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CONTENTS.

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The Norman Lockyer Memorial Lecture.

ON Monday last, the first Norman Lockyer lecture, under the auspices of the British Science Guild, was delivered by Sir Oliver Lodge in the hall of the Goldsmiths' Company, his subject being "The Link between Matter and Matter." It is fitting that the Guild should thus honour the memory of the man who, more than any other, was responsible for its formation, and no happier choice for the first lecturer could have been made than that of Sir Oliver Lodge. Lockyer was essentially a man of wide vision; his mind sought instinctively for generalisations. A fact was to him only of importance in so far as it was related to the general principles which underlie all facts. He was not content with a laboratory; he would have an observatory. He was not content even with an observatory; he would have a theory which would embrace all the revelations of the laboratory and the observatory and bind the whole physical universe into a single entity. The key to Lockyer's scientific career is to be found in this overpowering tendency to generalise, and no one who is not to some extent under the dominance of the same tendency can rightly interpret the apparently erratic course which his genius led him to pursue.

Sir Oliver spoke briefly of his personal association with Lockyer, which began so far back as the year 1873 when Lockyer was working in rooms generously placed at his disposal by Frankland in the new School of Science at South Kensington. He then referred to the discovery of helium, which, for twenty-six years after Lockyer had found it in the sun, remained a mere spectroscopic curiosity, but which, since Ramsay's isolation of the element from cleveite, has been instrumental in bringing about some of the most important advances of modern physics and astronomy. "Thus it is," he said, "that little discoveries, at first apparently isolated and without obvious meaning, turn out not to be little at all, but fundamentally important, being systematised by future workers until they furnish the clue to a magnificent series of discoveries about the constitution of matter." Lockyer, however, did not wait for future workers. He had his ideas about the constitution of matter long before helium was generally admitted to exist even in the sun, and he was fundamentally right.

Sir Oliver went on to speak of the human aspect of Lockyer's work. "Lockyer's work and speculations were never really remote from humanity; he kept before himself continuously, and eloquently urged upon others, the necessary bearing of all scientific discovery on human and social progress." It was the conviction that science was the chief factor in the material progress

of nations that led him to found the British Science Guild, and to choose for the subject of his presidential address to the British Association in 1903, not the development of his own individual researches, wide as they were, but the importance of science to national progress—"The Influence of Brain-Power on History," as he called it. The same conviction was an important factor in his determination, in the year 1869, to inaugurate a new journal of science—NATURE—in order that the progress of science might be followed by all, and not only by those actively engaged in scientific pursuits.

Coming to the subject indicated by the title of his address, Sir Oliver defined "the link between matter and matter" as "the impenetrable uniting ingredient, or cosmic unit, which connects the otherwise dissociated or dissevered atoms of matter, and enables them to act on each other even from a distance. This ingredient . . . is essentially 'radiation,' that is to say, a disturbance in the ether, or in space, which travels at one absolute velocity, which journeys without loss or dissipation of energy, and produces even at enormous distances its singular and striking results." This link between matter and matter is required to explain gravitation and the propagation and chemical action of light. One of its surprising characteristics is the power—commonly known as photo-electric action—"of unlocking the atom and enabling it to fling away one of its constituent electrons." Sir Oliver raised the question "whether the energy of . . . photo-electric emission is applied instantaneously by the radiation stimulus, or whether it is gradually accumulated in the atom up to some critical point, when it can wait till radiation of the right frequency pulls the trigger." He is of the opinion that there is something to be said for the second alternative, and that the discontinuity of the quantum might be found in the discontinuity of atomic construction rather than in "the otherwise demonstrated continuous activity or continuity of etheric radiation."

Radio-activity is another example of an apparently spontaneous process, but this also might really be due to the impact of radiation of critical frequency. "I believe that some people, I for one, are beginning to suspect that all atomic changes are due to radiation. And I would even venture to surmise that this etheric mode of inter-communication, the transmission of waves from one piece of matter to another, has more influence on ordinary, the most ordinary—even mechanical—processes than we are yet prepared to admit." The pressure of light, for example, has lately been found in certain circumstances to be very large and of cosmic importance—for instance, in the interiors of stars. Sir Oliver was not prepared to say whether or not it ought to be taken into account in the intimate structure of atoms. The stability of Bohr's atomic orbits was a fact which had not yet been accounted for, and our aim should be to explain this and other facts on dynamical principles—"perhaps not the ordinary dynamics but etherial dynamics."

Some attempt has already been made to assimilate matter with radiation "by the very unlikely path of thermodynamics." Radiation has been treated almost like a gas, and results have been arrived at which, though they have not yet been rationally accounted for, are nevertheless true. Thus we can speak of the "temperature" of space or of radiation, and we form the conception of matter in thermodynamic equilibrium with radiation. Developing the conceptions thus generated we arrive at the quantum. "If the energy could be absorbed or emitted continuously, all the energy of matter would go into the ether, and the universe would fade away. The effect of discontinuous emission and absorption saves the universe from destruction, and makes the planet possible."

These are all fundamental considerations, and it is characteristic not only of Sir Oliver Lodge but also, to some extent, of the age in which we live, that they should be so. We are deeply involved now in problems which, fifty years ago, could not be said to have existed: they are expressible only in terms of conceptions which had not then been formed. We see now no clear dividing lines between mechanics, physics, chemistry, geology, and astronomy. None of these departments of science is complete without the others, and it is becoming increasingly clear that the physicist can no longer exclude even the principles of metaphysics from his field of inquiry. Our age is prospective; it builds the unity of the cosmos. But in Lockyer's day things were far otherwise. The progress of that time, very real though it was, lay mainly in the discovery of isolated facts, which were interpreted in the light of old and long-established principles. "Our age is retrospective," wrote Emerson; "it builds the sepulchres of the fathers."

Into this age, with its rigid formulation of the fundamental bases of a number of discrete sciences, Lockyer came with his iconoclastic, unifying mind. He was as one born out of due time into a generation unprepared for his message. Much of his work which now suggests itself as so obvious a line of research to follow, and in which the mistakes present themselves so clearly to our view, must be seen against the background of the prevailing ideas of the time in order to be estimated at its true value. Although Kirchhoff had shown in 1859 how the solar spectrum was to be interpreted by laboratory experiments, no one before Lockyer (in 1869) combined the work of the observatory with that of the laboratory.

Because the atom was held to be indivisible, no one but Lockyer believed that physical conditions could influence the spectrum of an element. Lockyer at once cut across current ideas by proving the contrary in the laboratory and pointing to the spectra of the sun and stars for further evidence, not hesitating for a moment even to declare the atoms to be dissociated in order to explain his observations. Although in 1859 Darwin had finally established the conception of evolution in biology, no one before Lockyer spoke of the evolution of the chemical elements and of the stellar universe. It is easy, with our wider knowledge, to point to his mistakes in the formulation of his conceptions, and to the "obstinacy" with which he held to details now finally discredited. It is not so easy to estimate how great an influence his courageous individualism and breadth of vision have had in preparing the way for the relative enlightenment of our own day.

"All Lockyer's information," said Sir Oliver, "was derived from a study of radiation. The chromosphere, the partitioning of the solar atmosphere into regions, and the observation of red flames without an eclipse—represent the broodings of his genius on the information brought him by tremors or quivers in the ether of space." That is true, but Lockyer did not explicitly concern himself with radiation at all. To him it was not the link which bound matter to matter; it was the instrument which told him what he wanted to know about matter itself. Of the two great physical entities (or must we now call them one?) matter and energy, he confined his attention to matter alone. Perhaps with his mental and physical equipment he could have done no other, yet it appears that it is to the ether and radiation that we must now look for the completion of Lockyer's ideas. His two great generalisations—the dissociation hypothesis and the meteoritic hypothesis—were in error mainly in so far as they ignored the radiation factor. He saw that atoms might be dissociated, but he did not conceive that absorption of radiation was the agency through which the dissociation was brought about, and herein lies the relative barrenness of his view when compared with its modern equivalent, ionisation. He saw also that stars with similar spectra might be very different in physical state, but he did not imagine that the difference was related to the pressure of radiation and the generation of etherial energy from mass, which is the source of the fruitfulness of our latest conceptions. He could not, of course, have foreseen these things. Essential as they were to the completion of the ideas he held, he had no data from which they could have been suspected; yet, single-handed and faced by many obstacles, he came nearer to the conceptions which we now hold than any of his contemporaries. H. D.

A History of Mathematics.

History of Mathematics. By David Eugene Smith. Vol. 2: *Special Topics of Elementary Mathematics.* Pp. xii+725. (Boston, New York and London: Ginn and Co., 1925.) 21*s.* net.

THE two volumes of this history (the first of which was noticed in NATURE of November 15, 1924) deal with the subject from two different aspects. The first volume, described as a "General Survey," is devoted to showing "the growth of mathematics by chronological periods with due consideration to racial achievements," and to "relating the development of the science to the development of the race, revealing the science as a great stream rather than a static mass, and emphasising the human element." Details of the lives of mathematicians, their dates, and their relation to contemporary history accordingly find their place in the first volume, which in this respect follows the plan adopted by most of the writers of histories of mathematics, both English and foreign. The first volume is thus comparable with such useful and popular histories as those of Rouse Ball, Cajori, Günther-Wieleitner, and others. It contains, however, features of additional interest in the many portraits of mathematicians, pictures of mathematical instruments and illustrations of their use, facsimiles of pages from printed books and manuscripts, which are given in their proper places.

The second volume now before us, called the "Topical Survey," deals with special topics of elementary mathematics. (We may perhaps observe incidentally that, as the sub-title of each volume limits its scope to elementary mathematics, it might have been better if, with the view of avoiding misapprehension, the whole work had been called a "History of Elementary Mathematics," rather than a "History of Mathematics" simply.) That is to say, the history is here arranged according to subjects. As the author remarks in the preface:

"The teacher of arithmetic will now see, in three or four chapters, a kind of moving picture of the growth of his subject,—how the world has counted, how it has performed the numerical operations, and what have been the leading lines of applications in which it has been interested. In geometry he will see how the subject arose, what intellectual needs established it so firmly, what influences led to its growth in various directions, and what human interest there is in certain of the great basal propositions. In algebra he will see, partly by means of facsimiles, how the symbolism has grown, how the equation looked three thousand years ago, the way its method of expression has changed from age to age, and how the science has so adjusted itself to world needs as now to be a necessity for the average citizen instead of a mental luxury for the selected few."

Here Prof. Smith has no predecessors in English and only one comparable one in German, so that the work was well worth undertaking. Of his German predecessor's work, the "Geschichte der Elementar-Mathematik in systematischer Darstellung mit besonderer Berücksichtigung der Fachwörter," by Dr. Johannes Tropfke, Prof. Smith says truly that it is the best history of elementary mathematics. The first edition of 1902–3 was in two volumes of 322 and 496 large pages respectively; but the new edition, in seven volumes or parts issued between 1921 and 1924, is greatly enlarged and improved, and runs to a total of 1268 pages.

With such a model before him, Prof. Smith's difficulty must have been to compress his material, with the addition of illustrations, facsimiles, etc., into a volume of 725 pages of smaller size. It would have been comparatively easy to write a smaller volume containing only the most salient details, served up to suit the palate of the ordinary non-expert reader. But Prof. Smith's object is different; he wishes to supply the professional teacher of mathematics with all that he needs in order to be able to teach his subject with a proper sense of perspective derived from a real knowledge of the manner of its evolution. The difficulty is to give just sufficient details and no more, and not to leave out anything which is essential to make the subject comprehensible. In the general compression which Prof. Smith has found necessary, some topics suffer unduly. Logarithms, for example, are disposed of in the all too short space of ten pages. We could have wished to have a fuller statement of what Napier's logarithms exactly were, how evolved, and how related to the so-called Napierian or hyperbolic logarithms and also to Briggs's system. On the other hand, there is a very useful chapter on the history of the calculus as a separate subject.

Every effort has been made to produce a readable as well as a comprehensive book. A long chapter is devoted to elementary problems (including mathematical recreations, commercial problems, magic squares, and the like); another to measure (weight, length, capacity, time, etc.). In the second volume, as in the first, there is a wealth of interesting illustrations, facsimiles, etc., and a valuable collection of references in the notes. The labour involved in the whole work must have been prodigious, and we can only wish for it the success which it deserves.

It is inevitable that in a book containing such masses of detail there should be mistakes which have escaped detection, some being doubtless mere printer's errors. On p. 287, Pamphila, a historical writer of the first century A.D., is quoted as Pamphilius. On p. 291, "Lucian (second century), the scholiast to the Clouds of Aristophanes" should be "Lucian (second century) and the scholiast, etc." On p. 304 it is conveyed that Hippocrates of Chios showed how to square one type of lune only, whereas he actually squared three out of the only five types of lune which can be squared by means of the geometry of the straight line and circle. On p. 307 (note) Rose's edition of Vitruvius is cited as giving $4\frac{1}{2}$ ft. as the diameter of a wheel of circumference $12\frac{1}{2}$ ft.: this should apparently be $4\frac{1}{6}$ ft., making the value of π assumed by Vitruvius to be 3 and not "less than 3." On p. 313, Archytas is said to have solved the problem of the two mean proportionals by means of "two cylindric sections"; the surfaces actually employed by Archytas were three, namely, a right cone, a cylinder, and a tore or anchor-ring with inner diameter nil. ἔκθεσις (p. 496) is said to be a "selling out," where "setting out" is what is meant. The strangest case is that in note 1 on p. 615 referring to Ptolemy's division of the circumference of a circle into 360 parts and of the diameter into 120 parts. The note states that the parts were "τρήματα (trēmata, literally 'holes' and hence the holes, or pips, of dice)." We confess to being baffled as to the source of this statement; the word actually used by Ptolemy is τμήματα, which simply means "segments," *i.e.* the parts into which a line is "cut" (τέμνω).

The Ravages of Sea-Water.

Department of Scientific and Industrial Research. Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea-Water: Fifth (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by P. M. Crosthwaite and Gilbert R. Redgrave. Pp. vii+65+8 plates. (London: H.M. Stationery Office, 1925.) 3*s.* 6*d.* net.

THE Committee of the Institution of Civil Engineers which has been investigating the deterioration of structures of timber, metal, and concrete in sea-water since 1916, with the assistance of grants from the Department of Scientific and Industrial Research, has prepared a fifth interim report which has recently been published. It consists of a brief review by the Committee of ten reports included in the publication, together with the reports themselves and a number of abstracts received from correspondents.

During the past year further examinations have been made of the steel and other specimens exposed for corrosion tests at Auckland, Colombo, Halifax, Nova Scotia, and Plymouth, and detailed reports of the present condition of the steel bars, accompanied in some cases by photographs, have been received from the engineers in charge. A comparative statement has been drawn

up by Mr. Carothers for Mr. Savile, the Civil Engineer-in-Chief of the Admiralty, which presents in small compass the chief features of these periodical inspections in a form convenient for study. It is pointed out in certain of the reports that, owing to the constantly increasing growth of marine organisms and the heavy incrustation which is now attached to some of the frames, it is becoming exceedingly difficult at the present time to form a correct judgment of the condition of the metal work and bars; nor will it be possible in these cases to do so until they are taken out for final examination and measurement. Dr. Newton Friend's researches on preservative coatings for ferrous metals have been continued. The specimens tested are at Southampton, under the charge of Mr. Wentworth Shields.

Various experiments bearing on the protection of timber are still being prosecuted, while a further number of specimens impregnated with different poisons have been exposed during the year at Lowestoft; and certain timbers injected with creosote and D.M. (an arsenical organic compound) have been sent to Colombo, as the ravages of the Teredo have been found to be very severe in that port. Prof. Berger deals in his report with the changes made in the exposure of the specimens at Lowestoft. Specimens of wood tested at Plymouth have been more resistant than those at Lowestoft, and the experience there indicates that remarkable protection was secured by 2·2 per cent. of carbazole. A full account is given of the mechanical tests on sixteen varieties of Colonial timbers specially procured for this purpose from Australia, New Zealand, and Ceylon. An abstract has been prepared by Mr. Hamer reporting on the specimens of local timbers under exposure at Auckland. It would appear that none of the preservatives employed has altogether prevented the attacks of marine borers, though in some instances the specimens have shown considerable powers of resistance.

It was stated in the previous annual report that in consequence of defects found in a concrete building erected by the Admiralty and exposed to the action of sea-water, a thorough investigation of all similar structures controlled by the Admiralty had been agreed upon. The results of this inquiry are set forth in the present report. It would appear that in some cases considerable injury was found in the upper portions of certain of the jetties, especially on the underside of deck beams. In order to remedy these defects and to avoid similar imperfections in future, certain precautions are recommended for executing works in reinforced concrete that are to be exposed in the sea or in the neighbourhood of high-water mark. A paper on the disintegration of cement in sea-water, contributed to the American Society of Civil Engineers by Messrs. Attwood and Johnson, forms the subject of an abstract in the present volume. Dr. Ternent Cooke, who had been requested by the Harbour Board of South Australia to examine certain samples of decayed concrete prepared for a partially constructed breakwater, recently published an article on the subject, of which an abstract has been prepared for the volume. He states that it would appear from the chemical examination that organic matter from beds of decaying seaweed permeated the outer layers of the concrete and caused disintegration. The lime was then leached out and the superficial layers of the concrete were gradually decomposed.

The Department of Scientific and Industrial Research having intimated that its grants in future must be conditional on half of the expenditure being hereafter met from other sources, a number of Port and Dock Authorities were invited to contribute to a fund for five years. A very gratifying response was made to this appeal and a sum of 738*l.* was received during the past year. A considerable portion of this total has been promised for a series of years.

Huygens' Discovery of Saturn's Ring.

Œuvres complètes de Christiaan Huygens. Publiées par la Société Hollandaise des Sciences. Tome Quinzième: Observations astronomiques, système de Saturne, travaux astronomiques, 1658–1666. Pp. iv+619. (La Haye: Martinus Nijhoff, 1925.) n.p.

AFTER an interval of nearly five years (vol. 14 was reviewed in NATURE, vol. 107, p. 4) another instalment of this magnificent edition of the works of Huygens has made its appearance. It contains his astronomical observations and his publications on Saturn. Unfortunately the manuscripts recording the observations (1657–1694) are far from being complete. The chief source is a MS. called "K," in which Huygens evidently intended to copy all his observations from the originals. But in some cases the original records are not now extant, while there are signs that some of the records in still existing MSS., which have been copied into "K," are not themselves originals. In particular a "parvus libellus" containing observations earlier than December 1657 is lost; but the letters of Huygens and his book on Saturn have enabled the editors to draw up a supplementary list for the years 1655–1690. There were, however, long periods of almost complete inactivity as regards observing, due probably to ill-health or other work, although remarks found here and there in his letters show that Huygens had not very much sympathy with enthusiastic observers like Hevelius or Cassini. During his long residence in Paris, he observed occasionally at the king's library or at the observatory.

The telescope with which Huygens found the Saturnian satellite, now known as Titan, and the true explanation of the strange appearance of Saturn, had a focal length of about 11 feet, an object glass of 2·7 inches aperture (still preserved at Utrecht), and magnified 50 times. It was only in use for about a year, and was then superseded by another of about 23 feet f.l. and 4 inch o.g., made by Huygens and his brother Constantin, while others of about the same size were also made and used. In 1682, after his final return from Paris, Huygens made and tried to work with enormously long telescopes, but like everybody else found them too difficult to manage. Most of the glasses were kept together until 1754, when they were sold by auction and scattered. Seventeen of them can still be identified, of which three belong to the Royal Society, while the rest are at Leyden or Utrecht; but only five were made by Christian Huygens, the rest by his brother.

The observations printed in this volume fill 109 pages, and are illustrated by facsimile copies of Huygens' sketches. Nearly all of them are studies of the planets and their surface markings, and naturally most of them refer to Saturn. So early as 1659, Huygens considered it very probable that Mars rotated in about 24 hours. How some of his sketches have turned out to be very valuable for the exact determination of the period of rotation of Mars, is well known. He made attempts to measure the diameters of the planets in various ways, by comparing them with the breadth of a lamella at the focus or by an arrangement similar to W. Herschel's lamp-micrometer. But his search for satellites to the planets turned out to be of more value, as on March 25, 1655, he discovered a satellite of Saturn (Titan), the first satellite found since Galileo announced that Jupiter is accompanied by four satellites. The discovery was published in a small pamphlet of a few pages ("De Saturni Luna observatio nova"), which has now become so extremely rare (if it exists anywhere) that the editors have had to reprint it from the old edition of Huygens' "Opera Varia" (1724).

The fact that the satellite moved in a plane passing through the mysterious "handles" of Saturn, confirmed Huygens in the belief which he reached in the winter of 1655–1656, that these strange and variable appearances were due to a very thin, broad, plane ring surrounding the planet but detached from it. After the manner of those days, he announced his discovery in an anagram at the end of the pamphlet on the satellite, "in order that if any one thinks he has found the same thing, he will have time to announce it, so that it may not be said that he has borrowed it from us or we from him." The challenge was accepted by three people: by Hevelius, who thought that Saturn was a spheroid to the ends of which were attached two handles; by Roberval, who assumed the planet to be a sphere surrounded by vapour except at the poles; by Hodierna, who believed Saturn to be shaped like an egg, with two non-luminous spots near the ends of the longest axis. In his book "Systema Saturnium" (1659) Huygens did not find it difficult to show how impossible it was to account for the varied appearances of Saturn by any of these hypotheses, while he showed in detail how well his own theory agreed with all the observations made during the fifty years elapsed since the invention of the telescope. But a determined attack on the theory was made in 1660 by Eustachio Divini, whose little book on the subject was known to be inspired by the Jesuit Honorato Fabri. As it was difficult of access to people in the Netherlands, Huygens reprinted the whole of Divini's attack in the reply which he published in the same year; and some years after he had the satisfaction to learn that Fabri had recognised the truth of the ring-theory.

In addition to the above-mentioned writings, the volume under review contains a number of appendices to them, extracted from Huygens' notebooks, and dealing with various minor astronomical problems. Among these may be mentioned an approximate determination of the orbit of a satellite of Saturn from two observations, occasioned by Cassini's discovery of Iapetus and Rhea.

By the many hitherto unpublished memoranda, by the valuable, detailed introductions, by the French translations of the texts of the books published by Huygens himself (no doubt welcome to many readers), and last, but not least, by the beautiful paper and print, this edition forms a monument worthy of the great Dutch astronomer. J. L. E. D.

Guy Patin and his Times.

Guy Patin and the Medical Profession in Paris in the XVIIth Century. By Dr. Francis R. Packard. Pp. xxii + 334 + 10 plates. (London: Oxford University Press, 1925.) 18*s.* net.

THE present volume by Dr. Francis Packard, whose "Life and Times of Ambroise Paré (1510–1590)" was noticed in our columns on March 3, 1923, p. 281, has been reprinted with additions from the "Annals of Medical History," of which he is the editor. The work is divided into nine chapters, commencing with a historical foreword which contains an account of contemporary politics, the later chapters dealing with Patin's education, his home life and literary interests, his opposition to cinchona and antimony, and his relations to the surgeons, barber surgeons and apothecaries. A special chapter is devoted to a description

of the Paris medical faculty in which Patin's life interest was centred. "No praise," says Dr. Packard, "was too fulsome for those who furthered its cause and no abuse too savage for those who dared to attack it." Of particular interest are the pages concerned with Patin's relations to Molière, his controversy with Théophile Renaudot, the gazetteer and quack, and his quarrel with the physicians of Montpellier.

Guy Patin was born in 1601 at a village in Picardy, graduated in medicine at Paris in 1627, was elected dean of the faculty of medicine in 1650, and died in 1672, so that his active life covered the greater part of the seventeenth century. The historic value of his letters, on which his fame rests, has been impugned by such critics as Bayle and Voltaire, but Dr. Packard rightly maintains that as pictures of the life of the day they are invaluable. It must be remembered that they were never intended for publication.

Patin was an upholder of the old Greek medicine as represented by Hippocrates and Galen, and a bitter opponent of the new chemical remedies which had been introduced by Basil Valentine, Paracelsus, van Helmont, De Mayerne, and others. Like most of his contemporaries, Patin was firmly convinced of the value of copious bloodletting and free purgation in diseases of all kinds. "There is no remedy in the world," he said, "which works as many miracles as bleeding."

Dr. Packard points out that though Patin never became in the strict sense of the term one of the physicians to the Court, his letters are full of references to medical matters connected with the Court and of tales of physicians honoured by the king.

Patin's scholarly tendencies are illustrated not only by his interest in the history and literature of his profession, but also by his lively concern in general literature, as shown by the allusions in his letters to new editions of Vossius, Lipsius, Casaubon, Scaliger, Grotius, and so on.

The work is illustrated by contemporary portraits of Guy Patin, his son Charles Patin, professor of medicine at Padua, of whom Voltaire said that "his works were read by scholars, while his father's letters were read by the idle," Cardinal de Richelieu, Cardinal Mazarin, Jean Riolan the Younger, Gabriel Naudé, the librarian of Cardinal Mazarin and author of a well-known book on the history of magic, and François Guénault, physician to Louis XIII. and, owing to his advocacy of antimony, one of the men whom Patin most detested. In the bibliography which is appended, special attention is given to the articles by Chereau, and the editions of the letters published by Pierre Pic and Paul Triaire.

Dr. Packard's book is a scholarly achievement, written in an attractive style, and gives an admirable picture of French medicine in the seventeenth century.

Our Bookshelf.

Die Süsswasserflora Deutschlands, Österreichs und der Schweiz. Herausgegeben von Prof. Dr. A. Pascher. (Jena: Gustav Fischer, 1913–1925.)

THE series of volumes comprised in Pascher's "Süsswasserflora" first began to appear in 1913 and is now rapidly approaching completion. Those so far published deal with the Flagellatæ, the Isokontæ (apart from Volvocales and Desmidiaceæ), the Bacillariales, Heterokontæ, Phæophyceæ, Rhodophyceæ, Charales, and Bryophyta. The work deserves to be more widely known among those interested in the study of freshwater Algæ, for since each volume is compiled by a specialist on the particular group, it usually embodies the results of critical work and is strictly up-to-date. It is far more than a popular summary of what is known. At the same time, keys for the determination of genera and species are numerous and as a rule carefully prepared, so that even a relative novice is put in the position of being able to identify common forms both speedily and easily.

As with all such collective publications, the treatment is somewhat unequal. Perhaps the most disappointing was the volume on Zygnemales by Borge, which, both as regards text and illustration, was altogether too scanty. On the whole, however, one can have nothing but praise for the care that has been bestowed upon the text, whilst the majority of the volumes are excellently illustrated, nearly every species being figured. Of particular value are the early volumes on Flagellatæ by Pascher and that dealing with Heterokontæ and the Red and Brown Algæ just published, which contain a mass of information here collected together for the first time.

Although ostensibly a freshwater flora of Central Europe, several of the algal groups are treated almost *in extenso*, all the genera and a great majority of the species being mentioned, even such as are at present only known from regions quite remote from Central Europe. In this respect, however, there appears to be no uniform plan, and the result is somewhat incongruous. Especially in some of the volumes more care might have been expended on the preparation of the index, which is of special importance in a taxonomic work. The price of the different volumes (averaging about four shillings) is very reasonable.

As the above was passing through the press, a thick volume on Cyanophyceæ by Geitler has been published. Algologists will welcome the detailed systematic treatment of this difficult group. The only defect is a tendency to multiply genera rather unnecessarily, whilst the introductory matter is based on a somewhat one-sided consideration of the literature.

F. E. FRITCH.

Biology and Human Life. By Benjamin C. Gruenberg. Pp. xiv + 592 + xi. (Boston, New York and London: Ginn and Co., 1925.) 7*s.* 6*d.* net.

IN Great Britain, biology is taught in schools, usually only in secondary schools, mainly from the examination point of view, to pupils who intend to pursue the subject further at a university or are preparing for a medical career. The majority of pupils, and particularly those in elementary schools, receive little if any

instruction in biology. The author of this book is convinced of the importance of a knowledge of biology to every member of the community, and no biologist at least would controvert his statement that "boys and girls who look forward to an early entrance upon occupational activities and the responsibilities of earning and spending money have as much need for the study of biology as have those who plan to go to college or the professional schools." This book is designed to meet this pressing need, and, if somewhat novel in its treatment of the subject, is so planned as to make it a living and vital one by special emphasis on the applications of biology to human affairs at all points.

After a brief introduction, all too brief we fear, to general biology, the main part of the book is divided into two sections headed the Biology of Health and the Biology of Wealth. In the first of these sections the author gives what is practically an introduction to human physiology, public health, hygiene, and the biology of disease, treating man first as an individual and then as a member of the community. The second section is a short survey of the field of economic zoology and botany with special reference to those animals and plants which are of importance to the general economics of the human race. The book is written in an almost breezy style, and the interest of both pupil and teacher constantly stimulated by questions designed to emphasise or enlarge on the special points of each chapter. The general plan of the book can be recommended as a good one for use by teachers in elementary schools, for, presented in this way, the pupil cannot fail to realise the fundamental importance of biology to himself personally and individually, and consequently to every member of the community in which he lives.

Geology in its Relation to Landscape. By Prof. Junius Henderson. Pp. vii + 152 + 30 plates. (Boston, Mass.: The Stratford Co., 1925.) 2.50 dollars.

PROF. HENDERSON has enriched the literature of a picturesque subject by his attractive and almost romantic treatment. His book is informal, and though it will teach the geologist nothing new, it is of the inspiring kind that, falling into the right hands, will make new geologists. Any one of ordinary education, and an interest in scenery, will be able to follow these pages with ease and pleasure. The book is beautifully printed and illustrated, and the author amplifies his own literary gifts with numerous poetical quotations.

After five introductory chapters dealing with geological processes and structures, there follow longer chapters devoted in turn to rivers, waterfalls, lakes, the oceans, glaciers, mountains, and volcanoes. The final chapters are concerned with geology in relation to vegetation, animal life and civilisation, and these will perhaps be of most interest to readers already familiar with the physical evolution of landscape, for they show, with many a light and happy touch, how geological factors have controlled man's environment, and how they have been turned to his service. The book may be warmly recommended, in particular to teachers and students of geography, and in general to the wider public who find in scenery one of the leading attractions of a holiday.

The National Physical Laboratory. Collected Researches. Vol. 18, 1924. Pp. iv + 456. (London: H.M. Stationery Office, 1925.) 17*s.* 6*d.* net.

THIS volume is a reprint of twenty-one electrical papers which have issued from the National Physical Laboratory and been published in the proceedings of scientific societies or in the technical press during the years 1919–24. About half of them deal with problems which have arisen in some branch of the electrical industry, and the other half with improvements in the methods and instruments used in standard measurements. In the first category are investigations on the magnetic properties of silicon irons, the behaviour of intervalve transformers, the electrical resistance of overlapping joints in conductors, the rating of cables for intermittent loads, the improvement of carbons for searchlights, and the use of a cube whitened inside in the photometry of electric lights. In the latter group are investigations of new methods of calculating self and mutual inductances of coils, on the effects of eddy currents on measuring instruments, on the best methods of measuring the intensities of radio signals, on the properties of the triode valve, on the measurement of the earth's field by an electrical method, and on an electrostatic voltmeter for accurate measurement. Many of these investigations have been carried out for Government Departments the consent of which has had to be obtained before the results could be made public. The whole add to the credit of the Laboratory and its staff, and make one wonder how the electrical industry managed to advance at all in the days before the National Physical Laboratory came into existence.

The Nature of Enzyme Action. By Sir W. M. Bayliss. (Monographs on Biochemistry.) Fifth edition. Pp. viii + 200. (London: Longmans, Green and Co., 1925.) 9*s.* net.

THE fact that the monograph has reached its fifth edition shows that it occupies a definite place in modern biochemical literature, and it seems almost superfluous to state that it presents an excellent account of our knowledge of the nature of enzyme action. Its very excellence, however, makes us realise the loss which science has suffered in the death of Sir William Bayliss. The manuscript was brought up-to-date by the author before he was overtaken by his illness, and has been prepared for the press by his son, without any attempt to include the work of the last two years. The earlier chapters consider the physical and chemical properties of enzymes and their methods of preparation and investigation, the central connecting thread being that enzymes act in the same way as catalysts of known chemical constitution. After a chapter on the velocity of reaction, the author passes on to consider their mode of action, and shows himself to be an advocate of the view that enzymes act by adsorption of their substrates, so that the reacting substances are brought into a state favourable for the rapid progress of the reaction; the arguments for this view are fully and clearly presented. In succeeding chapters, co-enzymes, antienzymes, and zymogens are considered, and a short account is given of oxidation processes: doubt is thrown upon the real existence of a number of so-called "antienzymes." The work is concluded by an extensive bibliography.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Blindness of Cave-Animals.

PROF. MACBRIDE has contributed a chapter to a volume of essays published by Messrs. Blackie and Son which professes to treat of evolution "in the light of modern knowledge." Prof. MacBride's chapter is headed "Zoology" and sets forth a statement of older as well as novel observations and experiments made by other workers which lead him to conclude that the evolution of organic form in plants and animals has been caused—mainly if not entirely—by "use and disuse," as held by Lamarck—not in the light of modern knowledge—but more than one hundred years ago.

Prof. MacBride cites the experiments and records of others. Consequently his paper has not the significance it would have, were he relating his own researches. I submit that judgment should be suspended with regard to Kammerer's results as to salamanders and toads until they have been repeated: for as Mr. J. B. S. Haldane points out (in his valuable article, "The Causes of Evolution," in the Annual of the Rationalist Press Association, 1926, p. 56), in the majority of similar cases brought forward in the past, critical repetition has proved fatal to the conclusions drawn from them.

It is especially in regard to the reduction of the eyes of certain cave-dwelling animals to vestiges, a process accepted by Prof. MacBride (as by Darwin in 1859) as due to the "disuse" of these organs consequent upon the absence of light from their environment, that I wish to make some criticism. Certain cave-animals are known, as he states, to be allied closely to normal species which live outside the caves at no great distance. The cave species living in the dark are either devoid of eyes altogether or have their eyes reduced to vestiges. Darwin, as stated by Prof. MacBride, assumed that the eyes of animals living in darkness failed to grow to their proper size owing to lack of use, and that this diminution in size was heritable—in short, that the effects of disuse were inherited. Without more ado, Prof. MacBride accepts this conclusion, declaring that other explanations of this phenomenon, which he does not cite with one exception, were "amazing." The exception is Weismann's theory of "panmixia," which he discusses and rejects.

I wish now to point out two important defects in "the disuse theory" of blind cave-animals as stated by Prof. MacBride, which seem to me to render his position untenable.

(1) We have no record of experimental work showing that the eyes of animals bred in the dark are reduced in size as compared with the eyes of the same species bred in normal conditions. Nor have we any records of the exact changes, if any, in size or character of the various parts of the eye when an individual animal or a series of successive generations has been born and reared in the dark as an experiment. No such experiment has been recorded in regard to any one species of vertebrate, nor in regard to any insect, crustacean, mollusc, or jelly-fish—in each of which peculiar and elaborately constructed eyes are found. Nor, again, do we possess any extensive and well-considered account of "congenital defects" of the visual organs in any one animal or in representative animals from different classes to which we can refer for comparison, except in the records of human pathology. Again, our knowledge is very defective, especially as to microscopic details, in regard to the actual condition of the eye in blind cave-animals, as also in regard to that of the eye of blind deep-sea fishes and crustacea. Darwin seems to have regarded diminution in the *size* of the eye as the important matter; but such things as the condition of the retina and of the lens-like transparent structures, and again of focussing and light-screening parts of the eye, must each have its own decisive importance.

The absence of experiment in the matter has recently to some extent been removed by the American observer Payne (quoted by Mr. J. B. S. Haldane, *loc. cit.*). "Mr. Payne bred Drosophila, a fly which tends to move towards light, for seventy-five generations in darkness. At the end of that time no visible change had occurred in the eyes, and when 1000 such flies were given the opportunity of moving towards a light no change was found from the normal either in the proportion which moved within a minute, or in the average rate at which they moved." The majority of the experiments on the inheritance of the effects of use and disuse lead, writes Mr. Haldane, to equally negative results. Apparently the American observers have not yet had time to go into the question of the production of any departure from the normal in the minute *structure* of the eye as distinct from its physiological activity. In the actual state of knowledge we are not warranted in assuming that "darkness-disuse" produces a permanent change of structure in the disused eye.

(2) I now come to my second objection to Prof. MacBride's assumption of the truth of the disuse-theory of the blindness of cave-animals. It is this: we are not compelled to assume the inheritance of the effects of disuse in this case as the only probable explanation of the facts, since the theory of natural selection sufficiently accounts for the production of blind species of cave animals. Mr. Darwin in co-operation with Mr. Wollaston ("Origin of Species," chapter v.) pointed out that the wingless beetles of Madeira owe their relatively great abundance there (and in other sea-girt islands) to the fact that beetles with normal wings and normal powers of flight are continually caught when flying by the heavy winds and blown out to sea and destroyed. Those individuals with congenitally defective wings—a defect known to occur normally in a certain proportion of beetles of various species—will lie close to the ground and thus escape the fate of those caught by the winds when flying and consequently blown to sea. Thus by natural selection the beetles with defective wings will be favoured and preserved in the island so as to breed their like and establish wingless races or species. Darwin did not himself apply this parallel to the case of blind animals in caves. But many years ago, in the course of a discussion in one of the reviews, on the probable history of blind animals in caves (and in the deep sea), I ventured to do so. As it seems to have escaped attention in the interval, I submit this suggestion for consideration at the present juncture. Supposing, whether by gradual wandering into caverns (many of which are of vast extent) or swept in by swollen streams or floods, a considerable population of animals become the more or less well-established occupants of caverns. Then there will always be a tendency for those possessing normal eyes to follow up any gleams of light which they may encounter in their exploratory wanderings. They will follow up the light to some passage by which it enters the cavern, and gradually year by year escape in considerable numbers to the sun-lit surface. Those

with defective eyes will not thus escape, but remain and breed in the cave, establishing a series of races or species with defective eyes. The tendency of this process will be to favour the escape of those in every generation with normal eyes or with definite though feeble light-sensibility. These will include many born in the cave from parents with partially defective eyes. Thus constantly, year by year, the cave-dwelling blind forms will become purified from admixture with those possessing eyes of even minimal efficiency as organs of vision. The blind races remaining in the cave will develop in some cases organs of touch of special efficiency, and become established as blind cave-dwelling species.

No doubt further details as to the structure and functional qualities of the eyes of cave-dwelling animals are needed for fuller consideration of this matter, as well as an understanding of the malformations and congenital variations of eyes and of the essential optical mechanisms of eyes of all kinds. It seems to be a legitimate hypothesis that the modification of the organs of vision and their accessory parts in deep-sea fishes and deep-sea crustacea is brought about by photo-taxic migration similar to that affecting cave-dwellers, though at present this is merely a suggestion. The very curious modifications of structure in the eye-stalks of several deep-sea decapod crustaceans which have lost the power of vision have been described and figured by G. O. Sars. I have described and figured such modifications in species of the deep-sea crab, Cymonomus, and reproduced for comparison some of the figures given by Sars (see "On the modification of the eye peduncles in crabs of the genus Cymonomus," in *Quart. Journal Microsc. Sci.*, vol. 47, p. 439, and Plates 33 and 34). Histological details in regard to the changed and dwindled organs of sight in deep-sea animals have not yet been ascertained, nor is the process of change and degeneration as yet interpreted in relation to known morphological generalisations.

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November 1.

Choice of the Striking Point in the Pianoforte.

IN his interesting letter dealing with the above subject in NATURE for October 17, p. 575, Mr. R. N. Ghosh appears to suggest that there is disagreement between S. K. Datta's results and my own. This apparent disagreement is due to a difference in the relative masses of the hammers used. Quantitative experimental results so far published are :

Position of Impact (a/l) giving Maximum Amplitude of Fundamental.	Relative Mass of Hammer (m/M).
1/4	1/2·53
1/5·56	1/1·18
1/6·82	1·0
1/7	1·687 (Datta)
1/28·6	9·625

where a = distance of struck point from nearer bridge, l = length of string, m = "mass" of hammer, and M = mass of string. From this table it is clear that as the relative mass of the hammer increases, the position of the impact giving the greatest maximum amplitude of the fundamental moves nearer to the bridge. There are other maxima and minima which become fewer and less pronounced as the relative mass of the hammer is reduced, until for the mass ratio $m/M = 1/2{\cdot}53$ there is only one minimum and two maxima for the whole length of the string. The maxima are greater and the minima are less the nearer they are to a bridge. Reference is also made to the work of G. H. Berry, but in this case the mass of the hammer is not given.

The statement that the duration of the impact is about *one-half* the fundamental period of the string when the amplitude of the fundamental is a maximum would appear to be true only for some particular mass ratio. S. K. Datta (Ind. Ass. Proc., vol. 8, p. 116, 1923) finds a duration of nearly *three-quarters* the period of the string for a maximum when $m/M = 1{\cdot}687$. The treatment of the problem from the point of view of the duration of the impact presents great difficulties, for on the modern general theories this quantity cannot be derived analytically. Moreover, Prof. Raman has theoretically shown the interesting fact that the duration of the impact grows in a *fluctuating* manner as the position of the impact moves from a bridge to the mid-point of the string. This phenomenon has been verified experimentally by his own work and also incidentally by some of mine, where the conditions and method of measurement were quite different.

Influence of Energy Absorbed.—The problem may be examined from another point of view. In using an instrument like the violin or the organ, energy is almost continuously given to the system so long as sound is needed, but whatever energy is to be given to a note of the piano has to be communicated in, say, 1/50 to 1/5000 sec., depending on the pitch of the note. It therefore seems of interest to examine the influence upon the energy given up to the string by the hammer, of such factors as the position of the impact, the mass and speed of the hammer, the nature of the hammer face, and the stiffness and tension of the string. The experimental work for this investigation is now being carried out at University College, Nottingham, by Mr. H. E. Beckett. We are able by the method in use to make absolute measurements correct to within perhaps 1 per cent. of the energy absorbed, and it is hoped to have the work ready for publication by the end of the year.

There are several misprints in Mr. Ghosh's letter. Dutta should read Datta; 1/91 should read $l/7$ in the first place, and $l/9$ elsewhere where l = length of string. Also 1/71 should read $l/7$.

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The Zeeman Effect on the Helium Bands.

PROF. NICHOLSON has recently (*Phil. Mag.*, vol. 50, p. 650, 1925) pointed out the importance of investigating the effect of a magnetic field on the so-called "doublet bands" of helium. He gives reasons for expecting that these particular bands should be subject to a Zeeman effect of the same general character as in the case of atomic line series. Apart from this, such an investigation would be amply justified by the singularly interesting nature of these bands, both as regards their distribution in the spectrum according to a line-series law and the details of their structure (see Curtis and Long, Roy. Soc. Proc., A, vol. 108, p. 513, 1925). It happens that we had already completed the experimental part of such an investigation when Prof. Nicholson's paper appeared, and as the final results will not be ready for publication for some months, it may be of interest to describe their salient features at once.

A large electromagnet and the 7 ft. 9 in. concave grating in the Physics Branch of the Artillery College were very kindly placed at our disposal by Prof. Andrade, and helium tubes of design suitable for end-on observation in a direction perpendicular to the magnetic field were specially prepared at King's College. Fields up to 20,000 gauss were employed, and plates were taken simultaneously in the grating third order and in a Hilger constant deviation spectrograph in conjunction with a Fabry-Perot 1 cm. etalon. Only the strongest band, that near λ4650, which is the first member of the Rydberg band-series, has been studied so far, although many other band lines between λλ4380 and 4720 appear on the plates, and it is hoped to extend the investigation to the second member of the Rydberg series, the band near λ3680.

The band-lines exhibit no Zeeman effect of a "normal" order of magnitude except in the case of the first member of each of the three branches constituting the band, namely, $Q(1)$, $R'(1)$ and $P(2)$. These are broadened but not resolved into components, as are the neighbouring He lines λλ4713, 4471, and 4388, even when examined through a polarising prism; this appearance may, of course, be due to a structure more complex than the resolving power available is capable of revealing. It is noteworthy, however, that in $Q(1)$ and in $P(2)$ the component corresponding to vibrations parallel to the field is considerably broader than the "perpendicular" component, whereas the reverse is the case both in the "normal" and "anomalous" Zeeman effects in series lines. In the case of $R'(1)$ the difference is much less marked and is probably opposite in direction; that is, the "perpendicular" component is slightly the broader.

The magnitude of the effect is greatest in $Q(1)$, the extreme width of which in a field of about 20,000 gauss corresponds to a separation (presuming it to be an unresolved doublet) of about 0·27 Å.U., that is, roughly two-thirds of the "normal" Zeeman effect, which is shown by the nearest He line λ4713 (0·40 Å.U.). It is appreciably smaller in $P(2)$ and in $R'(1)$. In each branch the effect diminishes rapidly with increase of order number of the lines, that is, rotational quantum number, but it is still appreciable on the interferometer plates down to the fifth or sixth member of each branch, where it amounts to a few hundredths of an Ångström only. It is thus clear that the effect of the magnetic field on the molecule is largely determined by the state of rotation of the latter, being relatively small for the higher speeds of rotation.

It may be that these results, if of general validity, will be of use in the analysis of band spectra. Thus, for example, in the helium band spectrum itself there are, in the region covered by our present plates, a number of lines not yet arranged in series, a few of which show pronounced Zeeman effects of the nature described above, and would therefore be expected to be the first members of their branches. Similar considerations may possibly be helpful in the analysis of the secondary spectrum of hydrogen. Evidently it cannot be assumed that a line showing an appreciable Zeeman effect must belong to a line-series rather than to a band-series, or that an affected line is *ipso facto* disqualified from association with unaffected lines. In this connexion it would appear desirable that the Zeeman effect on the latter spectrum should be investigated over a much wider range of wave-lengths than was attempted by Dufour (*Jour. de Phys.*, 8, p. 258, 1909).

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Birth-Control among the New Zealand Maori.

In NATURE of October 17, p. 575, Miss Ettie A. Rout has made some interesting remarks concerning sexual life and birth-control among the Maori of New Zealand. Anthropologists and students of social hygiene will be grateful to her for directing attention to facts which have previously received little notice—the value attached by the native to physical fitness, its importance as one of the criteria of marriage, and the consequent influence of this ideal upon the general physique of the race. At the same time, it should be recognised that such important social institutions as betrothal, marriage and family life were not regulated by physical fitness alone, as Miss Rout seems to imply. Despite my sympathy with her views, I cannot help wondering whether these have not unconsciously coloured her statements about Maori life.

We are told, for example, "before betrothal occurred there was medical examination of both parties by the parents of the young couple and by the doctors." That this was a pre-European practice is very much open to doubt. In any event, from reasons of personal friendship of the parents, or tribal policy, betrothal quite often took place in early childhood, even soon after birth. Preliminary "medical examination" at such a stage, however, would scarcely appear to possess any great virtue in establishing fitness for reproduction. Also, if Miss Rout's statement is to be taken as valid, it must occasionally have been a matter of some delicacy, inasmuch as we know that infants were sometimes *taumau* (betrothed) *before birth* with the expectation that they would later turn out to be of different sexes!

Now as to "doctors." To elevate the old-time *tohunga* (priestly expert)—who is apparently the person meant—to the style and dignity of a *doctor* is, quite unintentionally no doubt, to give to European readers a highly exaggerated notion of the medical knowledge and capabilities of these folk, who were far more learned in magical practices than in physiology or pathology.

Before marriage a great amount of sexual freedom was allowed to the young people among the Maori, but after marriage was concluded strict fidelity was demanded. In general, the marriage bond was highly respected. Liaisons, of course, occurred, but adultery was never condoned; on its discovery a *taua muru* or plundering party which stripped the offender of property, was the result, while for an erring wife death was by no means a rare punishment. With these indisputable facts at disposal, it is difficult to see why Miss Rout has come to the conclusion that a married woman was allowed to have her children "by whatever father she desired." Again, it is stated that a woman "if she preferred some other man to become the father of her child might allege that this lover's spirit visited her" and that this was "a recognised polite fiction." It is to be feared that a Maori of the old school would indeed label it a fiction, though not of a very polite order. Moreover, to the children of any illicit unions a great stigma attached—the term *poriro* (bastard) was a perpetual shame to the person concerned; such an illegitimate child might be killed by the woman's husband or father; and women resorted to abortion rather than give birth to such. It is somewhat difficult, then, to conjure up Miss Rout's picture of a Maori warrior, humbly acquiescent in his wife's intercourse with another man, his sole reaction being one of self-pity because she considered her paramour a better potential father for her offspring.

In her selection of a husband, the Maori woman was drawn by his handsome appearance, his excellence in the *haka* (posture dance), his powers in war, his skill as a food provider, rather than by exalted notions

as to his worthiness for the high office of producing children by her. In brief, marriage and family relations among the Maori were determined by many other social factors besides that of physical fitness.

In substantiation of my remarks I refer the reader to various papers by Best, Gudgeon and Dr. Goldie in the Transactions of the New Zealand Institute and Polynesian Journal, besides the writings of S. Percy Smith, Judge Wilson and James Cowan, whose statements are fully confirmed by my personal knowledge of the natives in the Waikato and the Urewera districts. RAYMOND FIRTH.

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Greenland or Polar Front?

No doubt the gravitational outflow of air from the ice-dome of Greenland is the source of a good deal of cold air to the cyclones of the North Atlantic, as upheld by Prof. Hobbs in his paper to the Geography Section of the British Association at Southampton, and printed in NATURE for October 3. But why, many meteorologists will ask, should he go to the extreme length, implied in the article, of disregarding other sources of cold air for the Bjerknesian mechanism of cyclonic circulation? Can Prof. Hobbs seriously intend that the sloping ice plateau of Greenland, so very limited by comparison in area, can supply all, or nearly all, the cold air for the cyclonic activity of the entire northern hemisphere, Pacific, as well as Atlantic, centre? The idea seems incompatible with the scale of operations, and the facts quoted by Prof. Hobbs himself, if rightly interpreted, show that it really is incompatible. Of course, if Greenland were denuded down to sea-level one spring in the mechanism would be removed, and doubtless important modifications would be imposed upon the characteristic circulation of the North Atlantic Ocean; for in the last resort the details of the atmospheric circulation and the perpetual transpositions of the Polar Front are dominated by geographical configuration, or in other words by continentality and oceanity relationships. But the facts do not warrant the contention that Greenland, in a sense an accidental feature in the circumpolar configuration, is the mainspring of the circulation in the northern hemisphere.

Take the very fact adduced by Prof. Hobbs of the mean barometric pressure over the north polar basin, as established by the late Prof. Mohn, not being inordinately high. This is of little consequence. What *is* of consequence is the fact that the mean polar pressure is higher than the Atlantic minimum near Iceland and the Pacific minimum in the Bering Sea. This mean or average distribution of pressure means, when translated into *day to day changes*, that just as warm, humid equatorial air commonly drifts northward, so will cold dry polar air frequently drain southward irrespective whether Greenland is there to reinforce the process or not. This statement is simply in accord with the known laws of wind and pressure distribution, and every modern weather forecaster is familiar with true polar air on his day-to-day charts.

Then we are told that the air of the polar basin "where rain and fog are common" is not of the right quality to form discontinuities and interact with the equatorial currents in accordance with the admitted Bjerknesian process. Yet what could be farther from the truth than this statement? The north polar basin or Arctic Ocean is in the winter months one of the three "poles of cold" in the northern hemisphere, with a mean January temperature round the Pole, according to Mohn, of $-40°$ F. or C., the other two being north-east Siberia and the Greenland ice-dome itself. This extremity of cold over the inner polar basin necessarily implies dry air, and all polar explorers have testified to the *sparkling dry* atmosphere of the long polar night. The rain and fog occur temporarily and locally in the thaw weather of summer (never in winter except occasionally near Spitsbergen where there is warm Atlantic water); but, even so, outflows of polar air are amply cold and dry enough to interact with the equatorial air to supply the milder cyclonic activity of summer.

It must not be forgotten, further, that in winter the frost-bound continents can constitute additional reservoirs of "polar" air; and this fact is one of the chief, if not the chief, cause of the terrific state of turmoil which the North Atlantic Ocean is commonly in during the months of December and January—when supplies of "polar" air, to interact with warm damp Atlantic equatorial air, may be drawn not only from the North Pole and Greenland, but also from North America and Europe.

Finally, it should be observed that "glacial anti-cyclones" of the Greenland or Antarctica type are really disembodied systems, and it would surely be better to speak of gravitational cataracts of cold air. But that is another story. L. C. W. BONACINA.

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Relation of Language to Physiological Stimuli.

IN examining a vocabulary of more than a thousand words (compiled from upwards of sixty languages) bearing directly or indirectly on the sense of smell, it becomes apparent how many words are vocalisations and articulations of simple reactions to olfactory stimuli. A few examples must suffice here. [$\overline{ch}$ = ch in *loch*, $\overline{ch}$ = tch.]

A common reaction to odours would be the syllables like *bu, pu, fu, hu, su, tu*, etc., expressing the idea of blowing, puffing, budding, bulging, etc., and we have, *e.g.* Persian *bu*, odour; Efik *bu*, to rot, and *bu-bere*, to blaze; Circassian *buà gim*, sense of smell; Efate *busi*, to blow; Malay *busuk*, putrid; Chinook *piu-piu*, to stink, also skunk; Tibetan *pö*, incense; Tahiti *puha* and Hawaiian *puhi*, to blow; Samoan *puaoa*, mist; Inca (Quichua) *puhuni*, to blow, *puhucuni*, to kindle, *hapuni*, to smoulder, *puhura*, feather, and *puyu*, cloud; Melanesian *punu*, smoke; Japanese *punpun*, like a delicious perfume; Samoan *punapuna*, to ascend; Russian *pwc̄hnut*, to puff, blaze, and *puc̄h*, feather. We have the international expressions of disgust, *e.g. faugh, pfui, fi*, etc. We have *fimus, fumus, fœtid*, and so forth, the Efik word *futa*, to blow; Chinese *fu*, fragrance; Japanese *fuki*, to blow (*hanafuki* = handkerchief), and *shuki*, stench; Natick Indian *shuah*, to stink; Basque *su*, fire and nose; Latin *tus* and Gaelic *tuis*, incense; Russian *tuman*, fog; Melanesian *tunga*, fire; Zulu *tunga*, smoke (cf. *dung, Dünger, tongue*, etc.); Basque *tusuri* and Tibetan *dü*, devil; Ancient Egyptian *c̄hua*, to rot; Chinese *cheu*, stink, and smoke; and Russian *chuyanie*, scenting, understanding. Of interest here, too, are the Tibetan *u*, breath, and Honorific Tibetan = head; Russian *um*, mind = reason; the Inca *uma*, head, and *umu*, priest; the German *Atem, Odem*, breath; *Odin*, and the sacred *OM*; Ancient Egyptian *utu*, flowers, unguent; Basque *usu*, pus; Micmac *un*, fog, etc.

Another natural vocal reaction to olfactory stimuli, and of course connected with breathing, is a combination of guttural and vowel sounds and words, perhaps sometimes vocalisation of hawking or vomiting. To

quote but a few examples, we have the Danakil *haha*, air; Seneca *gahah*, wind, and *gaoh*, air (cf. *gas*); Tibetan *gak-pa*, to be choked; Inca *c̄hanani*, to kindle; Persian *gand*, stink; Urdu *gandhak*, sulphur; Japanese *hana*, nose, flower, the first; the Ancient Egyptian *c̄ha*, to enter, and *c̄hen*, flowers; *Ka*, the eidolon or familiar; Gipsy *cannelo*, stinking, and *nok*, nose; Melanesian *gnoko* and Eskimo *kenowk*, nose; Circassian *c̄hassa*, to learn; Arabic *c̄hassat*, sense of smell; Inca *c̄hosni*, smoke, and *humpi*, sweat; Chinook *humm*, stink (Ar. *shamm*, to smell; Russian, *shaman*, sorcerer; etc.); Inca, *c̄huncu*, stink; Yao *nunga*, smell; Suahili and Zulu *nuka*, Congo *nukana*, and Chinyanja *nunkisa*, to smell; Russian *nyuc̄hat*, to smell (cf. *nauk*, science).

The significance of the combination of the nasal and guttural sounds in connexion with smell may be seen by means of the following, somewhat rough, expedient. Taking 100 words signifying *nose* from Asia, Europe, Africa, Australia, the South Sea Islands, and America, and analysing the sounds present, it was found that of the 235 consonants present, 102 were n, ng, h, k, c̄h, and q; 59 were s, z, sh, zh, j, tch, d, and t; 35 r and l; 20 b, p, f, v; and 19 m. Of the 224 vowel sounds represented 63 were u, w; 53 a; 47 i, y; 36 o, ö; and 25 e, ä. While this method does not commend itself to philologists, it may serve to indicate a new way of building up an international language, based on the physiological reactions to stimuli, and in any case affording food for thought and discussion. It must be borne in mind that the few examples quoted above do not necessarily indicate their ontogeny. Perhaps what has been said about the nose may suggest even a connexion with the Ankh, and may not the anchor perhaps suggest a nasal symbolism?

JOHN H. KENNETH.

The Homestead, Clynder,
October 14.

Could the Romans in Britain weld Iron?

INCREASING attention has, within the last few years, been devoted to Roman remains in Britain, and a great deal of interest centres round such metallic remains as have survived from this period. Iron was always manufactured by the so-called "direct" process, that is, iron ore was reduced with charcoal direct to the metal without the intermediate formation of pig iron. The method was very wasteful, and in the further working of the metal so much oxidation took place that frequently the whole of the metal disappeared, the finished article consisting almost entirely of the hard ferrosoferric oxide, the remainder being slag or other impurity. This was the case with certain "iron" nails from the Roman villa at Folkestone which were forwarded to me by Mr. S. E. Winbolt.

As the Roman method of heat treatment was so crude and resulted in so much oxidation, I have often wondered if it was possible for them to weld their iron. Through the kindness of Mr. Walter G. Klein, I have been able to examine specimens of Roman iron from the excavations at Richborough, and an account of these was laid before the autumn meeting of the Iron and Steel Institute by Mr. W. E. Thorneycroft and myself. One piece of iron, when sawn through, showed that it consisted of a bundle of about 8 rods which had apparently been hammered together to make them unite. But metal did not touch metal, for each rod was separated by a thick layer of impurity, containing 45·47 per cent. of iron and 24·54 per cent. of insoluble material, mainly silica. The rods held together with surprising tenacity, but a heavy blow cracked the cementing material, when they readily fell apart.

An iron ring was examined from the same source, and we thought that this might indicate whether or not the Romans could weld. At first we thought we had a clue. There was a distinct crack visible under quite low magnification at one part of the ring. But on further grinding this disappeared and no further evidence of a weld was obtained. The ring might therefore have been made by driving a hole through a plate, for its external diameter was only 4·0 cm., the mean diameter of the metal being 0·75 cm.

A week or two ago I received from Mr. Francis B. Andrews, secretary of the Birmingham Archæological Society, a piece of Roman iron pipe from Uriconium. It was a ring of metal, not unlike a serviette ring, 4·3 cm. in diameter and 1·5 cm. deep. On grinding down it became evident that the ring had been made by bending over upon itself a piece of sheet iron and cementing or "soldering" the join with molten copper or copper alloy.

There has not yet been time to examine the specimen micrographically, or to determine the particular composition of the cupriferous "solder." A full description of these will, it is hoped, appear in due course.

Searching through the literature, I have been unable to find any reference to this kind of thing before, and it would be most interesting if any of the readers of NATURE could cite further examples.

One of the great difficulties of work of this kind lies in the fact that the antiquary naturally desires to preserve his "finds" and hesitates to allow objects of interest to be examined by any chemical or metallurgical process that may tend to destroy them. With this we all sympathise. Yet where specimens are not unique, but fairly common, it might be possible to hand some of these over to tried investigators in order that science might benefit by a further examination, even at the risk of spoiling for exhibition purposes these duplicated specimens.

My sincerest thanks are due to those gentlemen who have so generously placed at my disposal the material discussed in this note. J. NEWTON FRIEND.

Municipal Technical School,
Suffolk Street, Birmingham,
October 27.

Weather Prediction from Observations of Cloudlets.

I DO not think that the method described by Sir G. Archdall Reid in NATURE of November 7, p. 676, is at all of universal application. It certainly cannot be applied to cirro-cumulus; the cloudlets composing lenticular cirro-cumulus not only *may* wax at one end of the cloud and wane at the other, as mentioned by Sir G. Archdall Reid, but they always behave in this way; I do not think that any of the explanations he gives accounts for the phenomenon, but the point is not to account for it, but to decide whether the waxing or the waning of the cloudlets is to be taken account of in weather prediction. Again, a whole mass of cirro-cumulus cloudlets may form and disappear in a very short time; is the appearance or the disappearance to be reckoned with? The lower clouds seem to me to tell even more against the method; on almost every fine summer morning we may watch cloudlets waxing, but it by no means follows that rain will result; probably in nine cases out of ten it will not. I should imagine that there must be nearly a hundred days every year when the method is disproved by the waxing of cloudlets which will develop not into rain clouds, but into the cumulus of a fine day. C. J. P. CAVE.

Stoner Hill, Petersfield, November 9.

Michel-Eugène Chevreul, 1786-1889.[1]

By Prof. HENRY E. ARMSTRONG, F.R.S.

RECENTLY, in London, we celebrated the centenary of the discovery of benzene by Faraday and in so doing took occasion to proclaim Faraday's greatness as a chemist. The commemoration was remarkable, because it was held by the Royal Institution, where the discovery was made, in conjunction with three other associations: the Chemical Society, the Society of Chemical Industry and the Association of British Chemical Manufacturers. This was the first time these three bodies, which collectively represent all the interests of British chemistry, have shown themselves to be actuated by one purpose and have elected to work to a specific end, in harmonious, declared co-operation. In England, we regard the event as a happy presage of the union we have long sought to achieve—the union of our chemists into a single professional organisation.

Now, a further step is taken along the same path. I am charged by the Royal Society of London and the three bodies I have mentioned, which again act as one, with the honourable and most gratifying task of conveying to our French colleagues, their united warmest congratulations upon this occasion. We not only desire to join in paying homage to Chevreul's memory: we also desire both to carry on the work we began, with the powerful aid of French men of science, in London and to aid them in reminding their public of the inestimable value of genius and in enforcing upon the attention of the rising generation of students the value of the examples before them in the work of the famous men of the past.

The world of to-day is accustomed to take advantage of the work its leaders do for it, without in the least attempting to understand what leadership is and entails. Our need of leadership, the paucity of leaders, was never more obvious, perhaps never so great. We are too prone to think in terms of majorities—forgetting that evil may often, more easily than good, command a majority. We do not sufficiently realise how much the War has cost the nations in leadership. On such occasions as this, we do well to pose such problems before the public.

We have a remarkable series of English essays, too little read to-day, I fear, on "Hero-Worship," delivered by our great man of letters, Thomas Carlyle, the historian of the French Revolution. His heroes were: Odin and Mahomet; Dante and Shakespeare; Luther and Knox; Johnson, Rousseau and Burns; Cromwell and Napoleon: representing divinity, poet, priest, letters and king. Science was not considered: letters have yet to fathom its mystery, if indeed it be fathomable by the literary mind. Even Anatole France, though respectful, is fearful of us; he even goes so far as to say: "Our chemists and our professors of science are almost to a man anarchists." He probably failed to recognise, that the religion of the future, if indeed there be one, will be fashioned out of pure knowledge. Being, we are told, "liberated from religious belief, lacking the organ of superstition," he was perhaps unable to realise that the true office of science is to create belief by destroying dogma: to govern by necessary commandments.

Meetings on such occasions as this serve to correct unjustified literary partiality and misreading of our character. We can rejoice in what Chevreul did for civilisation, not against it: he was a veritable torch-bearer: he not only made the torch a thing of beauty to the eye but also deprived it of all offence to the nose. In doing so, he liberated glycerol but it remained for Sobrero to convert this into an engine of war.

Were Carlyle writing to-day, he would perforce include science in his gallery of heroes. The choice of representatives would be difficult. Certainly, one of the first to consider would be Lavoisier, the greatest philosophic chemist of all time. Then would come Faraday, I think, especially on the grounds of his moral outlook. To France would fall another nomination, that of Pasteur, as a great humanitarian. Anatole France would never have classed us as ultimately dangerous had he studied such examples. It would have interested him to know that, in 1824, the celebrated home of Sir Walter Scott, at Abbotsford, was lit by oil-gas, made from material which his countryman Chevreul was the first to study, the "gas" from which Faraday, a year later, was to isolate benzene. Not to be outdone by the Church, at the recent celebration, in London, of Faraday's discovery, in the evening, at the banquet in the Hall of the Goldsmiths' Company, one of the private palaces of our City of London, no less a number was lit than 578 of the candles made possible by Chevreul's invention of 1825. In such manner was honour done to the coming of benzene, in such manner was the chemist's "open chain" connected with the "closed." The great hall in which we met is one of the few now illuminated in accordance with ancient custom—by burning oil-gas, *in situ*, as it is produced from Chevreul's candle with the aid of the "retort" patented by Cambacères in 1834. To-day, Chevreul and Faraday march arm in arm, illuminating the world—the one bearing the candle, the other the electric torch. Anatole France, doubtless, in his time, burnt many candles as midnight oil—how then could he call us anarchists, unless it were because of the support our work gave to his anticlericalism? Had it not been for the constitutional inability of the literary to understand the experimental mind, he must surely have treated us as the most lovable of brethren.

Working as chemists, Chevreul and Faraday between them, practically at the same time, laid the foundations of organic chemistry: Chevreul of its open or paraffinoid, Faraday of its closed or phenoid systems. In our inability to escape from ancient practice, motorists to-day, fire-worshippers as they are, finding it to their advantage to associate the two types of combustible, unconsciously, the world over, render their burnt offering to the memory of the scientific fathers that begat them.

Chevreul's has long been an honoured name in England. He was elected a foreign member of the Royal Society in 1826 and received the Copley Medal,

[1] Address delivered at the fifth Congress of Industrial Chemistry organised by the French Society of Chemical Industry, on October 11, at the centenary celebrations of Chevreul's work on fats.

its highest honour, in 1857. He was elected a foreign fellow of the Chemical Society in 1849.

In the obituary notice published by the Royal Society (1889), it was said:

He will be known for his researches on the contrast of colours but his great work was that by which he cleared up the constitution of the fixed oils and fats and established the theory of saponification. Few scientific men surviving were even born [2] when this important research was commenced—a research in the course of which he laid the foundation of the method now universally followed in the study of organic compounds, by showing that an ultimate analysis by itself alone is quite insufficient and that it is necessary to study the substances obtained by the action of reagents on that primarily presented for investigation.

The notice given in the Journal of the Chemical Society (1890) is in similar terms. His investigations are said "to cover the whole of chemistry, branching out into physiological chemistry, hygiene and physics." In our survey we are carried far back, in the history of the development of the method of chemical inquiry, in considering Chevreul's early contributions. I have difficulty too in picturing his masterful activity—it was so ceaseless and varied. He thoroughly deserved the title he was accorded of "Encyclopédie vivante." To-day, students know him only as a chemist who lived to be more than a century old and was the discoverer of the higher fatty acids. Few will have seen the wonderful bibliography prepared, at the time of his centenary, by M. Godefroy Malloizel. The items catalogued number 506, including several comprehensive treatises. In our English Royal Society's Catalogue of Scientific Papers, 233 titles appear under his name, between the dates 1806 and 1884.

Born at Angers in 1786 and educated there, at the École Centrale, in 1803, at the age of seventeen, he went to Paris and was admitted by Vauquelin, the discoverer, in 1797, of the element chromium, to his chemical manufactory but soon became chief of the laboratory. In 1810, Vauquelin appointed him his assistant in his course of applied chemistry at the Museum of Natural History. In 1813 he obtained the chair of chemistry at the Lycée Charlemagne. In 1824 he became professor of special chemistry at the Gobelins tapestry factory and succeeded Roart as director of the dye works.

Chevreul began to publish in 1806. His early work was of a miscellaneous character. He began to study indigo in 1807 and was the first to recognise that it occurred naturally in "its lowest stage of oxidation" as indigo white. In 1811, he isolated the yellow colouring matter quercitrin. Morin and luteolin were discovered by him in later years. In 1815 he proved that diabetic sugar was identical with starch (grape) sugar. He began his studies of the saponification process in 1810 and recorded the results of his examination of the fats, in a series of papers, between 1813 and 1818. He discovered butyric, valerianic and caproic acids in 1818 and oleic acid in 1823. In 1832 he prepared kreatin from meat extract. He studied wool-fats in 1853. His attempt, in conjunction with Braconnot and Gay Lussac, to establish the stearin candle industry receives notice at other hands. It is well known that the manufacture was not successful until after the introduction of Milly's improved process of saponifying with lime and the invention of the plaited wick by Cambacères in 1834. In its early stages, the industry was largely developed in England by Price and Co. It has now reached colossal dimensions, though the hydrocarbon paraffin has largely taken the place of stearic acid.

Like Faraday, Chevreul was no mere laboratory worker: he was not only a philosopher but also a systematist and logician of the first order. His scientific writings are all models of clear and simple statement and a complete justification of the motto he adopted, from Malebranche, as his guiding principle, "On doit tendre avec effort à l'infallibilité sans y prétendre."

Recognising "les inconvénients d'exposer de nombreuses recherches sur un même sujet dans une suite de mémoires," in 1823, he published, in book form, a comprehensive account of his work on the fats—"Recherches chimiques sur les corps gras d'origine animale," which he dedicated to Vauquelin.

The point of view from which his work generally had been undertaken is clearly defined in the introduction to this volume, in the following terms:

On dit que la chimie se compose de faits, mais des faits seuls ne constituent pas cette science; car lorsqu'on donne des définitions générales, lorsqu'on forme des groupes de corps d'après des propriétés analogues et des propriétés différentes, il a fallu nécessairement interpréter des faits déjà observés pour établir les rapports qui les lient. Lorsqu'on définit, il y a donc des rapports établis et on reconnaît des propriétés de different ordres, quant à l'importance qu'on attribue à chacune d'elles: dès lors il y a plus que des faits, quoique en dernier ressort toute interprétation, toute définition, doivent s'appuyer sur des faits bien observés. Priestley a découvert un grand nombre de corps importants; il a reconnu la plupart de leurs propriétés et certainement il a fourni à la science plus de faits proprement dits que Lavoisier; cependant, sans que nous ayons l'intention de diminuer en rien la gloire du savant anglais, nous pouvons dire, sans crainte d'être démenti, que la postérité a placé Lavoisier au-dessus de lui. Quelle en est la cause, si ce n'est pas la manière dont les faits ont été interprétés? Ce qui est vrai pour les faits qui ont servi de base à la théorie antiphlogistique, doit l'être pour ceux qui restent à découvrir: nous pensons donc qu'au lieu de recueillir sur des sujets très différents des faits qui manquent de corrélation, il est préférable pour le progrès de la science de rassembler le plus possible des faits analogues, de les coordonner ensemble, afin d'en déduire les conséquences générales, qui seules peuvent imprimer à un ensemble de faits le caractère constitutif de la science.

Lorsque nous avons commencé l'étude des sciences physiques, nous avons été frappés du vague qui régnait alors dans la chimie organique, en même temps que nous avons aperçu l'étendue des applications qu'on peut faire de cette branche de la philosophie naturelle aux sciences physiologiques et anatomiques, à la médecine et à ces arts nombreux dont l'objet est de préparer avec la matière des corps organisés des substances utiles à l'homme. Tels sont les motifs qui nous ont engagés depuis longtemps à réfléchir sur tout ce qui se rattache aux connaissances chimiques des produits de l'organisation.

[2] Chevreul was only eight years old when Lavoisier was executed.

Nous nous sommes appliqués à connaître les principes que l'on sépare immédiatement des végétaux et des animaux, parce que *cette connaissance est la base de la chimie organique et de toutes ses applications.*

In a second volume, published in 1824, "Considérations générales sur l'analyse organique immédiate et sur ses applications," Chevreul dealt more generally with the methods to be followed in examining natural products. The copy of this book that I have consulted came from Faraday's library; that dealing with the fats was a presentation copy to Mitscherlich. He not only discusses the use of solvents but also the mode of action of the various chemical agents. The following quotation will serve to illustrate the crude state of knowledge at the time: "M. Berzelius a dit que la fibrine du sang, l'albumine, la gélatine, éprouve sur l'influence de l'alcohol et de l'éther une altération telle qu'une partie de leur matière est transformée en substance grasse adipocire."

After describing his experiments to test this statement, Chevreul concludes: "J'ai été ainsi conduit à reconnaître que les substances grasses contenues dans 'alcohol et dans l'éther qui ont été mis en contact avec es tendons, etc., sont simplement extraites de ces substances et non produites aux dépens de leur éléments."

What Chevreul would have attempted, what he would have achieved, had he remained a chemist and a free lance, it is difficult to say. I venture to think that systematic inquiry in organic chemistry might have been made more *de régle* at a far earlier date than it was. The fates determined that he should be called off to deal with the problems of colour and of practice. No one has handled them more comprehensively, more logically, than he did, in his capacity of Director of Les Gobelins. Not satisfied with treating the subject as a chemist, he at once proceeded to inquire into the effect of contrast in colour—not only in tapestry fabrics but also in clothing, in house decoration and even gardening—including the planting of the dahlia, the now fashionable flower. His great work "La Loi du contraste simultané des couleurs," first published in 1839, was long out of print. A new large quarto edition, with a preface by his son, was issued by l'Imprimerie Nationale in 1889. That he retained his interest in colour to the last is proved by his communication to the Institute, in 1884, in his ninety-eighth year, entitled "La Vision dans ses rapports avec les contrastes des couleurs."

Chevreul ranks alone as a student of the philosophy of the dyer's art apart from his craft. His works deserve renewed attention, at a time when colour plays so important a part in our civilisation. Judging from what I have seen at the Exposition Internationale des Arts Décoratifs, modern artists might consult them with advantage.[3] The first to study indigo, the dyestuff which still ranks before all others in importance, no one would have been better able to appreciate the extraordinary advance, within recent years, in our knowledge of colouring matters, both scientific and practical: he would have specially welcomed the discovery of the superlatively resistant indigo-like dyestuffs derived from anthracene and their appearance, in commerce, in the "lowest stage of oxidation," ready for application to the fibre by the dyer.

Some day, we may well compel the admiration of such achievement by the literary mind, even by the poet, if we can but paint the marvellous story in sufficiently simple terms and make clear what it is that has fired the heart of the chemist to match himself against Nature—even to her undoing. Chevreul was certainly one of the earliest and boldest among the conspirators and were he with us, to-day, would undoubtedly have sought to impress upon the public mind the marvellous development our art has undergone since he became its votary—within a single century.

Chevreul was greatly devoted to historical and philosophical study and deeply interested in making known the principles of scientific inquiry. In his "Histoire des connaissances chimiques," published in 1866, he speaks of his long friendship with Ampère and Frédéric Cuvier, begun forty-five years previously and refers to their frequent discussions on the classification of human knowledge. This work is full of sage reflexions. Let me quote one:

L'erreur prise pour vérité a encore le grave inconvénient de mettre obstacle au progrès de la science, parce que si une découverte véritable annoncée est contraire à cette erreur, il arrivera que les partisans de celle-ci repousseront la découverte, c'est-à-dire la vérité plus ou moins longtemps.

Telle est la raison sur laquelle je m'appuie pour réduire *l'enseignement élémentaire et l'enseignement* dit *professionnel à ce qui est vrai et susceptible d'être facilement démontré tel.* Car beaucoup de gens qui se disent *partisans du progrès*, ne voient pas que des erreurs promulguées par ces enseignements comme des vérités, sont autant de semences qui, en se développant dans de jeunes intelligences ou des intelligences d'adultes que nulle étude n'a préparés à les juger, deviennent des opinions erronées qui seront un jour les plus grands obstacles à la propagation de la vérité, c'est-à-dire *à ce même progrès que l'on veut favoriser.*

L'importance que j'attache à la destruction de l'erreur explique mon ardeur à propager la méthode.

We may well take such admonition to heart, in these days of unchecked hypothesis. If "l'enseignement

[3] In Paris, we had many opportunities of appreciating the importance of Chevreul's efforts to direct the use of colour and of noting how great is the part to-day played by its glory. The public gardens, those of the Luxembourg especially, were ablaze with it, the Dahlia being the predominant factor in its production. At the Exhibition of Decorative Arts it was everywhere to the fore. Many most exquisite effects and contrasts were to be seen in jewellery. Striking beyond measure, however, was the wondrous exhibit of the Lyons silk manufacturers. The colour contrasts and patterns were not always such as Chevreul would have advised but marvellously effective, for the most part. To judge from the display at the Salon, in comparison with that at the Exhibition, painters are no longer mindful of the rainbow, seeking to attract rather by abrogating than by following the harmonies therein disclosed. The potters, too, are behind in evoking pleasing effects and the glass makers also seem to be lacking in true feeling. In fact, the appreciation of colour seems now to have passed mainly into the charge of the textile workers, who not only have an endless gamut of tones at their disposal but are also able to produce varied effects of surface texture, unknown in Chevreul's day, which greatly enhance their power to please.

A happy accident gave us also an opportunity of appraising the value of pure natural colour. Lunching at Foyot's, we were opposite a lady wearing a most becoming "hat," of expensively simple design, a neutral light-brown in colour, who was sitting with her back turned to a window through which the brilliant rays of a midday sun came streaming in; these were evidently caught by a prismatic wedge, for every now and then, as she moved forwards and backwards, a complete spectrum hung upon her brow and the curved edge of the bonnet—the decorative effect was exquisite, one producible by no conscious art.

A greater opportunity was to come. In the interval, in sunshine and shower, we have explored our English Lakeland region and seen the full glory of the bow resting upon the brows of the fells and upon wondrously sculptured slopes clothed with harmonies of wetted autumnal colour—colour of indescribable, inconceivable beauty, yet mostly traceable to Faraday's benzene and to contrasts beyond compare in which Chevreul especially would have gloried.

dit professionnel" were reduced "à ce qui est vrai et susceptible d'être facilement démontré tel," how much higher would be the task of the teacher and how much more competent the pupil as student and worker.

That philosophical subjects continued to fill his mind is clear from his communication to the Institute, in 1883 (*C. R.* 96, 1521): "Considérations générales sur les méthodes scientifiques et applications à la méthode *a posteriori* de Newton et à la méthode *a priori* de Leibnitz," in which he discussed the diametrically opposite methods of the two philosophers. It would be to the advantage of students, if a complete edition of Chevreul's works could be published, at a cheap price. They would be of great value, if only as examples of style.

Like Faraday, Chevreul turned his attention to occult phenomena and dealt specially with certain aspects of occultism, as member of a Commission of three appointed by the Academy, in 1853, to examine a memoir by M. Riondet "sur la baguette divinatoire employée à la recherche des eaux souterraines"; also a letter, by M. Koeppelin, "sur les tables tournantes." His report was published in book form under the title "De la baguette divinatoire, du pendule dit explorateur et des tables tournantes." I have had at my disposal the autograph copy of this book presented by Chevreul to the Royal Society of London. He was prepared to undertake the task, having twenty years before addressed a letter to his friend Ampère "Sur une classe particulaire de mouvements musculaires," discussing experiments which he had made in 1812 to test the statement: "Qu'un pendule formé d'un corps lourd et d'un fil flexible oscille lorsqu'on le tient à la main au-dessus de certains corps, quoique le bras soit immobile." Like all who have discussed such subjects critically and exactly, he came to the conclusion that the manifestations were to be referred to no "faculté surnaturelle," but to "unconscious cerebration."

Chevreul's work on the fats was limited to the recognition of their proximate constituents. A long series of workers has since laid bare their molecular structure: of these Dumas and Boullay, Gerhardt, Würtz and Berthelot, not forgetting Schorlemmer, were among the first. The story is the story of the development of structural chemistry—a colossal work of the human intellect which is too little appreciated, even in scientific circles.

It is noteworthy that, at this early date, he discussed the possibility of preparing organic substances by artificial means and definitely decided that it is likely that they would be so produced. Four years later, Wöhler was to make urea, thus breaking down for ever the barrier between Nature and our art. To-day the Badische Co. is counting upon a production of 20,000 tons per annum and urea may well become the sole artificial nitrogenous fertiliser used by agriculturists. Indigo, Chevreul's early love, is fast being displaced by synthetic indigotin, the world production of which is already rated at 9000 tons (dry weight) per annum. The other natural dye-stuffs he studied are all but unused—the fats alone still carry the bloom of their natural origin, though, taught by Sabatier, we are now accustomed to pale the fresh complexion of those that are oils with hydrogen.

Our art has thus gone far in copying Nature but she still defies us to read and understand her purpose. We have also done much to alleviate man's ailments and are vastly more powerful. Nevertheless we are no happier nor better attuned to her beauty and goodness. Our art is not yet true art. Would Chevreul have been satisfied with our slavish worship of mere measurement, great as was his devotion to accuracy? Would he not have deprecated our insatiate desire to manufacture everything—our attempts to waive aside Nature's activity in every possible way? Would he not have asked for a less academic and broader treatment—for a greater display of humanity, for more reverence for the great scheme we presume to dissect? No one was more alive to the frailty of the human spirit but no one more conscious of its powers when rationally used. True science is dangerously far from the public ken and we need to recognise the duty that is upon us to bring home to all the infinite possibilities it affords of a future worship of abstract truth.

Chevreul, to-day, would be astounded at the lengths to which we have been carried by application of the philosophical methods of study of which he was so stalwart an advocate throughout his life. We know the structure of the diamond, thanks to the confirmation X-rays have afforded of the chemist's conception of the carbon atom, built upon the foundations laid by Frankland and Kekulé, by Biot, Pasteur, Le Bel and van't Hoff and established by the labours of a vast army of patient students of organic structure. We can, in fact, assert, that the diamond is made up of individual units—carbon atoms—commanding tetrahedral domains. The contiguous units are arranged alternately, as tetrahedra may be, base downwards and base upwards, lines between their centres forming a zigzag and meeting at an angle of 109°, the tetrahedral angle. Recent measurements, made by Dr. Müller, at the Royal Institution, of exceptionally good crystals of stearic acid, show that the carbon atoms in this compound meet at this same angle. In fact, the saturated fatty acids are simple rods of carbon atoms, clothed with hydrogen atoms along their length, their acidity being determined by the presence of a terminal group in which Lavoisier's oxygen is substituted for hydrogen.

This is a strange structure in comparison with that of Faraday's benzene, which may also be pictured as being hewn straight out of the diamond but as consisting of compact hexagonal blocks of six carbon atoms.

Why Nature, in making the fats, should build such extraordinary scaffold-pole like molecules is passing strange. The field is full of problems: it is surprising that so little attention has been given to it (see E. Frankland Armstrong, Presidential Address, Society of Chemical Industry, Liverpool, 1924). I have here a solid model of the geometrical structure of the fatty acids which I owe to Mr. William Barlow, F.R.S. It is a veritable *bougie stéarique*, built, not wastefully, in cylindrical form but so that the individual units interlock to fill space. Mr. Barlow and I believe this model to be worthy of special attention, as it has features which serve to represent peculiarities hitherto unexplained in the chemical behaviour of the fats and paraffinoid compounds generally. If the hydrogen atoms were arranged around the carbon atoms tetrahedrally, they would serve to isolate them in space and the formation of crystalline masses from such units

would seem to be "impossible"; moreover, such compounds would be chemically neutral, assuming hydrogen to lose all affinity when it unites with carbon. In the model before you, as in that of benzene, the unit of affinity and, therefore, the hydrogen atom is a regular dodecahedron. Four such dodecahedra arranged in a pyramid represent the carbon unit: consequently, the dodecahedral units are distributed in two layers. The hydrogen atoms, in the fatty acids, are all brought down, as they are in the model of benzene, into these two layers: therefore, an upper and a lower face in the model are free carbon surfaces. The models can, in consequence, be superimposed at these faces and also interlocked at the sides. Verily, we have done well to use the name *paraffin*, not *sinaffin*. They can be joined, in the same plane, at the carboxylic ends and at the sides. To join them at the hydrocarbon ends, the models must be stepped, so as to raise one a layer above the other: this mode of packing is commonly met with in benzene derivatives. The attachment of the hydrogen units is peculiar, different from that adopted in our printed formulae, in that, although they occur in pairs, alternate carbon units carrying each a pair, both are on either one or the other margin of the model. These models, therefore, portray a new method of geometrical analysis, more powerful and intimate perhaps than any yet devised. It is further noteworthy, that although carbon surfaces are exposed, no complete carbon unit of affinity comes to the surface: whereas, in the model of benzene, there are three such affinities on each face.

From the measurements made by Langmuir and by Adam, we are led to conclude that the molecules of a fatty acid spread out upon water in single layers, so arranged that they stand upright, the carboxyl tip dipping into the water, each upright molecule being closely fitted against its neighbours. The measured thickness of the thinnest black soap film is such that it may well be supposed to consist of two such layers, held upon a belt of water very few molecules thick, one standing upon the upper, the other depending from the lower face of the belt. Interpreting the film in this way, there is no reason to believe in the existence of a complex unit or micelle.

I can overlook sixty of the hundred years since Chevreul's invention. When I first studied chemistry, we were not entirely persuaded of the existence of atoms and were only beginning to form clear conceptions of molecular structure. We did not venture even to dream that we should ever be able to measure and speak with a close approach to certainty of the actual distances between atomic centres, which we now rate at little more than an Ångström unit, one hundred-millionth of a millimetre. Well might Chevreul say: "On doit tendre avec effort à l'infallibilité sans y prétendre": We seem to be near reaching it: though we can still make no claim to infallibility, we are probably far nearer to certainty than Chevreul ever thought possible. The methods which he did so much to make known and appreciated are the methods to which progress is due. As a result, the *bougie stéarique* is no mere illuminant to-day but something at which we can greatly marvel. The chemist can see massed in it wondrously built, tall staircases of atoms, up which the imagination may climb to infinite heights, seeing

. . . . . successive zones
Of several wonder open on some spirit
Flying secure and glad from heaven to heaven.
Paracelsus.

Does the Solar Heat Stream Vary?[1]

FIVE notable contributions to the literature of the "solar constant" have come recently from the United States: three, published by the Smithsonian Institution, give the evidence for variation in solar radiations and for the influence of that variation on terrestrial weather; the other two, appearing in the *Monthly Weather Review*, the organ of the Weather Bureau of the United States, contain critical analyses of the radiation statistics.

The first of these papers is an apologia by Prof. C. G. Abbot. He realises that critics have not been convinced hitherto that the fluctuations in the Smithsonian determinations of the "solar constant" represent real variations in the radiation received by the earth, and he sets out to marshal the evidence for variation in the most convincing way.

As a preliminary he narrows discussion by throwing over the earlier observations as too rough for the purpose in view. The paragraph is of such importance that it must be quoted in full:

Some writers mention our data for the past 10 or 15 years as if all were of equal value. Really, to speak in a figure, the Washington data of 1902 to 1907 were prehistoric. As for Mount Wilson results of 1905 to 1908, inclusive, before the invention of the silver disk pyrheliometer, or Fowle's method for estimating total atmospheric humidity . . . this work is ancient. Excluding altogether July and August 1912, the year of the eruption of the Katmai volcano, all Mount Wilson work of 1909 to 1920 can be classed as medieval. We had then but one station, operating only in summer. We obtained only one determination per day, subject to error from changes of sky transparency and also to errors of computing in the enormous multiplicity of computations used in the reduction of results by Langley's fundamental method. The period from January 1919 to the present is of another order of accuracy and represents the modern period.

It will be seen that it is only the comparatively short series of observations, those since January 1919, made mostly at Harqua Hala in Arizona, and of Mt. Montezumá in Chile, that need be taken seriously as evidence for rapid variations in the solar heat stream. Data for the greater part of this period, August 1920 to November 1924, have been published in a convenient form by the Smithsonian Institution (Misc. Collections, vol. 77, No. 3, Feb. 1925).

[1] Washington, Smithsonian Miscellaneous Collections, vol. 77 (1925), No. 5: "Solar Variation and Forecasting," by C. G. Abbot; No. 6: "Solar Radiation and Weather or Forecasting Weather from Observations of the Sun," by H. H. Clayton; No. 7: "Solar Radiation and the Weekly Weather Forecast of the Argentine Meteorological Service," by Guillermo Hoxmark. Washington. *Monthly Weather Review*, July 1925. "On the Question of Day-to-day Fluctuations in the Derived Values of the Solar Constant," by C. F. Marvin. *Smithsonian Solar-constant Values*, by W. W. Kimball.

The average value of the solar constant is about 1·945 in terms of the unit in general use for this study, the gram calorie per square centimetre per minute. In other words, if the heat were all absorbed by a layer of water one centimetre deep, the temperature of the water would be raised 1·945° C. per minute.

In his discussion Abbot states that the average daily difference Harqua Hala minus Montezuma is only 0·011 units. This agreement has been attained, however, by an adjustment of the original readings by a process which has not been explained yet in print. It is clear that this process is calculated to minimise discrepancies between the stations.

Knowing the average difference between the approximately simultaneous observations, and assuming tacitly a Gaussian distribution, Abbot finds that the probable error of the daily measurement at either station is 0·0065 units. He proceeds to discuss the deviations from average in the estimates. These deviations are, it is true, of the same order of magnitude as the probable error. In the case of 398 estimates, each based on nearly simultaneous measurements at the two stations, the probable error is $0{\cdot}0065/2^{\frac{1}{2}}$ or 0·0046, and the number of such deviations exceeding 0·0046 is 214. The natural deduction would seem to be that the results show just as much consistency as would be expected if the solar heat stream really were constant and the deviations were due to errors of observation. There are, however, a few cases in which the deviations of the estimated radiation from the average are comparatively large. There are 6 deviations greater than 0·0245 units. With a Gaussian distribution of errors, the proportion of such large deviations would have been only 1 in 4000. Dr. Abbot seizes on this as strong evidence of real fluctuations in solar radiation. He suggests that the contrast between the extreme estimates and the ordinary run is comparable with that between the Washington Monument and the blades of grass around it. Dr. Kimball's remark that the determinations on which the extreme estimates are based are generally in the lowest grade of the Smithsonian classification, and mainly observations from one station only, seems more to the point. By a pair of telling diagrams Kimball shows that such correlation as exists between Montezuma and Harqua Hala values is due, not to any agreement in the variations during short periods, but to the large drop in the solar constant at one epoch. For October 1920 to March 1922 the average estimate at each station was 1·945, and for April 1922 to November 1924 it was 1·922. This contrast naturally dominates the situation when the observations of the four years are treated as a single group.

Thus the direct evidence for day to day variations in solar radiation is decidedly weak. Dr. Abbot supports his case, however, by evidence for an association of changes in radiation with the appearance of sunspots and faculæ on the sun.

As to sunspots, this evidence is given in graphical form by Clayton. During the years 1918–1924 there were large sunspots, and the average values of the solar constant, reckoned for each of the 6 days before a spot passed the central meridian of the sun to 22 days after, fluctuate between 1·944 and 1·936. If the days are numbered −6 to +22, 0 being the day the spot was on the meridian, it so happens that days 0, 1, and 12 are on the lower of these limits; days 9, 16, and 22 on the higher. The probable error of a single determination of the "constant" is supposed to be 0·0065 in the years for 1921 onwards. The earlier observations for 1918–1920 had much larger fluctuations. The probable error would average for the whole period at least 0·01. For a mean of 114 determinations the probable error would be about 0·001, so that variations for the mean up to 0·004 are scarcely significant. Moreover, Clayton's figures show no regular sequence. If they are accepted at their face value they indicate that a sunspot causes as violent fluctuations in radiation when it is on the far side of the sun as on the near side. We are forced to the conclusion that the analysis is worthless as evidence for the phenomenon Mr. Clayton wishes to establish, an association between the Smithsonian "solar constant" and sunspots.

Dr. Abbot and his colleagues have not been content to work at the improvement of their sunshine measurements. With the generous aid of Mr. J. A. Roebling, they have investigated the possibility of forecasting the weather by referring its changes to solar variations. The greater part of Mr. Clayton's paper is devoted to tables, graphs, and maps showing the average of pressure and temperature at various places so many days after high or low values of the solar constant. There is no attempt to show that the results are not attributable to chance, and indeed the general run of the graphs is in accordance with the hypothesis that they are.

Having reached this conclusion, how are we to explain the fact that Mr. Clayton can claim a considerable measure of success in forecasting temperature in New York several days in advance? Judging the forecasts by the departure of the mean temperature from normal, we see that when the forecast was "above normal" the average departure was actually nearly +1° F., and when the forecast was "below normal" the average departure was −1·28° F. The system of forecasting was based largely on the observation of sunspots and faculæ: from these observations the solar constant was estimated and the subsequent pressure and temperature changes foretold. But Mr. Clayton did not trust to solar observations alone. "These were supplemented by the temperatures observed at Seattle, Withston, and Chicago, in order to ascertain to what extent the temperatures at American stations were responding to solar changes." Mr. Clayton will forgive us for thinking that his forecasts would have been equally successful if he had trusted to the weather telegrams and ignored the sunspots.

In Mr. Hoxmark's paper we have some account of the method adopted in the preparation of the forecasts which have been published at Buenos Aires for at least two or three years. The forecast published on a Wednesday gives the anticipated temperature at 8 A.M. and 8 P.M. for each day of the following week. As a sample of the results the paper includes a table showing the temperatures forecasted and observed for 12 weeks in the middle of 1924. If the reader takes the trouble to plot these figures he will find little correlation between forecasts and sequel. Calculations give 0·25 as the correlation coefficient in the case of 8 A.M. temperatures. As the standard value of a correlation

coefficient computed from the values of correlated variables is about 0·11, no importance can be attached to 0·25. For this particular period the forecasts must be regarded as a failure.

Mr. Hoxmark's own method of judging the points of his results is to find a correlation coefficient for each week. Of 131 weeks, 87 had positive coefficients and 44 negative. This disproportion must be counted as a point in favour of the forecasts. On the other hand, the fact that more than sixty per cent. of the week's forecasted yield correlation coefficients exceeding 0·3 is in no wise remarkable. Let it be noted that a correlation coefficient formed from seven pairs of samples is likely to be large even when samples are taken quite at random. The standard value of the coefficient derived from such samples is $1/\sqrt{6}$ or 0·41. In spite of the enthusiasm with which the results are recorded, we are left with the impression that these forecasts are not of practical value.

Thus the contention of Dr. Abbot and his collaborators that day-to-day estimates of solar radiation can already be used efficiently in weather forecasting would seem to fail. We have already seen that the reality of the fluctuations in solar radiation is itself highly problematical.

There is, it appears, a much stronger case for large swings in the value of the solar constant, such as was found in 1922. The measurements show a notable reduction of so much as 1 per cent. in the radiating power of the sun as between 1920, 1921, and 1923, 1924. The possibility that such a change may be due to a failure to make complete allowance for some change in the earth's atmosphere is not to be overlooked. Prof. Marvin has brought out how difficult it is to be sure that the atmospheric effects have been eliminated. It is interesting to learn from Dr. Abbot that the solar changes are localised in short wave-lengths. The energy in the green, yellow, red, and infra-red was not affected by the 1922 drop; the effect was confined to the blue, violet, and ultra-violet. It is an obvious comment that this adds to the difficulty of accurate determination, atmospheric scattering being more serious with the short wave-lengths. To Dr. Abbot, a change, such as took place in 1922, indicates a reduction in the effective solar temperature, attending lessened solar activity, and the effects should be larger for shorter wave-lengths.

Let us accept this doctrine as a working hypothesis and look to its verification in the course of the sunspot cycle. At present most of the evidence available dates from the "medieval" era and therefore requires confirmation. F. J. W. W.

Obituary.

Prof. Wilfrid Kilian.

CHARLES CONSTANT WILFRID KILIAN, whose death is announced at sixty-three years of age, was one of the most eminent of French geologists. For thirty-three years professor at the University of Grenoble, he was a man of enormous industry, his published papers and memoirs numbering nearly a thousand. The range of his work was very wide, but he is best known by his classic researches into the stratigraphy and tectonic structure of the French Alps, and by his palæontological work, dealing chiefly with the Lower Cretaceous Cephalopoda; on this group he was acknowledged to be the leading authority.

Born at Schiltingheim, in Alsace, in 1862, Kilian was educated at Strasbourg and at the Alsatian School in Paris, proceeding finally to the Sorbonne, where he was a contemporary of his lifelong friend and collaborator, Émile Haug. Here he was especially influenced by the teaching of Marcel Bertrand, and in 1885 served his apprenticeship in the field as assistant to this great Alpine geologist, on the expedition sent by the Paris Academy of Sciences to investigate the geology of Andalusia, following the great earthquake there. Three years later he presented as his thesis for a doctorate the "Monographie de la Montagne de Lure," a stratigraphical and palæontological study which stamped him as a worker of great promise. The next year found him in charge of the school of geology at Grenoble, and from this time onwards his field-work was devoted entirely to the French Alps, where he toiled with untiring enthusiasm. Spending each summer vacation in the mountains, he can almost be said to have explored every inch from Provence to Mont Blanc, discovering many fossil localities, and bringing precise evidence to bear on the age and stratigraphical relations of the rocks of this intensely complicated region. So enormous was the total of facts recorded by him that the titles of his papers occupy 25 pages of small text in the "Bibliographie géologique du sud-est de la France" compiled by him and a collaborator in 1922.

But never did the call of his field-work in the mountains detract from the care and accuracy of his palæontological studies in his laboratory at Grenoble. Kilian's work on the phylogeny and ontogeny, and on the faunal succession, of Lower Cretaceous ammonites will always be considered classical, and his unique collection at Grenoble is one which many palæontologists of the future will go there to see. In his rôle as ammonite specialist he was frequently called upon to report upon collections from other countries also, and so acquired an unrivalled knowledge of Lower Cretaceous stratigraphy. In the volume contributed by him to "Lethaea Geognostica" he attempted to bring this knowledge together into a comprehensive study. Three parts were published in 1907, 1910, and 1913, but the War intervened, and the work has remained unfinished.

Notwithstanding his immense scientific labours, Kilian never allowed himself to become too preoccupied to fulfil thoroughly his duties as a university teacher. Under his influence the school of geology at Grenoble has become one of outstanding importance, and already some of his pupils rank among France's leading geologists. Many were the awards made to him in recognition of his services to science; finally, in 1921, he received the Gaudry Medal, the highest honour that can be awarded by the Société Géologique de France; and so, after a short and sudden illness, has passed away one whose name will always occupy an honoured place in the history of French geology.

L. R. C.

DR. J. R. HENDERSON.

DR. JOHN ROBERTSON HENDERSON, C.I.E., who died in a nursing home in Edinburgh on October 26, was an example of that "brotherhood between medicine and natural history in its widest sense" which has been a conspicuous product of the University of Edinburgh.

Born in Melrose in 1863, and educated at Dulwich College and Dollar Academy, Dr. Henderson graduated in medicine at the University of Edinburgh, and, influenced by the teaching of Sir Wyville Thomson, turned at once to those studies of marine animals which engaged his attention during the remainder of his life. He was one of the distinguished band of naturalists (which included Hugh Robert Mill, J. T. Cunningham, W. A. Herdman, and W. E. Hoyle) associated with Sir John Murray's oceanographical investigations after the return of the *Challenger*, first on *The Ark*, a canal barge anchored as a floating marine laboratory near Granton on the Firth of Forth, and later, on the steam yacht *Medusa* on the west of Scotland.

In 1886 Henderson was elected professor of zoology in Madras Christian College and relinquished that post in 1911, having, on the retirement of Mr. Edgar Thurston in 1909, been appointed Superintendent of the Madras Museum and Connemara Public Library and Keeper of the Marine Aquarium. On his retirement under the age limit a few years ago, he returned to Edinburgh and at once took part in the scientific activity of the city. At his death he was a fellow of the Royal Society of Edinburgh, and a member of council of both the Royal Physical and Scottish Zoological Societies. His experience in conducting and transforming the well-known Madras aquarium was of much service in the adjustment of the final arrangements of the large aquarium now being erected by the latter Society at the Scottish Zoological Park.

Henderson's zoological researches were almost entirely confined to marine invertebrates. As a result of his early years on the Forth and the Clyde, he made many contributions to the faunal lists of zoophytes, mollusca, echinoderms and crustacea of these areas, mainly published in the Proceedings of the Royal Physical Society. He was responsible for the account of the Anomura in the *Challenger* Reports, and continuing in India his work on crustacea, he described the Paguridæ collected by the *Investigator*. His most important work there, however, lay in the impetus he gave, by teaching and example, by his extension and development of the natural history section of the museum and of the aquarium, to the study of animal life in the laboratory, in the schools, and in the field.

Henderson was a man of wide interests; he wrote an excellent catalogue of the coins of Tipu Sultan, and his goodwill and the geniality which never flagged under the burden of ill-health gained him many appreciative friends in India and at home. J. R.

DR. R. A. JOYNER.

DR. R. A. JOYNER lost his life as the result of an accident on Wednesday, October 7, through an explosion in the research laboratories of Messrs. Nobel's Explosives Co., Ltd. Dr. Joyner studied at University College, Bristol, taking a London degree with honours in chemistry in 1909, followed by the M.Sc. degree of the newly founded University of Bristol in 1910. His work during this period is recorded in three papers on amalgams of silver and tin published in the Journal of the Chemical Society. These exhibit his careful and thorough experimentation and stand unaltered. They form the accepted basis of the treatment of dental amalgams in modern courses on dental metallurgy.

Joyner proceeded as an 1851 Exhibition Scholar to Zürich and afterwards followed Bredig to the Technische Hochschule, Karlsruhe, where he qualified for the degree of doctor of engineering, which has seldom been obtained by students from abroad. His exceptional ability and independent judgment were recognised by Bredig. He published two very pretty experimental papers, one on the affinity constant of hydrogen peroxide, the other on the catalysis of camphorcarbonic acids by bases in various solvents which further elucidated the remarkable parallelism between ordinary reactions and life processes, showing a mechanism through which optical activity may play its well-known rôle.

For twelve years Dr. Joyner served on the research staff of Messrs. Nobel's at Ardeer, and most of the important work which he carried out on such War-time problems as mustard gas and explosives is of course not available for publication, but an estimate of his unusual experimental skill and scientific acumen may be obtained from a study of the paper which he published in the Journal of the Chemical Society on the viscosity of solutions of cuprammonium.

Those who came in contact with Joyner must have realised that few scientific workers showed such wholehearted devotion and enthusiasm. He had many other interests, having been versatile in athletics and being a keen Territorial officer for many years. His straightforward and unassuming personality gained him not only esteem but also affection from all who knew him. In spite of the tragedy of his loss at the age of thirty-eight years, his widow and three children can look back with pride on his devoted work in the cause of science

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WE regret to announce the following deaths:

Sir Alfred Woodley Croft, K.C.I.E., president in 1892–93 of the Asiatic Society of Bengal and sometime trustee of the Indian Museum and Vice-Chancellor of the University of Calcutta, on October 29, aged eighty-four years.

Dr. Theodor Fuchs, corresponding member of the Vienna Academy of Sciences and honorary director of the geological and palæontological section of the Natural History Museums in Vienna, on October 5.

Dr. Carl Kupelwieser, honorary member of the Vienna Academy of Sciences, and a founder of the Institute for Radium Research at Vienna and of the Biological Station at Lunz, on September 16.

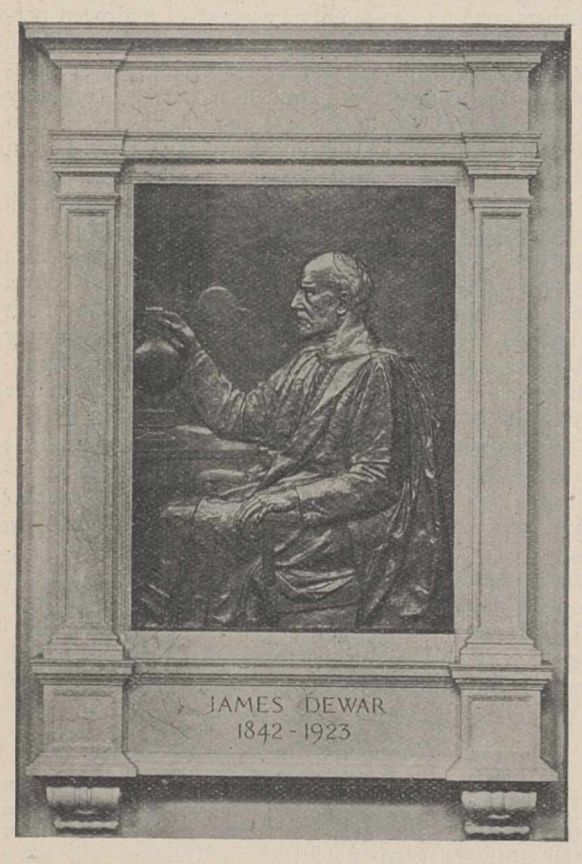
Mr. H. B. Mullen, Director of Museums and Libraries, Salford, and formerly an assistant in the Art and Ethnographical Department, National Museum of Ireland, on October 26, aged sixty-three years.

Mr. M. J. Nicoll, formerly assistant in the Zoological Gardens at Cairo, the author of numerous ornithological papers published chiefly in the *Ibis*, on October 31, aged forty-five years.

Dr. Henry H. Robinson, superintendent of the Connecticut Geological and Natural History Survey since 1920, on October 20, aged fifty-two years.

Current Topics and Events.

ON Thursday, November 12, a small company gathered in the entrance hall of the Royal Institution of Great Britain to witness the unveiling of the memorial to Sir James Dewar, who for forty-six years was director of the Institution. Mr. H. Munro Ross, chairman of the memorial fund committee, described the inception of the fund, and stated that although Dewar himself wished for no memorial, it was felt that a commemorative plaque in the Royal Institution, his home for so many years, and the scene of some of his best work, would meet with general approval. Mr. Munro Ross then asked the president of the Royal



Institution, His Grace the Duke of Northumberland, to accept the plaque as a perpetual memorial to Sir James Dewar and his work at the Institution, and to unveil it. The Duke of Northumberland acknowledged the gift on behalf of the Royal Institution and performed the unveiling ceremony, revealing the relief here illustrated of Sir James Dewar seated before his laboratory bench. Thus Dewar is added to the group of notable men of science connected with the Royal Institution whose memorials grace its entrance hall, and its position, on the main staircase opposite the entrance, ensures that all comers will see the likeness of one who was not the least of those who have directed its activities. After the unveiling ceremony, Sir J. J. Thomson gave a brief address on Dewar and his work. He referred to the originality and forcefulness which were characteristic of Dewar's methods, and also spoke of his genius for devising spectacular demonstrations. In Sir Joseph's view, Dewar's greatest achievements were the liquefaction of gases on a large scale, thus making possible their use as physical agents, and the use of charcoal cooled by liquid air for the production of high vacua. This work has proved to be of fundamental importance in experimental research on the structure of matter.

THE recent visit of Sir Ernest Rutherford to Melbourne, at the instance of the University authorities there, is described in news-cuttings from the Melbourne *Argus* which have reached us. We understand that the Melbourne visit was part of a programme organised jointly by more than one of the Australian universities, and that Sir Ernest had already visited Adelaide, and was proceeding to Sydney, thence going on to New Zealand, his native country. The immediate purpose of the invitation was to enable serious students, researchers, and teachers in physical science to meet and to hear—in some cases, for the first time—one of the prime movers of their own work; and it is evident, from the clearly reported meetings and lectures described in the news-cuttings, that this object was attained so successfully that it cannot fail to yield valuable fruits, directly and indirectly. At the same time, as members of the British Association who travelled to Australia eleven years ago will not need to be told, warm hospitality was shown to the president-elect of the Royal Society, even outside academic circles; and he also came into touch with those concerned in radio transmission, and with medical radiologists.

THE great stimulus of personal intercourse with the comparatively few living pioneers in science is one which comes fairly easily and frequently to the members of British universities, who may thus tend to forget what an extraordinary encouragement and impulse is brought by each such occasion. It will be interesting, therefore, to learn whether the Australian institutions which have arranged this fruitful visit of Sir Ernest Rutherford meditate any plan of making such invitations at regular intervals. High though the cost of a visit is, it would not fall heavily if divided between several universities of the Dominion at intervals of a year or two. To be selected as the "Dominion Lecturer for 19—" would become an honour, for which even the busiest of the most eminent leaders should willingly devote time and energy. The English long vacation falls in the term-time of the Southern Hemisphere, and the necessary additional month or so of leave should present little difficulty. We do not see why such a scheme need be restricted to the branches of science, for historians, economists, and others would no less benefit. It seems certain that a plan of this kind would form a real network of thought and action among British universities and would lead to valuable interchanges of all sorts.

THE Stockholm correspondent of the *Times* has telegraphed that the Nobel Prize in Physics for 1924 has been awarded to Prof. K. M. G. Siegbahn, of the

University of Upsala, for his work on spectrum analysis. The Prize in Physics for 1925 has been reserved, while the Prizes in Chemistry for both 1924 and 1925 have also been reserved. As the Prize in Chemistry for 1924 has thus remained unawarded for two years, the money must either be added to capital or used to form a special fund for promoting scientific research, independently of the annual prizes. Accordingly the 1924 Prize has been assigned to the reserve fund of the chemical section of the Nobel Institute.

ALL who are interested in the trend of modern atomic theory will welcome the announcement that the Nobel prize for physics for 1924 has been awarded to Prof. Manne Siegbahn of Upsala. When the prize was instituted it was intended as a recognition of outstanding experimental work, and Prof. Siegbahn is, first and foremost, an experimentalist. His most notable researches, and those for which the award has been made, have been in X-ray spectroscopy. Since Moseley's first measurements, the technique has been improved to such an extent that it is now possible to measure wave-lengths in this region of the spectrum to six significant figures. This advance is due, almost entirely, to the work of Prof. Siegbahn. In addition to these high precision measurements, he has made an exhaustive study of the soft radiations which lie between the ultra-violet and the ordinary X-ray region. These researches have made possible the theoretical work on which practically all our knowledge of the distribution and energy properties of the electrons in the atoms is based. The complete and accurate data now available have led to the identification of three new elements, hafnium and the two eka-manganeses, while another application which originated and is being pursued in the Upsala laboratories is the investigation of the effect on the X-ray spectrum of an atom of its different states of chemical combination. This work promises to throw much light on the distribution of the electrons in the molecule. It is certainly fitting that experiments which have led to such an important increase in our knowledge should receive recognition, and the new Nobel laureate is to be congratulated on a well-deserved honour.

THE long-awaited particulars of the projected reorganisation of the British Dyestuffs Corporation, Limited, were announced on Saturday, November 14, in an official communication to the shareholders. As anticipated, Government control is to be abolished and the capital of the company is to be drastically reduced. The company states that experience has proved that the restrictions imposed by the Government seriously militated against the successful conduct of business, and the Government has agreed to withdraw its veto and control provided that the company purchases its share interest of 1,700,001*l.* for the sum of 600,000*l.* in cash, communicates to the Government all necessary information concerning technical matters and research, and that the old restriction of not issuing more than 25 per cent. of the company's shares to foreigners, remains in force. The proposals, which are to be submitted to a meeting of shareholders on November 25, also include the writing off of nearly one-half the issued capital to cover depreciated assets, and the conversion of the three classes of shares into a single denomination. The authorised capital is to remain at 10,000,000*l.*, but not more than 6,000,000*l.* will be issued unless by resolution of the shareholders. If the proposals are accepted, the issued capital will be 4,775,580*l.*, all of which will be in the form of ordinary shares, and the sum of 1,667,185*l.* will be available as working capital. The accounts for the period of 17 months to March 31, 1925, show a profit of 88,674*l.*, after providing 437,832*l.* for depreciation. In view of the preponderance of plant capacity over consumption in all dye-producing countries, it is interesting to note that the board proposes to engage in the manufacture of "other products."

DR. KNUD RASMUSSEN, in an address to the Royal Geographical Society on November 9, gave an account of his travels from Greenland along the north coast of Canada to Alaska and across Bering Strait to Siberia In the course of this journey of three and a half years' duration, he had opportunities to explore fully the routes of migration and the culture of various tribes of Eskimos. On the shore of Lake Yathkied, about three hundred miles south-west of Chesterfield Inlet, he discovered an unknown inland tribe of Eskimos, ignorant of the coast life of tribes farther north and living in primitive conditions which suggested that they may be a remainder of the aboriginal Eskimos In places along the north coast of Canada, Dr. Rasmussen found other Eskimos still using bows and arrows and in a state of isolation so complete that no word of the War had ever reached them. As a rule they were very shy of white men, and turned out fully armed to meet the explorers. In several of the tribes it is the custom to put to death nearly all girls at birth, but in other respects they are kindly and well-disposed. Dr. Rasmussen came on traces of the Franklin expedition of 1845–48. He met an Eskimo whose father had seen several of Franklin's men and had visited his deserted ships at King William Island. The bones of two of Franklin's men were found, one in King William Island, the other at Starvation Cove in Adelaide Peninsula. These were men who had fallen in the retreat towards the Great Fish River

A SPECIAL meeting of the Institution of Chemical Engineers was held on Thursday, November 12, for the discussion of the report of the British Science Guild on "Scientific Research Workers and Industry," referred to in our columns on September 26. The president, Sir Frederic Nathan, took the chair, and the Hon. H. Fletcher Moulton opened the discussion and pointed out that although the proportion of science students in Great Britain has increased above the 1914 standard by 60 per cent., it is still only equal to the pre-War proportion for the United States and Germany. In spite of this, many research workers are unable to find posts. There is also an unfortunate tendency to belittle technical research in favour of fundamental research. The great problem is to combine efficiently university training with

factory work at some early period of a student's career. In the discussion which followed, a number of interesting points were brought out. For achieving the desired combination of practical experience and theoretical knowledge, it was suggested that the scheme followed by the Chemical Engineering School of the Boston "Tec," in which training classes under a responsible teacher are regularly held in several works for six months at a time, might be adopted. The importance of good industrial experience as part of the lecturer's qualification was also discussed. Many research workers are, indeed, really more suited for the works laboratory than for the more academic type of research. The discussion of the activities of research associations revealed the fact that the average cost to a firm of belonging to a research association is about the price of one office boy. In spite of the excellent results obtained, however, successful research associations tend to break down by the large firms forming their own research departments.

Two Chadwick public lectures on "The Control of the Food Supply" were delivered by Dr. William Howarth at the Royal Sanitary Institute on October 30 and November 6. In the first lecture, statistics were given illustrating the enormous amount of food imported into Great Britain, and the general principles controlling the supervision of imported food were reviewed. The importance of refrigeration in relation to food supply was emphasised, and it was suggested that local authorities ought to be vested with certain powers of control over cold-storage. Recent regulations designed to ensure greater cleanliness in the handling of meat, etc., will probably fulfil their aim, though the control of stores and shops presents difficulties not easy of solution. As regards the milk supply, considerable improvement might be effected. The control of pasteurised milk is unsatisfactory, as the official term "pasteurised milk" may be used only under licence, but this fact does not deter unlicensed persons treating milk by pasteurisation or sterilisation and selling it in bottles either as "milk" or as "heat-treated milk," or by any other designation so long as it is not an official one. Publicity may have given the impression that the food supply is deplorably unhygienic, but in Dr. Howarth's opinion this is not so, and the position in general is one that may be regarded as reasonably satisfactory, with room for improvement in certain directions. In the second lecture, the subject of milk was further considered. Dr. Howarth pointed out that the definition of cream in the "Preservatives Order" is unsatisfactory, and that cheese is another produce for which no declaration of composition is required, unless it is margarine cheese, with the result that remarkable variations in the fat content occur. The manufacture of canned foods was explained, as well as the method of inspection and sampling applied to them. Other subjects dealt with were eggs, ice, ice-creams, and the use of preservatives in food-stuffs. As regards the last-named, reference was made to the difference of opinion existing as to the harmfulness of such substances as boric acid, and Dr. Howarth expressed a doubt as to whether benzoic acid would prove to be an efficient substitute for boric acid.

We have received from the Central School of Science and Technology, Stoke-upon-Trent, a catalogue of its ceramic library, which includes the well-known collection of the late L. M. E. Solon. Solon was for thirty years in the service of Messrs. Minton, and was an indefatigable collector of ceramic literature. Since his death the collection has been acquired by a gift of 2000*l.* from the Carnegie United Kingdom Trust, and its deficiencies made good by a further gift from the same quarter—the Trust stipulating that the Library should be regarded as a national institution and that its contents should be available (under proper safeguards) to other than the inhabitants of the district. The printing of a catalogue of the collection thus became a necessity. The catalogue is an author catalogue with appendices of (*a*) catalogues and (*b*) periodicals, but this arrangement the student is left to discover for himself. Moreover, the classification is not strictly carried out. Catalogues of books, for example, will be found in all three sections. In other respects the cataloguing methods adopted are not satisfactory. The grouping of anonymous works under the general heading Anon is contrary to accepted practice. Biographical references are not appended to author headings. Hence the student must examine each entry in the author section if he wishes to consult the literature which has appeared around the names of Palissy, Tinworth or Wedgwood. The work, however, is well printed and will, no doubt, be useful to those interested in the literature of ceramics and glass.

In the course of a lecture to the students of the Royal Academy of Arts, London, on Wednesday, November 18, on the selection of stone for building, Prof. A. P. Laurie divided the stones which are used for building into two groups—sandstones and limestones. The most serious cause of weathering to-day is the attack on the stone of the acid oxidised products of sulphur, and this is not confined to the towns. The action of the sulphur acids results in the formation in the case of limestones, and in the case of sandstones which contain calcite, of calcium sulphate, which is slightly soluble in water. The most serious effect of calcium sulphate is its crystallisation within the stone, resulting in the stone being mechanically broken up. Some sandstones are practically free from calcite, and these should be used in modern cities. Limestones differ considerably in susceptibility to attack and in tendency to break up, owing to the crystallisation of the sulphate of lime. Apparently one of the conditions is that there should be free and rapid evaporation from the stone after wetting, so as to draw the sulphate of lime to the surface and prevent it from crystallising inside the stone. This raises the question as to whether the hosing of buildings during hot weather would not be of advantage. Further research is required in these directions, but in the meantime it was quite possible to guide the architect in the selection of sandstones and lime-

stones by chemical analysis and by experiments on the rate of attack of acid vapours upon samples of the stones.

IT is precisely one hundred years ago since the Memoirs of Samuel Pepys, F.R.S., Clerk of the Acts, were first edited by Lord Braybrooke, from a version of the shorthand manuscript in Magdalene College, Cambridge, which had been deciphered by the Rev. John Smith of St. John's College. The private thoughts and confidences of few persons have been more widely read and quoted than those of the versatile Mr. Pepys. He has illustrated the actions, feelings and sentiments of his contemporaries with such a wealth of detail that it is difficult to believe that the diary only covers the years 1659–1669, but as those ten years cover the period of the foundation of the Royal Society, it is very pleasant to receive a reminder of the scientific side of the great diarist, "a great cherisher of learned men," in the form of an article in the October issue of the *Quarterly Review*, from the genial pen of Sir Arthur Shipley. It is surprising to learn that Pepys had had no early preliminary education such as we now expect of a man of science. He reached his thirtieth year before beginning to learn the first four rules of arithmetic, but then an hour on a July morning sufficed for a good beginning with the multiplication table, an accomplishment which he afterwards used to distract and instruct his wife. By associating with the leading men of science of the day he became a scientific amateur of the best type: always receptive, always interested, unspoiled by over-education, he did a vast amount of good by encouraging others.

AN organisation for encouraging the study of natural history in China was formed at a meeting held on September 21, in the lecture room of the department of anatomy, China Medical Board, Peking. In his opening remarks Dr. A. W. Grabau, who was the enthusiastic promoter of the movement, enumerated the existing scientific organisations in China, and stated that he felt that there was a need for a new natural history society. Dr. W. H. Wong, Mr. R. Chapman Andrews, and Mr. Walter Granger also spoke in hearty approval of the organisation of the proposed society. Following a brief discussion, it was decided to adopt the name, "The Peking Society of Natural History." The object of the society is the promotion of the study of, and the spread of interest in, the natural history of China. The following officers have been elected for the coming year: *President*, Dr. G. D. Wilder; *Vice-Presidents*, Dr. W. H. Wong and Mr. Sohtsu G. King; *Secretary-Treasurer*, Mr. N. Gist Gee; *Council*, Dr. A. W. Grabau, Prof. S. C. Lee, Dr. R. K. S. Lim, Dr. H. H. Tan, Dr. Davidson Black and Mr. K. K. Chung. Upon the completion of the organisation of the society, Dr. Wilder addressed the meeting upon the subject "Some Common Birds of Peking." Dr. Wilder had a number of mounted specimens of Chinese birds, and coloured plates of closely related American birds. An interesting feature of the illustrations was some copies by Mr. Kungpah King of ancient Chinese paintings of birds. These were so accurate that in many instances the birds can be identified from them.

MR. L. C. M. S. AMERY, Colonial Secretary, has written to Sir William Thiselton-Dyer congratulating him upon the completion of the "Flora Capensis." An account was given of the inception of this work and the conditions under which it has gradually advanced to completion, in NATURE of September 26, p. 474.

AT the annual general meeting of the Cambridge Philosophical Society, held on Monday, October 26, the following officers for the session 1925–1926 were elected:—*President*, Prof. J. T. Wilson; *Vice-Presidents*, Mr. C. T. Heycock, Dr. G. T. Bennett, Mr. G. Udny Yule; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. J. Gray, Mr. F. P. White, Mr. R. H. Fowler; *New Members of Council*, Prof. G. H. F. Nuttall, Dr. J. Chadwick, Mr. H. Munro Fox, Mr. W. B. R. King, and Mr. P. M. S. Blackett.

AT the annual general meeting of the London Mathematical Society held on November 12, the following officers for the session 1925–1926 were elected:—*President*, Prof. A. L. Dixon; *Vice-Presidents*, Prof. S. Chapman, Mr. J. E. Littlewood, and Mr. H. W. Richmond; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton, D.Sc.; *Secretaries*, Prof. G. H. Hardy and Prof. G. N. Watson; *New Members of Council*, Dr. W. E. H. Berwick, Mr. R. H. Fowler, and Mr. E. C. Titchmarsh.

AT the annual general meeting of the Junior Institution of Engineers held on November 13, the following officers were elected:—*Chairman*, Mr. A. J. Simpson; *Vice-Chairmen*, Messrs. R. L. Kirlew and C. E. Atkinson; *Hon. Treasurer*, Mr. C. O. Hourant; *Hon. Librarian*, Mr. T. W. P. Mullings; *Members of Council*, The Master of Sempill, and Messrs. S. Dunlop, E. D. Gill, and D. B. Skinner.

THE Peterborough Natural History and Archæological Society has acquired for its Museum the collection of fossils made by the late Mr. P. J. Phillips from the Oxford Clay of the neighbourhood. When Mr. Alfred N. Leeds died in 1917, Mr. Phillips continued his work in collecting fossil reptiles and fishes, but he was much handicapped by the introduction of steam diggers in the brickfields. Under difficult conditions he obtained several fine specimens, including a unique example of the rare ganoid fish Heterostrophus.

THE fifth International Congress on Genetics will be held in Berlin during the latter half of September 1927. Those who attended the fourth Conference in Paris, 1911, will remember that a meeting in Berlin was then planned for 1916. The invitation, which now comes from the German Society for the Study of Heredity, has been unanimously accepted by the six surviving members of the International Committee appointed by the Paris Conference. The arrangements are in the hands of Prof. E. Baur, president of the German Society, with whom are associated Profs. Correns, Goldschmidt, Hartmann, and Nachtsheim.

SIR ARBUTHNOT LANE directs attention in the *Fortnightly Review* for November to the importance of good health and the prevention of disease to the nation as well as to the individual. It is estimated that sickness imposes a burden of 500,000,000*l.* per annum upon Britain in the form of lost earnings alone. Sir Arbuthnot Lane ascribes much ill-health to wrong feeding by the use of over-refined and over-manipulated foods. In order to renew the health of the nation, some medical and non-medical men have founded "The New Health Society," which proposes to begin a nation-wide campaign, and all those who are able and willing to help are requested to communicate with the Secretary at Sentinel House, Southampton Row, W.C.1.

AT the annual general meeting of the Philosophical Society of the University of Durham, the following officers and committee were elected:—*President*, The Chancellor of the University; *Vice-Presidents*, Sir Theodore Morison, Sir Chas. A. Parsons, Dr. Irvine Masson, Dr. A. Robinson, Prof. Havelock, and Mr. Wilfred Hall; *Secretaries*, Mr. J. W. Bullerwell and Dr. G. C. Leith; *Editor*, Dr. G. W. Todd; *Librarian*, Dr. F. Bradshaw; *Chairmen and Secretaries of Sections*: (Chemistry and Physics) Mr. P. L. Robinson and Mr. Clarkson; (Geology and Biology) Dr. K. B. Blackburn and Dr. Allan; (Mathematics) Mr. J. L. Burchnall and Mr. Colbourne; (Archæology) Dr. J. Wight Duff and Dr. J. L. Morison; (Applied Science) Dr. Morrow and Dr. Baker; (Philosophy) Prof. Ferguson and Mrs. Alderson.

WE learn that the London Mathematical Society intends to publish, in addition to its *Proceedings*, a second periodical entitled *The Journal of the London Mathematical Society*, which will be issued in four quarterly parts of about 64 pages each, and will be sent free to members. There can be no question that there is room for such a journal, for there is little periodical literature available in the field of mathematics. The new *Journal* is therefore assured of a wide welcome. Its contents will, in the main, consist of original contributions to knowledge, but the papers printed in it will be short and will be selected, so far as possible, from those most likely to appeal to a wide circle of readers. The *Journal* will also contain records of proceedings at meetings, abstracts of papers, obituary notices, and other matters of interest to members. The first part will be published in January next. All business communications should be addressed to the publisher, Mr. Francis Hodgson, 89 Farringdon Street, London, E.C.4.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two investigators under the Safety in Mines Research Board for research work in connexion with wire ropes used in coal mines—Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (November 27). A temporary advisory officer on farm economics under the Board of Agriculture for Scotland—Secretary, Board of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh (November 30). A professor of philosophy in the University of Bristol—Registrar (February 1). A glassblower at the University of Birmingham—The Professor of Chemistry, The University, Edgbaston, Birmingham. A chief mechanician and instrument maker for the chemical department, University College, Gower Street, W.C.1—The Secretary.

Our Astronomical Column.

A THEORY OF STELLAR EVOLUTION.—Dr. J. H. Jeans contributes a further paper on this subject to the Monthly Notices of the Roy. Ast. Soc. (vol. 85, No. 9). It is concerned with the question of stability, and the directions in which it may break down. In the case of the hottest stars a limit of output of energy is reached when, say, 99 per cent. of the nuclei are stripped of all their electrons. A limit on the side of smaller temperature is fixed in the case of the giants by the development under certain conditions of very large pulsations, such as are conjectured to be present in Betelgeux. In the case of the dwarfs it is concluded that at a certain point in their cooling, rapid contraction occurs, and they end their stellar career in a state like that of the companion of Sirius. But Dr. Jeans notes that unless these stars have very slow initial rotations, the acceleration of rotation that accompanies contraction will cause fission, accompanied by a rise of surface temperature. The end may thus be postponed for a season, but it is only delayed. A geographical analogy is used which enables some of the results of the paper to be stated very concisely. The stars are plotted with ordinate denoting absolute magnitude and abscissa spectral type. They group themselves over an area shaped something like North and South America, but with a widened isthmus of Panama. The giants are in North America, the Pacific coast being the line where 99 per cent. of the electrons have been stripped from the nuclei. The Plaskett star is appropriately located near the Victoria Observatory. The Canadian Atlantic coast is occupied by the M giants like Antares, the red dwarfs being much lower down.

The masses of the stars are indicated by graphs that are very nearly parallel to the lines of equal absolute magnitude, showing that Dr. Jeans now regards the law of dependence of absolute magnitude on mass as being a fairly close approximation to the truth.

THE NEW 200-INCH MAP OF THE MOON.—This large map of our satellite will be issued, as stated in NATURE of June 13, in sections measuring 22 by 30 inches. The following will be available for distribution by about the end of December, at a price of 4*s.* per section: Copernicus Region, Tycho R., Mare Crisium, Sinus Iridum, Clavius R., Pitatus R., M. Australe and Plato R. Copies of these, and also of the 60-inch map already published, may be obtained of the author, Mr. H. Percy Wilkins, 46 James Street, Llanelly, South Wales. It is intended that the map shall include every known object on the lunar surface, and the details have been represented with a very careful regard to accuracy. Selenographical literature has been ransacked for details, and every effort made to ensure correctness. The Mount Wilson photos have also been consulted, and the author himself has made a number of telescopic observations which have supplied useful evidence as to certain formations.

Research Items.

MAORI ROCK CARVINGS.—An interesting discovery which will probably prove of some importance in Polynesian ethnology is announced by the Wellington (New Zealand) correspondent of the *Times* in the issue of November 11. Two members of the State Forest Service have discovered a series of rock carvings in a shallow cave 4 ft. to 12 ft. deep, 7 ft. high, and extending for a distance of about 80 ft. along the base of the cliff at the edge of the Kaingaroa Plains near Rotorua. Rough bas-reliefs of canoes, some thirty in all, grouped in fours or singly, were found on the back wall of the caves. The canoes vary from 3 ft. to 8 ft. in length. A point of considerable interest in them is that while they have high stern frames, the bows differ entirely from the Maori form of canoe in having a beak on the waterline, and a high boarding platform. A further point of difference is that the carving on the sides is in the form of a double spiral instead of the single spiral of Maori art. Dr. Buck, the well-known Maori authority, apparently does not regard this difference as necessarily of fundamental significance, and thinks that the people who made the carvings were at least related to the Maoris. So far, the evidence of human habitation in the caves is confined to the stones of a primitive oven and a stone pestle used for pounding fern-root. It is suggested that this cave may have served as a refuge for the Ngatihotu tribe who inhabited the wide central area of North Island and were dispersed some time after the Maori immigration of the fourteenth century.

THE NORSEMEN.—In the *Dalhousie Review* for October, an article by Mr. Victor Plarr surveys some of the evidence for the extension of Norse influence in the tenth and eleventh centuries A.D. A much-disputed question in this connexion is that of the identity of "Vinland," colonised from Greenland by Torfinn Karlsefne in 1003. In the year 1000 A.D. (a year to which Mr. Plarr erroneously assigns the coronation of Charlemagne), Leif, son of Erik the Red, the coloniser of Greenland in 982 A.D., had already reached the mainland of America. Torfinn's colony soon came to an end, possibly, owing to the attacks of natives, the "Skraellings." Mr. Plarr accepts the view that identifies Vinland with Nova Scotia, the "grapes" which the Norsemen are said to have found being, it is suggested, mountain cranberries. He also agrees that the natives with broad faces and ugly hair were Eskimo. This description might equally well apply to some of the Indian tribes, now extinct, who inhabited this part of North America. Mr. Plarr refers briefly to the subsequent history of the Colony of Greenland which died out, the Norsemen being either exterminated by the Eskimo or more probably, he holds, absorbed by them through intermixture. Mr. Plarr, however, does not refer to the very interesting discoveries made in the course of excavations in the graveyard of the Church at Herjolfsnes and described by Nörlund, Hansen, and Jónson in *Meddelelser om Grønland*, vol. 67, 1924, which throw considerable light on Norse culture in Greenland. They included arms, clothes, and personal ornaments, as well as skeletal remains, and a remarkable collection of small crosses in very large numbers.

SNAILS OF THE GENUS PARTULA.—In a publication by the Carnegie Institution of Washington (Publication No. 228a, March 1925), Dr. H. E. Crampton gives the results of a close study of the variation, distribution, and evolution of the genus Partula, in the Mariana Islands, Guam and Saipan. This is the second memoir by the author: the first, published in 1917, dealt with the species of Tahiti. The present volume is illustrated with fourteen plates, four of which consist of beautiful coloured illustrations of the four species inhabiting the islands. The work contains important observations on the ecological characteristics of the Mariana Islands. Though the researches are biological in character, the author discusses the pertinent geological problem as to the prior existence of a great land-mass, or group of land-masses, in the western and southern Pacific Oceans, and from his present studies of the genus Partula he concludes that subsidence has been the general process by which an ancient land-mass with a widespread parental stock has been converted into lesser disconnected areas upon which occur the isolated daughter stocks. Some interesting details are given concerning the geological nature of the habitats and the breeding habits of the snails. *Partula salifana* (a new form from Mount Salifan in Guam) has a remarkably heavy shell, though it occurs in a region where no limestone exists. Conversely, *P. fragilis*, which lives in the northern part of Guam, in a calcareous region, possesses an extraordinarily thin and diaphanous shell. From these and other instances it is clearly evident that character of soil is not a factor influencing the density of the shell. *Partula fragilis* also produces eggs before the flaring lip of the aperture (the conventional sign of maturity) is constructed. Further, in contrast with its associates of the Mariana Islands, its egg-capsules are fully impregnated with calcareous salts. The eggs are also remarkable for their great size relative to the size of the parent shell.

MIOCENE SHELLS FROM TRINIDAD.—The object of Mr. W. C. Mansfield in a recently published paper (Proc. U.S. Nat. Mus., 66, Art. 2) is to describe some inadequately known Miocene Gastropoda and Scaphopoda from Trinidad, and to fix the exact geological horizons of the localities whence they were procured. Out of some 92 species considered, 58 are described as new, while 13 remain indeterminate. The ten plates in illustration of 72 of the species are exceedingly well done.

EXTINCT PROBOSCIDEA.—In the Proceedings of the American Philosophical Society for 1925 will be found Prof. H. F. Osborn's "Final conclusions on the evolution, phylogeny and classification of the Proboscidea." These conclusions Prof. Osborn himself describes as "very startling and novel to those conservatives who would embrace all the two hundred and ninety odd species described from all parts of the world in two genera, namely: *Mastodon* and *Elephas*." He divides them into twenty-eight genera, which are arranged in polyphyletic lines. In a pamphlet of twenty-eight pages it is not to be expected that the author should enter into detailed reasons for his views, and palæontologists will await with interest Prof. Osborn's forthcoming monograph on the group.

RAISED CORAL REEFS OF THE RIUKIU ISLANDS AND TAIWAN (FORMOSA).—Coral reefs raised to heights of from 10 to 684 feet above sea-level are found extensively in these islands of Japan. They are nearly horizontal and rest unconformably on Palæozoic or Tertiary sediments or on igneous rocks. The age of these reefs is discussed by H. Yabe and S. Hanzawa (Science Rep. Tôhoku University, Sendai, ser. 2 (Geol.), 7, 2, 1925). The fossils include numerous species of Foraminifera, Polyzoa, Brachiopoda and Mollusca. The Foraminifera, of which the more important forms are described and figured in this

memoir, differ considerably from those now living in the adjacent seas and suggest that the reefs are of Pleistocene or earlier date; but they are not likely to have been formed during the Glacial Period, since, according to Daly, even so far south as the Hawaiian Islands, the temperature was then too low for reef-building corals to flourish. The evidence at present available suggests that these reefs are either of late Pliocene or early Pleistocene age.

SWEDISH METEOROLOGY.—Among recent publications of the Statens Meteorologisk-Hydrografiska Anstalt is Part 4 of the *Årsbok* containing the meteorological observations taken at Swedish stations during 1922, including data collected at several lighthouses. Altogether there are about two hundred meteorological stations. The data from twenty of these are given in full; from some forty the monthly and annual means are given, and from the remainder the monthly and annual temperature means alone. Another annual Swedish publication of interest is Observations Météorologiques à Abisko en 1916. For this station in lat. 68° 20′ N. the observations are given in full. A further contribution to the hydrographic survey of Sweden is contained in Dr. G. Wersén's paper on the Lulälv in the series entitled De Svenska Valtendragens Areatförhållanden.

THE PASSAGE OF ELECTRONS THROUGH CRYSTALS.—An investigation of the Hall effect produced by applying a magnetic field at right angles to the direction of the photoelectric primary current in diamond and zincblende is described by Dr. H. Lenz in the *Annalen der Physik* for September. Two small electrodes touched opposite edges of the elongated crystal through which the current passed, and the magnetic field was at right angles to the broader faces. The sign of the difference of potential between these electrodes caused by the magnetic field was in the case of diamond that demanded by the theory of electronic deflexion. With zinc sulphide it was often reversed and a number of experiments were made in an endeavour to discover the reason, but neither the orientation of the crystal nor want of uniformity in the illumination accounted for the anomalous results. A theory is developed for the normal effect by means of which it is possible to calculate the free path x and velocity v of the electrons. In one observation with a field intensity of 4000 volts and a magnetic field of 4000 gauss, the Hall effect was 62 volts; this gave $x = 3{\cdot}4 \times 10^{-6}$ cm. and $v = 6 \times 10^{-6}$ cm./sec. for diamond. The lattice cell of this substance is of the order of 10^{-8} cm., so that the electron does not move from one molecule to the neighbouring one but through a greater distance. Values for normal observations with zinc sulphide are of the same order of magnitude. Observations were made with part of the crystal kept dark, and it was shown that the small current which passed through the dark parts was not caused by diffuse reflected light. No alteration in the diamagnetism of diamond was found when it was illuminated, as seemed possible theoretically. Experiments were made as to the production of conductivity by shooting electrons into the crystal, and others on the photoelectric current at the temperature of liquid air.

THE RAYLEIGH SEISMIC WAVE.—In a paper in Part 5 of Vol. 2 of the *Japanese Journal of Astronomy and Geophysics*, H. Nakano discusses the effect of a seismic disturbance in the interior of an elastic solid bounded by a plane face and otherwise extending to infinity. The problem, which is treated in two dimensions only, is an extension of Prof. Lamb's classical investigation of the disturbance arising from a surface pressure. Reference was made to the paper in NATURE of July 4, p. 27, and, as was remarked there, it is shown that the Rayleigh wave does not appear in the neighbourhood of the epicentre, and at no place is marked by a sudden beginning. At greater distances, the time at which it becomes prominent corresponds to the time taken to traverse the distance measured from the epicentre (and not from the focus). The following further details are of interest. When the initial disturbance is such as would give rise to both compressional and distortional waves, two systems of Rayleigh waves are formed. If the velocities of these three kinds of wave are respectively V_1, V_2, V_3, the disturbance of the first system is not appreciable at epicentral distances less than $V_3 f/(V_1^2 - V_3^2)^{\frac{1}{2}}$, where f is the depth of focus; the other system first becomes important at distances greater than $V_3 f/(V_2^2 - V_3^2)^{\frac{1}{2}}$. At distances less than this latter, the separation of an L phase from P and S phases will be almost impossible, as at distances between these values the Rayleigh wave (of the first system) arrives between the P and S waves. When this result has been extended to three dimensions, a comparison of records obtained near the epicentre may throw some light on the question of the depths of earthquake foci, but the problem will be greatly complicated by the existence of the granitic layer, which necessitates taking into account the formation of Love waves.

URINARY ANTISEPSIS.—The problem of the destruction of harmful micro-organisms in living tissues can only be satisfactorily solved with the discovery of substances which are germicidal when acting in the tissues of the body and at the same time are quite innocuous to the latter. The majority of known antiseptics also injure or destroy the tissues in certain dilutions, so that attention has been directed to the finding of compounds which will exert a specific effect on the organisms in concentrations far removed from those which are toxic. A further complication has arisen from the fact that many substances which are bactericidal in watery solutions lose much of their activity when acting in media containing proteins, such as the body fluids. Moreover, for efficient action in the body, it is frequently necessary for the compound to be conveyed to the site of action by the bloodstream, so that to be of any general use it should be capable of administration by the mouth, being subsequently absorbed in the intestine. In the case of the urinary tract, where, especially in the upper parts, the local application of antiseptics is not easy, the compound must also be one which is excreted through the kidneys. Hexamine, given by mouth, produces formaldehyde in acid urine, but effective concentrations tend to be irritating to the mucosa. V. Leonard (*Jour. Amer. Med. Ass.*, 1924, vol. 83, p. 2005) has been investigating the antiseptic properties of a series of alkyl derivatives of resorcinol and has found that the hexyl compound is forty-five times as efficient an antiseptic as phenol, and yet is comparatively non-toxic. When administered by mouth, it is absorbed in the intestine and excreted in the urine, chiefly in conjugation with some other substance, but also in small quantities unchanged; the urine acquires definite bactericidal properties. When tested clinically in cases of chronic urinary tract infection, it was found to destroy organisms such as the *Staphylococcus* and *B. coli*, and, except in cases with heavy infections of the latter, the urine became sterile after a variable period. The real value of the substance can only be determined after prolonged clinical trials, but the early results suggest that a useful urinary antiseptic has been discovered. Hexyl resorcinol has been put on the market by The British Drug Houses, Ltd., under the name of "Caprokol."

Engineering in Steel Works and Collieries.

THE presidential address of Sir William Henry Ellis, delivered at the Institution of Civil Engineers on November 3, was devoted to a survey of the varied and difficult problems arising in steel works and collieries connected with the great development in mechanical engineering which has taken place during the last forty years. In the early part of this period, steel works engineering was in the hands of good practical men who could only with difficulty move with the times, owing to their lack of knowledge of the technical side of engineering. Low pressure steam was supplied to distant mill and machine shop engines with inevitable waste. Electricity probably did not exist in any of the large steel works. High-speed tool steel was unknown, except Mushet steel, used more for its power of dealing with unexpectedly hard material than as high-speed steel is now used. There was, therefore, a great opportunity for young engineers who had received a combined technical and practical training to share in the work of introducing improved machinery. Economic production was not then so important, and there was comparatively little foreign competition.

The introduction of much higher steam pressures with water-tube boilers, and the advent of electricity, have been the two factors of the greatest help to steel-works engineers. To illustrate the advance—thirty years ago a large machine shop, with its inefficient driving and steam generation and distribution, was converting 1·5 per cent. of the total energy of the coal into useful work. Now, by taking power from one of the latest and most efficient super power-stations in Great Britain, the shop can convert 17·38 per cent. of the thermal energy of the coal into useful work. This represents less than one-fifth of the energy available, and hence engineers cannot yet feel satisfied.

Developments in marine engineering caused the introduction of hollow rolling. Up to the time of the s.s. *Lusitania* turbine drums had been nearly all welded. Sir William was able to apply a process of punching and hollow rolling to the production of drums, in some cases more than thirty tons in weight. The process has revolutionised this important industry, and the results have been entirely satisfactory. What has always been wanted for this purpose has been a satisfactory ingot, cast hollow. At present Sir William and his colleagues are interested in experiments in this direction by means of centrifugal casting, this point being mentioned as an instance of the importance of the metallurgist and engineer co-operating in the closest possible way.

The physical properties of steel begin to change at temperatures at which steam is now used—750° F. and higher, and Sir William is carrying out a research on this point, with his metallurgical colleague Dr. W. H. Hatfield. The results of the series of tests being made will be useful to engineers who have to deal with the very high steam pressures employed. If still higher pressures with their corresponding temperatures are introduced, it may be necessary to use alloy steels, the physical properties of which are only affected at much higher temperatures.

No engineers are more definitely entrusted with the lives of their subordinates than mining engineers. Such engineers must possess an extremely varied knowledge, and it is very difficult for the mining engineer of a large colliery to be conversant with all the modern developments in mechanical engineering. Immense progress has been made in recent years in colliery engineering, but much remains to be done, and Sir William urges the desirability of the mining engineer having well-trained mechanical engineers on his staff. Such could render very great assistance to their chief.

Electricity has as yet been introduced into collieries only to a limited extent. No doubt electrical engineers may aid its use by further reducing the liability to sparking. Oil-immersed switches in closed boxes are a considerable safeguard, and the well-thought-out designs of main cables now in use appear to afford great security against risk of short-circuiting in cases of falls of roof. Electric haulage in the workings has largely replaced the practice of surface engines with haulage ropes in boxes down the shafts. Electric winding has been introduced, and is making considerable progress.

Reference was also made to the work of the British Engineering Standards Association, which has now 475 committees and 2300 members. Engineers have shown great public spirit in giving time and attention to this great work—entirely on an honorary basis. Engineers and steel firms throughout Great Britain have generously supported the work by contributions to the funds, but this is a severe tax on industry in the present state of things, and it is earnestly hoped that some measure of Government help may be forthcoming.

The Ignition of Gases.

MANY of the difficulties connected with the ignition of gases are still unfathomed, although the subject has been investigated in one way or another from the time of Davy's well-known researches connected with safety in mines. Measurements of the rate of combustion were first attempted by Bunsen, but it was left to Berthelot, to Le Chatelier, and to Dixon to lay down the methods by which the propagation of combustion in gases could be satisfactorily studied. A further impetus to such investigations came with the development of the internal combustion engine. The recent work of Bone, which indicates that nitrogen plays a considerable part in the process of combustion, is particularly interesting and links the subject with the fixation of nitrogen. It was apt, therefore, that a discussion on the subject should have taken place at the meeting of the British Association at Southampton between the Chemistry and the Engineering Sections.

Prof. H. B. Dixon opened the discussion with a historical survey of the subject. He described Berthelot's discovery of the detonation wave and Le Chatelier's experiments on the same subject at the same date. Le Chatelier discovered three stages of combustion; the stage of uniform propagation, developing into a vibratory type of combustion which precedes the last stage, the initiation of the detonation wave. Prof. Dixon illustrated his remarks by some of his beautiful photographs of the propagation of explosions in mixtures of oxygen with cyanogen, acetylene, and other gases. The explosion wave travels with uniform velocity at the speed at which sound would travel in the gas, taking into account its high temperature and state of compression due to the combustion. Experiments on the measurement of ignition temperatures, which he has recently carried out by two different methods, were described. Tizard and Pye have shown that the delay which

may occur before ignition when a combustible mixture is suddenly compressed adiabatically, depends on the temperature coefficient of the gaseous reaction. Ignition occurs when the heat evolved by the ignition of a gas just exceeds that lost to the surroundings. For the purpose of their experiments, Tizard and Pye used a variable compression machine with a piston which could be stopped by a toggle joint as soon as the gas had been compressed to the desired amount. Prof. Dixon described a similar arrangement by means of which the ignition point of electrolytic gas has been found to be continuously lowered as oxygen is added, in agreement with Le Chatelier's earlier experiments. With methane-air mixtures there is first a lowering, then a rise of the ignition point. It may be mentioned that Tizard and Pye, on the other hand, have found that for heptane-air mixtures the ignition temperature is only changed some 8° C. when the heptane-to-air ratio is increased from 1 to 10. Prof. Dixon showed some interesting photographs of explosions occurring in gases compressed by his falling weight method; the combustion does not proceed from a point, but spreads out from an undefined region of luminosity.

The second method used by Dixon for the determination of ignition points depends on allowing a stream of inflammable gas to meet a stream of oxygen or air heated to the same temperature. This is effected by means of two concentric tubes surrounded by electric heating arrangements and so arranged that the gases can be introduced under high pressure or at reduced pressures. So long as the temperature is above a certain point, the gases on meeting ignite at a certain distance from the orifice of the tube. Increase of pressure as a rule decreases the temperature of ignition, but in the case of hydrogen, decrease of pressure also lowers the ignition temperature, even down to a pressure of one-tenth of an atmosphere.

Prof. David described his work on the effect of radiation on the rate of combustion of gas mixtures in a closed vessel. He finds the radiation which is effective is that which is absorbed by the combustible gas, but that no speeding up occurs if there is no nitrogen present. The radiation 4·4μ is absorbed by carbon monoxide and speeds up the combustion of carbon monoxide, oxygen, and nitrogen; while 3·2μ radiation is absorbed by methane and speeds up the combustion of methane, nitrogen, and oxygen mixtures. If the nitrogen is replaced by argon, oxygen, or carbon dioxide, no speeding up occurs. The rate of rise of pressure measured by means of an optical indicator determines the amount of the speeding up. The effect of radiation is shown not to be due to the inhibition of formation of oxides of nitrogen. Prof. David suggests that the radiation tends to inhibit the temporary association between the nitrogen and the combustible gas, which normally occurs according to his view. Bone has found that nitrogen plays a considerable part in combustions at high pressures, the rate of combustion being much slower when nitrogen is present, the effect being attributed to "activation" of the nitrogen. There result considerably greater amounts of oxides of nitrogen than otherwise would be expected.

When ignition of a combustible mixture occurs in a closed vessel, the rate at which the flame spreads depends on the rate of communication of ignition from layer to layer of the gas and the rate at which the mixture moves under the expansive force of the burning gas. Dr. O. C. Ellis described the method by which he has studied this phase of the subject; work which has been undertaken for the Safety in Mines Research Board. A mechanically controlled camera is arranged to take a series of photographs of the advancing flame; the final photograph has the appearance of being divided into alternate dark and light zones, the exposures being intermittent. For weak mixtures —mixtures near the limit of ignitibility—the lightness of the burning portion compared with the surrounding unburnt gas together with the convection currents which outrun the flame and return upon it, determine the propagation and spread of the flame. For stronger mixtures, burning first occurs at nearly constant pressure; in this case the effect of the enclosure makes itself manifest and the flame moves to the more open space. If there is an opening the flame will move towards it. In a spherical vessel with central ignition, the flame would spread as if to reach all parts of the wall at the same time, but if convection currents have time to influence the combustion, the spread will be quicker in the upward than in the downward direction.

A glow has been found to occur in the flame products and lasts longer than the time taken for the primary flame to spread throughout the vessel. The duration of the afterglow appears to vary with the amount of water present; the glow is greater when argon is used as a diluent rather than when excess of carbon monoxide or nitrogen is present. The glow appears to be due to burning of combustible gas which has escaped the passage of the flame. It is not mainly due to oxidation of carbon monoxide, because in mixtures of oxygen and excess of cyanogen, brilliant periods of residual burning are found.

The incompleteness of combustion and the continuance of processes of combustion after passage of the flame was one of the points brought out by this discussion. Another point, which will no doubt repay further investigation, was the very considerable part played by nitrogen in processes of combustion.

Ornithologists at Berlin.

THE seventy-fifth anniversary of the German Ornithological Society was celebrated in Berlin on October 3-7. The meeting was more like a congress, nearly two hundred members attending, including representatives of eight different countries, in addition to those from all parts of Germany. The programme was full and varied.

On the first evening of the celebrations, an opening address was given by the president, Dr. von Lucanus, and the addresses and congratulations from the ornithological societies of other countries were read and presented. Dr. Ernst Hartert and Mr. Gregory M. Mathews represented the British Ornithologists' Union. Dr. Stresemann compared the status of ornithology in 1850 and 1925. The lectures referred chiefly to Mediterranean and African ornithology: Lönnberg (Stockholm), on the influence of periods of climate on the African ornis; Spatz (Berlin), on Crete; Hartert (Tring), on Atlas and Sahara; Reiser (Vienna), on the present knowledge of the ornis of the Balkans; Koenig (Bonn), on the White Nile; Heck and Neumann (Berlin), on Abyssinia, and so on. Other lectures were concerned with bird-migration: Geyr von Schweppenburg (Münden), Drost (Heligoland), Drescher (Ellguth), especially the results of ringing; with systematic studies and distribution: Kleinschmidt, Freiherr von Berlepsch and others; and ecology: Heyder (Oederan). Most interesting

and valuable were Dr. Heinroth's reports on the rearing of many species of birds from eggs, illustrated by lantern pictures. The rest referred chiefly to local German ornithology (Schlott and others).

Many wonderful nature-photographs and films were shown on the screen; among the latter the remarkable "Ufa" films of bird life in Brazil (hummingbirds nesting, taken by Baron Dungern), in Abyssinia, East Africa, on the Kurische Nehrung (the ornithological station at Rossitten), and on bird migration; also the medieval method of catching thrushes on migration, which is almost extinct now, only lingering in one place in Westphalia. A striking figure among the ornithologists attending was the ex-King Ferdinand of Bulgaria, whose wide and varied knowledge astonished all those who did not know him. Dinners and luncheons concluded the meeting, as well as inspections of the Zoological Gardens and the Aquarium, the model from which the larger London Aquarium has been built. Last but not least, a flight in aeroplanes took place over the forests and swamps of the Mark Brandenburg, Dr. and Mrs. Heinroth explaining where rare birds, such as cranes, various species of Locustella, and others, were breeding. E. H.

University and Educational Intelligence.

CAMBRIDGE.—The School of Biochemistry built by means of funds from the trustees of the late Sir William Dunn has during the last few years found difficulty in maintaining itself on its endowments. The demands of biochemical research are bound to be somewhat extensive in material, and its materials are expensive in character. The same trustees recently gave 2000*l.* per annum to the Medical Research Council for the next five years; the Council has investigated the accounts of the Biochemical Department, and as a result has forwarded 500*l.* towards the maintenance fund of the School.

An extension of the Fitzwilliam Museum is proposed; this extension has been rendered possible by the generosity of two anonymous benefactors who have provided 50,000*l.*

LONDON.—Two free public lectures on "The Efficiency of the Heart and its Measurement" will be given by Prof. Y. Henderson, of Yale University, at University College on November 30 and December 1, at 4.30. On December 4, at 5 o'clock, at St. Thomas's Hospital, Prof. F. G. Parsons will give a free public lecture on "The Earlier Inhabitants of London."

MANCHESTER.—Mr. William Myers, formerly Director of Weaving, has been appointed professor of textile technology in succession to Prof. F. P. Slater, who has resigned.

The Council has received the resignation of Dr. Henry Stephen, senior lecturer in chemistry, on his appointment to the chair of organic chemistry in the University of the Witwatersrand, Johannesburg.

The following have been elected Honorary Research Fellows: Ann Bishop, in zoology; Anthony Claassen (Amsterdam), in physics; Dr. H. Raymond Ing, in chemistry; J. N. Ray (Calcutta), in chemistry; Dr. J. C. Smith, in chemistry.

The Knight Travelling Scholarship in Psychological Medicine has been awarded to Mr. L. C. F. Chevens.

THE East London College gives particulars in its Calendar for 1925–26 of the School of Dramatic Study and Research recently established by the College Council. The Faculty of Engineering offers, in addition to the usual civil, mechanical, and electrical engineering courses leading to the B.Sc. degree of the University of London, a three-years' course in aeronautical engineering.

WE learn from *Science* that the will of the late James B. Duke, former president of the American Tobacco Co., provides 8,000,000*l.* for Duke University, Durham, N.C., 800,000*l.* of which is to be used for the establishment of a medical school and hospital. This amount is in addition to the 8,000,000*l.* given to Duke University last December by Mr. Duke, to which reference was made in these columns (NATURE, December 20, 1924, p. 916).

THE Board of Architectural Education, which, under the Council of the Royal Institute of British Architects, controls education in architecture through the Institute's examinations, has recently been reconstituted in order to make it fully representative of all such educational interests throughout the British Empire. The R.I.B.A. is already in very complete touch with all architectural problems through its allied societies, which represent the profession in specific areas embracing the whole of Great Britain. The Board proposes to delegate executive powers to three committees concerned with schools, examinations, and prizes and scholarships respectively, confining its own work to matters of policy and principle. In addition, there will be a small body of moderators who will deal with the details of the examinations. The numerous schools of architecture and allied arts, polytechnics and art schools concerned, H.M. Board of Education, the Headmasters' Conference, the London County Council and several other bodies, will have seats on the board, which should thus form a very powerful and representative organisation able to stimulate the work of the schools by its visiting committees and to function in the best interests of students and the art and technique of architecture by securing a requisite uniformity in examination matters and educational policy.

THE University of British Columbia, which has long outgrown the quarters in Vancouver City in which it has carried on its work since its establishment in 1915, celebrated on October 16 the opening of its new buildings on the magnificent site, comprising 548 acres on the headland which forms the western extremity of the Point Grey Peninsula, granted for the purpose by the provincial government in 1911. The ceremony was presided over by Sir Arthur Currie, Principal of McGill University, to which Vancouver College, the *nidus* of the University of British Columbia, was affiliated from 1899 until 1915. The new buildings, which have cost nearly two million dollars, consist of three permanent units—the science block, library, and power house—and nine semi-permanent, designed for a life of forty years. Among the latter are an applied science building for departments of geology, botany, zoology, forestry, and civil engineering, an agriculture building accommodating departments of agronomy, animal husbandry, dairying, horticulture and poultry, a mechanical and electrical engineering, a mining and metallurgy, and a forest products building. There are at present but three faculties—Arts and Science, Applied Science, and Agriculture. The number of students enrolled in 1924–25 was 1451. The University is in the fullest sense a State institution. It is an integral part of the public educational system of the province, and its policy is "to promote education in general, and in particular to serve its constituency through three channels—teaching, research, and extension work." A principal aim of the extension work is to inform the people of the province of the results of special work by the staff. Last year the provincial legislature granted 480,000 dollars for the upkeep of the University.

Early Science at Oxford.

November 22, 1687. Some letters were read from Mr. Cluner with Mr. President's answers concerning the squaring the Circle, and Parabola. Some moulds of old coins were communicated by Mr. Musgrave sent by Mr. Hughs out of Somersetshire. Some stones communicated by Mr. Musgrave taken out of the ureters of a man; being 7 small ones, and one very larg being an inch long, and above an inch round. An account of the dissection of Mr. Castillion who dyed of a universal Tabes, and cancer of the Stomach, was also communicated by Mr. Musgrave.

November 23, 1683. Mr. Piggot informs ye Company, that filing takes off ye attraction of iron; as, he says, was found true by a late experiment; but this was afterwards found to be true, onely when ye Iron was filed *all over*: Dr. Plot tells us farther, that of 22 sorts of Iron-ores, which were dug in Sussex, and he has by him, not one applies to ye magnet. It was ordered to be tried whether a peice of this ore will apply after a very great Calcination? as also whether a magnet, and peice of iron, being put into Mr. Boyle's Pump, and ye air exhausted, will draw one ye other? A Catalogue of Bodies Electricall was ordered to be brought in. 'Twas ordered to be tried, whether electricall bodies will operate, as such, in vacuo. Severall of ye stones belonging to Mr. Ashmole's Musæum, were examined, as to their Electricity; A sapphire, a Bohemian granate, a spinall ruby, a balass ruby, and a hyacinth were observ'd to be electricall.

Dr. Pit was pleased to promise, that ye next time we met, he would give an account of some experiments relating to Digestion.

November 23, 1686. Mr. R. P., vicar of Kildwick in Yorkshyre, sent an account of a strange *eruption of waters*, June 1686, in Craven.

An account was communicated from one Tho. Wells in Oxford who cures himself of the *Gout* by drinking Beer, wherein mustard-seed has been Steeped.

He likewise gives us an account of the great *herring fishing* trade lately begun in Summersetshire, by ye coming of the Herrings up the Severn which was not known before this year.

All things were prepared by Mr. Caswell for observing ye Eclipse on the Friday night, but the cloudinesse of the night hindred him from makeing any observations.

Dr. Plot communicated an account of a monstrous *Cucumber* growing in the garden of Dr. Wm. Jacob at Canterbury. Ye length was 3 foot ten inches and a quarter, ye girth circumference 9 inches.

November 24, 1685. An Experiment was tried before ye Society which shewed, that 12 ounces of water was enough to buoy up a vessell of more than two pounds weight, so that ye vessel did plainly swim. This experiment was made use of to confirm ye 10th Prop: of ye 4th book of Stevinus's Staticks concerning ye different pressure of ye same quantity of water in vessels differently shaped.

A Description of a new sort of Pump was read: The contriver of it has made some tryall of it, and thinks it will be usefull, where there is occasion to pump much water, and especially in deep pits.

Dr. Plot shewed us ye *Corallium Album Fistulosum* of Ferrante Imperato; and another Corall with fine small threads of a dark red not described by any, that we know of. He also shewed us an egge of the Sea-Tortoise, which was somewhat bruised, but seemed to have been exactly globular; and a piece of whitish substance very light, called cream of Soap, said to be made by ye nuns of Prussia.

Societies and Academies.

LONDON.

Royal Society, November 12.—Sir William **Bragg** and R. E. **Gibbs**: The structure of α and β quartz. The original investigations upon α quartz left four unknown parameters, namely, the distance of the silicon atoms from the trigonal axis and the spatial relations of the oxygen to the silicon atoms. One parameter could be estimated from the results of intensity measurements, but more data were required. At 573°, α quartz undergoes a transition to the β hexagonal variety, probably with little structural change. If, therefore, the β structure could be determined, that of the α would become nearer solution. The evidence of theoretical calculations and of X-ray rotation photographs of quartz above its transition point shows that in the β structure the oxygens surround the silicon atoms tetrahedrally, and that the spirals parallel to the principal axis are formed by alternate atoms of silicon and oxygen. Atomic dimensions are consistent with the normal values, and the structure agrees with requirements. The structure is consistent with the development of pyro- and piezo-electricity and compatible with the theory of electrical conductivity.—Lord **Rayleigh**: The light of the night sky: its intensity variations when analysed by colour filters (ii.). The observations now extend over nearly $2\frac{1}{2}$ years. The intensities of the various chromatic components of the light undergo important variations when measured against a fixed terrestrial standard, and the components also undergo considerable relative variations when measured against one another. Attention is primarily concentrated on the spectral region transmitted by a screen designed to isolate the green auroral line as nearly as possible. Notwithstanding the definite relative variations, this auroral intensity is highly correlated with the intensity in the orange-red region, not so highly with the blue region, and still less with the photographic region centred near λ4300. The values found for the correlation coefficients are: Aurora-red, 0·70; Aurora-blue, 0·66; Aurora-photographic, 0·44. On the other hand, the auroral intensity is not correlated appreciably with the degree of magnetic disturbance or the height of the barometer. The connexion with the sun-spots, if any, is not yet apparent. The intensity does not vary measurably with the sun's distance below the horizon, within the limits, evening and morning, when twilight is excluded. Parallel observations of the auroral intensity at Pasadena, and at Mt. Wilson, California, are, in the mean, more than double those prevailing in England.—W. A. **Bone** and G. W. **Andrew**: Studies upon catalytic combustion. Pt. i. The rate of combination of a (moist) theoretical mixture of carbon monoxide and oxygen ($2\,CO+O_2$) in contact with a gold surface in a "normal" state of activity at 300° C. or thereabouts is always proportional to its pressure. The "normal" catalysing power of the surface at such a temperature can be (*a*) greatly diminished by *either* keeping it at the room temperature for some days *or* prolonged evacuation of it at 300° C., or (*b*) highly stimulated by previous exposure to either of the two reacting gases at 300° C. Whenever, starting with the surface in a state of "normal" activity, either one or other of the two reacting gases is present in excess, the subsequent rate of combination, which rapidly becomes "supernormal," is always proportional to the partial pressure of the carbon monoxide. It is considered that an "activation" occurs of both of the combining gases of the surface, which is not confined to superficially "adsorbed" gas-films of monomolecular thickness, but extends also to more deeply occluded gases.—O. W. **Richardson**

and F. C. **Chalklin**: The excitation of soft X-rays. When the curves between efficiency of X-ray emission and primary voltage using a photo-electric method are plotted, a number of abrupt changes of slope are observed. Within the range 40-600 volts, four such discontinuities, of which the lowest one is complex, have been observed for carbon, 13 for tungsten, 10 to 13 for nickel, and 15 for iron. Some of these discontinuities are due to the excitation of characteristic X-rays and allied phenomena. The total X-radiation per electron impact is approximately proportional to the square root of the atomic number, for the target elements tested, and to the square of the energy of the impinging electrons.—R. Campbell **Thompson**: On the chemistry of the ancient Assyrians. Ashurbanipal's library of clay tablets inscribed in cuneiform in the seventh century B.C., excavated at Nineveh and now preserved in the British Museum, included tablets now in 24 fragments, giving the native Assyrian receipts for making glazes, glass, and their colours. The first section of these chemical texts describes the furnace for the glass, the magical formulae necessary, and the fuel of *Styrax-logs. The next few sections detail the ingredients for making the celebrated blue glaze, first with a frit of 10 parts sand, 15 alkali, and $1\frac{2}{3}$ *Styrax-gum, followed by copper-scale, prepared by heating, and the subsequent directions for its admixture. Glasses were of three kinds: *sirçu* (60 parts sand, 180 alkali, 5 salt(petre), 2 chalk); *dushū* (crystal) (60 sand, 180 alkali, 6 salt(petre), $\frac{1}{2}$ chalk, 3 oxide of tin (?), 3/10 oyster shell (?)); and *zukū* (components mutilated). The most interesting receipt is to make '*bahrē*'-stone (red coral (?)), approximately 7200 parts of *zukū*-glass, 32 oxide of tin (?), 20 antimony, some salt(petre), and 1 part of go(ld), which suggests the well-known Purple of Cassius.—J. E. **Lennard-Jones**: On the forces between atoms and ions. The repulsive fields of 20 atoms and ions have been determined. Applications of the results are made to evaluate the interatomic distances of 32 crystals, including 16 alkaline halogens. In the case of the latter, the calculated values are found to lie, with one exception, within 1 or 2 per cent. of the observed distances.—F. G. **Mann** and Sir William **Pope**: β, β', β'' triaminotriethylamine and its complex metallic derivatives. The preparation of triaminotriethylamine hydrochloride from bromethylphthalimide has been improved. This amine acts as a tetra- or as a tri-acidic base, according as the tertiary nitrogen atom exerts or fails to exert its basicity. Consequently, two distinct series of aurichlorides, platinichlorides, and rhodiochlorides have been prepared. Co-ordinated derivatives of the base with divalent and tetravalent metals have been prepared: in all these compounds the amine acts as a tetracidic base, and satisfies four co-ordination valencies of the metallic complex.—K. R. **Ramanathan**: The structure of molecules in relation to their optical anisotropy. Pt. ii.—E. V. **Appleton** and M. A. F. **Barnett**: On some direct evidence for downward atmospheric reflection of electric rays. In a study of signal variations at short distances (18-100 miles) from a short-wave transmitter, by changing the wave-length of the transmitter continuously through a small range, interference phenomena were observed, indicating the existence of two or more rays. Experiments made at Cambridge on the signals from London (2LO) have shown that the signal variations are greater on a loop antenna than on a vertical aerial, the ratio of the variations indicating that the direction of propagation of the down-coming waves makes an angle of 65°-70° with the ground. The existence of down-coming waves has been demonstrated at distances of 18 miles from a transmitter, which indicates that the ionised layer reflects waves at almost normal incidence. The rays returned from the upper atmosphere are of complex polarisation, as is to be expected according to the magneto-ionic theory of wave propagation, and are of sufficient intensity to be responsible for the directional errors experienced in short-distance transmission. An inferior limit for the number of electrons per cubic centimetre in the ionised layer is 10^5.

Royal Microscopical Society, October 21.—R. J. **Ludford**: Short osmic acid methods for the demonstration of the cytoplasmic inclusions of cells. After a number of experiments carried out with the view of shortening the technique previously described, shorter methods have been worked out, which give quite as satisfactory results. The tissue is fixed in corrosive-osmic, and the osmication is carried out with 2 per cent. osmic acid at 30° C., for three days, followed by water at the same temperature for another day, to complete the reduction of the acid. An alternative method is to begin the osmication in 2 per cent. osmic acid at 35° C., and dilute daily with an equal quantity of distilled water. At the end of the third day transfer to water also at 35° C. After sections have been cut, mitochondria can be stained by the modified acid-fuchsin method already described.

Physical Society, October 23.—H. E. **Smith**: The influence of strain on the Thomson effect. For pianoforte steel, charcoal iron, constantan and nickel, the Thomson coefficient numerically decreases with tension until the elastic limit is reached, after which it increases. With removal and restoration of tension a new definite cycle is followed. The Thomson effect in tungsten, here measured for the first time, increases with tension and also follows a cycle. No change is noticed in brass or German silver. Heterogeneity was not present in the specimens investigated.—W. **Mandell**: The measurement of temperature by thermocouples in unequally heated enclosures. In doing this, the recorded temperature depends upon the thickness of the couple, the nature of the walls of the enclosure and the nature of the gas. An explanation is suggested based upon the fact that the amount of radiation received and emitted by a couple depends upon its position in the enclosure, and that the amount of energy transferred to it by molecular impact varies with the nature of the gas.—W. **Clarkson**: On the flashing of certain types of argon-nitrogen discharge tubes. Discharge tubes having various types of electrodes, and in which the filling gas, a mixture of argon and nitrogen, had a wide pressure range, were used. At higher pressures the discharge is no longer of the "glow" type, but takes place between definite points on the electrodes.

Royal Anthropological Institute (Indian Section), October 27.—S. M. **Edwardes**: The population of Bombay City: remarks on its origin and growth. The history of the City falls into five well-defined periods, each of which contributed certain distinct elements of population. During the first four periods Bombay consisted of seven separate islets, which were welded together during the fifth or English period. The prehistoric period contributed the fishing-population of Kolis and their aboriginal goddess, whose title has given the name Bombay to the city and western presidency. The second or Hindu period, which lasted until A.D. 1300, witnessed the arrival of the Parsis and Beni-Israel in Western India, as well as the mixed Mohammedan population, resulting from the union of Arab traders and refugees with Hindu women of the coast. The rule of the local Silahara chiefs was responsible for the immigration of various castes of Hindus, notably the Pathars, Prabhus and Panchkalshis, and probably also the

Bhandaris, who cultivate and tap the liquor of the coco-nut palm. During Mohammedan rule the famous shrine of the Saint at Mahrin was established, while under the dominion of the Portuguese (A.D. 1524–1661) the Bombay population was considerably reduced and dispersed by the proselytising tyranny of the Portuguese religious orders, their only contribution to the population being the native Christian and Indo-Portuguese or "Topass" elements. The customs of some of these converts present an interesting study. The real growth of population commences with the arrival of the English in Bombay, and can be traced to certain definite political and domestic events, including the steady reclamation of the island from the sea, and the foundation of the local textile industry. In A.D. 1660 the population was said to be 10,000; to-day it numbers more than one million, including persons from all parts of India and Asia, Europe, Africa, and America.

CAMBRIDGE.

Philosophical Society, October 26.—Sir Ernest **Rutherford** and W. A. **Wooster**: The natural X-ray spectrum of radium B.—C. D. **Ellis** and W. A. **Wooster**: (1) The atomic number of a radioactive element at the moment of emission of the γ-rays. The atomic number found in the case of radium B (82) is 83, and in the case of radium C (83) is 84. Since both these bodies disintegrate by emitting an electron from the nucleus, these results show that the γ-ray emission occurs after the actual disintegration. (2) The β-ray type of disintegration. In a β-ray disintegration the γ-rays are emitted after the electron has left the nucleus. This result is discussed and a general picture given of the β-ray type of disintegration.—D. H. **Black**: The analysis of the β-ray spectrum due to the natural L-radiation of radium B.—D. R. **Hartree**: Doublet and triplet separations in optical spectra as evidence whether orbits penetrate into the core. The separations of terms of all available doublet and triplet spectra are compared with Landé's formula, which is derived on the assumption that the orbit of the series electron penetrates into the core. If in any actual case the orbit does not penetrate, no agreement is to be expected. The results agree in most cases with the assignment of quantum numbers proposed by Bohr; except for lithium-like atoms, *all* p-terms correspond to penetrating orbits.—H. F. **Baker**: On the reciprocation of one quadric into another.—P. A. **MacMahon**: The enumeration of the partitions of multipartite numbers.—R. H. **Fowler**: Assemblies of imperfect gases by the method of partition functions. Theorems of statistical mechanics in a mathematically simple form, applying to assemblies of isolated systems, such as perfect gases or single crystals, are extended to imperfect gases, where the free atoms and molecules continue to act on one another with forces of short but not negligible range, and again with long range forces obeying the inverse square law. We thus recover in a new setting the usual results of the theory of van der Waals, and examine the basis of the important combined use of Boltzmann's and Poisson's equations.—J. P. **Gabbatt**: Note on the pedal locus.—L. H. **Thomas**: An extended form of Kronecker's theorem, with an application which shows that Burgers' theorem on adiabatic invariants is statistically true for an assembly.—W. F. **Sedgwick**: On the series of forms of Jacobi's rotating liquid ellipsoid.

DUBLIN.

Royal Irish Academy, November 9.—Kenneth C. **Bailey**: The estimation of aldehyde in alcoholic liquors by means of Schiff's reagent. The estimation, as usually performed, often gives very inaccurate results. The development of a colour from Schiff's reagent and alcohol, which is apparently not due to aldehyde originally present, is noted, and possible explanations suggested. A reliable technique for the estimation is proposed.

LEEDS.

Philosophical and Literary Society, November 3.—C. K. **Ingold**: Structural relations of natural terpenes. Utilising the principle that gem-dialkyl and allied groupings appear in natural compounds only in such positions that they stabilise the structure, the number of possible natural terpene structures is shown to be limited and to conform to all recorded observations, except one—the alleged occurrence in Nature of sylvestrene.—J. **Ewles**: The luminescence of solids. The lines along which the theory of luminescence of solids is being developed are indicated. It is suggested that the slight trace of impurity necessary for luminescence enters into the crystal lattice of the substance in the form of solid solution. The impurity nuclei, with their linked solvent atoms, are supposed to act as the radiating system.—G. F. **Brett**: The photographic effect of slow electrons. For slow electrons ordinary films and plates are unsuitable and a method is described in which a fluorescent substance in the form of a thin layer of special grease is applied to the film. By this method, electrons having speeds of at least 65 volts and upwards can be registered photographically.—H. M. **Dawson** and J. S. **Carter**: A contribution to the study of the ionisation of strong electrolytes. The solubility of iodine in sodium chloride solutions of widely varying concentration shows that the halogen combining capacity of the salt is independent of its concentration. The condition of the dissolved salt thus appears to be unaffected by change of concentration in agreement with the theory that strong electrolytes are almost completely ionised.—E. **Rhodes** and R. M. **Woodman**: The fatty substances of the plant growing point. Data are supplied as to the fats present at the growing apices of root and shoot of the broad bean at different stages of growth. These are supplemented by data as to the fats formed in excised root tips kept growing in culture media under sterile conditions.—J. H. **Priestley** and G. **Redington**: The effect of diurnal periodicity upon fibre production. Plants have been grown under artificial light, some remaining continuously illuminated, other being removed to a dark chamber for 8 or 16 hours each day. A diurnal periodicity in illumination greatly favours the production of sclerenchyma.—W. T. **David**, S. G. **Richardson**, and W. **Davies**: The effect of infra-red radiation upon combustion of gaseous mixtures containing nitrogen. The rate of combustion of inflammable gaseous mixtures contained in a closed vessel is increased by introducing radiation into the reacting system provided that (1) the radiation is of the type which is absorbed by the combustible gas, and (2) that nitrogen is present in the mixture.

SHEFFIELD.

Society of Glass Technology, October 21.—T. C. **Moorshead**: (Presidential Address) The glass bottle industry and its future developments. The last quarter of a century saw practically a revolution in the manufacture of glass containers. About 1900, two ideas, totally different in principle, suddenly blossomed forth. One was Homer Brooke's idea of feeding a machine with a stream of glass flowing by gravity from the furnace—the other was the application of the suction principle in feeding the machine, a process developed by M. J. Owens. From this

time progress in the development of mechanical devices for glass manufacture has been rapid. To-day many bottle manufacturing plants are mechanically operated practically throughout. In the firm belief in the feasibility of the principle of feeding and melting the batch at the same time, and with the view of blazing the trail for future and more extensive research work, the United Glass Bottle Manufacturers, Limited, are arranging to finance some experimental work based on the principles outlined by Mr. Alex. Ferguson, and described to the Society of Glass Technology in May 1923. The theoretical advantages claimed for the new process are: (1) Smaller radiating surface per ton of furnace melting capacity, the ratio being approximately 2 to 1. (2) More intimate contact between the flame and the constituents of the batch. The first mentioned, however, depends upon (*a*) the feasibility of melting the batch, when pulverised and fed into the furnace in fine powder, in the short time of passage through the flame; (*b*) the corrosive effects of the stream of melted glass on the side walls of the funnel-shaped melting chamber, as well as the effect on the glass itself.

PARIS.

Academy of Sciences, October 5.—Maurice **Hamy**: Study of the photography of stars in full daylight.—H. **Deslandres**: Complementary researches on the structure and distribution of band spectra. Further considerations regarding the formula giving the frequency as a multiple of the universal constant 1062·5.—R. **Szilard**: A new method of distinguishing culture pearls. The method is based on the difference in the densities of natural and cultivated pearls. The pearls are placed in a tube with methylene iodide, and bromonaphthaline added drop by drop, with shaking. For a certain mixture, some float at different heights, others go to the bottom of the tube: the latter are the culture pearls. This test is not applicable to "blue" pearls.—R. H. **Germay**: The cycles of periodic integrals infinitely near partial differential equations of the first order.—A. **Dufour**: Michelson's experiment. A correction of an earlier communication.—Mlle. Anastasie **Anargyros**: Colloidal oxide of manganese. Potassium permanganate, reduced in the presence of sodium protalbate, gives stable colloid solutions of manganese dioxide. After purification by prolonged dialysis, the colloid exhibits Brownian motion, is electronegative, and remains unchanged for a month.—Alfred **Schoep**: Buttgenbachite, a new mineral. This mineral was found adhering to cuprite from the Belgian Congo, and has the composition 18 CuO . 3 Cl . N_2O_5 . 19 H_2O.—R. **Weil**: The synthesis of cristobalite in the wet way. Precipitated silica and sodium silicate solution, heated in a steel tube at 650°-750° C. for seven to fifteen hours, gave crystals of quartz and cristobalite.—G. **Georgalas** and N. **Liatsikas**: The new eruption of the volcano of Santorin (August 1925). Details of observations made during the eruption, July 28-August 23.—Henry **Hubert**: The seasonal clouds of the rains in western Africa.—L. **Petitjean**: The distribution of the forces in the neighbourhood of a discontinuity.—Jacques **Pellegrin**: The presence in Morocco of *Pelobates caltripes*.—Armand **Dehorne**: Observations on *Lagis Koreni*: hermaphrodism, paramyelinic formations in the ovule; nephridian cells with capsules containing a central body.—G. **Mouriquand** and **Leulier**: Avitaminosis C (with or without tuberculosis) and cholesterol of the blood and suprarenals. It is shown that both chronic and acute avitaminosis C is accompanied by profound changes in the metabolism of the cholesterol of the suprarenal capsules. The trouble is aggravated when associated with tuberculosis.—A. **Gruvel** and B. **Conseil**: Remarks on the biology of *Orcinus alalonga* in the sea near the Antilles.—S. **Métalnikov** and **Rapkine**: Phagocytosis and immunity in the blastula and gastrula of sea urchins. The larva of sea urchins, even in the blastula and gastrula stages, possesses a marked immunity against *Bact. tumefaciens* and Contacuzène's micro-organism. On the other hand, it is very sensitive to the cholera bacillus. It is shown that the immunity against the first two organisms is due to phagocytes detached from the summit of the primitive intestine.—E. **Grynfeltt** and H. J. **Guibert**: The alterative lesions of the lamellar tissue in the course of experimental inflammation.—Léon **Binet** and René **Fabre**: The elimination of camphor and oil, after experimental injection of camphorated oil. The camphor is rapidly eliminated, mainly through the kidneys. The oil remains for some weeks at the place of injection, and is slowly absorbed by leucocytic action.

CAPE TOWN.

Royal Society of South Africa, September 30.—James **Moir**: Colour and chemical constitution. Pt. xxi.: An astronomical orbit theory of colour with special reference to the dicyclic azo dyes. In the monocyclics, colour is built up from one ring by adding a hapton; in the dicyclics colour is built down by bending the chain. The mathematical theory in the paper does not supplant the author's earlier factorial theory, but endeavours to give it a physical basis.—C. **Pijper**: Note on witchcraft in Europe: the case of Anne Boleyn. The motive for the execution is considered to have been the belief that Anne Boleyn was an adherent of the witch-cult. The author bases his study on the work of M. A. Murray.—Ernest **George**: (1) The preparation of umbelliferone.—(2) Some phthalein analogues.—T. R. **Sim**: The Bryophyta of South Africa.

SYDNEY.

Linnean Society of New South Wales, August 26.—E. C. **Chisholm**: The Comboyne Plateau: its general conformation and flora. In this paper the flora of the Plateau is briefly dealt with from an ecological or economic point of view; and a list is given of the plants collected on the Plateau arranged in botanical sequence.—John R. **Eyer**: A comparison of the male genitalia of the Palæosetidæ with those of other Lepidoptera Homoneura. From a tabulation of the archaic characters of the genitalia, it is shown that the male genitalia of Palæoses possess certain structures quite similar to those in Prototheoridæ and Hepialidæ. They retain more archaic characters than these two families and stand intermediate between Prototheoridæ and Micropterygidæ, the latter family having the greatest number of archaic genitalia characters among the Lepidoptera Homoneura.—Rev. H. M. R. **Rupp**: Notes on species of Pterostylis. Of the forty-three known species of Pterostylis the author has obtained thirty-two and has made extensive field notes regarding their character, habit and geographical distribution. One of the finest species, *P. Baptistii*, was originally found in a peaty swamp near Fivedock and was thought to be rare but has been found to be fairly abundant at Bulladelah.—Prof. M. **Bezzi**: On the tachinid genus Euthera, with descriptions of new species from Australia, Africa and South America. A key is given for the determination of the seven known species of Euthera, four of which are described as new.

Official Publications Received.

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Period ended 31st December 1924; with Report of the Director of Fuel Research. Pp. vi+78+8 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 11, Part 3: The Sphegidae of South Africa, Part 6, by Dr. George Arnold; Three additional new Species of South African Dolichopodidae (Diptera), by C. H. Curran; On Upper Albian Ammonoidea from Portuguese East Africa, with an Appendix on Upper Cretaceous Ammonites from Maputoland, by Dr. L. F. Spath; Cretaceous Gastropoda from Portuguese East Africa, by Leslie R. Cox. Pp. 137-216+plates 27-39. (Cambridge: Printed at the University Press.)

University College of North Wales. Calendar for Sessions 1924-25 and 1925-26. Pp. 469. (Bangor.)

Empire Cotton Growing Corporation. Memorandum by the Mechanical Transport Sub-Committee, G. H. Baillie, R. H. Brackenbury, Col. C. N. French. Pp. 20+9 plates. (London: 2 Wood Street, S.W.1.) 2s.

Scientific Papers of the Institute of Physical and Chemical Research. No. 37: Change of Wave-Lengths for certain Lines of Zinc, Cadmium and Mercury in a Condensed Discharge. By Mitsuharu Fukuda. Pp. 183-192+plates 11-16. 65 sen. No. 38: On the Insecticidal Principle of Insect Powder (Chrysanthemum Cinerariifolium, Bocc.). By Ryo Yamamoto. Pp. 193-222. 80 sen. No. 39: Sur la composition du nickel réduit comme catalyseur. Par Bennosuke Kubota et Kiyoshi Yoshikawa. Pp. 223-232. 20 sen. No. 40: Use of Grating for the Ether-Drift Experiment. By Uzumi Doi. Pp. 233-241. 25 sen. (Tokyo: Institute of Physical and Chemical Research, Komagome, Hongo.)

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-sè (Chine). Tome 14, Fascicule 1: Observations du soleil (taches et protubérances), 1920, 1921, 1922. Pp. A59. (Chang-hai.)

Memoirs of the Asiatic Society of Bengal. Vol. 9, No. 1: Geographic and Oceanographic Research in Indian Waters. By Major R. B. Seymour Sewell. Part 1: The Geography of the Andaman Sea Basin. Pp. 26+5 plates. 3.15 rupees. Vol. 10, Part 1: Studies in Santal Medicine and connected Folklore. By Rev. P. O. Bodding. Part 1: The Santals and Disease. Pp. vii+132. 5.1 rupees. (Calcutta.)

Imperial Economic Committee. Report of the Imperial Economic Committee on Marketing and Preparing for Market of Foodstuffs produced in the Overseas Parts of the Empire. First Report: General. (Cmd. 2493.) Pp. 38. (London: H.M. Stationery Office.) 9d. net.

Diary of Societies.

SATURDAY, NOVEMBER 21.

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11 A.M.—S. Dickinson: New Method of Isolating Single Spores.—W. J. Dowson: Fall of Apples Associated with Core-rot due to Sclerotinia Fructigena. —J. Ramsbottom: Fragmenta Mycologica IV.—A. Smith: Pénicillium Diseases of Gladiolus and Narcissus.—A. Lorrain Smith: Lichen Dyes. —E. M. Wakefield and W. Buddin: Life-history of a Fungus Parasitic on Antirrhinum Majus.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (jointly with Institute of Mining and Mechanical Engineers) (at Neville Hall, Newcastle-upon-Tyne), at 3.—R. Dowson: The Steam Turbine in the Electrical Industry.

MONDAY, NOVEMBER 23.

NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (Annual Meeting) (at Central School of Science and Technology, Stoke-on-Trent), at 5.—Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—E. E. Tasker and others: Discussion on The Testing of Large Electric Plant.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—T. Carter: The Engineer: his Due and his Duty (Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Dr. R. Lessing: Coal Ash and Clean Coal. I. (Cantor Lecture.)

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Dr. H. Gordon Thompson: From Yunnan-Fu to Peking along the Tibetan and Mongolian Borders.

CHEMICAL INDUSTRY CLUB.

TUESDAY, NOVEMBER 24.

ROYAL DUBLIN SOCIETY, at 4.15.—K. C. Bailey: The Action of Radon on Mixtures containing Ammonia and an Oxide of Carbon.—P. A. Murphy and R. McKay: Methods for Investigating the Vivies Diseases of the Potato, and some Results Obtained by their Use.—E. J. Sheehy: An Examination of the Errors Introduced by the Various Approximate Methods used for Estimating the Total Quantities of Milk and Butter Fat Produced during a Lactation.

INSTITUTION OF AUTOMOBILE ENGINEERS (at 83 Pall Mall), at 6.30.—Discussion on Gradient Meters and Tire Pumps.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—O. Brunler: Internal Combustion Boilers.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—T. Carter: The Engineer: his Due and his Duty (Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. J. Noel: The Story of the Mount Everest Film and Slides.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.30.—Sir Arthur Evans: Early Nilotic, Libyan, and Egyptian Relations with Minoan Crete (Huxley Memorial Lecture).

WEDNESDAY, NOVEMBER 25.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Neville Hall, Newcastle-upon-Tyne), at 7.15.—C. H. Cooke: Lubrication.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Houldsworth Hall, Deansgate, Manchester), at 7.15.—Capt. R. K. Hubbard: The Requirements of the Military Motor Vehicle.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.15.—A. T. King: Migration of Alkali (in Wool), or Indicator-dyed Wool.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.30.

ROYAL SOCIETY OF ARTS, at 8.—D. Greenhill: Colour Printing.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 1 Wimpole Street), at 8.30.—Dr. E. Glover: The Neurotic Character.

THURSDAY, NOVEMBER 26.

ROYAL AERONAUTICAL SOCIETY (at 7 Albemarle Street), at 5.30.—A. H. R. Fedden: Installation Problems in Air-cooled Engines.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Dr. L. J. Llewellyn: Diathesis (Presidential Address).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Brig.-Gen. R. J. Kentish: Playing-Fields for Children.

INSTITUTION OF STRUCTURAL ENGINEERS (Yorkshire Branch) (at Great Northern Hotel, Leeds), at 6.30.—E. C. Snelgrove: Fieldwork in Central Africa.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7.30.—W. B. Flint: The Motor Omnibus as a Means of Public Transport.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry, Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—J. W. Mitchley: Fuel.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Neville Hall, Newcastle-upon-Tyne), at 7.30.—G. S. Baker: Measured Mile Trials and other Ship Propulsion Data. Part II.

CHEMICAL SOCIETY, at 8.—Prof. R. Robinson: Recent Researches on the Structural Relationships of some Plant Products (Informal Lecture).

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (London), at 8.—Impromptu Debate.

FRIDAY, NOVEMBER 27.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section, jointly with International Society of Medical Hydrology), at 10 A.M.—Discussion on The Treatment of Rheumatism in Industry.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Olympia), at 11 A.M.—C. H. Macmillan: The Installation of Small Marine Motors.—At 2.30.—Basil H. Joy: The Advantages of Twin-Screw Installation for Motor Boats.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—R. G. Lunnon: Atomic Dimensions.—W. E. Benton: On Edge Tones. —J. J. Manley: The Spectroscopic Determination of Minute Quantities of Mercury.—Demonstration by G. R. Mather of an Instrument for Imitating the Eastward Motion of Bodies Dropped from a Great Height.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institute of Chemistry) (at 39 Elmbank Crescent, Glasgow), at 7.—W. G. Hiscock: The Heat Evolved during the Detonation of Explosives.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.—A. P. Hill: The Tungar Rectifier.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—E. Granville-Smith: The Engineer and his Relationship to the Tea Industry.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. P. F. Fanghanel and others: Discussion on The Work of the Mechanical Engineer in Non-Engineering Industries.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch, Graduate Section) (at Middlesbrough), at 7.30. —W. L. Rigby: Steel Framed Structures.

SATURDAY, NOVEMBER 28.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—S. L. Pepper: Mining Royalties, with Special Reference to Surveying. —Papers open for further discussion:—Underground Efficiency in Collieries, with Special Relation to Labour, by H. R. Houston; Modernisation of Old Collieries, by H. P. Mould.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 21.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—G. C. Robson: Animal Life in the Depths of the Sea.

TUESDAY, NOVEMBER 24.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Philosophy of Aristotle: The Highest Good for Man: The Best and Actual States.

WEDNESDAY, NOVEMBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. W. M. Willoughby: Infection in Ships and the Prevention of Spread therefrom.

CHEMICAL SOCIETY, at 5.30.—Dr. B. A. Keen: The Physicist in Agriculture, with Special Reference to Soil Problems (Lecture in the series "Physics in Industry," given under the auspices of the Institute of Physics).

UNIVERSITY COLLEGE, at 5.30.—G. F. Barwick: The British Museum for Research Purposes.

THURSDAY, NOVEMBER 26.

KING'S COLLEGE, at 5.15.—E. L. Woodward: Thomas Hobbes.—At 5.30. —M. Beza: The Story of the Creation and the Flood in Roumanian Folklore. (Succeeding Lecture on December 3.)

SATURDAY, NOVEMBER 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—E. Lovett: The Luck of an Old Shoe.