PROCEEDINGS OF
THE ROYAL SOCIETY.

SECTION B.—BIOLOGICAL SCIENCES.

Address of the President, Sir Ernest Rutherford, at the
Anniversary Meeting, November 30, 1926.

At this anniversary meeting, it is customary to refer to the losses by death
suffered by our Society during the year. These include sixteen of our Fellows
and one Foreign Member. The Society has to lament the untimely removal of
some of our most distinguished workers in the field of general Biology and
Pathology.

On January 2 died John Gray McKendrick, Emeritus Professor in the
University of Glasgow, in his eighty-fifth year. A veteran Physiologist, he
 colaborated with the late Sir James Dewar in the discovery of the excitation
by light of an electric current in the retina and optic nerve, and made distinc-
tuished contributions to the physiology of the special senses. He was a man
of wide interest, distinguished also as a lecturer and writer.

Benjamin Neave Peach, aged 84, was for many years a member of the
Geological Survey of Scotland. Pre-eminent as a field geologist, both by his
teaching and original contributions, he influenced greatly the progress of
Scottish Geology.

The untimely death of William Bateson has deprived the Society and
Natural Science of a great biologist. As the immediate sequel of a brilliant
academic career came studies that gained for him an outstanding position as
a comparative anatomist. These studies proved only a prelude to an exhaustive
investigation of variation in species, which revealed in him the qualities of
a scientific observer and traveller of the first rank.

The sustained study of the principles of heredity, to which his energies
were now devoted, enabled him to found and to inspire at Cambridge a genetical
school whose discoveries have added materially to natural knowledge. The
last fifteen years of all too short a life were given by Bateson, as Director of
the Horticultural Institution at Merton, to a continuation of the pursuits

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initiated at Cambridge, to the application of results to culture, and to the establishment of co-operation between the practical breeder and the scientific student. Bateson was more than the foremost exponent of Mendelian research in this country. A highly skilled amateur of art, with a special knowledge of the art of the Far East, he was an ardent and successful collector. Among the specimens his taste and knowledge enabled him to acquire, which now serve as a permanent memorial of him and of his association with the British Museum, are things, their present custodian assures us, which the national collection "could hardly have hoped to acquire by purchase." The happy combination of penetrating vision, balanced judgment and generous readiness to comply with requests for counsel which enabled Bateson to do the State the service of fostering a harmonious relationship between science and practice in breeding, was equally marked in all that he did for the Society as a member of many important Committees.

James Fairlie Gemmill, in later years Professor of Natural History, University College, Dundee, and formerly teacher in the University of Glasgow, was a Zoologist with a special interest in Embryology. He helped much by his devotion and example to develop the Millport Biological Station as a centre of training and research.

By the death in his seventy-third year of Heike Kamerlingh Onnes, Foreign Member and Rumford Medallist of our Society, and Nobel Laureate, we have lost one of the greatest experimenters of our age. Influenced by the teaching of his great countryman, van der Waals, he early decided to devote his life to the experimental study of the properties of matter at low temperatures. By his power of organisation and his experimental skill, he built up in the University of Leyden the Cryogenic Laboratory, which is unique in the world. His most spectacular triumph was the liquefaction of helium in 1908, but of still greater scientific importance was his fundamental discovery of the electrical supra-conductivity of certain metals at temperatures closely approaching the absolute zero. It is difficult to exaggerate the significance of this discovery, which is likely ultimately to provide the key to the explanation of the passage of electricity through metals. Science owes him a debt, not only for his personal contributions to knowledge, but for his international services in offering freely the facilities of his laboratory to other workers on the effects of low temperatures. No one could fail to be attracted by his genial and forceful personality.

Arthur Robertson Cushny, Pharmacologist, recognised as a leader in that department of medical science throughout the world. Having been assistant
to Schmiedeberg, one of the founders of the modern science of experimental pharmacology, Cushny was for 13 years Professor in that subject in the Medical School of Ann Arbor, Michigan, for 12 years in University College, London, and for the last eight years of his life in the University of Edinburgh. Among his many original contributions to science may be mentioned, his experimental analysis of the causes of irregularity in the action of the heart, and of the remedial action of digitalin and similar drugs in heart disease; his demonstration of the wide difference in physiological activity between optical isomers; and his work on the mechanism of the secretion of urine. He was a man of deep learning and wise judgment in all matters pertaining to the subject of his life's work, and his opinion and advice were sought and trusted in scientific and administrative circles alike.

Sir Philip Watts, who died in his eightieth year, was for the greater part of his active life associated with the development of Naval Architecture in the Admiralty. From 1885 to 1912 he was in charge of the design of warships in Armstrong's works, and in 1902 was appointed Director of Naval Construction in the Admiralty. When Lord Fisher became First Sea Lord, Watts was given his opportunity to produce the big-gun ship. The combination of the high technical skill of Watts with the unbounded energy of Lord Fisher resulted in the production of the series of Dreadnoughts and Super-Dreadnoughts of which our Grand Fleet was mainly composed when the hour of battle came. A man of marked scientific ability, he contributed many papers of high merit. A valued member of our Society, he served on its Council and was Vice-President in 1915.

William James Lewis, who died in his eightieth year, was for 45 years Professor of Mineralogy in the University of Cambridge. A mineralogist of the old school he had many interests, ranging from the collection of mineralogical specimens to the direction of a scholastic agency which he founded as a private venture in 1884, long before the setting up of an official Appointments Board by the University.

Henry Brougham Guppy, already endowed with the instincts of a naturalist took ample advantage of the opportunities enjoyed by a naval surgeon for observation in the field, and devoted to this work the years that followed his retirement from public service. His death took place during his return from a visit to the Pacific undertaken in connection with his scientific studies.

James Thomson Bottomley, a nephew of the Lord Kelvin, was closely associated with him not only in the Physics Department of the University of Glasgow but also in the design and construction of scientific instruments.
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An active experimenter in many branches of Physics, well known as the author of a useful compilation of four figures mathematical Tables.

William Boog Leishman, Lieutenant-General, since 1923 Director-General of the Army Medical Service, distinguished for his practical application of immunology to the protection of the Army, during peace and in the field, and for his brilliant original discoveries in the pathology of tropical disease. Leishman was associated with Almroth Wright at a time when the method of protective inoculation against the enteric fevers was being evolved, and had later the chief responsibility for organising and perfecting the measures for its practical application on the largest scale. A measure of his success in this application of scientific principles was given, in due course, by the relatively trivial proportion of deaths from the enteric fevers in the British armies during the great war. Leishman discovered in 1900, though he did not publish the discovery until 1903, the protozoal organism responsible for Kala Azar, thus opening the way for the later discovery by others of the means of treating this widely spread endemic fever of eastern lands, formerly regarded as inevitably fatal. The generic name Leishmania, given to this and allied organisms, commemorates his association with the discovery. In more recent years he was engaged in brilliant and suggestive observations on the developmental cycle in its intermediate host, a tick, of the *Spirochaeta duttoni*. This work was interrupted by calls made, during the war and since its close, on his administrative ability and experience. He was Pathological Adviser to the Expeditionary Force in France, became Director of Pathology to the Army Medical Department in 1919, and in 1923 Director-General of the Service to which he was to give but three more years of a devotion too eager for his strength. Among his many activities he found time for good service to the Royal Society, on its Council and its Committees, and was a Vice-President from 1921 to 1922. His untimely death has brought a heavy loss to science and the nation.

Frederick Walker Mott, neurologist, working both as a pathologist and clinical investigator, made contributions of great importance to knowledge of the causes, and of the means of treatment, of diseases of the brain and the nervous system. For 28 years Mott held with great distinction the position of Pathologist to the London County Asylums, and his laboratory at Claybury became a centre of progressive research for visiting neurologists of this and other countries. Among his more important contributions to science may be mentioned the definite discovery that general paralytic insanity is due to a specific infection, and therefore no longer a hopeless problem from the point of view of either prevention or treatment; his demonstration that the so-called
“asylum dysentery” is a bacillary dysentery occurring and spreading under the conditions of asylum life, so that it can be eliminated by adequate sanitary measures; his work on the pathology of dementia praecox, and on heredity in mental and nervous diseases.

The Rev. Thomas Roscoe Rede Stebbing died aged 91. At one time master in our Public Schools and then Fellow and Tutor of an Oxford College, in mature age, attracted by the writings of Darwin, he threw himself into the controversy then raging in support of the theory of evolution. To gain first-hand knowledge, he studied the Crustacea, and was entrusted with the examination of the material obtained in the Challenger Expedition. His masterly report covering three volumes was admirable in arrangement and in literary form. Trained in the older learning, he brought to the study of science not only much erudition but a sense of the historical perspective of knowledge.

John George Adami, pathologist, Vice-Chancellor of the University of Liverpool since 1919, and before that for 17 years Strathcona Professor of Pathology in McGill University, Montreal. Early associated with the late C. S. Roy in pioneer research on the borderland between physiology and pathology, Adami was later responsible for many original contributions to science, in a wide field of pathological investigation, and author of a well known and comprehensive work on the Principles of Pathology. He served during the war as Assistant Director of the Canadian Army Medical Corps, and in more recent years, gave distinguished service to the cause of general and medical education. A man of wide interests and sympathies, he showed a genius for friendship.

In the early death of Frederick William Gamble, at the age of 57, Zoology has lost a distinguished teacher and investigator. At one time lecturer in the University of Manchester and then Professor of Zoology in the University of Birmingham, he proved himself an inspiring lecturer and an enthusiastic investigator. Some of his most important work in conjunction with Sir Frederick Keeble was connected with the discovery of the colour changes of the “Phantom shrimp,” and other crustacea, and the working out of their physiological significance. His two small books “Animal Life” and the “Animal World” are admirable examples of the presentation of the problems of biology to an unscientific audience.

Joseph Henry Maiden, of English birth and Australian adoption, applied with sound judgment for 45 years a wide and accurate knowledge of botany to the furtherance of the economic interests of the great Commonwealth in which he lived, and to the advancement of science and education in Australasia.
On October 9, died George William Lamplugh, aged 67, for long a member of the Geological Survey of this country and in later years an Assistant Director. A geologist of wide experience and a traveller in many lands, he made numerous contributions to our knowledge of the geology of Great Britain and Ireland. He was an active member of our Society serving on its Council, 1914–16.

Turning to other matters, we have to record a gratifying improvement in connection with international scientific relations. For two successive years, the Council of our Society had unanimously supported the admission of the Central Powers to full membership of the International Research Council. At the meeting in Brussels this summer, I had the honour of moving a resolution in this sense which was carried unanimously. It is understood that this invitation to join the International Research Council will be accepted in due course. In achieving this happy result, we owe much to the wise guidance of Sir Richard Glazebrook, our Foreign Secretary, and to Sir Arthur Schuster. I am sure that all members of our Society will welcome the disappearance of restrictions in membership which were seriously hampering the international co-operation of scientific men. We may look forward hopefully to an ever-growing friendship and co-operation between the scientific men of different nations, thus promoting not only the advance of science but goodwill between the nations.

It is a great pleasure to me to record the gift from one of our Fellows, Mr. Campbell Swinton, of £1,000 for a fund to be used for other than direct scientific purposes. The donor in his letter to the Council, expressed the hope "that others may be induced to subscribe to the fund so that the income may in time become sufficient for the purpose for which, as I understand, no specific fund is available." In attendance at the meetings of our Council and Committees, some of our members who come from a distance often incur heavy expenses which have been uncomplainingly borne. A fund to be used for this and other general purposes of the Society would be of much help.

I would like to take this opportunity to refer briefly to the striking advances in radio-communication which have been made this year, and to the new avenues of research in the electrical state of our atmosphere that are being opened up by the study of the mode of propagation of wireless waves over the earth.

Among the many developments of science during the past 30 years, none has left a deeper impression on the lay and scientific mind alike than the remarkable growth of wireless as a means of long-distance transmissions of signals, speech, music and even of pictures. The history of this new method of signalling is
of special interest to all scientific men, for it illustrates in a vivid way the value of a close co-operation between pure and applied science for rapid progress. The first great chapter in the history of radio-communication we owe to the genius of Maxwell, who, in a paper communicated to this Society in 1864 entitled "A Dynamical Theory of the Electromagnetic Field," showed that electric and magnetic effects cannot be produced instantaneously at a distance, but must be propagated through space with the velocity of light. He demonstrated the wave-nature of these electrical disturbances in space and the mode of their propagation. It is no exaggeration to say that the complete theory of electrical waves and their transmission in space is contained in his famous equations, and that too at a time when no experimental methods were known of producing or studying such electrical waves.

The next great step in advance we owe to the brilliant researches of Hertz, who in 1887, in his laboratory at Karlsruhe, showed how electrical waves in space could be produced by an open electric oscillator, and devised methods for their detection and study.

It was not long before the results of these small scale laboratory experiments were applied for practical ends. In 1896, attempts began to be made in England to utilise electric waves for signalling purposes, and the rapid development of this new branch of applied science owes much to the pioneer work of Marconi and Lodge. Progress in the later stages has been largely influenced by the utilisation of another scientific discovery, namely the use of electric currents in vacuum tubes as a powerful method of producing and detecting electrical waves. It is of interest to note that the first use of an electron tube as a detector of electrical waves was made by Professor J. A. Fleming.

It is not my object to detail subsequent progress except to refer to the noteworthy developments that have taken place this year. On January 1 the new Post Office Station at Rugby was opened for the transmission of messages to ships in all quarters of the globe and for Foreign Office messages. This long wave installation is in many respects unique. It is the only high-power electron-tube station in the world, and contains many novel features in its design and operation. The frequency of the continuous waves emitted by this Station is controlled with great accuracy by a vibrating tuning fork and the numerous high-power electron tubes in parallel are used to magnify five hundred thousand million times the energy of one of the harmonics of a small triode valve operating the tuning fork. The extraordinary flexibility of these electron tubes both as oscillators and receivers has been fully utilised in the design of the installation which incorporates all the latest developments in
this branch of science. The success of the station for the purposes for which it was designed is a tribute to the breadth of the scientific knowledge and the boldness of the initiative displayed by the Imperial Wireless Commission and the Engineering staff of the Post Office. This station has been also successfully used for experiments in radiotelephony with the Long Island station near New York. It is now possible, and will, it is expected, soon be practicable, to connect any telephone subscriber in Western Europe with any telephone subscriber on the North American Continent.

During the past two or three years, telegraphy on a commercial scale by the aid of short waves has been conducted in many countries. A still further development by the Marconi Company is to be recorded this year. Short wave stations, in which a series of parallel wires are arranged to act as a reflector and emit a beam of waves in a definite direction, have been erected near Bodmin in Cornwall and near Montreal in Canada. After a successful series of experiments, these stations began to operate commercially last month. Similar stations for communicating with the other Dominions are in the course of erection. It will be of great interest to see how far a continuous service is feasible by these new methods, in spite of the atmospheric disturbances which sometimes so seriously affect ordinary short wave transmissions.

It is remarkable how the progress of applied science in many instances depends on the utilisation of some obscure property of matter discovered in the course of purely scientific experiments. For example, in 1888, the brothers J. and P. Curie, working on the properties of crystals, discovered the piezoelectric properties of quartz. In a suitably cut crystal of quartz, an electric charge on the surface appears when the crystal is compressed or extended. Conversely a charge applied to the surface of the crystal alters its dimensions. No one at that time could have foreseen that this property could be utilised to control, automatically and with great accuracy, the frequency of the waves emitted by Broadcasting Stations, and thus be a factor of great importance in reducing interference between stations. Illustrations of this kind can easily be multiplied. For example, the discovery about 30 years ago in the laboratory of the photo-electric effect, in which certain substances exposed to light produce a copious emission of electrons, has formed the essential basis of the methods used to-day in transmitting radio-pictures and in experiments on tele-vision.

I should like to add a few words in connection with the problem of the propagation of long and short electrical waves over great terrestrial distances, which
has been the subject of discussion for many years, but on which valuable new data have been recently obtained. When wireless signals were first transmitted across the Atlantic, the late Lord Rayleigh immediately raised the question whether the waves were able to follow the curvature of the earth by the agency of diffraction alone. This problem has attracted the attention of many able mathematicians who have shown conclusively that some other agency must enter into the transmission of these waves over great distances. It was early suggested by Kennelly and Heaviside that the bending of the rays might be accounted for by supposing that there was in the upper atmosphere a layer which was electrically conducting and which guided the waves round the earth’s surface. Precision was given to this view by the work of Eccles and others, who showed that ionised gases could refract and absorb electrical waves passing through them. A still further advance was recently made when Sir Joseph Larmor pointed out the paramount importance of the long free path of the electrons in the upper atmosphere in producing scattering and refraction of electrical waves. He showed that a comparatively sparse distribution of electrons was sufficient to bend the path of the rays round the earth.

A direct attack on this problem has been recently made in this country by several methods, and convincing evidence has been obtained of the existence and height of this refracting layer. Appleton and Barnett, using wave-lengths of about 400 metres, have shown that at moderate distances from a wireless transmitter two sets of waves are received which produce interference phenomena. One set of waves travels in a straight line from the transmitter along the ground and the other passes into the upper atmosphere where it is refracted or reflected back to the receiving station. These experiments are of much interest as providing large scale analogues of the ordinary optical interference experiment carried out with wave-lengths a thousand million times as long. From the results of these investigations the height of the effective layer is estimated to be about 90 kilometres. In general, the refracted ray is elliptically polarised, an effect no doubt connected with the action of the earth’s magnetic field on the motion of the free electrons. Similar results by other methods have been obtained by Rose and Barfield of the National Physical Laboratory. These important series of experiments have been conducted in connection with the Radio-Research Board of the Department of Scientific and Industrial Research, and it is a pleasure to me to welcome here to-day its Chairman, Admiral Sir Henry Jackson, as one of our Medallists.

These observations not only give an explanation of night-time errors in direction-finding and of signal variations, but in a general way throw light on the
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vagaries observed in the transmission of short waves, where a signal may be undetectable a few miles away from the transmitter but may be received strongly a thousand miles away.

While the study of the propagation of electrical waves through our atmosphere is of much interest in itself, it is of even more value as giving us a new and powerful method of attack on the problem of the electrical state of our atmosphere, particularly at heights where direct observations are impossible. We may anticipate that an extension of such experiments will provide us with much valuable information not only on the degree of ionisation of the upper atmosphere but on its diurnal and seasonal variations. Although only preliminary observations have so far been made on this question, the results obtained show that there is much promise in this new method of attack on a difficult problem.

The phenomena of the aurora and the diurnal variation of the earth’s magnetism have long been supposed to indicate that the upper atmosphere is highly ionised and an excellent conductor of electricity. The origin of the ionisation is a matter of much interest. Part, no doubt, is due to the ultra-violet light emitted by the sun, but there may be other important contributory causes. During this year, E. A. Milne has shown how certain atoms of matter, ejected from the sun, notably those of calcium, may, in consequence of absorption and emission of radiation, acquire sufficiently high velocities to penetrate deeply into our atmosphere. It may be that the brilliant aurorae and magnetic storms which so often accompany sunspot activity, are a consequence of the projection into our atmosphere not only of electrons, as has long been supposed, but of swiftly moving atoms of matter.

Another source of ionisation to be taken into account is the very penetrating radiation in the upper atmosphere brought to light by the experiments of Kohlhörster and Millikan. The origin and nature of this radiation is still sub judice. Some have supposed it to be of cosmical origin and see in it evidence of the disintegration or formation of atoms of matter in worlds remote from us. On the other hand, we must not exclude the possibility of a mundane origin, for C. T. R. Wilson has given very strong reasons for believing that very high speed electrons and penetrating radiations may be produced as a result of the movement of electrons in the intense electric fields which arise during thunderstorms. This penetrating radiation has been detected by the minute ionisation observed in electrosopes at high altitudes. The effects are very small and the experiments difficult, but we may hope to obtain more definite information as to the origin and nature of this radiation by the experiments now in progress.

I now pass to the presentation of medals.
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The Copley Medal is awarded to Sir Frederick Gowland Hopkins.

For 20 years, Sir Frederick Hopkins has been a foremost leader in Biochemistry, a branch of science that has grown rapidly in importance and influence during this period. The guide and Director of a great Research Laboratory in Cambridge, he is everywhere recognised as one of the great pioneers of his science. In his active life, he has made a series of fundamental discoveries, each of which has led to the opening up of new fields of work. The isolation and identification of tryptophane 25 years ago, at a time when but few of the amino-acids that enter into the composition of proteins were recognised, marked an epoch in the pure chemistry of these substances. The importance of this discovery was enhanced by Hopkins’ later work on this substance, which led to a revolution in the physiology of proteins in nutrition, the end of which is not yet in sight. Some of the most fruitful work in recent physiology has been upon the nature of muscular contraction. The work of A. V. Hill and of Meyerhof, of Embden, and many others, turns upon the fundamental earlier discoveries by which Hopkins, in collaboration with W. M. Fletcher, defined the conditions governing the appearance of lactic acid in muscle during activity, and its disappearance during recovery. One of the most important discoveries of this century is summed up in the word Vitamines. Fifteen years ago, Hopkins had carried out experiments which not only showed that appropriate mixtures of proteins, carbohydrates, fats and salts, might, for lack of traces of unknown substances, be inadequate for the nutrition of animals, but at the same time established the general lines of the methods used ever since in the investigation of these substances by important groups of biochemists in all parts of the world. The discovery of the dipeptide glutathione, coming at a time when the nature of the processes underlying biochemical oxidations was the subject of significant work in many laboratories, has again brought Hopkins into the van as a leader in yet another part of the field of biochemistry and given the signal for intense renewed activity there. Hopkins’ work throughout has shown a genius for discovery. It has inspired a very large part of the best work in biochemistry in this century.

The Rumford Medal is awarded to Sir Arthur Schuster.

Sir Arthur Schuster began his work on Optics in the early days of Spectrum Analysis, and, indeed, was the first to employ in 1881 the word Spectroscopy to designate this branch of Science. He has made numerous original contributions to Optics in many directions. We may refer particularly to his work in the group velocity of waves and the pulse theory of white light. The
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breadth and penetration of his knowledge is clearly shown in his book on "Optics," a standard work which has served as a guide for generations of students. Schuster has made valuable contributions to many branches of Experimental and Mathematical Physics. When Professor in the University of Manchester, he made with Gannon a well-known determination of Joule's equivalent, and did valuable work in that connection by calibrating the thermometer originally used by Joule in his fundamental experiments. He was a pioneer in the study of the discharge of electricity through gases, and has taken a deep interest in the problems of Geophysics, particularly in connection with the magnetism of the earth and the state of the upper atmosphere, and is responsible for valuable additions to knowledge in these fields. Besides this original work, Schuster has always shown an active and keen interest in the progress and organisation of Science. He was a member of the General Board of the National Physical Laboratory from its inauguration and for six years acted as Chairman of its Executive Committee. He was Secretary of our Society 1912–19 in the difficult war period and Foreign Secretary 1920–24. He took an active part in the formation of the International Research Council, and since its inception has acted as its Secretary. The Society owes much to his wise guidance and to his generosity.

A Royal Medal is awarded to Sir William Bate Hardy.

The scientific investigations of Sir William Hardy in Physical Chemistry and Physics are of outstanding importance in many different fields of work, and are characterised by the highest degree of originality. In colloid chemistry, his name is known in every country for the fundamental and pioneer work which he has accomplished in that field. The stability of colloid sols in relation to the electric charge, the theory of flocculation, the nature and importance of the iso-electric point, the theory of protein ampholytes, and the electric charges of the positive and negative colloid ions represent some of the important discoveries with which his name will be for ever associated. The modern theory of protein solutions, which is of such great importance in biochemistry and physiology, is very largely due to his pioneer work in that field.

Sir William Hardy has also been a pioneer in the elucidation of the nature of surface forces and surface films and the orientation of molecules at surfaces. This work has been of the highest importance for the development of a new and extremely important branch of physico-chemical science. As a natural outcome of this work, Sir William Hardy has turned his attention in recent years
to the friction between surfaces and the nature of lubrication, and in a series of important investigations has thrown a flood of light on a subject which had long been neglected by both physicists and chemists. For the first time in the history of science the dependence of friction and lubrication on the structure and molecular orientation of surface films and the force-fields of molecules in relation to their structure and polarity have been elucidated in a series of beautiful and highly important researches.

In all these various fields of molecular science—colloid chemistry and physics, surface films and molecular orientation, friction and lubrication—the researches of Sir William Hardy have been of fundamental importance and have been characterised by an originality of outlook and an imaginative insight which bear the impress of genius.

I can only refer in passing to his many original contributions to another branch of Science, Physiology, and to the work that he has done for Science and Industry as Director of the Low Temperature Laboratory at Cambridge. For many years one of our Secretaries, we are grateful for his devoted service.

A Royal Medal is awarded to Professor Archibald Vivian Hill.

Professor A. V. Hill has made important contributions to knowledge of muscle and nerve. As to the former his enquiries, begun some 16 years since, were taken up at a time when, owing to the emergence of new facts, views of general acceptance stood in essential need of re-examination. In the past seven years Hill has accomplished this with a success beyond expectation. He has related to the mechanical the thermal aspects of muscular activity with a precision hitherto unattained, and obtained data as valuable for the chemical as they are fundamental for the physical study of the problem. The technique developed by him enabled for the first time the discrimination, in the heat production of muscle, of successive quantities and rates characterising successive stages of that activity, in spite of the closely consecutive and in part evanescent character of those phases. "Initial heat," uninfluenced by oxygen, the immediate accompaniment of the mechanical changes in the muscle, was thus distinguished from a "delayed heat" associated with functional recovery of the muscle; and in this latter there were recognised two portions which evaluate the relative shares of aerobic and anaerobic disappearance of lactic acid in the processes of restoration of the muscle. In association with this recovery process the molecular ratio between removed and oxidised lactic acid has thus been estimated. Besides furnishing this essential analysis of the functional reactions of isolated muscle, Hill has prosecuted notable enquiries into the
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Factors conditioning the performance and maintenance of muscular effort in the human body, measured its chemical cost and traced to their causes certain of the limits set to the speed and endurance of the athlete. Further, Hill has succeeded in not only detecting but in measuring heat-production accompanying the conductive activity of nerve. The scale of energy-change involved in this has required the devising of a refined technique; here again he with his pupils has obtained and measured the heat not only in block but in its separate phases of production. Both for muscle and nerve, the advances made by Professor Hill and his collaborators place knowledge on a new footing; whenever the intimate mechanism of the activity of these two important tissues may finally be elucidated, it is certain that the contributions of Professor Hill will remain fundamental for the explanation of the mechanism of them both.

The Davy Medal is awarded to Sir James Walker.

The investigations of Sir James Walker in the field of physical chemistry have been of great importance in the advance of that science. His work on the electro-synthesis of organic compounds, carried out originally in conjunction with the late Professor Crum Brown and continued up to the present time, has thrown much light on the phenomena of electrolysis and has led to the synthesis of a large number of new and interesting substances. One of the pioneer investigators of ionic equilibria he has developed the theory of Arrhenius in many directions. His discovery of the nature and equilibria of amphoteric electrolytes constitutes a fundamental advance which has been of the greatest fruitfulness not only for the general theory of electrolytic solutions, but also for the development of the chemistry of the proteins. The work of Sir James Walker on the theory of amphoteric electrolytes represents one of the greatest advances in the elucidation of the nature of solutions. His investigations on the adsorption of dissolved substances by solids, for example, the adsorption of picric acid by silk fibres, were of cardinal importance in the recognition of the true nature of a class of phenomena whose occurrence has been established in many branches of science. In the theory of reaction-velocity and chemical reactivity, and in many other parts of physical chemistry, the work of Sir James Walker is of high value and importance.

The Darwin Medal is awarded to Dr. Dukinfield Henry Scott, for his distinguished work on Fossil Plants.

At a moment when there seemed some danger that the brilliant advances in Palaeophytology made by Professor Williamson might slacken owing
to advancing years, Dr. Scott entered upon a fruitful co-operation with the veteran. Several joint Memoirs were the result of this happy coalition; but later Scott established a quite independent position of his own. Among the numerous Memoirs published by him during the last 40 years, none stands out more prominently as a model of presentation of complex structure than that on *Cheirostrobus*, a new type from the Calciferous Sandstone. Not only was its elaborate structure fully described, but the comparative treatment showed a master hand.

This quality came out with even greater effect in the study of the new class of the Pteridosperms, or primitive Seed-Plants with Fern-like habit. The extensive knowledge of these early land-plants which we now possess has been mainly based upon the work of Scott, Oliver and Kidston.

Such work, of which these examples do nothing more than suggest the nature and the scope, has been gathered up by Scott into his "Studies in Fossil Botany," a book now in its third edition. It deals primarily with early Vascular Plants, placing them in natural relation to their living correlatives, and giving a picture of early land-vegetation that has never been surpassed in clarity of presentation, combined with accuracy of detail and of reference. This constitutes a real constructive contribution to natural knowledge. It supplies not only a great mass of fact that is positive and new; but it also subjects those facts to a detailed criticism and a philosophical treatment such as Darwin himself would have been among the first to appreciate.

The Hughes Medal is awarded to Admiral of the Fleet Sir Henry Bradwardine Jackson, in recognition of his investigations in Radio-Telegraphy.

His experiments date from 1899, and in the following year apparatus of his design was fitted to certain of H.M. ships, and some of the problems connected with the screening effects of high land were investigated by him. He described his results in a paper read before the Royal Society on May 15, 1902. At a later date, he was responsible for the erection of one of the earliest continuous wave stations in which an arc of 100 kilowatts was used. In 1915, at his suggestion, work on Directional Wireless was begun at the National Physical Laboratory. As Chairman of the Radio Research Board, his wise guidance and his enthusiasm for his subject have in no small measure contributed to the success of the important investigations on the fundamental problems of radio-transmission carried out under the auspices of that Board.