Anniversary Meeting of the Royal Society.

IN his address on the occasion of the anniversary meeting of the Royal Society, held on November 30, the retiring president, Sir Charles Sherrington, referred to the heavy toll which death has taken of the Society since the last anniversary meeting. Brief mention was made of the lives and work of no less than twenty-three fellows and two foreign members who died during the past year. The president also spoke of the retirement of Sir William Hardy, biological secretary of the Society since 1915, on the completion of his statutory term of office.

The substance of the remainder of Sir Charles Sherrington's address is printed below.

The generous bequest of 10,000*l.* received last year from an anonymous donor for the promotion of medical research has this year, on the recommendation of the Tropical Diseases Committee of the Society, been resorted to for prosecuting investigation into the disease kala-azar, endemic in India and the Orient. At the instance of the Society, Major Patton and Dr. Hindle started for Northern China in June last in pursuance of that object. From the same generous and anonymous source a further munificent bequest has been received of something over 28,000*l.*, to be applied on the same terms and under the same condition of anonymity.

The Society, at the request of the Government, again organised, through a committee appointed for the purpose, an exhibition of pure science at the British Empire Exhibition. The catalogue of last year's exhibition was revised, enlarged and republished under the title "Phases of Modern Science." It is estimated that the Pure Science Exhibition was visited this year by at least 120,000 persons.

From the fund accruing to it in 1921 by the bequest of Miss Foulerton, the Society has this year been able, in pursuance of its scheme for advancing natural knowledge by the establishment of research professorships, to institute a further Foulerton Professorship, and the new Foulerton Professor appointed is Prof. A. Vivian Hill. Prof. Hill is already universally known as a most distinguished and fruitful investigator in animal physiology. He has placed the knowledge of muscular contraction upon a new footing. Taking up the problem from the viewpoint which chemical researches had at that time reached, Hill, by his own experiments, and experiments in conjunction with his pupils and others, has carried its study much further, especially in its physical aspects. The technique devised and the lines of analysis pursued have been masterly. He has attained preciser measurements, both of the energy changes and their time relations, and of the mechanical work realisable. Examining under various conditions the several ratios existing between these quantities, he has thrown fresh light upon the intimate mechanism of muscle. Not always has it been entirely welcome news that Prof. Hill has brought us about our muscles; we learn from him that they are sadly viscous machinery, but to that he reconciles us by pointing out compensatory advantages arising from that property. Deeper acquaintance with the principles underlying that function should enable better advantage to be taken of it. Some of Prof. Hill's results already touch practical issues. He is determining decisive factors concerned in the performance and maintenance of physical effort, and is tracing physiological characteristics underlying the skill and endurance of the athlete. Such researches promise information of value in regard to the management of muscular effort and its application on a wholesale scale to industrial labour. They also promise further insight into what may be termed manual skill. Prof. Hill's researches concern, therefore, questions of large practical as well as of theoretical importance.

As regards the biological papers brought before the Society during the past year, one feature which they display is that at this present time the growth of what one may term the experimental biological sciences—physiology, pathology, bacteriology, and pharmacology—is in some measure a convergent growth. Their individual boundaries seem more and more to merge. They are individual in their application rather than in their essential nature, and an advance made by one is of immediate advantage to all. Of any particular paper it would be often difficult, were it desirable, to say under which of these individual sciences it might best be singly classified or catalogued. Nor, under the elastic working of the Society, does that create difficulty; and that again affords evidence of the practical efficiency of our working arrangement.

With certain stages of growth there goes, on the other hand, increasing independence of an individual science. This seems so to-day for psychology viewed under the rubric of experimental biology. That psychology is rapidly growing is evident—not least so from its enhanced and successful application to practical problems lying before it in the sphere of industrial management and conditions of labour. Psychology as a part of experimental biology possesses, of course, recognised ties with the physiology and pathology of the nervous system; but on them it no longer explicitly leans to the extent it did. Its discipline becomes more intrinsically its own. This is, to my mind, well, and of favourable augury for its immediate progress as an experimental science. Concurrently with that tendency in psychology it is noteworthy that physiologists, Prof. Pavlov and his school, with, in Great Britain, Dr. Anrep, are pursuing analyses of complex behaviour of the higher animals under systematic avoidance of all reference, even by implication, to such psychical reactions as accompany that behaviour. Their method applies to animal behaviour in wider ambit than hitherto, the principles of reflex action. To illustrate by one example:—In his admirable Croonian lecture last June, Prof. Magnus described analyses by himself and his colleagues of the pure reflex behaviour of the cat without cerebral hemispheres. He showed how, for example, a moving mouse before the eyes of such a cat attitudinises the whole mechanism of the animal, exciting from it appropriate posture and direction in readiness for the final spring upon its prey. After that, "all the cat has to do is to decide to jump."

To jump or not to jump, that becomes the question. At such a point it is that the work of Pavlov and his school dovetails on to the work of Magnus and his school. Pavlov shows how in the intact animal such a final turning-point in its train of reactive behaviour —for example, "jump" or "not-jump"—can be studied as what is termed a "conditioned reflex"; he shows how that turning-point can be examined as the outcome of a balance between physiological impulsions and restraints, dependent partly on conditions under which the act is called for at the moment, partly on conditions under which it has been called for in the past—that is to say, the physiological history of the act in the individual, the mutual time-relations of the dominant stimuli, and so on. The result is thus treated as a sum of physiological factors, positive and negative, interacting under physiological rules, which can be determined, therefore, as obtaining for the cerebral cortex. In this way is pursued a physiological study of higher nervous functions of the animal brain, without appeal to psychical reactions, of which, indeed, the method affirms nothing and denies nothing. To my thinking this line of attack is a gain both for physiology and for psychology, since psychology and physiology thus tread an essentially common terrain, yet do so each untrammelled by the other and without explicit reference to the eternal psycho-physical problem.

But it would be a far step, and a difficult, and of questionable gain, to carry such divorce of psychology and physiology into the study of fields such, for example, as human speech with what that connotes for reaction in the human brain. There it would seem better, as in Dr. Head's analysis of aphasia, to treat the anatomical, physiological and psychical data together. This seems the better, possibly the only, course of approach to those highest conjoint physiologico-psychological problems than which there can be few scientific problems which are of greater or more special interest to man.

PRESENTATION OF MEDALS.

THE COPLEY MEDAL: PROF. ALBERT EINSTEIN.

The name of Einstein is known to every one through the theory of relativity which he originated in 1905 and extended by a notable generalisation in 1915. Einstein realised that the time and space with which we are so directly acquainted by experience can be no other than the fictitious *local* time and space of the moving system—the motion in this case being that of the earth; we have no means of determining, nor can physical science be concerned with, any absolute reckoning of space and time. After this Einstein was led to the identification of mass with energy—another result of far-reaching importance, which allows us to know the exact amount of the store of energy so tantalisingly hidden within the atom.

There was a feeling that this theory of relativity for uniform motion must be a particular case of something more general; but observational knowledge seemed to oppose a decisive negative to any extension. It was Einstein again who found the way to the generalisation by bringing gravitation into his scheme.

Einstein's general theory of relativity is remarkable alike for the brilliance of conception and the mastery of the mathematical implement required to develop it. The new law of gravitation must be reckoned the first fundamental advance in the subject since the time of Newton. It involves an interaction between gravitation and light, which had indeed been suspected by Newton and almost taken for granted by Laplace, though it dropped out of scientific speculation when the corpuscular theory of light gave way to the undulatory theory. The three crucial astronomical tests of Einstein's theory have all been verified—the motion of perihelion of Mercury, the deflexion of light, and the red-shift of the spectral lines. The last-named proved the most difficult to test, but there is now general agreement that it is present in the solar spectrum. More recently Einstein's theory of gravitation has appealed to astronomers not merely as something which they are asked to test, but as a direct aid to the advancement of astronomical research. Invoked to decide the truth of a suspicion of transcendently high density in the "white dwarf" stars, it has decided that in the companion of Sirius matter is compressed to the almost incredible density of a ton to the cubic inch.

The other direction in which modern physical theory has broken away altogether from the ideas of the nineteenth century is in the quantum theory. Probably no one would claim that he really understands the quantum theory. For such illumination as we do possess we are in great measure indebted to Prof. Einstein. In 1905, almost at the same time as he published his first work on relativity, he put forward the famous law of the photo-electric effect, according to which the energy of a single quantum is employed in separating an electron from an atom and endowing it with kinetic energy. This was, perhaps, the first recognition that the development of the new quantum mechanics was not to be tied to classical mechanics by pictures of quasi-mechanical oscillators or other intermediate conceptions, but was to proceed independently on radically different principles. Noteworthy contributions followed on the theory of ionisation of material, and on the problem of the specific heats of solids. In 1917 Einstein reached another fundamental result—namely, the general equation connecting absorption and emission coefficients of all kinds. This gives deep insight into the origin of Planck's law of radiation, besides providing new formulæ with the widest practical applications.

A ROYAL MEDAL: PROF. WILLIAM HENRY PERKIN.

The science of organic chemistry owes a debt to Prof. Perkin, as instanced in recent years by his monograph on cryptopine and protopine, a record of chemical research rarely equalled in experimental skill and precise reasoning. He has revealed the constitutions of the alkaloids harmine and harmaline; he is nearing the solution of the structures of strychnine and brucine, two alkaloids which have hitherto resisted all attempts to determine their structural formulæ. His work on berberine has left few questions unanswered concerning the constitution of this important substance. He has developed new methods of attack on the chemistry of these natural products, and has faced many problems in structural organic chemistry. He succeeded, during a period of twenty years at the University of Manchester, in building up there a notable school of chemical research. During the past twelve years, in the University of Oxford, he has again organised and developed a similar research school.

A ROYAL MEDAL: PROF. ALBERT CHARLES SEWARD.

Prof. Seward's work has been conspicuous on account of the way in which he has extended and reduced to order our knowledge of the palæobotany of Gondwanaland, especially in India, South and Central Africa, Antarctica and the Falkland Islands. The lower stages of the Gondwana system are characterised by evidences of a glacial climate; and in order more completely to understand the conditions of life that existed, Prof. Seward has visited Greenland and otherwise paid special attention to the effect of climate and light in explaining the rise and luxuriance of the Glossopteris flora in the Southern Hemisphere. In addition to its direct stratigraphical value to geologists, his work has added greatly to our knowledge of plant migration, and especially of the way in which the Glossopteris flora invaded the Northern Hemisphere previously occupied by the groups familiar to us by our Coal Measure plants.

THE DAVY MEDAL: SIR JAMES IRVINE.

The constitution of the simpler sugars (monosaccharoses) was based on a sure foundation by the classical researches of Emil Fischer. Taking up the investigation where Fischer had left it, Sir James has carried the inquiry into the more complex field of the disaccharoses, and by means of new processes, which he has been able to evolve and apply, to assign definite chemical structures to many of these most important natural products. He has also studied the constitutions of the still more complex polysaccharoses, starch and inulin, incidentally gaining an insight into the manner in which the plant forms and utilises these fundamental reserve materials.

THE SYLVESTER MEDAL: PROF. A. N. WHITEHEAD.

Always primarily interested in the foundations of mathematics, it is in the logical analysis of these foundations that Prof. Whitehead's reputation has been won. The great work, "Principia Mathematica," written in collaboration with Bertrand Russell, contains the most systematic and the most profound analysis to which the foundations of the subject have yet been submitted.

From pure mathematics both Prof. Whitehead and his collaborator have turned independently to physics. In his more recent books Whitehead has endeavoured to apply the spirit of "Principia Mathematica," and in particular the principle which he calls "extensive abstraction," in the more complicated and more controversial field of physical existence. That a point, whether in the older physics or the modern physics of space-time, is a class, or a class of classes, of events, that an electron is a systematic correlation of the characters of all events throughout all Nature, are doctrines at which the unsophisticated may be tempted to scoff, but the tendency of modern scientific thought is to the conclusion that, if the world of physics is indeed ultimately capable of any rational interpretation, it must be interpreted in some such way.

THE HUGHES MEDAL: MR. F. E. SMITH.

Mr. Smith began work on the realisation of the fundamental units of electrical measurement in 1902; and such further experiments as have been made since have served only to confirm his results. Other important investigations by Mr. Smith have dealt with the measurement of terrestrial magnetism. The recording magnetometers which he designed have proved of great value, while more recently he constructed, at the suggestion of Sir Arthur Schuster, a horizontal force magnetometer of extreme accuracy. During the War his services to the nation were of great importance, and since the Armistice, as Director of Research at the Admiralty, he has been responsible for a number of valuable investigations.

The Conference on Solid Smokeless Fuel in Sheffield.

A CONFERENCE on solid smokeless fuel was held in the Department of Applied Science at the University of Sheffield on Friday November 20. To point the moral, a tasty fog prevailed throughout the proceedings. The meeting was under the joint auspices of the Society of Chemical Industry, the Institution of Chemical Engineers, the Institution of Gas Engineers and the Midland Institute of Mining Engineers.

The objects of the meeting were to discuss methods of improving the quality of high-temperature coke and the alteration to present equipment and to plant which is required for the purpose. Dr. C. H. Lander contributed a general résumé, and papers were read by Dr. E. W. Smith on "The Qualities Requisite in a Solid Smokeless Fuel for Domestic Use," Prof. R. V. Wheeler on "The Production of Free-burning Solid Smokeless Fuel at High Temperatures," Mr. E. V. Evans on "The Combustibility and Reactivity of Coke," Mr. D. Rider on "Coke Quenching," and Mr. F. M. Birks on "Coke Handling, Screening and Breaking." There were about three hundred present, and the meeting was highly successful. In addition to the papers, investigations under the direction of Prof. Wheeler in the Fuel Department were inspected. There was also a demonstration of ordinary coke burning in open grates and in a closed one.

Low-temperature processes have been discussed with some thoroughness, and consequently the position as to these is fairly well known. Briefly, there is no low-temperature process. Many are the systems on paper, few are on works-sized concrete foundations, none show appreciable returns to the owners. It may be said of all, that none have mastered their engineering difficulties, few know even part of the chemistry of their products, whilst the efforts of all the systems have made no impression on the fuel question. It is clear that a low-temperature process will have to pass through the difficulties attending the evolution of the high-temperature process without any of the advantages attaching to these statutory bodies.

Such being the case, and assuming a demand for a free-burning solid smokeless fuel, can anything be done to render high-temperature coke more combustible and thus suitable for the domestic grate? If this can be done, then remembering that gas-works and coke-ovens together have an output of about 20 million tons of coke and that the domestic consumer consumes more than 40 million tons of coal per annum, the field for expansion is obvious. With regard to this scheme, it may be said that gas-works and coke-ovens do possess carbonisation technique, of a sort, capital has certainly been expended on them, they are old and tried servants.

If this were all, and provided high-temperature processes provide a free-burning fuel, then coke-ovens and gas-works have it. But it has yet to be proved that they can and will provide a coke that is easy to ignite, easy to keep alight, free from ash, low in moisture, clean and free from dust. But assuming that all this could be done and assuming that the combined output went to the domestic consumer—a very far-fetched assumption—only half of the domestic coal consumption would be displaced. A doubling of plant cannot reasonably be visualised within the next ten years.

Consequently there is still plenty of scope for low-temperature carbonisation, if the processes could be put on a commercial footing. Considerable interest was taken in low-temperature processes owing to the probable oil obtainable under these conditions. But a good deal more oil seems probable by the use of hydrogenation methods, the one process being yet as problematical as the other. Little is known of the composition of the liquid products of low-temperature processes. It is for this reason that low-temperature processes are desirable. It may well be that new classes of compounds may be brought to light with new properties and new uses. New drugs, new dyes, may be obtained, new substances with yet unknown benefit to mankind. Whatever the financial results from low temperature, the probable scientific results should be known.

The technical contributions to the subjects of the conference may be summed up in a short space, as was done by Prof. Wheeler. Fine grinding followed by blending, and the mixture of coals thus produced to be carbonised in narrow ovens under high-tempera-