim to it is based on "administrative and constructive work" of outstanding merit in the service of hygienic science.

Hughes Medal

The Hughes Medal has been awarded to Prof. Enrico Fermi, now of New York.

Prof. Fermi has made most notable contributions both to theoretical and experimental physics. In the early days of the modern quantum theory he was one of the first theoretical physicists to appreciate the generality of the considerations put forward by Pauli and known as the 'exclusion principle'. This led him to discuss the statistical theory of a perfect gas of particles in equilibrium, obeying this principle, with results which were obtained independently and almost simultaneously by Dirac by similar methods. These results of Fermi and Dirac are of the utmost importance in the modern theory of assemblies of similar particles, such as electrons, protons, and neutrons. Following this outstanding personal contribution, Fermi played a great part in building up at Rome a distinguished school of theoretical physics, where he himself made one of the earliest successful attempts to construct a theory of radioactive β-ray change. This theory shows the most profound insight into the theoretical nature of the quantum theory.

His interest in the atomic nucleus led Fermi naturally to his experimental studies in this field. Immediately after the discovery of the neutron, he realized that it provided a new possibility of attack on the nucleus and of stimulating nuclear change by neutron bombardment. This work opened up the fruitful modern field of study concerned with the transformations of nuclei of medium and great atomic number, and led directly to the most exciting transformations of all, the nuclear fission of uranium and thorium.

Prof. Fermi's work is characterized throughout by profound insight and great experimental skill. In the fields which he has made his own he is universally acclaimed a leader.

ANALYSIS AND TESTING OF COAL

THE testing of coals for their suitability in use, even after many years of effort, continues to give rise to investigation. This is due to the great economic importance of fuels, change in methods of utilization, and also to the fundamental complexity of the nature of coal. Unlike many raw materials, every coal contains several constituents, recognizably distinct, which vary in composition and character according to their origin and geological age. Moreover, they contain inorganic matter which varies widely in chemical composition and physical properties.

These complexities make the actual chemical composition of secondary importance, with the possible exception of the sulphur content. The so-called 'proximate analysis' is of prime importance as a guide to the usefulness of a coal. This involves the measurement of the quantity of combustible and of incombustible matter. Each is further subdivided —the combustible into 'fixed' carbon and volatile matter, the incombustible into 'ash' and 'moisture'. By means of these empirical tests, the observant and experienced analyst can reach useful conclusions as to the suitability or unsuitability of a coal for many purposes. Standardization of such a test is essential and more than forty years ago the American Chemical Society drew up a standard procedure. A few years later the United States Bureau of Mines made a start on this work, which has been continued in other industrial countries until a vast literature has been collected.

Dr. A. C. Fieldner, chief of Fuels and Explosives Services, U.S. Bureau of Mines, in his Melchett Lecture to the Institute of Fuel, delivered by talking film on October 13, traced the development of testing