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Financing Research

ONE of the commonest indictments of the financial structure in Great Britain as compared with, for example, Germany and the United States of America, has been the reluctance of our banking system to make advances for the financing of new industrial enterprises or the reconstruction on modern lines of established industries. There has, indeed, existed a definite gap in our national organisation, to which the Macmillan Committee directed attention, and to close which it suggested the development of a new body or Board of National Investment. Reference has frequently been made to this gap in recent months, notably in a letter to the Prime Minister from Mr. T. D. Barlow, the chairman of the Lancashire Industrial Development Council.

The unanimity with which, at recent general meetings of various important banks, the chairmen have been at pains to stress the importance of scientific research is accordingly the more remarkable and indeed startling, while Mr. J. W. Beaumont Pease, addressing the meeting of Lloyds Bank, made the significant statement that steps to form an organisation to close this gap in our financial structure are actually being taken.

Addressing the shareholders of Martins Bank Ltd. on January 24, Mr. A. A. Paton, for example, quoted examples of successful research in the cotton industry, particularly the recent discovery of a method of treating cotton cloth chemically which renders it practically indistinguishable from silk, and said that this result was directly due to research on scientific lines undertaken in Manchester. It may well establish cotton goods as a rival both to rayon and to silk, and substantially assist our export of cotton cloth in the finer qualities. "This success," said Mr. Paton, "should encourage all industrialists to recognise the important part that scientific research can play in the development and improvement of their production and lead them to a wider realisation of its value to them."

Mr. F. C. Goodenough's address to Barclays Bank Ltd. similarly asserted that the importance of research work in the advance of industry cannot be overestimated. The place to be assigned to the scientific worker in industry is, he said, a factor of the greatest importance which we cannot afford to overlook in the production of high quality goods. We must look forward to the development both of co-operation and individual effort in

research if the craftsmanship of our workmen is to receive the maximum support of scientific knowledge in facing the present severe world competition. Similarly, the Hon. Rupert E. Beckett, addressing the Westminster Bank on February 2, asserted that we must endeavour by every means at our command to keep abreast of development in existing industries and take advantage of every opportunity to establish new industries. To allow industry to mark time would be fatal. We have a great reserve of scientific and inventive ability and it is essential that, faced as we are with shrinking markets for our products in many directions, we should utilise to the full any opportunities for new development which may be made available to us by scientific investigation. Mr. R. MacKenna's address to the Midland Bank on January 27 also referred to the great attention paid by many firms to scientific research, the value of which can scarcely be overstated, "though there is still room for great advance in this direction. The facilities for such research, through Government establishments, trade organisations and university institutions are greater than ever before and should be used to the full."

In the same strain Sir Christopher Needham told the District Bank Ltd. on January 27 that "A modern competitive industry must regard industrial and technical research as a necessary part of its very structure; only then will it be ready to take full and prompt advantage of improvements which scientific discovery reveals. The benefits of research are not necessarily restricted to big business, for any concern, great or small, which is wise enough to seek it can now find the essential help of this kind at its disposal." Of the cotton industry he added, "To-day more than ever before the cotton industry needs to know all that science can discover about the raw material it uses. The industry is singularly well served by its Research Association at the Shirley Institute and this co-operative effort of the industry to apply science to the production of cotton goods has been more than justified by results." He expressed the hope that the efforts of the scientific workers and technicians will receive that encouragement and help from the industry which they deserve.

Joining in the same chorus, Mr. G. P. Dewhurst also referred to the position in the cotton industry and told the Williams Deacon's Bank Ltd. on the same day that "Facilities for industrial research are available for all and science is fully capable of showing how processes of manufacture may be improved upon and persistent investigation to that end cannot fail to bring its reward".

Sir Harry Goschen's address to the National Provincial Bank Ltd. on January 26 referred to scientific research and the application of its results in industry as being at the root of our power to sell our goods and to meet the needs of our population so far as possible out of our own resources. Slow as the practical man in Great Britain has been on the whole to take full advantage of the products of the laboratory, the greater interest he is now taking in scientific activity is a happy augury for the future welfare of our people. There is room, Sir Harry said, for still closer contact between the industrialist and the scientific worker and this is provided by that useful organisation, the Department of Scientific and Industrial Research.

Mr. J. W. Beaumont Pease's contribution, as chairman of Lloyds Bank Ltd., is sufficiently important to merit quoting in detail. Admitting that a prime condition of industrial recovery is the solution of the difficult international financial problems which confront us, he asserted that that in itself would not ensure the return of prosperity to Great Britain unless we exercise the same resourcefulness and enterprise which our predecessors showed in no less difficult though somewhat different circumstances in the past. "To-day there is probably no direction affording a better prospect of rich reward than scientific discovery. It has to be remembered that the exercise of the native and untutored genius for improvisation and invention which in the past was sufficient to keep us in the van of progress is no longer sufficient. Economic production is to-day a highly expert business requiring the specialised training such as is possessed by the man of science. We must turn more and more to the research worker to point the way towards new advances and industry must realise that an efficient and well equipped research organisation is an essential element of good management."

Referring to the facilities for industrial research which are open to all in Government establishments, trade research associations and university institutions, Mr. Pease, in answer to the argument that only the larger and richer firms can finance such research, agreed that some organisation for providing finance for intermediate loans of modest amounts, and for comparatively short periods, which would fill the gap between ordinary banking loans and those of a longer duration and for

larger sums, would be a desirable addition to our financial machinery. Steps to form such an organisation, he announced, are actually being taken.

The scientific worker may well rub his eyes in bewilderment and wonder whether the millennium has dawned! That the chairmen of eight large banks should speak in exactly the same strain and in the course of balanced and comprehensive surveys of the national position, in which due regard was had to all the other relevant factors, can scarcely be mere coincidence. The statements regarding the position and importance of research as a factor in national and industrial development could not be bettered and represent an outlook we have consistently urged in these columns for years past. Such sudden and mass conversion of a section of the community renowned for its conservatism cannot but quicken expectations of welcome and beneficial developments in national policy.

To whatever leaven this change of outlook is to be ascribed, whether to the educational work of the Department of Scientific and Industrial Research and other organisations, to the intensity of our present difficulties, or to increased contact with those responsible for developments in Germany, the United States, or Soviet Russia, undue optimism would be premature. On one hand, research is only one factor in new industrial development and the revival of trade is indeed only one of the fields in which scientific thought makes an important if not essential contribution. On the other hand, the present precarious position of the Research Association of British Rubber Manufacturers, which was discussed in NATURE of February 11 and 25, reminds us that industry is still very far from accepting research as a fixed charge comparable with obsolescence and insurance.

Plenty of evidence could be found that in other industries also, those in control have yet to learn that there is something to be gained by the application of the results of research. In the cotton industry, more co-operation is still required between the Shirley Institute and the technical staff in the industry. The scarcity of technical men on the directorates and boards of many industries is a common obstacle to the full appreciation of the value of scientific work, and research staffs are often the first to be cut down in times of panic.

There is, however, in such unanimity as is shown by the banking interests, at least the danger that over-emphasis may be laid on the assistance which scientific research can contribute towards recovery. Research is only one factor, and a great expansion in scientific and industrial research is more likely to contribute to our future prosperity than to the relief of our immediate difficulties. What is perhaps even more important at the present moment is that greater use should be made of the results of research already available, and that the scientific spirit and method should be more seriously and widely applied to assist in the handling of those difficult and intricate problems of management, production and distribution, on a national as well as on an international scale, with which industry and politics alike are confronted in a scientific age. It is to be hoped that the scientific outlook indicated in the eight addresses we have quoted will be reflected in the banks themselves according a place to scientific and technical opinion and advice in their counsels. It is only as such steps are taken that we can hope for the appropriate handling of the difficult problems which research inevitably brings in its train. It must be remembered that, from one point of view, scientific and industrial research disturb the stability of our economic and social order. Research tends to a dynamic society the ordering of which makes much greater demands on administrative ability than are made by a static order.

That scientific research should be commended in this manner is at least an encouraging sign. We may hope that such encomium will induce industry generally to apply more wholeheartedly and widely the results of research, to accord technical and scientific men a much more influential place in the conduct of its affairs, if not indeed to demand technical and commercial attainments as essential qualifications for a place on its boards of directors and management. We may hope, too, that the changed outlook will result in far more generous support for fundamental and long-range research, whether conducted in Government institutions or in the universities, upon which in the end even industrial progress depends. There is so much room for improvement in these matters that long before excessive effort has been expended on research, scientific workers themselves should be able to bring home to the community the essential fact that research is only one factor in recovery, one aspect of the fundamental problem of ordering the life of industry and of society in the light of reason and knowledge and not of prejudice.

Radio Communications by Very Short Electric Waves

THE Marchese Marconi delivered the Friday evening discourse at the Royal Institution of Great Britain on December 2 and described his experimental investigations during the past year or two with electric waves less than one metre in wave-length. The systematic investigation of the properties and characteristics of these very short waves was taken up in view of the advantages which they seemed to offer in the field of practical radio communication, on account of the small dimensions of the apparatus necessary for emitting and receiving a considerable amount of electrical energy, combined with the freedom from interference due to electrical disturbances on such wave-lengths. At the commencement of his lecture, the Marchese Marconi referred to the fact that in 1896 he demonstrated the possibilities of short-distance wireless communication on a wave-length of about 30 cm., using a 'spark' transmitter and suitable reflectors. In the more recent work, a thermionic electron oscillator was employed, operating on the principle first demonstrated by Barkhausen and Kurz as a means of producing oscillations corresponding to wave-lengths of less than 100 cm.

Development of the Transmitting Circuit

After testing, with varying success, all available receiving and amplifying valves with cylindrical electrodes used in the standard circuits, a special

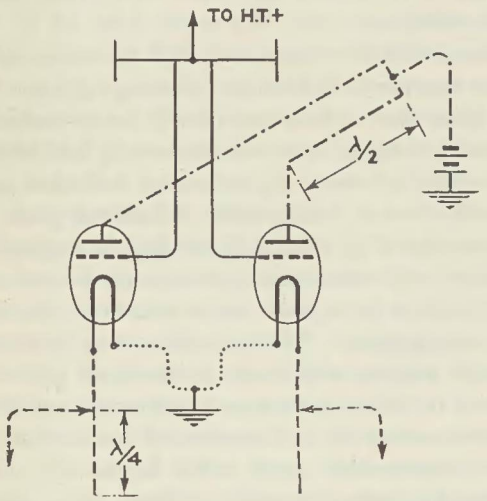

Fig. 1. Valve circuit for short-wave transmitter. Outside filament tuning – – – ; inside filament tuning ..... ; plate tuning – – – ; aerial and feeder impedance transformer ———.

type of valve was developed, suitable for generating powerful oscillations under conditions leading to a reasonable life. These valves were made in pairs, as the mirror images of one another, and the basic circuit developed for their use is indicated in Fig. 1.

This new electronic oscillator is characterised by three definite tuned circuits, namely, an inside and outside filament-tuning circuit and an anode-tuning circuit, and also by the use of a feeder-impedance-transformer, the purpose of the latter being to match the internal resistance of the valves with that of an efficient dipole aerial. The small discs at the end of the dipole aerial act as end capacities, and experience has definitely indicated that their use secures more radiated power and renders easier the adjustment of the feeder-impedance-transformer than is otherwise possible.

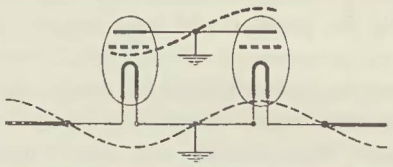

Fig. 2. Distribution of potential along filament tuning and plate tuning circuit.

The anode-tuning and the inside filament-tuning circuits are the controlling factors of the wave-length at which the transmitter can be made to oscillate with efficiency, all the other adjustments being dependent upon them. It is necessary to point out that the length of conductor required to connect the two anodes together for correct tuning is very small—it is only about 5 cm. for a wave-length of the order of 50 cm.—and the explanation of the fairly long kind of Lecher wire, shown in Fig. 1, is that it has been found possible and also desirable to add to that short conductor another conductor one wave-length long, bent back on itself to avoid loss by radiation.

The correct distribution of the potential along the plate and filament circuits, obtained by these tunings, is shown in Fig. 2. In addition to adjusting correctly all the external portions of the new circuit, it is necessary to arrange the electrical supplies to the valves employed so as to generate electronic oscillations between their electrodes at a frequency corresponding as closely as possible with that of the external circuits.

The radiated energy of one standard unit transmitter has been measured by placing the whole apparatus, except the aerial and feeder, in a calorimeter and taking temperature curves first with the transmitter in oscillation, and then in non-oscillating condition, all the electric currents being kept constant. Consistent results were obtained by this method indicating an average radiation power of 3·5 watts. The power absorbed by the filament was approximately 30 watts, that by the grid approximately 25 watts, the overall efficiency being, therefore, about six per cent, increasing to fourteen per cent, if the grid power only be taken into account.

The possibility of substantially increasing the radiating power of a transmitter was successfully realised by running several of these unit transmitters in parallel with their aerials all in line and

spaced so as to secure the maximum directive effect.

Various methods of modulating the new transmitter were investigated, and the one finally adopted, chiefly on account of its simplicity, was that of superimposing the modulation on the steady negative bias voltage applied to the valve anodes. Where several transmitting units were connected together in correct phase, the anode circuits were connected in parallel and were thus modulated simultaneously. The anode-filament impedance of a unit transmitter has been measured and found to be about 2,500 ohms, and this value has been used in designing the modulating transformer.

Wave-length Measurement

During the investigations, a practical form of wave-meter and radiation indicator was developed consisting of a dipole aerial provided with large discs to form end capacities. A standard type of thermo-milliammeter of low internal resistance was connected at the centre point of this aerial to indicate resonance with the radiated field from the transmitter. Wave-lengths of the order of 60 cm. could be measured to about 1 mm. by coupling the meter to an ordinary Lecher wire system, which, when in tune, reduced the oscillation in the meter to zero. After calibration in this manner the indicator was employed to adjust the transmitters to the working wave-length. In the case of the transmitters already described, it was found that by adjusting the external circuits and the electrical supplies, the standard valves were capable of generating oscillations at practically constant efficiency over a continuous range of wave-lengths of 80–50 cm. With the aid of other valves having smaller and shorter electrodes, a continuous wave-length range of 55–35 cm. could be covered at about the same efficiency.

Reflector Arrangements

The idea of utilising a system of unit reflectors followed logically on that of the system of unit transmitters just described. The advantages inherent in the possibility of placing side by side several transmitter units working in phase with each other for the purpose of increasing the power of a transmitting station, would, in fact, have been partly lost if the same method could not have been extended to the reflector.

Considering the type of multi-unit transmitter developed, it was decided to adopt the ordinary well-known cylindrical parabolic reflector, on the design of which a considerable amount of experience was already available. The high efficiency observed by experimenting with these very short waves with free end reflector rods in place of wires or rods supported at each end by insulators, leads to a peculiar type of construction where each reflector rod is supported at its middle point by a copper tube bent into a true parabolic curve.

The accompanying photograph (Fig. 3) illustrates the type of reflector adopted; this is economical in construction and has an important advantage in offering a small wind resistance. This system comprised four reflector units side by side, the aperture being three wave-lengths, and the focal length one quarter of a wave-length. The reflector rods were excited by three unit transmitting aerials, arranged along the focal line of the parabolic cylinder. Each transmitting aerial was located so as to overlap two adjacent reflector systems, this arrangement facilitating the correct phasing of the several transmitters. In this manner

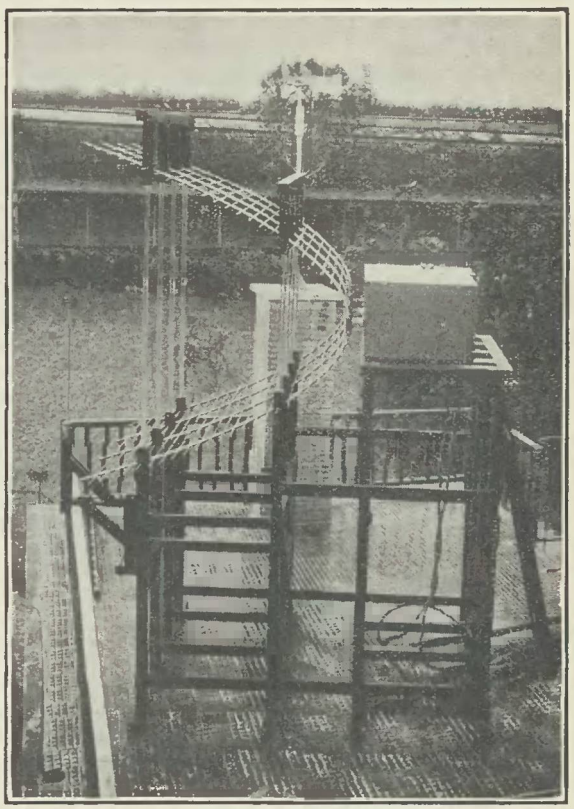

Fig. 3. Reflector system.

a directional transmitting system was provided in which the radiated energy concentrated in the forward beam was about 17 decibels above (about fifty times) that given by a half-wave dipole aerial alone.

Ranges Obtained for Practical Communication

After developing suitable receivers for the very short wave-lengths involved, a number of short-range communication tests were carried out during October and November, 1931, at distances of 11–23 miles oversea. In April 1932, a demonstration of duplex communication was given with equipment incorporating ordinary two-wire telephone terminal apparatus. This demonstration

showed the practicability and resulting advantages of working both transmitter and receiver in the same reflector, and satisfactory two-way communication was maintained for several hours over the distance of 23 miles. Soon after this demonstration, the Vatican authorities decided to adopt this system for telephonic communication between the Vatican City and the Palace of the Pope at Castel Gondolfo, near Rome. The distance between these two points is more than twelve miles entirely overland, and the direct line between them is obscured by intervening trees. The apparatus has now been installed, however, and is giving satisfactory operation on what constitutes the first commercial radio link on a wave-length of less than one metre.

For the purpose of carrying out long distance tests, a more powerful transmitter was developed, comprising a five-unit reflector with a four-unit transmitter. A standard receiver with single reflector unit was installed on the yacht *Elettra*, and after preliminary tests over distances up to 28 miles, preparations were made for tests over longer ranges. The transmitting equipment was installed in an obsolete observatory at Rocca di Papa, near Rome, at a height of 2,500 ft. above sea-level and about fifteen miles inland. Under these conditions the maximum optical range as set by the curvature of the earth, for a rectilinear path between transmitter and receiver, was 52 miles.* In August 1932, duplex communication was established on a wave-length of 57 cm. between this station and the yacht at a distance of 18 miles. Satisfactory communication was continued at distances up to 58 miles, beyond which the signals became subject to slow and erratic fading, although they were still perceptible up to a distance of 110 miles.

After a repetition of the above test, in which the maximum range of perceptible signals was 125 miles, the receiving apparatus was installed on Cape Figari, Sardinia, at an altitude of 1,100 ft. above sea level. The distance between Rocca di Papa and Cape Figari is 168 miles whilst the optical distance, taking account of the heights of the two places, is only 72 miles.* When tested under these conditions, signals were immediately received from the transmitter, although they were subject to the same slow deep fading observed on the yacht. Excellent intelligible speech was received during the strong periods of the signals, but these became practically inaudible during the weak periods. This test lasted from about 4 P.M. until midnight, and the average signal strength appeared to be greater before than after sunset. On investigation at Cape Figari, it was found that the waves were arriving from a horizontal direction.

In conclusion, it may be said that these investigations serve to illustrate some of the practical possibilities of the application of electric waves, less than one metre in wave-length, in the field of radio communication. R. L. S.-R.

* These values for the optical range, as given by the Marchese Marconi, do not appear to be correct. For the height of transmitter given, the range to sea-level is about 63 miles, while to the receiver at the height stated above, the optical range is 105 miles. It may also be pointed out here that ranges in excess of the optical distance have previously been obtained for radio telephonic communication on wave-lengths between 5 and 8 metres (see *Proc. Inst. Radio Eng.*, **19**, 485, 1325, 1931).

Humour and Humanism in Baeyer's Laboratory

PROF. H. RUPE entered the private laboratory at Munich, as assistant to Baeyer, in 1891. At that date the great indigo problem had been solved, but the classical work on the reduction of the phthalic acids was still in full swing. These investigations, so well known in the abstract because of their bearing upon the constitution of benzene, take on at once a rich vesture of human interest to the reader of Prof. Rupe's delightful reminiscences of life in Baeyer's laboratory which have recently been published*. The work was beset with difficulties. At one time, for example, during the intensive search for dihydrophthalic acids, gigantic quantities of sodium amalgam, up to forty kilograms a week, were prepared and used in vain. The author remarks with feeling that the situation became very disagreeable to the assistants. It must have been, indeed, a "schwere, scheussliche und gefährliche Arbeit"; but no labour was too tedious for the Master and his band of devoted helpers. There was, as Prof. Rupe says, something of the magnificent in this prolonged contest with matter.

Eventually, however, even Baeyer was supersaturated with these hydrogenations ("übersättigt von diesen Hydrierungsarbeiten"), and the sorely tried assistants hailed with deep relief the transference of his interest to succinylosuccinic ester and diketocyclohexane. By means of a 'Kunstgriff' of which Baeyer was very proud (treatment with sodium amalgam in presence of sodium bicarbonate), the diketone was reduced to quinitol. At the first glimpse of the crystals of the new substance Baeyer ceremoniously raised his hat!

It must be explained here that the Master's famous greenish-black hat plays the part of a perpetual epithet in Prof. Rupe's narrative. As the celebrated sword pommel to Paracelsus, so the 'alte Melone' to Baeyer: the former was said to contain the vital mercury of the medieval philosophers; the latter certainly enshrined one of the keenest chemical intellects of the modern world. Hats are not associated as a rule with chemical research, although it is true that Trautschold's illustration (1842) shows the striking variety of headgear which was to be seen in

* Adolf von Baeyer als Lehrer und Forscher: Erinnerungen aus seinem Privatlaboratorium. By Hans Rupe. (Sammlung chemischer und chemischtechnischer Vorträge, herausgegeben von Prof. Dr. H. Grossmann, Neue Folge, Heft 15). Pp. 26. (Stuttgart: Ferdinand Enke, 1932.) 2.50 gold marks.

Liebig's original laboratory at Giessen: these choice pieces, although perhaps not including an 'alte Melone', ranged from the postman's cap of Ortigosa the Mexican through the tam-o'-shanter of his unnamed neighbour to the stylish topper favoured by A. W. Hofmann. It now appears that the tradition of laboratory hats descended from Liebig to Baeyer. However that may be, Baeyer's head was normally covered. Only in moments of unusual excitement or elation did 'the Chef' remove his hat: apart from such occasions his shiny pate remained in permanent eclipse.

When, for example, the analysis of the important diacetylquinitol was found to be correct, Baeyer raised his hat in silent exultation. Soon afterwards the first dihydrobenzene was prepared, by heating dibromohexamethylene with quinoline: Baeyer ran excitedly to and fro in the laboratory, flourishing the 'alte Melone' and exclaiming: "Jetzt haben wir das erste Terpen, die Stammsubstanz der Terpene!" Such is the picture from behind the scenes of the dramatic way in which the Master entered upon his famous investigations on terpenes.

Incidents of this kind may appear to be slight, and yet cumulatively they throw a stream of light upon the personality of this great chemist. There is no doubt, for example, that at times 'the Chef' was unduly impulsive. One morning he burst into the private laboratory, and, without having lit his cigar (an indication in itself of unusual emotional disturbance), raised the ancient 'Melone' twice, and exclaimed: "Gentlemen [the audience was composed of Claisen and Brüning], I have just had word from E. Fischer that he has brought off the complete synthesis of glucose. This heralds the end of organic chemistry: let's finish off the terpenes, and only the smears ('Schmieren') will be left!" Prof. Rupe's reminiscences are rich in snapshots of this kind, which are often more revealing than pages of formal description could be.

Baeyer's customary tools were test-tubes, watch-glasses, and glass rods. As an example of his endless patience, Willstätter relates having seen him keep a test-tube in gentle play over a flame for three-quarters of an hour when activating magnesium with iodine. He valued at least three things which were deemed of fundamental importance by the alchemists; for he impressed upon his students that the essential attributes of the chemist are patience, money, and silence. His lectures were marked by clearness and simplicity of diction, with occasional delicate touches of North German humour or sarcasm. He urged his listeners to learn to think in terms of phenomena; and, like Kekulé, he emphasised the importance of giving occasional rein to the imagination: "so viele Chemiker haben nicht genügend Phantasie".

Although 'the Chef' was often regarded as stiff, unapproachable and severe, he was in reality a kindly man who did much good by stealth. He was free from vanity; and, unlike many men of learning, he was always ready to acknowledge ungrudgingly the merits of others. Baeyer favoured the use of simple apparatus, and the introduction into his laboratory of any device savouring of complexity had to be undertaken with great tact. The first mechanical stirrers, worked by water-turbines, were smuggled in one evening. On the following morning, 'der Alte' beheld them in full working order. For a time he affected to ignore them; then he contemplated them unwillingly, with an air of challenge; next came the first remark, so anxiously awaited: "Geht denn das?" "Jawohl, Herr Professor, ausgezeichnet, die Reduktionen sind schon bald fertig." The Herr Professor was finally so much impressed that he took the exceptional step of summoning the Frau Professor. 'Die Lydia,' as she was called in the laboratory, stood by the merrily clattering apparatus for a while in silent admiration; then she uttered these unforgettable words: "damit müsste man gut Mayonnaise machen können"! What a great deal depends upon one's point of view!

These truly fascinating pages afford glimpses also of the personnel surrounding 'the Chef'. Among them, Herr Leonhard, the old Bavarian factotum inherited by Baeyer from Liebig, stands out by reason of his liberal attitude towards the ethics of lecture demonstrations. Upon occasion he triumphed over his scruples to 'help' his experiments in their fight against the malignity of matter ("Tücke des Objektes")—that bane of the whole race of lecture-assistants: as witness his dry reply to a remark upon the difficulty of making chloroform from alcohol and bleaching powder: "Wissens Herr Doktor, dös Chloroform, dös is schon do herinnen"! There was also the old 'Laboratoriumdiener', Carl Gimmig, a veteran zouave of the war of 1870, with his compelling six-o'clock cry: "Ihr Herre, s'isch Zeit!" If the workers lingered, Carl remorselessly turned off the gas at the main and became 'terribly evident'. There is, too, an instantaneous snapshot of a 'filia hospitalis' of the laboratory, the fair daughter of Herr Inspektor Fehl; but of her it may be said, as of her prototype in the song so beloved of German studentry, that "die Füsschen laufen wie der Wind" off Prof. Rupe's pages.

A narrative of this kind cannot fail to reflect something of the personality of the author, and in the concluding relation of the surreptitious help he once extended to a would-be pharmacist, overcome with 'Examenangst' (expressive word!) in Baeyer's 'Bleikammer', we obtain a glimpse of Prof. Rupe's innate kindness of heart.

"Chemistry has always seemed to me such a *dead* subject—so utterly devoid of human interest!" exclaimed a classicist within the hearing of the present writer the other day, as he stepped somewhat reluctantly into a lecture on alchemy. May he and others who share that mistaken view seek a truer orientation in this matter from such writings as these sparkling reminiscences of life and labour in the laboratory of Adolf von Baeyer.

John Read.

Obituary

Sir J. Arthur Thomson

WITHIN two years of his retirement from the chair of natural history at the University of Aberdeen, Sir J. Arthur Thomson was struck down by a heart illness which had hampered his well-being for many years, and although he rallied, his power of resistance was broken and he died at his home at Limpsfield in Surrey on February 12, aged seventy-one years.

Born at Saltoun, East Lothian, on July 8, 1861, a son and grandson of the manse, Thomson graduated M.A. at the University of Edinburgh in 1880, and thereafter completed the divinity course at New College. But the influence of his teachers, and a natural bent derived from two generations of naturalists on his mother's side, swung the balance towards the study of natural science, and in 1883 he was at Jena under the guidance of Ernst Haeckel, and in 1885 with Schulze at the Zoological Institute in Berlin. He returned to Edinburgh to become the most popular teacher of his time in zoology and botany, and his success there led to his appointment in 1899 to the regius chair of natural history at Aberdeen. He was a good teacher, clear and sympathetic, never losing sight of the wood for the trees, insistent upon the broad truths to which the facts pointed; and so during these thirty-one years he kept turning out a stream of scientific workers remarkable in its volume for a small university recruited from schools where biology is unknown.

At the same time, Thomson was constantly engaged upon systematic investigations of the Alcyonaria, collections of which came to him for identification from almost all the seas of the world. The majority of his papers upon these collections were included in the reports of special expeditions, so that the mass of his descriptive work has been scarcely recognised; but although it was perhaps the least important of his great activities, it was very far from being negligible, as is witnessed by the extent of the collection of type and named specimens he presented to the British Museum on his retirement, and by the excellence of such memoirs as his accounts of the Alcyonaria of the Australian *Thetis* Expedition, of the Prince of Monaco's collection, and of the Dutch *Siboga* Expedition to the East Indies, the last of which appeared not many months ago.

Apart from his teaching, Thomson's great achievement was undoubtedly as an expositor of science and scientific thought. He had a gift of simple, lucid writing and lecturing, which enabled him from his full knowledge to expound the beauty and interest of Nature, so that no man of his time has done so much to interest the people in natural history. That was a work of importance, paving the way for that appreciation of scientific work which will allot to it its proper place in the life and progress of civilisation. He was in demand at home and abroad as a lecturer, and his lectures in book form, together with his other writings, make a considerable library in themselves. They were by no means all of the popular sort, and amongst the best I should be inclined to place "The Evolution of Sex" (1889) written with Patrick Geddes, "The Science of Life" (1899), a neat summary of biological progress, "The Wonder of Life" (1914), the St. Andrews Gifford lectures "The System of Animate Nature" (1920), the "Biology of Birds" (1923), and his last great work, written again with Geddes, "Life: Outlines of General Biology" (1931), a store-house of biological themes. On the popular side, the larger works which were probably most widely read were "The Outline of Science" which he edited and mostly wrote, and "The New Natural History".

Many honours came to Sir Arthur: he was invited to give several important series of lectures in Great Britain, in South Africa and America; he was created a knight on retirement from his chair, and then also Aberdeen made him an LL.D., a degree which had already been conferred upon him by his own University of Edinburgh, and by McGill University and University of California. Throughout it all he preserved a charmingly simple, almost shy demeanour, which hid a warm heart and much friendliness.

Sir Arthur Thomson could not have accomplished his vast output without the active assistance of Lady Thomson, herself a naturalist, and it is evidence of the strength of heredity and of the influence of early nurture, that each of the members of their family, three sons and a daughter, has contributed to scientific literature.

James Ritchie.

Prof. A. H. Sayce

With the passing of Archibald Henry Sayce on February 4, Oxford loses one of the last, if not the last, of the old life-fellows, and the world a link with the scholars, of whom Sayce was by no means the least, who first deciphered the languages of the inscriptions of the old tongues of Mesopotamia and the surrounding regions, and so put on a firm basis the study of the ancient history of the Nearer East.

Sayce was in many respects a most remarkable man. He was born so far back as 1846, the oldest son of the Rev. H. S. Sayce, vicar of Caldicot, Mon., and even in undergraduate days had the misfortune to have bad health, but he was endowed with a remarkable persistence, and a scarcely less remarkable memory. He found the handling of heavy texts, lexicons and dictionaries an unpleasant task, and certainly for very many years abandoned their use, preferring to quote, not always perhaps accurately, from his well-stored memory. It is perhaps to this fact that we owe the enormous breadth of his learning, for he remembered all he read and up to the very last was reading and annotating with many linguistic

parallels the latest current periodicals. He always moved with the times.

Sayce's early interests were mainly of a philological nature, including not only technical work on ancient languages, but also services to the revisers of the Old Testament, and a text and commentary on Herodotus. Later, he turned to questions of comparative religion, and when he was already more than sixty years of age, pure archæology especially attracted him. He acquired a very complete knowledge of modern work on prehistoric archæology, and the present writer remembers discussing with him, in his eightieth year—and it was Sayce who did most of the discussing—the problems of Mousterian and Upper Palæolithic flints in Transjordan. The geographical and scientific side of Assyriology was always of great interest to him, possibly owing to his early training under the Rev. Bradford Waring Gibson of Trinity College, Cambridge, a keen student of mathematics who was headmaster of Grosvenor College, Bath, where Sayce was educated. Unfortunately, apart from such publications as his "Notes on an Unexplored District of Northern Syria" in the *Proceedings of the Society of Biblical Archæology* of 1911, most of his geographical work is buried in former editions of the "Encyclopædia Britannica".

In addition to these wide interests, Sayce was an admirable preacher, and a pleasant and witty companion even to those widely separated from him in years, and it is sad to think that he no longer occupies the rooms in Queen's which he has had since he first became a fellow, nor shall we see any more the frail figure of our old friend walking along the sunny side of the Banbury Road on his way to visit one of his many pupils, for so we were, though he never gave and, indeed, of later years disliked, formal teaching.

Sayce obtained a first-class both in Moderations and Greats, taking his final Schools in 1868, a year which included Andrew Lang, E. A. Knox, afterwards Bishop of Manchester, T. Humphrey Ward, and K. A. Muir-Mackenzie. He obtained his fellowship in 1869, and was classical and theological tutor from 1870 until 1879. He was a member of the Old Testament Revision Company from 1874 until 1884, and deputy professor of comparative philology from 1876 until 1890; in the following year he became professor of Assyriology, and resigned in 1914. In 1897 he became president of the Society of Biblical Archæology, and retained this position until the Society was amalgamated with the Royal Asiatic Society in 1918. He was Hibbert lecturer in 1887, Gifford lecturer in 1902, when he discussed "The Conception of the Divine among the Egyptians and Babylonians", Rhind lecturer in 1907 and Huxley lecturer of the Royal Anthropological Institute in 1930. His honours were naturally mainly academic. His old University made him an Hon. D.Litt. in 1907, he was an honorary fellow of the British Academy and Hon. LL.D. of Dublin, and also held the honorary degree of D.D. at Edinburgh and Aberdeen.

It is not possible to recount Sayce's many publications. His first publications were Assyrian grammars; in 1874 he published "Principles of Comparative Philology" and six years later "Introduction to the Science of Language". Perhaps his best-known work is "Fresh Lights from the Monuments" which passed through no less than nine editions between 1883 and 1895, while his standard book on the Old Testament was "'Higher Criticism' and the Verdict of the Monuments" (1894). This does not include a host of other books and articles, some of which have been mentioned above, for, during his long working life, scarcely a year passed without an important contribution from his pen dealing with some aspect of Assyriology. L. H. D. B.

MR. T. A. COWARD

THE sudden death from heart failure of Thomas Alfred Coward at his home at Bowdon on January 28 leaves a gap in the ranks of British field naturalists and came as a blow to those who knew and loved him.

Coward was born in Bowdon, a Cheshire suburb of Manchester, in January 1867, and there he spent his life. Educated at Brooklands School, Sale, and Owens College, Manchester, he endured nineteen years in the uncongenial atmosphere of a Manchester warehouse, until the absorption by one of the large industrial combines of the firm which he was serving gave him the chance he craved, and for more than thirty years he was able to follow his own bent in studying animals, particularly vertebrates, in the field. He contributed occasional notes and papers to the *Proceedings of the Zoological Society*, to the *Zoologist*, *British Birds* and other more or less technical magazines. Articles in the *Field* and other newspapers and in the *Nineteenth Century* appealed to a larger public, and as "T. A. C." of the *Manchester Guardian* he was widely known.

Of Coward's many books on topography and natural history, the most serious contribution to scientific literature was perhaps the "Vertebrate Fauna of Cheshire and Liverpool Bay" (1912), which ranks high among county faunas, but better known is his "Birds of the British Isles and their Eggs", first issued in 1919, a household word among amateur ornithologists, which has done more to promote and encourage the intelligent study of birds in Great Britain than any other work of our time. To study birds he went to many out of the way parts of Britain from the Shetland Isles to Cornwall, and with his wife, who shared his tastes, visited Holland, the Camargue, the Pyrenees and Hungary in order to find birds he could not see at home.

What Coward wrote was always good reading. It was mostly the outcome of his own wide and varied experience, was free alike from technicalities and rhetorical frippery, and above all was accurate. He had a considerable vogue as a lecturer and his lectures and broadcast talks were compact of the

same sound material as his writings. For more than a quarter of a century he was a distinctly educative force.

During the War, Coward was acting keeper of the Manchester Museum, and in 1921 the University conferred upon him the degree of M.Sc. in recognition of his services in that capacity. He was an active member of the Museum Committee, and devoted much time to the arrangement and care of the Dresser collection of birds. He was a member of the executive committee of the Lancashire and Cheshire Fauna Committee, and acted as referee for vertebrates. He was president of the Manchester Literary and Philosophical Society in 1921 and 1922 and a fellow of the Zoological and Entomological Societies.

C. O.

Mr. Henry A. Fleuss

We regret to announce the death on January 4, at the age of eighty-two years, of Mr. Henry Albert Fleuss. He was one of the pioneers of rescue apparatus. After serving in the mercantile service for many years, he left it about 1879, in order to make a pipeless diving apparatus. He designed a suitable pump for compressing oxygen and made his first test in a tank at the old Polytechnic in Regent St., London. Without any previous experience of diving, he remained under water for one hour, which at that time was an amazing performance.

Fleuss claimed to be the first man to breathe pure oxygen without any ill-effects. At the request of Sir B. W. Richardson, he went into a chamber filled with a gas that meant death in one minute if inhaled, and stayed in there for half an hour. Later, during a lecture given by Sir B. W. Richardson, Fleuss remained in a chamber through which a current of carbon dioxide was made to flow.

Fleuss then turned his attention to mine rescue apparatus and carried out experiments at the Netherseal Colliery and Seaham Colliery. His next exploit was during the building of the Severn Tunnel, the workings of which became flooded. Fleuss went down a shaft 200 ft. deep with 40 ft. of water at the bottom, and was given up for dead a long time before he returned to the surface. The celebrated diver Lambert then put on the dress and was able to close the necessary doors to enable the tunnel to be pumped out. Messrs. Siebe, Gorman and Co., Ltd., afterwards put the apparatus on the market.

Among Fleuss's other inventions was the well-known 'Geryk' vacuum pump. He claimed to be the inventor of the first mechanical high efficiency vacuum pump ever made, in 1885. About 1890 at a demonstration at the Royal Institution an electric lamp bulb was exhausted with a 'Geryk' pump, and the lamp burned for about 1,000 hours.

Fleuss also invented a tubeless pneumatic tyre which was in great demand about thirty-five years ago.

W. G.

Dr. Willy Merck

We regret to learn from the *Chemiker-Zeitung* of the death on December 15 of Dr. Willy Merck, a member of the well-known firm of chemical manufacturers, E. Merck of Darmstadt. Dr. Merck, who was born in 1860 at Darmstadt, was the son of Dr. Georg Franz Merck, the discoverer of papaverine. After studying at the Universities of Heidelberg, Strasbourg and Kiel and at the Polytechnic at Aachen, he graduated at Kiel in 1886, where he had worked under the direction of Ladenburg. His thesis embodied the results of his studies on cocaine and he had been able to effect a partial synthesis of this alkaloid by the methylation of benzoylecgonin, a by-product obtained during the extraction of cocaine. Many years later, the complete synthesis of naturally occurring *l*-cocaine and of *d*-pseudococaine was carried out in the Merck laboratories by W. Merck in collaboration with R. Willstätter.

Immediately after his graduation, Merck entered the service of the firm and, after a year's travel in the Far East, he returned to Darmstadt to undertake a leading part in directing the work not only in the laboratories but also in the factory, where he successfully initiated the manufacture of many new drugs. In 1905 the University of Halle conferred upon him an honorary doctorate in the Faculty of Medicine and he was the recipient of many public honours and decorations. He was made *Geheimer Kommerzienrat* in 1918 on the occasion of the two hundred and fiftieth anniversary of the foundation of the firm.

The death on February 5 is announced of Mr. J. J. F.-X. King, aged seventy-seven years, one of the best-known Scottish entomologists. Mr. King was an accomplished field naturalist and collector, and some few years ago he presented his main collection of British insects to the University of Glasgow. The University is now to receive under his will the portrait of Mr. King painted by Forrester Wilson and the remainder of his collections, together with his library of books on natural history.

We regret to announce the following deaths:

Dr. C. A. Barber, C.I.E., lately lecturer in tropical agriculture at the University of Cambridge, formerly Government Botanist, Madras and Sugar Cane Expert for India, on February 24, aged seventy-two years.

Sir Benjamin Gott, chairman of the Commission on Educational and Cultural Films, who was secretary of the Middlesex Education Committee from 1898 until 1928, and formerly headmaster of the Cheltenham School of Science, aged sixty-seven years.

Prof. Johannes Schmidt, director of the Carlsberg Physiological Laboratory, Copenhagen, a leader of several deep-sea expeditions, and known especially for his work on the life-history of the eel, aged fifty-five years.

News and Views

The Pepys Tercentenary

ON February 23 the tercentenary of the birth of Samuel Pepys was commemorated in London and at Cambridge. The London celebrations included a lecture by Mr. E. Chappell arranged by the Society for Nautical Research at the Clothworkers' Hall; an address by Mr. A. Bryant to the Women's Section of the London Municipal Society at Admiralty House, and a commemoration service at the Church of St. Olave, Hart Street, where Pepys was buried and close to where he lived and worked. The service was attended by the Lord Mayor and sheriffs of the City of London and the address was given by Prebendary Wellard, chaplain to the Pepys Club. During the service a wreath was placed on the Pepys monument. At the meeting of the Royal Society in the afternoon, the fellows stood in silence as a tribute to the memory of Pepys, and the president, Sir F. Gowland Hopkins, recalled that they met on the actual date of Pepys's birth, three hundred years ago. Though Pepys, he said, was not an investigator, it was clear his business acumen and his general interests in their problems had put him high in the estimation of his contemporaries, as he was thrice elected to the council and ultimately to the presidential chair. The references in his "Diary" to the Society showed his appreciation of the privileges of a fellow and his interest in the Society's work. The commemoration at Magdalene College, Cambridge, was attended by Sir John Simon, who proposed "The Immortal Memory of Samuel Pepys".

Samuel Pepys and the Royal Society

IT was recorded in NATURE of February 18, p. 229, that Pepys, after an interval of non-service, re-entered the council of the Royal Society at the anniversary meeting on November 30, 1681, Sir Christopher Wren being president. At the anniversary meeting in 1684, Pepys became the Society's president, and it is of interest to note the frequency or otherwise of his attendances at council meetings, or at the general gatherings afterwards in Gresham College, for discourse, or for experimental purposes of the kind then possible. When presiding at councils Pepys did not always remain for these later meetings, and the reason may doubtless be found in his numerous public duties, but, as substitute, Dr. Gale, Sir John Hoskyns, Dr. Lister, and Sir Joseph Williamson were often called upon in turn. Pepys was not present at the Society's meeting on December 3, 1684, but he attended the council on December 10, as well as presiding at the subsequent meeting of fellows. From the following January 7, until September 18, he attended three councils and one meeting. He was continued on November 30, 1685, in the presidency for another year, and during that period he attended eight council meetings and three ordinary meetings. On November 30, 1686, the Earl of Carbery was made president, and Pepys a vice-president. Opportunity may here be taken to record that Sir Anthony Deane, the eminent ship designer, and co-adjutor of Pepys in naval matters, who was made a fellow of the Society in 1681, was elected to the council on November 30, 1682. At the anniversary of 1684, when Pepys became president, Sir Anthony Deane re-entered the council; thus the two were colleagues. We may, perhaps, believe that Deane owed his entry to Pepys's recommendation.

Number 60 in Time Measurements

A CORRESPONDENT has sent an inquiry as to the origin of the division of a day into twenty-four hours, each divided into sixty minutes, and these into sixty seconds. The preliminary observation may be made that the numbers five and twelve are both marked out naturally by the fingers on our hands and the months in the year; it is not surprising that their product should be selected as a convenient number. Sixty is also twice the number of days in a month, the length of the average lunar month being a little less than thirty days, and that of the average solar month a little more than thirty. John Williams, on p. 17 of his "Chinese Observations of Comets", describes the Chinese reckoning of time by cycles of sixty years and smaller cycles of sixty days, the same system of names being used for the individual years and days of a sixty-fold cycle. Possibly they used the divisor sixty again in forming smaller time-intervals. It is, however, probable that our present subdivisions of time are derived from countries less remote than China. The independence of ancient China from western nations is shown by the completely different division of the stars into constellations that was adopted there.

DR. J. K. FOTHERINGHAM gave some details of the divisions of time in use in ancient Mesopotamia at the November meeting of the Royal Astronomical Society (*Observatory*, December 1932). There were twelve months, each of about thirty days, in an ordinary year. The Sumerians divided a day into twelve *beru*, each *beru* into thirty *uš*, thus following the analogy of months and days; incidentally, this gives the origin of the division of the circumference of a circle into 360°, or twelve signs of 30° each. Dr. Fotheringham states that the Babylonians afterwards divided day and night each into twelve hours, which changed in length with the seasons. The Egyptians also followed this arrangement. Moreover, sixty was an important number in the Chaldean system of numeration, so that it was natural to use it in subdividing the hour into sixty minutes, and, at a later date, in dividing the minute into sixty seconds. The latter unit was unimportant until fairly accurate clocks had been constructed.

Gift to Herbarium of University of Bristol

MR. J. W. WHITE, the Bristol field botanist, who died on October 26 last, bequeathed the whole of his British and Continental herbarium and a hundred valuable books to the Botany Department of the University of Bristol. The whole herbarium is made up of about 15,000 sheets of which those

carrying British species occupy six, and those carrying Continental European species occupy fifteen large cabinets. Most of the plants in this herbarium were collected by White himself on his walks and travels at home and abroad, but numerous additions have from time to time been made by exchange and purchase. The specimens are beautifully mounted, well labelled, carefully catalogued and useful notes and relevant cuttings are frequently attached to the sheets. White was the author of "The Flora of Bristol", published in 1912, which is rightly considered a model of what a county flora should be. His herbarium is, however, of far more than merely local importance. The accuracy and critical nature of his determinations make it of real scientific value and wide general interest. By coming into possession of this herbarium the *hortus siccus* of the University of Bristol has become one of the four best-equipped university herbaria in England.

Verulamium, 1932

EXCAVATIONS at St. Albans in 1932, of which Dr. and Mrs. R. E. Mortimer Wheeler gave an account at the Society of Antiquaries on February 23, have again added to the impressiveness of the prehistoric site and enhanced its importance as a source of knowledge of conditions in Britain immediately before the Roman invasion. The chance discovery in 1932 of a hoard of silver coins a mile north of the Abbey in the dyke running across country from the north of St. Albans in the direction of the village of Sandridge, not only proved the existence of the dyke before the second century A.D., but also led to the determination of the true character of this remarkable work, which is 100 ft. broad, 30–40 ft. deep and some five miles long, as a British defensive work extending from the pre-Roman city at the south-west of St. Albans to prehistoric works, of which the remains are still to be seen at Wheathampstead. Excavations here in the past summer have shown this to be a prehistoric 'city' about a hundred acres in extent, the most remarkable of its kind in the period yet found in Britain. It would appear that this great work was constructed by the Belgic invaders of Britain, who established their headquarters at St. Albans towards the end of the first century B.C. In his account of the past year's exploration of the Roman city, Dr. Wheeler drew a gloomy picture of the social and economic depression, alleviated only by a brief and illusory recovery, which invaded Verulamium as Roman power declined, after a brilliant and perhaps too optimistic efflorescence of prosperity. In the juxtaposition of pre-Roman and Roman on an extensive scale and in the evidence of the varied fortunes of a prolonged Roman occupation, St. Albans, under continued exploration, promises to become one of the most instructive and impressive archæological sites on the fringe of the Roman Empire in the western world.

Federal Council for Chemistry

IN its report for 1932, the Federal Council for Chemistry refers with regret to the necessary postponement of the ninth International Congress of Pure and Applied Chemistry and the eleventh conference of the International Union of Chemistry, which were to have been held in Madrid in 1932. The next meeting of the Union will take place in the spring of 1934 in Madrid, and not in Switzerland, as previously arranged. During the year, the Verein Oesterreichischer Chemiker and the Svenska National Kommitten för Kemie were elected members of the International Union. The report refers to a conference on chemical documentation, held in Paris in October 1932, and indicates that the Federal Council and the Division of Chemistry and Chemical Technology of the U.S. National Research Council are in complete agreement with regard to certain criticisms of the activities of the International Committee dealing with the reform of biochemical nomenclature. The efforts of the British Standards Institution to extend the use of the words "British Standard" to include "chemical substances used in manufactures, photography, or philosophic research and anti-corrosives" were supported by the Federal Council. The Board of Trade agreed to the Institution proceeding with an application to register provided that it was in a position to submit support from the appropriate trade association or similar body. A significant passage in the report is as follows: "In October, a Committee consisting of Dr. E. F. Armstrong, Mr. E. R. Bolton, Dr. L. H. Lampitt, Prof. G. T. Morgan, Mr. Emile Mond, Prof. J. C. Philip, Sir William Pope, Mr. J. Davidson Pratt, and Mr. D. Rintoul was appointed 'To consider how the resources of the various bodies concerned with the professional and scientific welfare of chemists can be most economically and efficiently utilised'. This Committee has met on several occasions, and will present, early in 1933, a report on its findings for consideration by the Federal Council." We shall look forward with interest and expectation to the outcome of the deliberations of so representative a committee, which is dealing with a matter of national as well as professional importance.

Photographic Analysis of Explosion Flames

AT the Friday evening discourse at the Royal Institution on February 24, Prof. W. A. Bone discussed "The Photographic Analysis of Explosion Flames". Nowadays the photographic analysis of explosion flames has become an indispensable part of the scientific study of explosions. Prof. Bone described first, with experimental illustrations, how the earlier work of Mallard and Le Chatelier and of Berthelot and Vieille in France, as well as that of H. B. Dixon and his collaborators in Great Britain, during the period 1883–1903, revealed, not only the successive stages in gaseous explosions, but also much about the nature of the final phase of 'detonation' (*l'onde explosive*) with its intensive chemical action, high constant velocities (one or two metres per second) and shattering effects. Prof. Bone then dealt principally with recent developments in the designing of high-speed cameras by Mr. R. P. Fraser at the Imperial College, South Kensington, where it has now become possible not only to photograph,

but also to analyse with precision, periodic movements in explosion flames occurring with frequencies up to a million a second. A number of the resulting photographs were exhibited showing the influence of compression waves in accelerating explosion flames and setting up detonation therein and, more particularly, the new phenomenon of 'spin' in detonation, which is due to a highly luminous comet-like 'head' of detonation spiralling through the medium with a frequency of several tens of thousands a second, and appears to be a concentrated locus of positively charged particles. These developments are not merely important but have also opened up a new field in the investigation of the propagation of chemical change through gaseous media under the most intensive conditions of temperature and pressure.

Recent Acquisitions at the British Museum (Natural History)

THE Rev. A. H. Cooke has given the whole of his collection of shells of land-snails of the genus *Clausilia* and of the dog whelk (*Thais lapillus*); the former is very rich in series from central Europe and the Balkans, and the latter includes specimens from practically the whole distributional area, and illustrates very completely the remarkable variation of this species. Recent accessions to the Department of Entomology include the final instalment, consisting of several hundred Hymenoptera, of the very large amount of material collected by the Percy Sladen Trust Expedition to the Seychelles and other islands of the western Indian Ocean. This expedition, which was led by Prof. (then Mr.) Stanley Gardiner, in 1905 and 1908–9, resulted in the gift of many thousands of specimens to the Museum. The final instalment consists almost entirely of small or minute wasps, many of them obviously new, which it has so far proved impossible to work out owing to the lack of specialists in these groups. The Department has also received a set of the Hymenoptera collected on the island of Rodriguez by the late H. J. Snell and by Mr. H. P. Thomasset. From Mount Kina Balu in North Borneo a series of a new species of *Blepharocera* has been sent by Mr. H. M. Pendlebury. Flies of this genus have hitherto been found only in the north temperate regions, and their discovery in Borneo is therefore both surprising and of importance in zoogeography. The larvæ of these insects live only in waterfalls and rapids, attaching themselves to rocks and stones by means of ventral suckers; and it has been considered therefore that they would be able to spread only along land routes. The four, widely separated, compound eyes in this species give the head a most remarkable appearance. The American Museum of Natural History has presented to the Department of Geology a model of an extinct straight-tusked elephant.

Game Animals in the British Museum (Natural History)

THE Trustees of the British Museum announce the closing of the exhibition of the game animals of the British Empire in the New Whale Gallery at the Natural History Museum on March 19. As, owing to the financial stringency, it was impracticable to begin last year the removal of the exhibited specimens of whales to their new quarters, the Trustees decided to use the space available for the temporary exhibition of the game animals, grouped by the three great faunal regions in which they occur and arranged without glazed cases. Unhappily the skins are attractive to moths; it would therefore be risky to leave the specimens exposed when the moths begin to fly in spite of the daily dusting which these skins receive, and they will be returned to their cases before the end of the month. Capt. Guy Dollman, who was responsible for the arrangement of the exhibition, will talk in the New Whale Gallery about the animals in the three great faunal regions at 11.30 on March 4, Indo-Malaya; March 11, Africa; March 18, Canada and Newfoundland. Visitors will be admitted free.

Ross Institute for Tropical Diseases

AT a recent meeting of the Industrial Advisory Committee of the Ross Institute, Putney Heath, London, S.W., reports were received of the over-seas activities of the Institute. Seven research centres in Assam and northern Bengal have been opened, and anti-malarial work and the testing of new drugs for the treatment of malaria have been pursued there and in Rhodesia and East and South Africa. In the Assam tea gardens, anti-malarial work has resulted in much improved health, for in 1930 among a population of 13,248 the admissions to hospital were 23,226 but in 1932 with a slightly larger population the admissions were reduced to 15,141. A standard oil mixture for killing mosquito larvæ has been devised in conjunction with the Burma-Shell group. The health among lead miners in Yugoslavia was investigated and a health scheme was formulated and is now in operation. At the conclusion of the proceedings, Mr. Still and Sir Malcolm Watson addressed the meeting on the subject of yellow fever. Now that travel by aeroplane is so rapid, the grave danger that infection may be carried from the yellow fever zone in West Africa to East Africa and Asia, which would be followed with disastrous consequences, was emphasised.

Norwegian Antarctic Expedition

CAPT. H. RIISER-LARSEN, the leader of the forthcoming Norwegian expedition to the antarctic, has outlined his plans in the *Polar Record* for January. With two companions and eighty dogs, he hopes to be landed from a whaler at Enderby Land early this year. A hut will be built as a base for the winter months but various sledge journeys will be made in April and May. In the spring the three men will start sledging westward over the sea-ice along the coast of the Weddell Sea to Snow Hill or Hope Bay in Graham Land, where supplies were to be landed by a whaler this (southern) summer. The expedition is to be picked up early in 1934. A short wave radio equipment will be carried which will make it possible for arrangements with the whaler to be altered. Capt. Riiser-Larsen believes, from his view of the

ice during flights in recent years, that the land-ice round this coast is heavily crevassed and would make travelling difficult. On the other hand, he thinks that the sea-ice will give a suitable surface and that lines of stranded bergs prevent it breaking up near the coast. The experience of others in the Weddell Sea suggests that these are optimistic views, but Capt. Riiser-Larsen admits that if the route proves impracticable, journeys will be made in an easterly direction from Enderby Land, where there is much work to be done. The use of a sea-ice route will certainly allow plenty of seal-meat to be got for men and dogs, and so obviate the necessity of carrying full rations.

Institution of Mechanical Engineers

AT the annual general meeting of the Institution of Mechanical Engineers on February 17, Mr. A. E. L. Chorlton, M.P., was inducted as president and the annual report for 1932 was adopted. The total membership of the Institution is now 11,295, a net increase for the year of 134. While the numbers of associate members and graduates show considerable increases, there has been a decrease in the numbers of members and of students. During the year Sir Alfred Ewing, Sir Henry Fowler, Sir Vincent Raven, Sir J. J. Thomson and the late Mr. W. H. Patchell were elected honorary life members. The total revenue for the year was £34,052. The report refers to the work of the various research committees and also to the educational work done. Examinations for National Certificates and Diplomas in Mechanical Engineering were held in conjunction with the education departments in England, Scotland and Northern Ireland at which 2,829 candidates sat. Twenty National Diplomas (Air) in Mechanical Engineering were awarded jointly with the Board of Education and the Air Ministry to officers of the Royal Air Force on completion of the engineering course at Henlow. In addition to the meetings held at the headquarters of the Institution, full programmes were carried out by the nine provincial branches, the average attendance of members and visitors at each meeting being more than a hundred. The gifts to the Institution include a plaque modelled by F. J. Halnon and cast in steel, showing Faraday in his laboratory, the donor being Sir Robert Hadfield.

Illuminated Fountains

RECENT installations of illuminated fountains in Paris and Stockholm prove that magnificent effects can be produced in this way which fit in well with festive occasions. In the *Escher-Wyss News* for October an interesting technical description is given of an illuminated fountain which was constructed in the lake of Zurich for a 'lighting week'. A pontoon was moored 85 metres distant from the shore and away from the route of the steamers. The caisson is circular in shape, its weight is 12 tons and the upper platform is ten metres in diameter. Five pump sets are arranged in the bottom of the caisson each capable of delivering 220 lb. of water per second when the motors rotate at 1,450 r.p.m., producing a total pressure head of 20 metres. They can be connected in series or parallel. The play of the water is arranged in eight different ways producing the appearance of circles, tulips, baskets, etc. With one arrangement the main water jet rises to a height of 45 metres, the whole fountain being apparently enveloped in foam. The whole of the playing waters are illuminated by thirty-two search-lights, each taking between 1,000 and 1,500 watts. The lamps are hermetically sealed in concrete casings. The entire pontoon is painted in a neutral colour so as not to form a contrast and interfere with the picture presented by the lake. The general effect of this fountain fits in very well with the shore illuminations. The work was completed in a few weeks and the fountain was set in operation on October 1, 1932.

Steam, Electric and Diesel-Electric Traction

IN a paper read before the Institution of Civil Engineers on February 21, H. W. H. Richards, electrical engineer to the London and North Eastern Railway, makes a definite comparison, both technical and financial, between steam, electric and Diesel-electric traction. The comparison is based on the existing traffic conditions of load and speed, so that it is on exactly the same basis in each case. It can be shown that the most satisfactory unit to adopt is the trailing ton-mile per annum per single track. The average traffic density for steam trains is about three million ton-miles and for electric trains which are practically confined to suburban service it is about 4·5 million ton-miles. It appears that on an average load of about fifty per cent for the complete electrification of the main lines in Great Britain, the total power of the steam turbines required for the electric service would be 3·5 million brake horse power. If Diesel-electric service were adopted throughout, the total Diesel engine power required would be 15 million brake horse power. On the same basis, the total weight of electric tractors would amount to 850 thousand tons as compared with 1,300 thousand tons for Diesel-electric tractors. The capital costs for traffic densities ranging from 2 million to 10 million ton-miles are in all cases cheapest for steam and the costs of electric and Diesel-electric services are much the same at a traffic density of 4 million, after which electric traction becomes progressively cheaper. As regards operating costs, for main line services, including interest on capital, the cost of electric traction is lower than that of steam or Diesel-electric traction at traffic densities greater than 2·5 million ton-miles.

Reading under Vibratory Conditions

IN the paper on recent developments on electric lighting read by Mr. W. J. Jones to the Royal Society of Arts on November 30 and published in the Society's journal (*J. Roy. Soc. Arts*, vol. 81, p. 132) some novel experiments and phenomena were described in connexion with illumination. He showed a swinging pendulum with the letter *E* printed at various points down its shaft. The speed of translation of any particular *E* is directly proportional to its

distance from the point of suspension. When the illumination on the pendulum was only two foot candles, the letter *E* could only be seen about a quarter of the way down the pendulum. But when the illumination was increased to 100 foot candles the letter *E* could be seen almost at the bottom of the pendulum. A connexion can thus be obtained between the speed of vision and illumination. Experiments were described on the effect produced by the vibration of public vehicles. When the vehicle was moving, an appreciable reduction both in the speed of reading and in visual acuity took place. Experiments made a few years ago by reading a newspaper in a train on the Bakerloo Railway when it was at rest and when it was running showed that in the former case the speed of reading was 220 words a minute and in the latter 140 words a minute. In this case the illumination was two foot candles. Tests carried out in trains and buses under similar conditions about the same time gave similar results, showing that there was an appreciable reduction in the speed of reading when the vehicle is in motion. Reading under vibratory conditions in a poor light is known to cause visual fatigue and is apt to produce headaches. We are glad to hear that in some of the London Underground railway coaches to-day, the illumination at reading level has been raised to about twenty foot candles. This automatically does much to mitigate the effects of vibration, so far as visual performance and comfort are concerned.

English Folk Dance and Song Society

THE recent amalgamation of the Folk Song Society with the English Folk Dance Society has been marked by the appearance of a new journal with the title *Journal of the English Folk Dance and Song Society*, under the editorship of Mr. Frank Howes. The contents of the first number are indicative of the policy which it is now considered desirable for the reorganised societies to pursue in common. The primary object which the original societies had in view was the collection and preservation of the remains of traditional songs and dances. This work now being regarded as completed, so far as can be seen, the main work of the joint society on its scientific side will be intensive comparative study of the material which has been collected. In the first issue both activities, it is true, are represented. Ten more of the forty Gaelic songs collected by Miss Lucy Broadwood twenty-five years ago are published, as well as some English folk songs and dances recently recorded. On the comparative side, Mr. A. G. Gilchrist makes an exhaustive study of the Scottish and Northumbrian ballad Lambkin, discussing its growth and origin in the light of some forty versions. Similar studies of no little interest to students of culture and of 'survivals' and their distribution are Miss Violet Alford's record of the form and distribution of the Farandole in the south of France and in Spain and the study of the sword-dance by Dr. R. Wolfram of Vienna, who connects it with the initiation ceremony, seeing in the decapitation of the 'fool' the ritual death of initiation rather than the memory of a fertility sacrifice.

Sadi Carnot, 1796–1832

IN *La Nature* of February 1, under the title "Grandeur et Modestie d'un savant Français: Sadi Carnot", M. Roger Vène gives a sketch of the life and character of the young French engineer who wrote the famous essay "Réflexions sur la puissance motrice du feu". Carnot was only twenty-eight years of age when he published the essay, and he died of cholera eight years later. According to the regulations, the clothes and papers belonging to the victims of the cholera epidemic which swept through Paris in 1832 were to be destroyed, but fortunately some of Carnot's manuscripts were saved by his friend Clapeyron. Born in the Petit Luxembourg when his father, Lazare Carnot, was a member of the Directory, Sadi had a brilliant career as a student of the Ecole Polytechnique but was too young to take part in the Napoleonic Wars, and his life was spent mainly in the routine of the barracks. The extracts given by M. Vène reveal a charming personality. The article is accompanied by a portrait of Carnot at the age of seventeen years. An article on Carnot appeared in our columns on August 20, 1932 (p. 266).

Plant Pathology at Rothamsted Experimental Station

THE Committee of Management of the Rothamsted Experimental Station recently decided to reorganise the old Department of Mycology, started in 1918 under the charge of Dr. W. B. Brierley, now professor of agricultural botany at the University of Reading, and to constitute it a Department of Plant Pathology with Dr. J. Henderson Smith as head. Dr. Henderson Smith studied medicine at Balliol College, Oxford, and then proceeded to the University of Edinburgh, where he took his medical degree; he was then awarded the Philip Walker studentship in pathology, which he held at Oxford until his appointment first as bacteriologist at the Lister Institute and afterwards as plant pathologist in the Mycology Department at Rothamsted. He has published numerous papers on animal pathology, especially immunity and bacteriology, and on plant pathology, especially virus diseases.

Motor-Car Speed Record

ON February 22, Sir Malcolm Campbell broke his own motor-car speed record on Daytona Beach, Florida, in his car the *Blue Bird*. On the southward run Sir Malcolm covered the mile in 13·16 sec. and in the northern run in 13·60 sec. His mean speed worked out at 272·108 miles per hour, thus being well ahead of his record of 253·978 miles per hour set up last year. The *Blue Bird* is fitted with a Rolls-Royce engine developing 2,350 H.P. at 3,200 R.M.P. The engine has a bore of 6 in. and a stroke of 6·6 in. This type of engine was also installed in the aeroplane which won the Schneider Trophy for Great Britain and in the machine in which Flight-Lieut. Stainforth achieved the world's present air speed record of 407·5 miles per hour.

British Fresh-Water Fishes

THE Trustees of the British Museum have published a second edition of their "Guide to the British

Fresh-Water Fishes" exhibited in the Department of Zoology of the British Museum (Natural History). This edition has been revised by the original author, Dr. C. Tate Regan; it is practically a reprint of the 1917 edition with one or two very minor alterations, but the paragraph on the common eel has been rewritten to include the new knowledge gained in recent years on the life-history of this fish through the researches of the late Dr. Johannes Schmidt. This publication, which is still priced at sixpence, is an invaluable little handbook for the identification of the fresh-water fishes of Great Britain.

Amphibia and Reptiles of North China

A CONCISE and excellent "Handbook of North China Amphibia and Reptiles" by Dr. Alice M. Boring, C. C. Liu, and S. C. Chou, has been published as a Peking Natural History Bulletin (August 1932). It contains keys for the identification of the various families, and of eggs and tadpoles of the species of frogs and toads. The descriptions of the characteristic structures and habits of species, and the excellent drawings, should greatly help the natural history survey of the country, which is one of the objects of the Peking Natural History Society.

Mr. T. Sheppard and the *Naturalist*

WITH the close of 1932, Mr. T. Sheppard retired from the editorship of the *Naturalist*, having served it as editor for thirty years. As an illustrated monthly journal, designed for readers within the domain of the Yorkshire Naturalists' Union, the *Naturalist* has maintained a high standard, and in its comments and reviews it conveyed a touch of the editor's vitality and boisterousness. The occasion of his retirement was made an opportunity of presenting Mr. Sheppard with his portrait in oils by Mr. Vincent Galloway.

Kansu Earthquake of December 26

EARLIER than was expected, reports have arrived from north-west China about the earthquake of December 26 (local time). From these, it appears that 280 persons were killed and 300 seriously injured, while 800 houses were destroyed. These losses occurred in the north-west of Kansu, one of the Chinese provinces most frequently visited by disastrous earthquakes.

Announcements

DR. F. A. BATHER has been awarded the Mary Clark Thompson medal of the National Academy of Sciences, Washington, "for his distinguished services in the fields of palæontology and geology".

THE tenth annual conference of the Association of Special Libraries and Information Bureaux will be held at the Wills Hall, Bristol, on September 22–24, under the presidency of Sir Charles Sherrington. Further particulars can be obtained from the Secretary of the Association, 16, Russell Square, London, W.C.1.

AT the annual general meeting of the Association of Economic Biologists held in the Imperial College of Science, London, on February 24, the following officers for the ensuing year were elected:—*President*, Prof. W. B. Brierley; *Vice-Presidents*, Prof. J. W. Munro, Prof. W. Brown; *Hon. Treasurer*, Dr. J. Henderson Smith; *Hon. Editors*, Prof. W. B. Brierley, Prof. J. W. Munro; *Hon. Secretaries*, Prof. R. H. Stoughton, Mr. G. Fox-Wilson.

AT the ninety-first meeting of the American Association for the Advancement of Science, which was held on December 27–31, at Atlantic City, Prof. Henry Norris Russell, research professor in astronomy and director of the Observatory at Princeton University, was elected president for the ensuing year, and Prof. Henry B. Ward, who retires from the professorship of zoology in the University of Illinois in June next, was elected permanent secretary. The American Association prize of 1,000 dollars has been awarded to Dr. Henry Eyring, of Princeton University, for a paper entitled "Quantum Mechanics and Chemistry, with particular Reference to Reactions involving Conjugate Double Bonds".

THE Oxford University Press will publish in April the first number of a new *Empire Journal of Experimental Agriculture*. This journal will offer agricultural research workers in the British Empire a medium for disseminating the records and results of their investigations on the feeding and management of livestock, cultivation and manuring of crops, trials of farm machinery, agricultural economics and experimental technique. The *Journal* will command a strong editorial Board, including, among others, Sir John Russell, Sir Rowland Biffen, Sir Daniel Hall, Sir Robert Greig, Sir Frederick Keeble and leading agricultural authorities in the chief countries of the Empire. Dr. E. H. Tripp, 40 Trewsbury Road, Sydenham, London, S.E.26, is secretary and general editor. The *Journal* will be published quarterly: subscription price 20*s*. for four numbers or single numbers 7*s*. 6*d*. net, each.

APPLICATIONS are invited for the following appointments, on, or before, the dates mentioned:—A mathematics master at the Junior Technical School of the Wimbledon Technical College—The Principal (March 10). An assistant lecturer in zoology at the University of Manchester—The Registrar (March 11). A teacher in electrical engineering subjects at the Southall Technical College—H. M. Walton, Education Offices (H), 10, Great George Street, London, S.W.1 (March 21). A woman tutor in hygiene and biology at the Edge Hill Training College, Ormskirk, Liverpool—The Principal (March 24). A director of the Royal Technical College, Glasgow, and a professor of technical chemistry at the College—The Secretary (April 17). Physicists and electrical engineers for the staff of the Radio Research Board of the Commonwealth of Australia Council for Scientific Research—F. L. McDougall, Australia House, Strand, W.C.2.

ERRATUM.—NATURE, February 25, p. 268, col. 2, paragraph entitled "Fat in Æstivating Animals", line 13 for *Pachyurus* read *Pachyuromys*.

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Reviews

Pliny's Chemical Knowledge

The Elder Pliny's Chapters on Chemical Subjects. Part 2. Edited, with Translation and Notes, by Dr. Kenneth C. Bailey. Pp. 299. (London: Edward Arnold and Co., 1932.) 15*s.* net.

"IT occurs to one to marvel at the persistent experimenting of humanity," said Pliny, "which has exempted neither dregs nor foulest residues from the most varied examination." It did not occur to him—vain though he was—to marvel equally at his own persistent accumulation of the most varied scraps and orts of knowledge. What a contributor, through accident of time, was lost to "Notes and Queries"! So vast is the extent of the "Natural History" that few men, in these rapid days, can have read the whole work; and so heterogeneous is it that probably few men would care to do so. Yet to the historian of chemistry, Pliny must be of paramount importance as a source-book of Roman chemical knowledge, not only because his mass of information is so great, but also because there are so few other sources of any kind. It is therefore with peculiar pleasure and satisfaction that we welcome the second and concluding part of Dr. Kenneth Bailey's book, in which all the important chemical passages not contained in the first part are collected, translated, and very adequately annotated.

Among the interesting facts that Pliny describes is the manufacture of cadmia or zinc oxide by roasting zinc ores. "It is made", he says, "when the most subtle portion of the charge is expelled by the fiery blast and deposited either in the roof-chambers or on the furnace-walls, in accordance with its density." As in modern practice, the product was graded by density and the distance to which the fumes were carried, the best quality occurring inside the furnace itself, where it hung from the arches of the roof-chamber. Ores containing zinc were well known to the Romans, and it appears probable that the alloy which we call brass was indeed a Roman discovery. Dr. Bailey observes that Roman copper coins from Augustus to Gallienus regularly contained zinc, and that brasses discovered at Silchester are practically identical in composition with Tournay's alloy (copper, 82·5; zinc, 17·5), used extensively for the imitation of gold.

Upon lead, Pliny remarks that it "is mined with great toil in Spain and in all the divisions of Gaul, but occurs in Britain in the surface stratum of the ground, and in such abundance that the amount refined is actually limited by law". It is a little surprising that in his note on this passage, Dr. Bailey, though mentioning the occurrence of lead in Cornwall, Derbyshire, Cumberland and Shropshire, does not refer to the extensive Roman lead mines on the Mendips—those *montes minerarii, plumbi admodum fertiles*—where the largest pig of Roman lead ever found in Britain was discovered at Charterhouse-on-Mendip in September 1873. Possibly his attention was momentarily distracted by the delightful application of lead described a few lines further on: "Nero, by the will of the gods Emperor, used to sing solos with a sheet of lead over his chest, and thus demonstrated a method for maintaining the voice"!

Verdigris, used in salves and for other medicinal purposes, was manufactured in various ways, such as sprinkling vinegar on copper filings and stirring the mixture several times a day with a spatula until the reaction was complete. The product, especially that exported from Rhodes, was frequently adulterated with powdered marble, pumice or gum, but more particularly with shoemakers' black (ferrous sulphate). Pliny says, quite rightly, that the presence of the last adulterant may be detected by means of a piece of paper steeped in extract of gall-nuts, which is immediately blackened by verdigris containing *atramentum sutorium*. Such versatility in experiment as is implied by qualitative tests of this recondite nature renders all the more incomprehensible the later fortunes of chemistry, with its 'artificial' gold and silver almost universally accepted as genuine.

Among the properties of blue or green vitriol Pliny mentions its use to cure deafness, to expel intestinal parasites, to relieve pains in the eyes, and to cleanse ulcerous excrescences. But it is

plain that he likes best of all the "recent discovery for use in the arena", namely, that if vitriol is thrown into the faces of bears or lions, it exercises so powerful an astringent effect as to prevent them from biting.

The prevention of the rusting of iron, though not so urgent a problem for the Romans as for the modern world, had received attention. Pliny complacently remarks that, as iron inflicts most loss on short-lived humanity, a benevolent nature showed laudable foresight in exacting from it the penalty that it needs must rust; but he goes on to say that it may be protected against rust by white lead, gypsum, or pitch. He also relates the story (without lending it his support) that rusting may be prevented by a suitable religious ceremony, and mentions that an iron chain was still in existence, at Zeugma on the Euphrates, which was used by Alexander the Great in bridging the river there. "Those links which have been renewed are a prey to rust, from which the original links are quite free." The iron pillar at Delhi is an indication that the production of rustless iron is perhaps not altogether a modern achievement, and the story of Alexander's chain may possibly have some foundation in fact.

It would be easy to lengthen considerably this selection of extracts from Pliny's engaging story, for no page is without its interest and its problem. The interest is Pliny's own, who in the end discovered more about sulphur dioxide than its bleaching and germicidal powers; but the solution of most of the problems is due to Dr. Bailey, whom we may once again thank for his careful and ingenious labour. E. J. Holmyard.

Comenius in England

Comenius in England: the Visit of Jan Amos Komenský (Comenius), the Czech Philosopher and Educationist, to London in 1641–1642; its Bearing on the Origins of the Royal Society, on the Development of the Encyclopædia, and on Plans for the Higher Education of the Indians of New England and Virginia, as described in Contemporary Documents. Selected, translated and edited, with an Introduction, and Tables of Dates, by Robert Fitzgibbon Young. Pp. vii + 99 + 12 plates. (London: Oxford University Press, 1932.) 10*s.* net.

JAN AMOS KOMENSKÝ, the famous Czech philosopher and educationist, better known by his Latinised name, Comenius, was born at Uherský Brod, Moravia, in 1592. He spent a few years at the University of Herborn, in Germany, under Alsted, whose encyclopædic ideas he was later to develop. Comenius returned to teach for a time in Moravia, but his promising career was interrupted by the Thirty Years' War which began in 1619. As one of the Bohemian Protestants, Comenius went into exile in 1628 and settled at Leszno in Poland, where he taught at the college of the *Unitas Fratrum* and wrote some of his remarkable Latin and vernacular educational works which are still of interest to-day.

Always hoping to be allowed to return to his native land, Comenius made many journeys across Europe. Everywhere he impressed men of learning by his teaching abilities, his writings and by his pansophic plans. He conceived the idea of erecting an international college or academy of sciences where every branch of human knowledge would be studied and made available in encyclopædic form. Such a 'universal college' was to be a "living laboratory supplying sap, vitality and strength to all".

At this time great developments in mathematics, physics and biology were taking place in England and elsewhere as an aftermath of the humanistic Renaissance of the fifteenth century. Comenius's all-embracing schemes appealed to contemporary scholars and through Samuel Hartlib, a native of Elbing in East Prussia, they were made known in England.

In 1641 a group of members of both Houses of Parliament invited Comenius to England. He arrived on September 21, 1641, and remained until June, 1642. The exact influence of Comenius upon his English contemporaries is difficult to ascertain and for this purpose Mr. R. Fitzgibbon Young has collected in his valuable monograph the relevant documents (ten in all) describing Comenius's plans for a Baconian college and other details of his visit to London. From these carefully annotated documents it is clear that many influential scholars (including several who were later prominent fellows of the Royal Society) and public men were favourably impressed by these plans.

Unfortunately, more urgent matters absorbed the attention of Parliament and the plan for a universal college was abandoned. Only after the Restoration in 1660 was it possible to make use of some of Comenius's ideas when the Royal Society was incorporated in 1662. As outlined in his "Via Lucis", which was written whilst he was

in England, Comenius intended his college or society to serve as a meeting-ground and intellectual clearing-house for men of science from all over the world and it is interesting to note that, from its inception, the Royal Society had a certain international character through its foreign members and correspondents.

There is no doubt that Comenius was deeply disappointed when he found that his plans could not be realised in England. His subsequent efforts in Sweden and Holland were no more successful, but he rejoiced later when the Royal Society was founded and he dedicated his "Via Lucis" to it in 1668.

Mr. Young has also discovered interesting evidence which seems to indicate that whilst in England, Comenius was approached by John Winthrop, Governor of Connecticut, with the view of visiting America and establishing a college for educating the Indians of New England, but this also did not materialise.

Mr. Young has included tables of dates of events in the life of Comenius and illustrating the development of scientific societies. He throws fresh light upon the origins of the Royal Society and the general development of plans for scientific societies and for the compilation of encyclopædias in the seventeenth century. He is the first to point out that Comenius's ideas found fruition in the writings of G. W. Liebniz, who, with Comenius's grandson, Bishop D. E. Jablonski, was the principal founder of the Berlin Academy of Sciences in 1700. J. G. F. D.

Sir Bertram Windle

Sir Bertram Windle, Bertram Coghill Alan Windle, F.R.S., F.S.A., K.S.G., M.D., M.A., LL.D., Ph.D., Sc.D.: a Memoir. By Dr. Monica Taylor. Pp. xiii + 428 + 4 plates. (London: Longmans, Green and Co., Ltd., 1932.) 12*s.* 6*d.* net.

BY a stroke of good fortune it has been possible to secure for the writing of this memoir the services of one who—a distinguished pupil of Prof. Graham Kerr—shared both the scientific interests and spiritual emotions of her subject. Those who knew how deep his religious sense, how strong his liturgical leaning, will appreciate how incomplete would be any memoir of Windle in which this side of his personality was not adequately represented. Another cause for congratulation is that not merely has the task been entrusted to sympathetic hands, to the hands of one who shared his technical knowledge of that branch of biology, cytology, which particularly interested him, but also to the hands of one who obviously possesses rare literary ability, the result being that we are given a complete, intimate and vivid portrait of a very remarkable man.

No one who ever entered Windle's presence could fail to realise that he was an outstanding personality, an impression which, if we can analyse such things, was largely due to the sense of energy and power which he conveyed: the charm of his personality, great and irresistible, was only clearly disclosed to his friends and only fully to them in his rare moments of ease and relaxation.

His life naturally falls into three periods, spent in centres so apart as Birmingham, Cork and Toronto. It was in Birmingham that his scientific investigations began and ended, for already before he left that city his energies were being more and more employed in general educational work—the foundation of the University (the first civic university in England), the organisation of its faculty of medicine, the chairmanship of the Education Committee of the General Medical Council, the performance of almost innumerable offices in connexion with general education in the Midlands. Had he continued his scientific investigations, they would in all probability have been along the lines of experimental embryology, a subject of unfailing interest to him and one to which he had been led by his studies in teratology—for many years he contributed an annual summary of the literature on this subject to the *Journal of Anatomy*—and in cytology, studies which made him an early member of the vitalistic school.

In Cork, where he went as president of Queen's College, Windle found ample scope for his energy and ability in the re-organisation of the College—adding to its buildings, dividing up its departments, enlarging its staff, improving residential accommodation for its students and taking an active general interest in the welfare of its staff and students. He was particularly successful in securing increased grants and generous benefactions, with the result that the College rapidly rose in status. Although he never achieved his ambition of converting the College into a university—the University of Munster—he was largely instrumental in its becoming one of the three university colleges in the National University of Ireland. As

in Birmingham, his interest in education was far from being confined to the institution with which he was officially connected. He became a well-recognised figure on the platform, often in the chair at meetings throughout the country and was one of those nominated by the Prime Minister as a member of the Irish Convention of 1917.

At the close of the War, the dismal rôle for which Ireland above all countries seems to be cast, that of 'stoning the prophets', in other words, driving into exile those most willing and best fitted to serve her, came again to be played. The strange and violent opposition of Sinn Fein to Windle's project of a university for Munster, the project which had been close to his heart ever since his first landing in the country and to which the major part of his energies had been persistently bent, made his resignation inevitable and irrevocable.

The last period of Windle's eventful history was spent in Toronto where, far now from Ephesus, he spent the evening of his life in the quiet air of congenial studies, writing and lecturing on many subjects, some as diverse as Roman Britain, Thomas Hardy, science and religion. As always, he played an important part in the life of the city, being particularly prominent in connexion with university institutions and medical charities.

Such in barest outline is the record of a life and career of ceaseless activity and high distinction, a record which Dr. Taylor, assisted by an unusually large number of intimate letters, but yet with consummate knowledge and skill, has been able to convert into a narrative of absorbing interest, placing incidentally the many friends of Windle under a debt of deepest gratitude.

WILLIAM WRIGHT.

Georgia and its People

A History of the Georgian People: from the Beginning down to the Russian Conquest in the Nineteenth Century. By W. E. D. Allen. Pp. xxiv+429+31 plates. (London: Kegan Paul and Co., Ltd., 1932.) 31*s.* 6*d.* net.

IN a laudatory introduction to this book, Sir Denison Ross emphasises the scant attention Georgia has received latterly from historians and other scholars. Since the publication of Brosset's "L'Histoire de la Géorgie", three quarters of a century ago, nearly everything that has been written relating to the people and the country has appeared in either Russian or Georgian. For this, no doubt, its troubled history in the earlier half of the last century is responsible; but it is surprising that a country, of which the beauty and charm has been celebrated by more than one Russian writer well known to the western world, should have been thus neglected in later years.

Mr. Allen's "History of the Georgian People" covers a long range of time. He begins with the bronze age and ends with the beginning of the nineteenth century, when the Georgian kingdom fell before Russia, although the country was not completely subdued until many years later. Mr. Allen does not write as an archæological expert. His account of the prehistoric period is a summary of the views generally accepted by archæologists at the moment, but it is none the less to be appreciated on that account. He marks how little is known with certainty and how great a field for exploration is offered in this little-known area, which not only includes the ancient Colchis, but was also evidently in more or less close touch with the Hittites and, probably, with other early empires of the Middle East. The archæology and ethnology of a people speaking a language with no proved affinities clamour for intensive study.

An enormous mass of information in Russian and Georgian, mostly from the periodical literature of learned societies, has been digested in the preparation of this history. The story of the medieval Georgian kingdoms is virtually a new chapter in history, which in its account of the relations of the Georgian monarchs to Mongol, Turk and Persian is of interest not merely as it affects the Caucasus, but also for the sidelights it throws on the history of the various peoples and rulers with whom the Georgians were in contact. It is instructive, for example, to see how the tolerant rule of the early Mongol conquerors actually functioned from the point of view of the conquered country.

In addition to the historical sequence of events, Mr. Allen deals with the development of the social and economic organisation of medieval Georgia and its religion, literature and art. Each of the chapters on these subjects is valuable, but the account of the social organisation, tracing its growth from the primitive congeries of family groups at about the beginning of the Christian era to the feudalised kingdom, is a field untouched by, and indeed unknown to, European sociologists. The picture of manners and customs places in a true perspective the somewhat coloured accounts of de Chardin, Tournefort and other travellers of the late sixteenth and early seventeenth centuries.

Mr. Allen has added considerably to the interest of his narrative by his illustrations, some of which show striking examples of Georgian art, while others are portraits and sketches which illustrate arms and dress at different periods from contemporary Georgian sources.

British County Flora

The Comital Flora of the British Isles (Flora Comitalis Britannicæ : Fl. Com. Brit.) : being the Distribution of British (including a number of Non-Indigenous) Plants throughout the 152 Vice-Counties of Great Britain, Ireland and the Channel Islands, with the Place of Growth, Elevation, World-Distribution, Grade, Chief Synonyms and First Names by which the Plants were recorded as British. By Dr. George Claridge Druce. With an original coloured Map showing the Botanical Vice-Counties presented by William James Patey. Pp. xxxii + 407. (Arbroath : T. Buncle and Co., 1932.) 20*s*.

IN his introduction, Dr. Druce gives an account of the work of Hewett Cottrell Watson, who devoted many years of a long life to the study of the geographical distribution of our British plants. Watson divided the country into provinces, subprovinces and counties or vice-counties (112 in number) and also employed terms to indicate altitudinal distribution and the nature of the habitat. His results were collected in two classic works, the "Cybele Britannica" in four volumes (1847–59) with a "Supplement" (1860) and the "Topographical Botany" in two parts (1873–74). A second edition of the last-named was prepared by J. G. Baker and the Rev. W. W. Newbould and two "Supplements" have since been published in the *Journal of Botany*, the first by Arthur Bennett (1905), the second by Bennett, C. E. Salmon and J. R. Matthews (1929–30). Dr. R. L. Praeger's "Irish Topographical Botany" (1901), with "Supplements" in 1906 and 1929, is authoritative for the Irish counties.

These works together with "Floras of the Channel Islands" by Lester-Garland and Marquand form the basis of the "Comital Flora" in which Dr. Druce essayed to collect in one volume all available information. The plan of the work is as follows : the scientific and popular names of the plant are followed by its more important synonyms ; the natural habitat, altitudinal and horizontal distribution according to Watson's vice-counties, are given, and finally the first record of the species as British based mainly on W. A. Clarke's "First Records of British Flowering Plants".

The volume, appearing so shortly after the author's death, is a memorial of his industry and his devotion to the study of our British flora ; and is valuable as bringing together much scattered information. Its defects are traceable to the personality of the author, and perhaps also to hasty production, excusable in a man who has completed his four-score years. Dr. Druce was unwilling to merge his own opinions in the compromise involved in the acceptance of generally agreed rules of nomenclature, and the student will find in the pages of the "Flora" familiar plants under unfamiliar names, such as *Dondia* for *Suæda*, *Juncoides* for *Luzula*, and *Savastana* for *Hierochloe* ; and whereas botanists in council have 'barred' tautonyms, Dr. Druce uses such combinations as *Meum Meum* Druce. A more serious fault is the failure to deal more fully with large and critical genera where the information was ready to hand—as in the case of *Rubus* in the work of Moyle Rogers and of more recent botanists, and *Euphrasia*, the British species of which have been treated in detail by Rigsley. The notes on the general geographical distribution of the species are sometimes incomplete—*Najas flexilis*, for example, is cited as European but occurs also in North America—or even inaccurate ; and errors in the records of vice-county distribution are noticeable.

The book is neatly bound and of convenient size for a hand-book ; the typography is well arranged and clear ; and a large, coloured map indicating the vice-counties in Great Britain and Ireland, included as a folder, is a useful addition.

A. B. R.

Experiments on Memory

Remembering : a Study in Experimental and Social Psychology. By Prof. F. C. Bartlett. (The Cambridge Psychological Library.) Pp. x + 317 + 3 plates. (Cambridge : At the University Press, 1932.) 16*s*. net.

PROF. BARTLETT'S experimental investigation of remembering is to be welcomed as a valuable scientific investigation which, in many ways, breaks new ground. During the years since Ebbinghaus invented the experimental method which makes use of nonsense syllables, it is probable that as much has been discovered by this method as ever will be. On the whole, the results have been disappointing.

With the passing of interest in the laws of association, which are now recognised to be merely the laws of thought habit formation and not the fundamental laws of effective thinking, new ways of study have become necessary. Prof. Bartlett has used a method in which folk-lore stories, news stories, drawings, or other items of meaningful material are successively reproduced by a single person or are handed on from person to person. Particularly interesting are the results of the latter kind of experiment, which demonstrate the process of social conventionalisation by which folk stories may be supposed to have been formed and by which originally representational drawings may have been conventionalised into the letters of the alphabet.

The present stage of development of experimental psychology is undoubtedly one in which the widest possible variety of methods is to be encouraged since no one knows which will be most fruitful. It is a pity that Prof. Bartlett allows himself to attack the use of statistical methods, which provide one of the most promising methods of approach. He complains that statistical methods are scientific makeshifts because they are only used on data in which disturbing causes prevent the appearance of invariable relationships. This, however, is really an argument for excluding all quantitative problems in which relationships are not invariable (that is, those in which there is merely a 'tendency' for an effect to appear in certain conditions) and is not an argument for admitting tendencies to relationship without adequate consideration of the problems of chances of sampling. Prof. Bartlett himself refers to many tendencies which arise out of his work. Thus, on p. 61 it is stated that visualisation 'tends' to lead to confusion as to order of presentation and 'favours' the introduction of extraneous material, while vocalisation 'favours' a certain kind of classification and 'tends' to set up an attitude of uncertainty.

Prof. Bartlett is a careful and self-critical investigator and it is most likely that he has adequate evidence for these tendencies, but he does not give the figures which alone can enable us to determine the likelihood that these are not spurious tendencies produced by the chances of sampling. The truth is that in many biological inquiries, and particularly in psychological ones, the choice is not between invariable relationships and tendencies. The most carefully controlled conditions will not make the observed relationships invariable. The choice is between inadequate treatment of observed tendencies and their adequate treatment by the use of statistical methods.

Prof. Bartlett's theoretical chapters on the theory of remembering, on the functions of images and on meaning are a valuable contribution to the subject. He rejects the over-simple 'memory-trace' hypothesis, still too popular amongst the teachers of allied sciences, and bases his own view on Head's theory of 'schemata'. He describes remembering as "an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organised past reactions or experience, and to a little outstanding detail which commonly appears in image or in language form" (p. 213). R. H. T.

The Process of Metamorphism in Rocks

Metamorphism : a Study of the Transformations of Rock-Masses. By Dr. Alfred Harker. Pp. x + 360. (London : Methuen and Co., Ltd., 1932.) 17*s.* 6*d.* net.

A RICH store of observations especially on the metamorphic rocks of Great Britain, numerous excellent drawings of rock sections as seen in the microscope and admirable clarity of statement are the outstanding features of this new book on metamorphism. In the first part, which is devoted to thermal metamorphism, general genetic considerations occupy about one-third of the space and are followed by a detailed account of the thermal metamorphism of argillaceous, calcareous and siliceous sediments and of igneous rocks. Especially in connexion with the last named, much interesting information is given. The second part treats in similar fashion of dynamic and regional metamorphism with very brief chapters devoted to injection, repeated and retrograde metamorphism.

Throughout the book the reader is left with the impression that the author's knowledge of metamorphism is based on the rocks of Great Britain and is struck by the fact that a discussion of the conditions prevailing in the oldest formations as in the youngest, for example, the fold-system of the Alps, is largely wanting. In these circumstances the systematic and most important parts of the book offer an interesting counterpart to publications dealing especially with archæan and alpine metamorphism. But it is no less true that the limitations thus indicated, to which must be added the fact that a lack of references to the

non-English literature of the past twenty years is very noticeable, constitute a real shortcoming in the work as a whole. It is greatly to be feared that this book with all its obvious advantages (should it come to be used in Great Britain as a compendium of contemporary knowledge on metamorphism) will tend by what it omits to delay the adaptation of many results of modern research to the further study of British metamorphics. A divergence between the Continental and British schools of metamorphism might thus arise, which could only be of mutual disadvantage.

Dr. Harker stresses the point that his text is equally allotted between thermal and dynamic metamorphism and that he is more concerned with the processes than with the results of metamorphism. In these respects he believes his point of view to be in contrast to that of what he calls the "German School" but which more correctly should be termed the Austrio-Swiss or Alpine School after its most eminent representatives, F. Becke and U. Grubenmann. This assumption, which is the starting point of the book, is in two respects erroneous. For, on one hand, it has apparently escaped the author's notice that a third edition of Part I of Grubenmann's book "Die kristallinen Schiefer" appeared in 1924 under the title "Die Gesteinsmetamorphose" and treats practically only of the processes of metamorphism. Thermal and dynamic metamorphism are discussed separately and full account is taken of the general physico-chemical principles governing these processes. If, secondly, Grubenmann in his systematic part was mainly concerned with the products of metamorphism, it must not be taken to mean that he (or Becke) was indifferent to the processes as such. It was, however, necessary to clear up the question of terminology, to bring out the importance of the chemical composition of the original rocks and to find a basis on which to discuss polymetamorphic rocks or such, about the mode of metamorphism of which nothing precise is known. Dr. Harker has, of course, to deal with all these questions, too, but no progress is achieved when vague terms such as "argillaceous sediments", "basic igneous rocks", etc., are used instead of the preciser information given by the chemical classification in the older book.

It must be considered a serious omission in the book that no mention is made of the question of *Gefügeregelung*, of the methods used in its investigation or of its dependence on tectonics. The names of the Austrians, Sander and Schmidt, who in the past twenty years have done work of the greatest importance and have recently published books, are not even mentioned. Very many phenomena connected with pneumatolysis, injection, assimilation and palingenesis are left untouched, so that the impression gained from Dr. Harker's treatment is quite inadequate as regards the complexity of these processes.

It is obvious that the various points mentioned in no wise lessen the value of what Dr. Harker has written, so long as the reader is aware of the limitations in the treatment. For the alpine petrographer, for example, much of the information, based as it is on accurate observation, will be of the greatest interest. At the same time, it is to be hoped that a book which may be described as the most important contemporary English work on metamorphism, will not obscure the existence of some wider issues in metamorphic petrography which are of very real importance to the subject as a whole.

P. Niggli.

Early History of the British Coal Industry

The Rise of the British Coal Industry. By Prof. J. U. Nef. In 2 Vols. (London School of Economics and Political Science (University of London): Studies in Economic and Social History.) Vol. 1. Pp. xiv+448+14 plates. Vol. 2. Pp. vii+490. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

THE above work is in many respects a very remarkable one. First of all it is sufficiently curious that a professor in the heart of the United States, in Chicago, which is not even a coal-mining centre, should concern himself with a study of the coal industry of Great Britain. The material which the author has made use of is also very remarkable both for the extent of the resources of which he has availed himself and of those which he has overlooked. He himself admits in his preface that he has not made as much use as he might have done of the important work by Messrs. Ashton and Syke, "Coal Industry of the Eighteenth Century"; he appears to have entirely overlooked that valuable compilation "Historical Review of Coal Mining", published by the Mining Association of Great Britain in 1925 in connexion with the Wembley Exhibition, and he has not made any really effective use of the very valuable collection of manuscripts and other documents in the possession of the North of England Institute of Mining and Mechanical Engineers.

Had his researches been somewhat more extended, Prof. Nef would probably not have taken the same limits to his work as he has done, because he puts down the growth of the British coal industry as having taken place between the dates 1550 and 1700, basing his arguments upon the following statistics: he states that the vend from the Newcastle coalfield in 1564 was a little less than 33,000 tons, whilst in the year 1700 it was 650,000 tons, and in 1864 it was approximately 18,350,000 tons. He shows that the rate of multiplication in the first period was very much greater than in the latter periods. But surely the rate of multiplication is not the correct basis for an estimate of this kind, which should be rather the rate of addition than the rate of multiplication. It is quite true that in the year 1550 very little coal was consumed, and in the year 1700 there was a much greater consumption of coal, owing no doubt to the increasing scarcity of wood, which caused coal to come into fairly extensive use for domestic purposes. No doubt the increase in domestic consumption had something to do with the fact that at the earlier date most of the coal available would be outcrop coal, which, as is well known, is very much dirtier than coal obtained from greater depths in the seam, where surface effects have probably disappeared.

Of course, by selecting arbitrarily the year 1700 as the end of his investigation, Prof. Nef has missed entirely the great main reason for the expanse of the British coal industry, namely, the use of coal for the generation of power and for the smelting of iron, which came in, as is well known, towards the end of the eighteenth century. Furthermore, it was towards the end of the eighteenth century that the power-loom was invented, which would have been practically useless without the steam engine to drive it or iron made by the use of coal to construct the machinery. Then again, even at the beginning of the nineteenth century means of transport were exceedingly bad; the first railway (another utilisation of steam and therefore of coal) was not opened until 1822, and even at the beginning of that century roads were few and extremely bad.

It may fairly be claimed that whatever developments future ages may have in store, there will probably be none of such far-reaching importance as the application of the latent energy of coal to the generation of power. Until that date the only energy made use of by mankind had been kinetic (that is, visible) energy; even potential energy, such, for example, as that of water at a high level, was not really used until the water was in motion and made to turn a wheel, so that even in this case it may fairly be said that kinetic energy was the source of power. Possibly at some future date we shall learn to make use of atomic energy, but even such a discovery would be less epoch-making than the discovery that latent (that is, invisible) energy could be pressed into the service of mankind.

The fact that both the use of coal for the production of power and the use of coal for the production of iron were British inventions necessarily contributed enormously to the development of the British coal industry. Again, Murdoch's discovery of coal gas was not made until the very close of the eighteenth century, or a century after Prof. Nef has thought fit to close his review of the rise of British coal mining, yet to-day more than ten per cent of the coal produced in Great Britain is gasified, whilst the consumption of coal for iron-making averages something like eight per cent.

Prof. Nef seems to have overlooked the fact that for many centuries Great Britain was the world's leading producer of coal; indeed it was not until the year 1899 that the British output—obtained from this one small island—was exceeded by the output from the United States with its vast territory. In fact, the coal trade of Great Britain continued on a steady increase until well into the twentieth century; the output of British coal for 1913 (the year before the War) was not less than 287·43 millions of tons, of which more than one-third was exported. Even to-day when the output has necessarily fallen off considerably, for reasons which are perfectly well known but need not be discussed here, Great Britain is producing more than seventeen per cent of the world's coal, whilst according to the latest statistics, its coal resources are barely 2½ per cent of those of the whole world. In other words, Great Britain is producing something like seven times as much coal as its known resources should entitle it to do, and even if we admit that the zenith of the British coal industry has been passed, we are still, in comparison to our resources, by far the world's greatest coal producers.

Although, therefore, one cannot possibly agree with Prof. Nef as to the limits within which he has attempted to restrict the rise of the British coal industry, seeing that the maximum output of British coal was probably about ten times as

great as it was in the year which he has selected for the close of his survey, one is bound to admire the industry which he has shown in compiling the great mass of facts, some of them by no means easy of access, which relate to the period to which he has chosen to confine his attention. We may perhaps express the hope that at some not too distant date he will complete his history up to, say, the commencement of the War, which probably marks the zenith of British coal production.

Evolution of Hydrodynamics

Hydrodynamics. By Sir Horace Lamb. Sixth edition. Pp. xv+738. (Cambridge: At the University Press, 1932.) 45*s.* net.

THE development of a book through successive editions is very like the evolution of a species. It has to adapt itself to changed circumstances by the insertion of new material; portions cease to be of explicit use, sometimes through the acquirement of new methods that do the work better, sometimes because their applications cease to exist. For economic reasons the book will survive better the more thoroughly the new adaptations are carried out and the superfluous parts eliminated. Nevertheless vestigial traces remain.

In such a work as Lamb's "Hydrodynamics", first published in 1879, these processes are well exemplified. It may perhaps be thought that the whole plan of the book is obsolete and that complete rearrangement is necessary. For the first 561 pages it considers only the classical fluid, in which the internal reaction across an element of surface is always normal to the element, and which can slip freely over solid boundaries. The next chapter considers for the first time the real or viscous fluid; and there is a return to classical fluids in the last. Perhaps this is inevitable; the equations of viscous motion are not things one would like to meet at the very introduction to a subject. Further, though classical hydrodynamics is scarcely ever in exact agreement with the facts, it is often an excellent approximation; for example, the whole of the chapters on tidal waves, surface waves, and waves of expansion are still valid in a viscous fluid.

Still, seeing that the fundamental postulates of classical hydrodynamics are wrong, there is a definite problem in explaining why its results are ever right. The attention given to this question is somewhat casual. On p. 106 the inability of a fluid to turn round a projecting corner is attributed to the formation of a negative pressure, instead of to the fact that this is the most striking case where classical results do not give any approximation to the behaviour of a real fluid. The proposition that vorticity in a real fluid cannot originate in the interior, but must be diffused inwards from the boundary, is given in small type on p. 578; I should prefer to state the result in the form of a modification of the circulation theorem, but even in the form given to it by Lamb it could have been made the basis of an explanation of why so much of the earlier part of the book has physical value. Again, much attention is given to vortex motion in Chap. vii; but we might have expected to find somewhere an explanation of how isolated vortices come to exist. Many results are given that have a bearing on these questions, but they are not co-ordinated in such a way as to bring out their fundamental importance.

The process of adaptation to modern conditions has, however, been successful in other matters. The lift of a Joukowsky aerofoil is determined on p. 82; the formula for the resistance due to a Kármán street is quoted; the theory of the effect of viscosity on sound waves is extended. But the most striking additions are the inclusion of an account of the boundary layer theory and one of the effect of compressibility on the motion of fluids around solids, both of which topics are becoming extremely important in aeronautics.

The account of Reynolds's theory of the stability of laminar motion survives; this is remarkable, since Reynolds's discussion proves nothing at all. Orr showed that above a certain Reynolds number some of the types of disturbance, starting small, increase to a maximum, and then die down again. According to Reynolds's method, which considers only the early behaviour arising from a given initial disturbance, these would imply instability; but Orr's discussion of their later behaviour shows that they do not. On the other hand, where Reynolds fails to find his disturbance increasing, stability is not proved, for instability might occur for a different type of initial disturbance.

There is a curious minor vestige on p. 17, where it is stated that the reason for the introduction of the minus sign in the definition of the velocity potential is given in the preface; but the preface that gave it has disappeared in the process of revision. Another is the slip of the pen, $-\omega^2 z$ for 0 on p. 697.

Nevertheless, if we carry our biological analogy a little further, we may predict that the new edition will succeed and probably lead to further successful adaptations. Where a species has material for its existence, even if its adaptation to its conditions is not perfect, it will survive until a better adapted species enters into competition with it; and a book on hydrodynamics capable of competing with Lamb's is unlikely to be produced for some considerable time.

HAROLD JEFFREYS.

Chemistry and our Idiosyncrasies

The Inborn Factors in Disease: an Essay. By Sir Archibald E. Garrod. Pp. 160. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 7*s.* 6*d.* net.

EVERY one of us is characterised by more or less marked personality as an individual, in addition to belonging to a particular race and having its special attributes. It is permissible to assume that we possess chemical individuality also, that each one of us, varying perhaps on either side of a chemical mean, is built up of slightly different materials from his fellows and leads his own chemical life.

Sir Archibald Garrod, whose well-known book on the inborn errors of metabolism has for many years stimulated thought on this subject, has in his new essay, which had its origin in a Huxley lecture delivered at Charing Cross Hospital, still further broadened the outlook. Bodily metabolism is definitely chemical; our idiosyncrasies, the inborn factors which are apparent in disease, are all intimately connected with the chemical life of their subjects and the chemical structure of their tissues. Since man springs from the chromosomes of the germinal cells, the starting point of the mutations must lie in their variation, and it is difficult to escape the conclusion that upon the chemical structure of the chromosomes depend the structure and form of the creatures which originate from them.

The influences of natural selection which are always at work ensure the survival of helpful mutations and the destruction of those that are detrimental. It is to be supposed that just as, normally, the same chemical reaction is repeated when the same reagents come together under suitable conditions, so it is possible when the conditions are ever so slightly varied for side reactions to occur in greater or less degree. The laboratory experience with catalytic agents, particularly those of an organic nature like the enzymes, affords ample evidence of this variable secondary change, and it is, therefore, not difficult to see how mutations can arise which are in no way restricted to members of a single family or race.

The normal man is one who does not depart in any conspicuous respect from the average of the race: some deviate from the normal to their benefit, others to their detriment. It is highly probable that chemical defects, or errors of metabolism, are common but they escape detection because but few of us, and then only occasionally, are subject to clinical and chemical examination. Our idiosyncrasies, which often affect health out of all proportion to the external causes which provoke them, are undoubtedly due to the disturbances caused by the intrusion of a foreign chemical substance, most often probably of a protein nature. Some of us are hypersensitive to eggs, others to shell-fish, others to strawberries, a few are sensitive to pollen and suffer from hay fever: there is much evidence that all these are inborn and hereditary peculiarities. In such idiosyncrasies it is to be supposed that the poison acts as an antigen reacting with an antibody in the cells of the subject, with the result that histamine is liberated from the damaged cells. What is inherited is an undue liability to such cellular protests.

Metabolism in the body is brought about by ferments activated apparently by specific chemical messengers set free from the ductless glands. Such ferments may be pictured as normally engaged in regular daily work, but they are available, particularly those in the liver, to deal from time to time with unusual substances as best they can. Some day we shall isolate and synthesise the antitoxins just as we have begun to do with the hormones, adrenalin and thyroxin.

We may ask the question: Is the human body a mere machine governed wholly by the principles of physics and chemistry? Whenever it is understood, the answer is in the affirmative, and such work as that of Pavlov has extended our positive knowledge into the field of the control of the nervous reflexes. The growth of science has largely swept away the beliefs of the traditionalist, but vital principles may still lurk in processes not completely understood.

E. F. ARMSTRONG.

Short Reviews

Anthropology and Archæology

Israel: from its Beginnings to the Middle of the Eighth Century. By Prof. Adolphe Lods. Translated by Prof. S. H. Hooke. (The History of Civilization Series.) Pp. xxiv+512+16 plates. (London: Kegan Paul and Co., Ltd., 1932.) 25*s.* net.

"The unique importance of the people of Israel," says M. Lods, "is due to its religion"; but he adds that the study of the origin and development of that religion depends upon the success of a number of preliminary or subsidiary investigations. He therefore surveys the archæology, history and social, cultural and religious development of Palestine under three main heads: first, of the people who inhabited the area before the settlement of the Hebrews; secondly, of the Hebrews themselves before they entered it; and thirdly of the Hebrews after the settlement, when the two streams of cultures had coalesced to produce the characteristic Hebraic system prior to the middle of the eighth century before our era.

It will be obvious that if the field covered by Mr. Lods is one to which the greatest interest is attached owing to its influence in the development of the modern cultures of Christianity and Islam, it is also one into which conjecture enters largely. Upon the major controversial issues such as the ethnic character of the early inhabitants of Palestine and their relations with the Hebrews, the sojourn in Egypt and the Exodus therefrom, M. Lods displays a wise conservatism. He has not allowed himself to be led away by recent tendencies to regard every archæological discovery as a confirmation of the Bible text. The facts are placed before the reader and discussed thoroughly and dispassionately. For this, but not for this alone, M. Lods's book must be accounted a valuable addition to the already extensive literature of the subject.

(1) *Social Anthropology.* By Dr. Paul Radin. (McGraw-Hill Publications in Sociology.) Pp. xii+432. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 21*s.* net.

(2) *Economics in Primitive Communities.* By Prof. Richard Thurnwald. (Published for the International Institute of African Languages and Cultures.) Pp. xiv+314. (London: Oxford University Press, 1932.) 25*s.* net.

(1) The aim of Dr. Radin's textbook of social anthropology is to emphasise man's positive achievement in social organisation and to avoid the undue stress hitherto laid on magic and the irrational side of primitive man's life. He has also avoided general theoretical discussion except in an introductory chapter in which he submits ethnological theories to a very fair and unbiased critical examination. His method has been to set himself a number of specific tasks in description such as the organisation of the State, the organisation of law and custom, economics and industrial life, and the like and to show by a concrete example, the description of a typical tribe or people, how primitive man has solved the specific problem the author has in mind. It is his view that "every type of societal organisation can be encountered among primitive peoples . . . [excepting] representative government".

(2) Dr. Thurnwald, on the other hand, while covering in part the same ground as Dr. Radin, analyses primitive economics by comparative rather than unitary methods, with the view of showing the essential difference in approach to economic problems in a primitive community from that of modern society, owing to the conception of the close interrelation between members and units in a group. It is also his object to show the unreality of the 'three stages' of primitive economic development and the conception of cultural advance along a single line only of previous economic theory, owing to the domination of the views of Darwin and Spencer in the last century. He has brought together a valuable array of facts bearing not merely on food-supply—as he says, rightly, too exclusively the pre-occupation of previous theory—but also on the types of economic life, forms of economic activity, including handicraft, wages, trade, distribution, ownership, etc., and the development of economic methods and simple technical skill, this last illustrated by a series of telling diagrams.

Biology

Scientific Riddles. By Sir J. Arthur Thomson. Pp. 384. (London: Williams and Norgate, Ltd., 1932.) 10*s.* 6*d.* net.

Sir Arthur Thomson divided his last book into four very unequal parts. The first consists of twenty-five brief chapters averaging four or five pages each, most of the titles of which end with a query mark: What is protoplasm? Why do we fall asleep? What are hormones? How does our hair turn grey? The second part contains fourteen somewhat longer chapters discussing such topics as homing, galls, walking in a circle and concluding with an amusing chapter on natural history in everyday conversation which recalls such phrases as 'proud as a peacock', 'raining cats and dogs' and others even more obscure. In Part 3 Sir Arthur treads the borderland between physiology and psychology and gives us six short chapters on animal intelligence, telepathy, dreams, and so on. In Part 4 he sets forth his views on the purpose of evolution, concluding with an epilogue on "The Wonder of the World".

Throughout the volume, Sir Arthur has given full measure of his immense store of biological knowledge, and in his characteristically delightful style.

The book will suggest many problems to the biological student, while for the general reader it shows the present position of knowledge on debated topics, with a wealth of happy analogy and often humorous comment: thus, speaking of protoplasm, Sir Arthur says that it "may be compared to an archipelago with a very large number of small islands on whose multitudinous coastlines there are endless opportunities for brisk trading." Part 4 is a serious contribution to the philosophy of evolution; the remainder is a 'common-place book', for constant reference—and entertainment.

Water-Fowl and Game-Birds in Captivity: some Notes on Habits and Management. By Arthur F. Moody. Pp. 240+6 plates. (London: H. F. and G. Witherby, 1932.) 10*s.* 6*d.* net.

The study of birds in captivity can provide much valuable information, such as the length of incubation and the different stages through which the chicks pass on their way to maturity. In the present volume, we have the author's personal knowledge of how he tended the birds. He gives much information on the construction of aviaries; the varying foods and how to give them; how to handle the birds; how to feather clip and how to pinion them. Under "Vermin" many creatures are included and instructions given for dealing with them. The book ends with a chapter on diseases and how they should be treated.

The volume contains an abundance of information on many different birds and should be welcomed by all aviculturists. Some of the plates are very attractive.

Principles of Soil Microbiology. By Prof. Selman A. Waksman. Second edition, thoroughly revised. Pp. xxviii+894+15 plates. (London: Baillière, Tindall and Cox, 1931.) 52*s.* 6*d.* net.

Much additional information has been incorporated in the second edition, but to avoid undue enlargement of the volume the earlier text has been considerably condensed by certain omissions and by the combination of several chapters to avoid unnecessary duplication.

An Introduction to the Scientific Study of the Soil. By Prof. Norman H. Comber. Second edition. Pp. 208. (London: Edward Arnold and Co., 1932.) 7*s.* 6*d.* net.

In the second edition of this textbook the chief alterations are an expansion of the section on soil microbiology and the re-writing of that dealing with mechanical analysis. Other parts of the book are being brought up to date.

Chemistry

Liesegang Rings: and other Periodic Structures. By Dr. Ernest S. Hedges. Pp. viii + 122 + 8 plates. (London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

Although the Liesegang phenomenon, having engaged the attention of mineralogists, histologists and colloid chemists, has given rise to an extensive and scattered literature, the present work is the first monograph devoted exclusively to the subject. The author gives a full account of the experimental material, beginning with Liesegang's original silver chromate rings and enumerating the numerous other combinations of reactants which have since been found to produce periodic precipitates in certain gels and within certain limits of concentration. He then devotes a chapter to the various theories so far proposed, which have in turn postulated metastable supersaturation, adsorption at the precipitate, membrane formation, variations in the rate of diffusion, periodic coagulation of a colloidal reaction product and periodic inhibition of precipitation by the second (soluble) reaction product as the principal agency. Most of these theories are based on a few, or even on isolated, examples and are incapable of explaining others. This is not really surprising, as there is no *a priori* reason for assuming that the mechanism of periodic precipitation is necessarily the same whatever the reaction producing it.

The author proposes a "comprehensive theory" of periodic phenomena, which however does not at present amount to more than a general qualitative statement of the conditions necessary and (possibly) sufficient for their occurrence, and does not allow one to predict the result in any specific instance.

Interesting chapters are devoted to other periodic phenomena, such as periodic sedimentation and crystallisation, as well as to periodic structures in Nature. A feature of the book is a bibliography containing nearly five hundred references, in which the reviewer has not been able to detect any omissions and has found much that was new to him. The work should stimulate exploration of one of the more curious by-paths of colloid chemistry.

The Structure and Composition of Foods. By Dr. Andrew L. Winton and Dr. Kate Barber Winton. Vol. I: *Cereals, Starch, Oil Seeds, Nuts, Oils, Forage Plants.* Pp. xiv+710. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 53*s.* net.

The name of Dr. A. L. Winton is well known to food technologists for his editing of Leach's "Food Inspection and Analysis" and for his collaboration with Hanausek in "The Microscopy of Technical Products" and with Moeller in "The Microscopy of Vegetable Foods". In this, the first of three entirely new volumes, he has joined with Dr. K. B. Winton, and the work will not in any way replace the earlier books, though it extends and amplifies them; its emphasis is on description, classification, and identification, rather than on the technique of analysis, inspection, or microscopy. It will evidently be considerably larger than the earlier books of which Dr. Winton has been editor or joint author, and, judging by Part I, will form a most comprehensive and well illustrated book of reference. A. L. B.

Geography and Travel

(1) *Southern Europe: a Regional and Economic Geography of the Mediterranean Lands (Italy, Spain, Portugal, Greece, Albania and Switzerland).* By Dr. Marion I. Newbigin. (Methuen's Advanced Geographies.) Pp. xviii+428. (London: Methuen and Co., Ltd., 1932.) 15*s.* net.

(2) *The Geography of the Mediterranean Region: its Relation to Ancient History.* By Prof. Ellen Churchill Semple. Pp. ix+737. (London: Constable and Co., Ltd., 1932.) 21*s.* net.

THESE two volumes, each based on extensive personal travels of the author, are complementary to one another and together will be invaluable to the advanced student of geography.

(1) Dr. Newbigin's volume covers Italy, Spain, Portugal, Greece, Albania and Switzerland and contains also several introductory chapters on the physical geography of southern Europe. In a relatively small compass the conflicting theories of geomorphology are outlined in a way that will be a real help to the student. Climate is treated on a basis of fact free from the simplified generalisations which are too often far from the truth. The various lands are fully treated on a physical foundation and the relegation of statistical matter, except climatic data, to appendices makes the text readable and allows scope for discussion of the broad issues of human response to physical circumstance. There are copious lists of authoritative works and papers and full indications of the maps available for each country.

(2) Prof. Semple's book, on the other hand, deals primarily with the development of human civilisation in the Mediterranean area. The physical background is sketched briefly. Physiographic processes are outside the scope of the book. Climate is considered in its influences, and the sections on vegetation and agriculture are particularly valuable. It is a volume that is packed with information and ideas and every chapter is fully documented. It should become a standard work for geographer and historian alike.

Northern Lights: the Official Account of the British Arctic Air-Route Expedition, 1930–1931. By F. Spencer Chapman. With Additional Chapters by J. M. Scott, Capt. P. M. H. Lemon and Augustine Courtauld. Pp. xvi+304+64 plates. (London: Chatto and Windus, 1932.) 18*s.* net.

FEW arctic expeditions from Great Britain in recent years have succeeded in accomplishing more useful work than that which the late Mr. H. G. Watkins led to East Greenland in 1930. The programme before the expedition was ambitious but much of it was carried out, including the survey of a long stretch of little-known coastline between lat. 64° and 68° N., two traverses of the interior ice cap, the establishment of an ice cap meteorological observatory as well as one on the coast, and various geological and biological investigations.

Many of the details of this work cannot be told in this popular account of the expedition, but enough is said to show that no opportunities were wasted. Two aeroplanes proved useful though they seem scarcely to have given the services that were hoped for. On the ice cap the old-fashioned dog teams were found to be the most serviceable transport. Wireless equipment was a doubtful blessing, in spite of certain advantages.

The story is well told by various members of the expedition. There is no attempt to exaggerate difficulties or to magnify dangers. In fact, the long journeys are described so briefly that they give the reader the false impression of ease. There are several scientific appendices. The book is a notable contribution to arctic literature.

R. N. R. B.

Geology

Petrography and Petrology: a Textbook. By Prof. Frank F. Grout. Pp. xvii + 522. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 30*s.* net.

THE aim of this book is to study the life-history of rocks rather than their description and classification. To this end, perhaps, the author has subordinated petrography to petrology, the result being that some readers may wish he had omitted petrography entirely. The petrographic parts of the book, especially that on the igneous rocks, are very disappointing when compared with the outstanding excellence of the petrological parts. However, these petrographical portions include many good illustrations well worth studying by readers able to neglect the associated letterpress.

In the petrological sections, which follow the petrographies of the igneous, sedimentary and metamorphic rocks in turn, there is given a really excellent account of modern views on the origin of rocks. An attempt is made to separate fact from theory, and the author is not engaged in boosting a theory of his own—a circumstance to be thankful for nowadays in a work accessible to students.

The modern American points of view on igneous and sedimentary petrology are well known to European geologists, but not so that on metamorphism. In this field it seems that the Europeans are more likely to fulfil the author's aim—interpretation of rocks in terms of history—than are his countrymen.

The sets of mineral tables given are not necessary in a book such as this. A list of selected readings is a welcome feature, though certain omissions, such as Eskola, Sederholm, Sander and others from the metamorphic section, will be noticeable to European readers.

In summary, this book, in spite of its petrographical blemishes, is a very valuable contribution to the general literature on the origin of rocks.

Der Bau der Erde und die Bewegungen ihrer Oberfläche : eine Einführung in die Grundfragen der allgemeinen Geologie. Von Prof. Dr. W. von Seidlitz. (Verständliche Wissenschaft, Band 17.) Pp. ix + 152. (Berlin : Julius Springer, 1932.) 4.80 gold marks.

This little book is an excellent introduction to present-day geological thought. The classic question, first answered by Leonardo da Vinci, as to why sea shells are found in the rocks of high mountains, is here put again, and answered on modern lines.

The origin of rocks is lucidly explained on sound uniformitarian principles. It is worth noting, however, that the author directs attention to certain limitations in *Aktualismus*, as, for example, those due to the circumstance that the moist vegetation-covered Europe of to-day furnishes none too reliable a clue to the past.

The main part of the book is concerned of course with the movements to which the earth's crust has been subjected. The contrasts between the rapid, violent movements of the orogenic or mountain-building belts and the slow vertical movements of the more stable areas are developed. But, as we would expect from the author of "Diskordanz und Orogenese der Gebirge am Mittelmeer", we find the importance of the broad epirogenic movements consistently emphasised. The integration of minute movements leads to transgressions and regressions, and thus produces results of fundamental importance for earth history. One of the most interesting parts of an interesting book is that dealing with the detection of epirogenic movements in action at the present day. Further, positive uplift is considered to be the chief cause of mountains : "the mountains grow from the depths, and are still growing".

The book concludes with a table of geological formations, short bibliography, a glossary, and index.

A Textbook of Mineralogy : with an Extended Treatise on Crystallography and Physical Mineralogy. By Prof. E. S. Dana. Fourth edition, revised and enlarged by Prof. William E. Ford. Pp. xi + 851. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1932.) 34*s.* net.

Certain additions and much revision, as compared with the third edition of 1922, have been made in this new edition of E. S. Dana's well-known textbook. The chief additions are two. The crystallography section now includes a short account of crystal structure, as revealed by X-ray analysis, which provides a good introduction to an increasingly important branch of mineralogy. A section entitled "Origin, Mode of Occurrence and Association of Minerals" is new to this book, though much of it has appeared in Dana's "Manual of Mineralogy". This section consists of less than twenty pages, so that only a very inadequate summary of mineral paragenesis is presented.

The descriptive part of the book has been revised, the most recent data incorporated, and accounts of more than two hundred new minerals added. Descriptions, short or long, of all known minerals are given. It has been Prof. Ford's aim to give the important facts of mineralogy as known "on January 1, 1932". In this, so far as a work of this kind can be tested, he seems to have succeeded.

Mathematical and Physical Sciences

British Association for the Advancement of Science. Mathematical Tables. Vol. 1 : *Circular and Hyperbolic Functions, Exponential Sine and Cosine Integrals, Factorial (Gamma) and Derived Functions, Integrals of Probability Integral.* Prepared by the Committee for the Calculation of Mathematical Tables. Pp. xxxvi + 72. 10*s.* Vol. 2 : *Emden Functions : Being Solutions of Emden's Equation, together with Certain Associated Functions.* Prepared by the Commission for the Constitution of the Stars of the International Astronomical Union and the British Association Committee for the Calculation of Mathematical Tables. Pp. viii + 34. 7*s.* 6*d.* (London : British Association, 1931 and 1932.)

From 1873 onwards, at irregular intervals, the British Association has published in its annual report various mathematical tables. Unfortunately, these were generally compiled for special purposes, and when regarded as a whole were not well suited for general use. To remedy this defect a committee undertook the heavy task of filling the gaps and (a point altogether neglected in the original form) making them suitable for interpolation. The first volume, begun by R. A. Fisher and completed by J. Henderson, with the assistance of J. R. Airey, L. J. Comrie, A. T. Doodson, A. Lodge, J. Wishart, and others, contains sixteen tables. Some of these are new, and two of them (dealing with tetragamma and pentagamma functions) are the only tables of these functions in existence. The degree of accuracy is high, extending (except in the last) from ten to fifteen decimal places. There is an elaborate introduction filling thirty pages, beginning with interpolation, using Everett's formula and central differences of even orders, for which these tables are specially suitable. After a brief treatment of the better-known functions, the introduction concludes with an extensive account of the properties of certain probability repeated integrals (really Hermite functions) and their applications to statistics.

The second volume is entirely devoted to solutions of Emden's differential equation, which is fundamental in modern theories of the internal structure of the stars, and to certain auxiliary functions. The work, undertaken at the request of Sir Arthur Eddington, was carried out by J. R. Airey, J. C. P. Miller, and D. H. Sadler.

H. T. H. P.

The Queen of the Sciences. By Prof. E. T. Bell. (A Century of Progress Series.) Pp. iv+138. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 5*s.* 6*d.* net.

This fascinating little volume opens with the famous words of Gauss, "Mathematics is queen of the sciences and arithmetic the queen of mathematics. . . ." Prof. Bell takes us from the objects and descriptions of mathematics through the development of systems of algebra, groups and matrices, the Einstein geometry, etc., to Hilbert's logic. Whilst, however, the manifold applications of mathematics are briefly touched upon, especially in the chapter on groups, the treatment rather follows the aim set forth by Jacobi, who, when reproached by the applied mathematician, Fourier, retorted, "The true end of mathematics is the greater glory of the human mind". Indeed, the progress of the century is aptly summarised by the author in the words, "Ever greater generality and ever sharper criticism".

One feels that many of the excellent illustrations are a little too brief to be really effective: just a slightly fuller explanation here and there would not only have safeguarded essential principles being misinterpreted, but would also have made a greater appeal to the lay reader. It is surprising to find no mention of Boole in the chapter on the development of algebra.

The whole book, nevertheless, is extremely interesting, for it tends to broaden the mathematical horizon of the reader, and especially so in the case of a student whose vision has been partially dimmed by the artificial boundaries of examination syllabuses. Here, too, the mature mathematician may derive renewed inspiration. A few references to original sources of some of the topics discussed would have enhanced considerably the value of these.

The Exponential and Hyperbolic Functions and their Applications: a Practical Book for the General Student and Engineer. By A. H. Bell. (Technical School Series.) Pp. x+82. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s.* 6*d.* net.

This little book deals with the practical applications of exponential and hyperbolic functions as required in engineering, physics, etc. Only an elementary knowledge of trigonometry and calculus is assumed. The treatment, whilst not rigorous, is carefully thought out and written. There is, however, a grave danger in not warning the student sufficiently of the necessity of justifying certain operations. Even in subordinating rigour to practical utility, it is nevertheless essential to point out clearly what assumptions have been made and to state that the validity of such assumptions requires further investigation. Especially is this necessary in dealing with series. Yet, on pp. 46–50 it is assumed, without comment, that a circular function is expressible in a valid series, and that the process of differentiation may afterwards be applied to the supposed identity.

The text is well illustrated by fully worked out practical examples, and a fair number of exercises are provided for the student. It is curious to see logh written for $\log_e$. There is an unfortunate misprint on p. 3 where *ex* appears in thick type for e^x.

Advanced Algebra. By Clement V. Durell. Vol. 1. Pp. viii+193+xxii. (London: G. Bell and Sons, Ltd., 1932.) 4*s.*

This book, originally intended to be Part 4 of the author's "New Algebra for Schools", deals comprehensively with the Higher Certificate requirements. The topics discussed include permutations, combinations, finite series, limits, convergence, logarithmic, exponential and quadratic functions, theory of equations and determinants. The treatment is not only thoroughly sound but also fascinating, the student's interest being stimulated from the beginning. In accord with modern experience, Mr. Durell has not hesitated to introduce calculus methods where necessary. The long, cumbersome and often fallacious methods of the older books have therefore been replaced by valid and elegant proofs. Especially is this manifest in the excellent chapter devoted to the logarithmic and exponential functions, which most teachers will appreciate.

The treatment of limits and convergence, which is often dull, is well adapted to the ordinary pupil, and reveals the author as a practical teacher who knows how to present to young students a difficult part of the subject.

A new book on advanced algebra is long overdue, and teachers will be grateful to Mr. Durell for so ably providing the needed volume.

Recent Advances in Atomic Physics. By Prof. Gaetano Castelfranchi. Approved translation by Dr. W. S. Stiles and Dr. J. W. T. Walsh. Vol. 1: *Atoms, Molecules and Electrons.* Pp. xii+360+12. Vol. 2: *Quantum Theory.* Pp. xii+400+12. (London: J. and A. Churchill, 1932.) 15*s.* each vol.

The two volumes before us constitute the latest addition to a well-known series dealing with "Recent Advances in Science". Up to the present, we have been able to 'Buy British'; now, if we wish to study "Recent Advances in Atomistics", we have to turn to an English translation of an Italian work, of which three editions have appeared in two years. Well, this is very good free trade and sound internationalism; the book is good of its kind, and may be unequivocally welcomed. It is something of a feat to present in compact form a general introduction to the fundamentals of physical atomic theory, with a discussion on wave motion and kinetic theory, and then to proceed, chapter by chapter, to give succinct accounts of fluctuations, electrons and positive rays, isotopes, X-rays, crystals, radioactivity, nuclear properties,

radiation and the quantum theory, spectroscopy, the Stark and Zeeman effects, specific heats, the photoelectric effect, the Compton effect, wave and quantum mechanics, and the new statistics; the whole exposition being completed within the compass of 800 small octavo pages.

It is small wonder that the translators, who have executed their task most competently and critically, decided to omit those sections of the Italian edition which deal with Brownian motion, relativity and astrophysics. It might, in fact, have been better had a few more sections, or some of the more elementary topics, been omitted, and the remainder expanded a little; for modern physical theory is full of subtleties, and a highly condensed treatment is apt to leave a delusive feeling of ease of comprehension that vanishes with a little further thought. This apart, the volumes give an interesting and informative account of modern atomistics, developed in such a way as to make a minimum of demand on the reader's mathematical knowledge; moreover, the author has, very wisely, kept close enough to experimental and technological matters to include brief résumés of such topics as television, supersonics and photo-telegraphy. A. F.

Physical Principles of Mechanics and Acoustics. By Prof. R. W. Pohl. Authorized translation by Winifred M. Deans. Pp. xii + 338. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1932.) 17*s.* 6*d.* net.

Two years have elapsed since the English edition of Prof. Pohl's "Physical Principles of Electricity and Magnetism" was published, and many teachers of physics who were charmed with the novelty of his treatment and the ingenuity of his experiments will welcome this new volume on mechanics and acoustics. The numerous diagrams and illustrations at once attract attention. Most of the figures are based on photographs, and several have been made into silhouettes. It is claimed that this simple method of reproduction indicates whether an experiment is suited to a large lecture-room, as it is then important that the outlines should be clear and uninterrupted. Prof. Pohl tells us that in the Göttingen lecture-room that "troublesome obstacle, the large fixed lecture-table, was got rid of years ago". Small handy tables are set up as required. "The apparatus in actual use at any moment can be made to stand out so that it is easily seen by each member of the audience." Special mention ought to be made of the plates illustrating streamline flow in liquids and gases, and of the exceptionally clear photographs of waves on the surface of a liquid and of sound waves in air by the *schlieren* method.

The subjects treated in the text are those familiar in elementary courses on mechanics, but even the experienced teacher will find much to rouse his own interest and in turn that of his students. The human aspects of the subject are not lost sight of, as for example in discussing the translation and rotation of a man, and the free axes of rotation of human beings and animals. Excellent accounts are given of the motion of liquids and gases, and also of waves and vibrations. H. S. A.

Numerical Examples in Physics. By Dr. W. N. Bond. Pp. 128. (London: Edward Arnold and Co., 1931.) 4*s.*

This book of some 450 numerical examples in physics, with answers set forth very clearly, covers a remarkably wide range and will be of great use to advanced students of the subject, particularly those reading for a special or honours degree. Nothing like it has hitherto appeared, and the university teacher, who has long felt the want of something parallel to the several excellent books of numerical examples in advanced physical chemistry, will undoubtedly give it a warm welcome.

Dr. Bond is to be congratulated on starting with a section on methods of calculation; and the examples on calibrations, probable error, order of accuracy and curve fitting inculcate the right spirit at the outset. The largest section is naturally on classical electricity where the variety of question is excellent, problems on inductances and ballistic galvanometers and on absolute determination of current and resistance being most instructive. Of particular note is the unique section on atomic physics giving numerical examples on the determination of electronic charge and mass, on Avogadro's number, crystal structure, photo-electrons, the magneton, X-ray scattering, Planck's constant and radioactivity. A few odd questions, not even semi-numerical, have crept into several sections, and might be omitted. Question 132, which deals with special units, has an answer for the mass of the sun of 1·47 kilometres, and question 245 deals with the spectrum produced by a glass prism of refractive index 1·961! But these are mere slips, and there can be nothing but praise for this remarkably comprehensive collection, of the range and quality of which the title gives no indication.

Miscellany

Osiris and the Atom. By J. G. Crowther. Pp. viii + 221 + 4 plates. (London: George Routledge and Sons, Ltd., 1932.) 5*s.* net.

This is a collection of notes and essays of 'popular science' which is actually both popular and on the whole scientific. Mr. Crowther has a chatty, interesting style, the gift of making fairly complex matters readily understood, and a true journalistic instinct for the arresting phrase. The title of the book, "Osiris and the Atom", is an example of the latter; the contest for the soul between the forces of life and death in ancient Egypt is the root idea from which ball games have developed, and the peculiarities of bounding and spinning balls provide useful analogies in the study of atoms. The

phrase also expresses aptly the wide range of the book—the great Siberian meteorite, human biology, the structure of wool fibres, modern advances in engineering, Thames floods, terrestrial magnetism, the constitution of the stars, viruses and vitamins.

The author has travelled widely in search of material, visiting Prof. Kulik in Russia for example to discuss the Siberian meteorite. This and the chapter on the structure of wool fibres are especially good, but a few, such as the sketch of "magnetism in the universe", are too superficial to be of real interest. It is curious that the author should have made so elementary a mistake as that on p. 141, where the average air pressure over the oceans is said to be 28 inches. The last article is entitled "Basic English", and is included because the author realised that "a science expert writing for the public has necessarily to make use of a sort of Basic English". The article reads so fluently and naturally that it comes as a shock to find at the end that it is itself written in Basic English.

The Problem of Incentives in Industry: Three Lectures given at the London School of Economics under the Heath Clark Bequest to the National Institute of Industrial Psychology. By Dr. G. H. Miles. Pp. v+58. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s.* 6*d.* net.

THE three lectures contained in this volume give a popular analysis of the various classes of incentives, including fear and financial incentives, non-financial incentives such as appreciation, knowledge, loyalty, welfare schemes, co-operation, and special incentives like responsibility and promotion which affect those holding management positions. The dangers and limitations of particular types of incentives are discussed and Dr. Miles asserts that the essential problem is that of the development of human power.

Incentives which are designed and applied to increase the general welfare of the worker and his interest in life and work do far more than merely augment output and increase the profits of industry. Those who hold with Dr. Miles that the ultimate purpose of industry is the amelioration of the conditions of life of society in general will welcome the issue to a wider public of this lucid statement of general principles. R.B.

Muscular Work, Fatigue and Recovery: Three Lectures given under the Heath Clark Bequest to the National Institute of Industrial Psychology. By G. P. Crowden. Pp. ix+74+6 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 3*s.* 6*d.* net.

THESE lectures outline certain aspects of the rationalisation of industrial work in the light of the physiological requirements of the human body. They describe in a popular and readable manner the way in which the scientific principles determining human efficiency and fatigue are being elucidated and indicate the contribution which this branch of industrial physiology has to make to human welfare in industry. The survey is not limited to the investigations of British workers alone but also includes a brief description of the Dortmund Institute for the Study of the Physiology of Labour.

The influence of such factors as ventilation, temperature, clothing and food is indicated and this clear and concise statement of the methods of science in this field should stimulate that enthusiastic co-operation among trade unionists, employers, scientific workers, and employees which is essential if full use is to be made even of the knowledge already acquired. R.B.

Philosophy and Psychology

A History of Psychology in Autobiography. (The International University Series in Psychology.) Vol. 2. By Benjamin Bourdon, Harald Höffding, James Drever, Charles H. Judd, Knight Dunlap, C. Lloyd Morgan, Giulio Cesare Ferrari, Walter B. Pillsbury, Shepherd Ivory Franz, Lewis M. Terman, Karl Groos, Margaret Floy Washburn, Gerardus Heymans, Robert S. Woodworth, Robert Mearns Yerkes. Edited by Carl Murchison. Pp. xvii+407. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1932.) 28*s.* net.

THE first volume of this work was noticed by us at the time of its appearance. We think that the editor and his co-adjutors were quite justified in their view that the history of recent psychology could scarcely be written, and that indeed a comprehensive statement about present trends in psychology could scarcely be made, without such help as this great work affords. Furthermore, to many readers the personal note which runs through each of these records will prove an aid to understanding, although we must express our conviction that a good deal of the autobiographical detail is superfluous. Still, the work is an important one, and one that reflects credit upon every person concerned in its production.

David Hume. By Dr. B. M. Laing. (Leaders of Philosophy Series.) Pp. xi+273. (London: Ernest Benn, Ltd., 1932.) 12*s.* 6*d.* net.

AT a time when the extraordinary wealth of our knowledge in all directions threatens our sense of values with conflicting conclusions and assumptions, Hume's scepticism finds a renewed actuality. Dr. Laing's able monograph gives the right historical and philosophical setting of Hume's doctrines, and will no doubt encourage his readers to a closer study of Hume's writings. They will thus find out for themselves that Hume's influence on scientific investigation, or on the theory of it, is strongest where the experimental method and its presuppositions are stressed. But the important part played by mathematics in physical science has set limits to his influence in this direction because of doubts concerning the adequacy of his theory in this respect. T. G.

Berkeley. By Prof. G. Dawes Hicks. (Leaders of Philosophy Series.) Pp. xii+336. (London: Ernest Benn, Ltd., 1932.) 12*s.* 6*d.* net.

THIS is a valuable addition to the series of monographs on the philosophers who have mainly influenced Western thought. Much has been written already on Berkeley; yet Prof. Dawes Hicks succeeds in being both original and interesting in his account of the Bishop of Cloyne. In the exposition of Berkeley's doctrine, he rightly stresses the importance of his opinions about mathematics and the sciences for the understanding of his philosophical views; and the section devoted to Berkeley's place in history adds some fresh material to the valuation of this most fascinating thinker. T. G.

Technology

A Dictionary of Electrical Terms: including Telegraphy, Telephony and Wireless. By S. R. Roget. Second edition, revised and enlarged. Pp. vii+396. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 7*s.* 6*d.* net.

So rapid has been the progress made in various branches of electrical science that even scientific workers themselves have sometimes to look up many of the latest treatises published before they find the definition of the term or phrase they are looking for. We have looked up many words such as bel, néper, booster, in this dictionary, and have found clear and satisfactory definitions. Purely trade names of apparatus have been omitted. The use of many technical terms in the electrical industry is almost entirely confined to the United States; but some which originated there are equally used on both sides of the Atlantic; the author gives both. Conciseness has been attained without the sacrifice of intelligibility and the author does not trespass on the function of the encyclopædia or the technical treatise.

In the second edition more than nineteen hundred further expressions have been added and a good many alterations have been made. The author's purpose has not been to compete with the officially established definitions compiled by the British Standards Institution and by the International Electrotechnical Commission. His purpose has been to give explanations rather than definitions. The dictionary should prove useful to many.

Advanced Electrical Measurements. By Dr. William R. Smythe and Dr. Walter C. Michels. Pp. x+240. (New York: D. Van Nostrand Co., Inc., 1932.) 3 dollars.

THE object of this book is to train students so that they may be useful in research, testing and development work. Perhaps it is too much to hope that all the information given can be assimilated in thirty laboratory lessons; but the book can be commended. It is stated (p. 101) that "the growth of modern physics dates from the time of the conception of the electrical theory of matter". If this is regarded as the definition of 'modern physics', evidence can be produced in support of it, but we think that it rather limits its scope.

Comparing this book with similar books published thirty or forty years ago, it will be seen how the methods given of measuring, for example, inductance and capacitance, have improved in the direction of attaining higher precision, but possibly they are less instructive. Students now experiment with various kinds of alternating current bridges, ionisation gauges and hot wire manometers. Photoelectric cells and optical manometers are also used. The mechanisation of laboratory experiments is proceeding so rapidly that there is little time to develop originality. The proof reading seems to have been carelessly done as there are variations in the spelling of the names of continental physicists.

Forthcoming Books of Science

Agriculture, Forestry and Horticulture

George Allen and Unwin, Ltd.—Practical Sheep-Farming, T. C. Norris. *Ernest Benn, Ltd.*—The Garden, W. E. Shewell-Cooper. *Cambridge University Press, Ltd.*—West African Agriculture, O. T. Faulkner and J. R. Mackie. *Martin Hopkinson, Ltd.*—The Apple, Sir Daniel Hall and M. C. Crane; The Garden of To-day, A. Tipping. *Macmillan and Co., Ltd.*—Tropical Soils, Dr. P. Vageler, translated by Dr. H. Greene. *A. Wheaton and Co., Ltd.*—Gardening Science and Biology (Books 2 and 3), Ivan Dowding and H. Bennett.

Anthropology, Archæology and Ethnology

Edward Arnold and Co.—Byzantine Civilisation, Steven Runciman. *B. T. Batsford, Ltd.*—Domestic Utensils of Wood from the 16th to the 19th Century, Owen Evan-Thomas. *Ernest Benn, Ltd.*—If the Blind Lead, M. Alderton Pink. *Cambridge University Press.*—Indo-European Folk-Tales and Greek Legend, W. R. Halliday; Our Forefathers: the Gothonic Nations (vol. 2), Dr. G. Schütte. *Cassell and Co., Ltd.*—The Tomb of Tut-Ankh-Amen (vol. 3), Dr. Howard Carter; An Outline of Italian Civilization, Dr. Decio Pettoello. *Jarrolds, Ltd.*—Backwaters of the Savage South Seas, Evelyn Cheesman. *Sampson Low, Marston and Co., Ltd.*—Incomparable India, Col. Robert J. Blackham; The Martial Races of India, Lieut.-Gen. Sir George MacMunn; Forms and Ceremonies of Marriage throughout the World, E. N. Fallaize. *Macmillan and Co., Ltd.*—A Handbook to the Palace of Minos at Knossos with its Dependencies, J. Pendlebury: with a foreword by Sir Arthur Evans; Ivory Poaching and Cannibals in Africa, J. T. Muirhead. *Methuen and Co., Ltd.*—Prehistoric Europe, C. F. C. Hawkes. *Kegan Paul, Trench, Trubner and Co., Ltd.*—The Rise of the Celts, H. Hubert; A History of Buddhist Thought, Dr. E. J. Thomas; Nomads of the European Steppe, G. F. Hudson. *G. P. Putnam's Sons, Ltd.*—The Discoveries of Tell Halaf, Baron Max von Oppenheim. *Charles Scribner's Sons.*—Mexico before Cortez, J. E. Thompson. *Sheed and Ward, Ltd.*—Enquiries into Religion and Culture, C. Dawson; The Age of the Gods, C. Dawson. *C. A. Watts and Co., Ltd.*—The Diffusion of Culture, Prof. G. Elliot Smith. *Williams and Norgate,*

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Biology

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Letters to the Editor

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Molecular Weights of the Blood Pigments of the Invertebrates

BY means of the ultra-centrifugal method, it has recently been shown that the red blood pigment of the annelids is not identical with the hæmoglobin of the vertebrates as was previously assumed, but is a protein more allied to chlorocruorin and hæmocyanin with regard to molecular weight[1]. It was suggested that a comparative study of the properties of the respiratory proteins throughout the animal kingdom might bring to light interesting relationships between the various groups of animals. Such an investigation has now been started, and although so far only some forty species have been studied, a number of regularities have been found which seem to merit general attention.

Four types of respiratory proteins are known from the blood of the invertebrates, a red pigment (erythrocruorin), a green pigment (chlorocruorin), a blue pigment (hæmocyanin) and a pigment of reddish brown colour (hæmerythrin). In the following, only the first three types will be considered.

Of the erythrocruorin type we have found five different forms dissolved in the blood and two forms in blood corpuscles differing with regard to sedimentation constant. Each of the five forms of the first type is characteristic of one of the following groups of invertebrates: oligochæte worms, polychæte worms, gastropods, crustaceans, insects. The two forms of the second type have been found in the erythrocytes of the capitellide and glyceride worms. For the chlorocruorin type only one sedimentation constant has been observed. For the hæmocyanin type we have found six sedimentation constants representing the following animal groups: gastropods, cephalopods (two different constants), xiphosurans, crustaceans (three different constants). Within some of these groups several species have been studied, all of which give the same sedimentation constant with a probable error of about 2 per cent. It is not possible to determine the molecular weight with the same degree of accuracy, but the fact that the sedimentation constants agree so closely makes it extremely probable that the molecular weights are also almost identical.

Among the polychæte worms six species belonging to six different families possess respiratory pigments with the same sedimentation constant, namely, $57{\cdot}5 \times 10^{-13}$ (corresponding to a molecular weight[2] of 2,850,000). Among the gastropods no less than eleven species representing seven different families show the same sedimentation constant of $99{\cdot}5 \times 10^{-13}$ (corresponding to a molecular weight[3] of 5,000,000) and among the crustaceans five species of three families have the constant $23{\cdot}0 \times 10^{-13}$. The lowest sedimentation constant for a respiratory pigment dissolved in the blood is found for the erythrocruorin of the insects (*Chironomus* larvæ). It is only about half that of the constant of the hæmoglobin of the vertebrates and therefore corresponds to a comparatively very low molecular weight. Only a few invertebrates possess red blood corpuscles. So far, we have only had the opportunity of studying the respiratory proteins from two such species. It is noteworthy that in both cases low sedimentation constants were found.

The constancy of the molecular weights of the respiratory blood proteins within various animal groups becomes still more puzzling when the following facts are taken into consideration. The erythrocruorin and the chlorocruorin of the polychæte worms, the erythrocruorin of *Planorbis* and the hæmocyanin of *Calocharis*, the erythrocruorin of the polychæte worms and the hæmocyanin of *Sepia* and probably the erythrocruorin of *Daphnia* and the hæmocyanin of *Eupagurus* have identical sedimentation constants and therefore probably identical molecular weights. The measurement of the absorption of light in the visible part of the spectrum for the blood proteins of the gastropods has further shown that the hæmocyanins of *Helix*, *Paludina* and *Littorina*, which have the same molecular weight, nevertheless are distinctly different with regard to the chemical constitution of the active group of the molecule. A detailed and systematic investigation of the isoelectric points of the respiratory proteins of the invertebrates, now being carried out in this laboratory by Dr. K. O. Pedersen, has brought to light another circumstance of considerable importance. He has found that, as a rule, each species is characterised by a special value of the isoelectric point of its blood pigment. This means that the chemical composition of the blood pigment varies from one species to another, although the mass of the molecule remains practically constant.

It seems, therefore, that only a few molecular masses are stable and that it would depend upon the composition of the molecule with regard to various amino-acids whether one or the other of the different possibilities is realised. The constancy of the molecular weight within a certain animal group would then be a measure of the similarity of certain chemical processes leading to the formation of the respiratory protein.

The regularities in the sedimentation constants which we have found seem to justify an effort to extend this investigation to other species and other groups of animals possessing respiratory proteins.

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[1] T. Svedberg and Inga-Britta Eriksson, NATURE, **130**, 434, Sept. 17, 1932.
[2] Unpublished determination by Miss I.-B. Eriksson.
[3] T. Svedberg and E. Chirnoaga, *J. Amer. Chem. Soc.*, **50**, 1399; 1928.

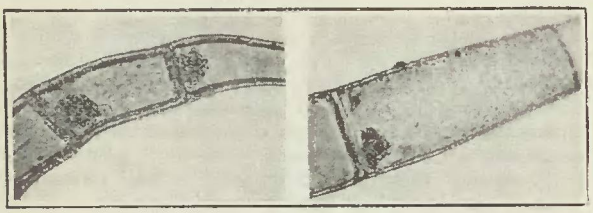
Virus Diseases and Intracellular Inclusions in Plants

VIRUS diseases of both plants and animals are often characterised by the production of abnormal inclusion bodies within the cells of the host. The bodies are usually of more or less spherical form and are protein in nature. Although they commonly accompany virus diseases, they have not been found to occur in hosts infected with any other type of disease, nor are they at all similar to the many intracellular inclusions formed in normal healthy plants.

These virus inclusion bodies have attracted much attention and various theories as to their origin and

significance have been advanced. New light was recently thrown on the problem by a study of the response of the cells of several Solanaceous hosts to infection with aucuba mosaic of tomato[1]. The first symptom of the virus attack to become apparent was an increased activity of the cell contents; the cytoplasm became more conspicuous and flowed more rapidly. Then minute particles of protein appeared in the cytoplasm which carried them passively about the cell. These particles aggregated and fused to form a few large masses; the latter ultimately coalescing to give a single mass which became compact and rounded. The mode of formation of these bodies lent support to the view that they are essentially products of reaction of the host cell to the virus. The question then arose as to whether similar effects could be induced in plant cells by physico-chemical means.

The species used in the study of aucuba mosaic disease included, among others, *Solanum nodiflorum*, *S. nigrum* and *S. lycopersicum*. Healthy plants of these three species were treated with small doses of chemical substances known to cause coagulation of protoplasm. The latter comprised mineral acids and salts and organic compounds such as acids, alcohols and alkaloids. Each of these reagents produced, in



(*a*) (*b*)

Fig. 1. (*a*) Intracellular inclusions in cells of hair from *Solanum nodiflorum* infected with aucuba mosaic disease. (*b*) Intracellular inclusion formed in a hair cell of *S. nodiflorum* as a result of treatment with ammonium molybdate. Magnification, about 220.

greater or lesser degree, symptoms similar to the first microscopic evidence of a virus attack: the cytoplasm became increasingly conspicuous and its streaming was accelerated. In some cases, hyaline spheres, similar to bodies which accompany certain virus diseases, were produced. These, however, always proved ephemeral; their movement about the cell might be followed for some hours but suddenly they would be lost into the general mass of plasm.

With one radicle it was possible to induce in the cells processes analogous to all stages of an attack of aucuba mosaic disease. Molybdenum, given in the form of molybdic acid, or its ammonium or sodium salts, produced these phenomena, but it has not been possible to reproduce them with any chemically related substance. Soon after treatment began, the cytoplasm became more conspicuous and seemed to increase in volume. It streamed more rapidly, then minute yellowish particles appeared in it and were carried about the cell. When brought together by the flowing of the plasm, these particles coalesced. By aggregation and successive fusions a single large mass was gradually built up. The body, as finally formed, was rougher in outline and slightly more granular than those produced by infection with aucuba mosaic, to which it appeared to be essentially analogous (Fig. 1).

As all produced similar preliminary effects, it is not obvious why the molybdate radicle should induce a much closer imitation of the microscopic effects of the virus than did any other chemical reagent used. If an adequate control could be exercised over conditions within the cell, it is possible that other coagulants might induce similar effects, but this introduces many technical difficulties which cannot at present be overcome.

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[1] *Ann. App. Biol.*, 18, 471–493; 1931.

Recrystallisation Power and Shear Hardening in Aluminium Single Crystals

Recrystallisation experiments with stretched aluminium single crystals seem to indicate that, for the same amount of shear*, the number of crystallites formed under identical conditions of heat treatment is the smaller the greater the number of slip-planes involved in the distortion.

This behaviour can be readily understood with the aid of the results obtained in a former investigation

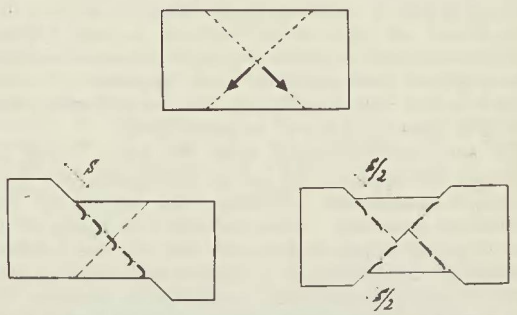

Fig. 1. Diagrammatic representation of locally curved regions along the slip planes.

of the recrystallisation of homogeneously deformed aluminium single crystals[1], in which it was shown (1) that the nuclei of the new crystallites are formed in the locally curved regions of the slip planes (see Fig. 1), which, according to G. I. Taylor and other investigators[2], are brought about as a necessary consequence of the fact that the actual slipping is initiated along limited parts of the planes of slip [which parts may be generally denoted as *Lockerstellen* (Smekal)]; (2) that the number of crystallites formed increases rapidly with the increase of curvature of these locally deformed regions, and therefore with the amount of shear along the slip-planes.

If now a given 'total shear' is divided over several intercrossing planes of slip, it may be expected to lead to deformed regions of, in the mean, weaker 'curvature' than if the whole shear has taken place along only one such plane. This is schematically illustrated by the accompanying figure (Fig. 1). As a consequence thereof, the number of crystallites formed on recrystallisation is much less in the first case than in the second.

Now it is known from investigations of Taylor[3] and from those of R. Karnop and G. Sachs[4] that during plastic extension or compression of aluminium single crystals, the resistance against slip seems to be not materially influenced (or if so, then slightly increased) by a 'division' of the slip over several planes: in fact, the shear-hardening practically only

depends on the 'total amount' of shear. In connexion with this, the possibility arises for aluminium of the *simultaneous occurrence of smaller recrystallisation power and greater hardening* and vice versa.

With the aid of this conception it has been possible to understand in principle the results obtained by several investigators[5], in which this non-parallelism between hardening and recrystallisation power has been demonstrated.

The experiments also permit us to understand why large aluminium crystals, grown by recrystallisation of strained polycrystalline test pieces, seem to favour a position in which a [110] direction is parallel to the direction of straining[6]. This can be related to the fact which has been shown experimentally, that the recrystallisation power is, in general, greatest for aluminium crystals which have been stretched in a direction approaching the [110] direction, the reason for which seems to be that in this direction the probability of the occurrence of *multiple* slip (along 'forbidden planes') is smallest. Therefore it seems probable that on stretching a polycrystalline aggregate, a crystal grain of such orientation will serve as nucleus for the single crystal formed on heating.

I wish to thank Mr. J. J. A. Ploos van Amstel for his valuable help with these experiments. For details I refer to the *Zeitschrift für Physik*, in which they will be published shortly.

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Nov. 24.

* The 'amount of shear' is defined by the relative displacement of two parallel planes of slip at unit distance.

[1] W. G. Burgers and P. C. Louwerse, *Z. Phys.*, **67**, 605; 1931. *Metallw.*, **11**, 251; 1932.
[2] *Trans. Far. Soc.*, **24**, 121; 1928. Compare also A. Müller, loc. cit., 173; H. J. Gough, 137.
[3] *Proc. Roy. Soc.*, A, **116**, 39; 1927.
[4] *Z. Phys.*, **41**, 116; 1927.
[5] See, for example, P. Beck and M. Polanyi, *Z. Elektrochem.*, **37**, 521; 1931. A. E. van Arkel and M. G. van Bruggen, *Z. Phys.*, in the press.
[6] See, for example, C. F. Elam, *Phil. Mag.*, (6), **50**, 517; 1925. G. Sachs and J. Weerts, *Z. Phys.*, **59**, 497; 1929.

Debye's Dispersion of Nitrobenzene

ACCORDING to Debye, dispersion must take place in polar liquids around a frequency ν given by the expression:

$$\frac{1}{2\pi\nu} = \tau = \frac{\zeta}{2kT} \qquad (1)$$

where T is the so-called time of relaxation, k is Boltzmann's constant, T is the absolute temperature and ζ is a constant corresponding to the internal friction which prevents the polar molecules from rotating freely. In the case of spherical molecules, to which Stokes's law can be applied

$$\zeta = 8\pi\eta a^3 \qquad (2)$$

where η is the coefficient of viscosity and a the radius of the molecules. The time T is of the order of 3×10^{-11} seconds for water and this period corresponds to a wave-length of about 1 cm. In order to bring the dispersion in a region of wave-length more accessible to undamped oscillating circuits, one can dissolve the polar liquids in very viscous non-polar solvents, as has been shown by Williams and Johnstone[1]. This procedure has another advantage, namely, that of eliminating the spurious effects of molecular association always present with polar substances.

We have dissolved different polar molecules in Shell oil BL 3, which has a coefficient of viscosity of about 5 poises at 35° C., and we have measured the dielectric constant of these solutions for eight wave-lengths between 328 m. and 18 cm.

The small value of the dielectric constant of the oil ($\varepsilon = 2{\cdot}32$) has led us to believe that its molecules were not polar. We verified that the pure solvent showed no dispersion in the region studied. For the polar solutions, however, we obtained two regions of dispersion. A typical curve is given in Fig. 1 for two concentrations of nitro-benzene. These two dispersions follow separately and closely the law predicted by Debye.

In order to explain the presence of these two regions of dispersion, we have been led to assume that they correspond to two different types of resisting media in which the molecules can rotate. The

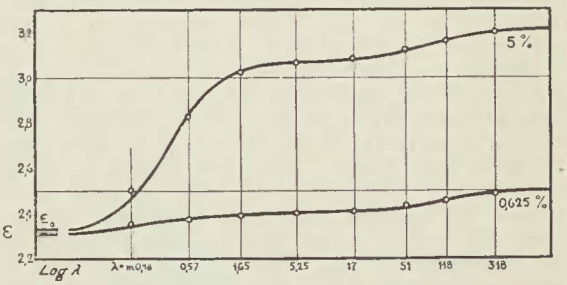

FIG. 1. Dispersion of nitrobenzene at 20°C in Shell oil BL 3.

region of relatively long wave-length would be brought about by the friction with which the oil molecules hinder the rotation of the nitrobenzene polar molecules. The second region would be due to the viscous forces of nitrobenzene itself. Thus our experiments would show that when nitrobenzene is dissolved in viscous oil, some of its molecules form a sort of aggregate while others are relatively free. This view is in complete accord with measurements of the dispersion of amyl and butyl alcohol which we have made and with measurements of this dispersion as a function of the temperature.

A more detailed account of this work, which forms the dissertation of one of us (R. L.), is to appear soon in the *Helv. Phys. Acta*.

J. WEIGLE.
R. LUTHI.

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University of Geneva.

Jan. 20.

[1] Williams and Johnstone, *Phys. Rev.*, **34**, 1483; 1930.

Reversal of Current in Rectifier Photo-Cells

I HAVE just seen the letter on the above subject by Messrs. H. H. Poole and W. R. G. Atkins in NATURE of January 28. I encountered the phenomenon to which they refer about three months ago when determining the spectral sensitivity of some gold—cuprous oxide—copper cells of the Auger type, but refrained from directing immediate attention to it as it was apparent from an examination of the results that further work was required before a completely satisfactory explanation was forthcoming.

That the cuprous oxide—copper junction is the essential factor in producing the reversal, as suggested by Messrs. Poole and Atkins, is certain, because in cells which I have since been able to

examine by the courtesy of the Westinghouse Brake and Saxby Signal Co., in which there is no copper backing to the gilt cuprous oxide layer, no signs of the reversal near 0·6μ are obtained. On the other hand, these cells show a small, but definite reversal in the ultra-violet.

There is no doubt that the wave-length of reversal and the magnitude of the reverse current depend on the thickness of the gold film and also, probably, on the thickness of the oxide layer. The variability of the effect over the surface of the cell described by Messrs. Poole and Atkins suggests that the gold was much thinner than in the cells I have used. The magnitude of the reversed maximum is also apparently greater, which points in the same direction. On this point, however, I would be glad to know if the figures given have been reduced to an 'equal energy spectrum', or if they relate to the intensities obtained in a spectroscope uncorrected for dispersion or for the energy distribution in the spectrum of the source used. I am hoping to obtain, in the not too distant future, the necessary data on the spectral transparency of the gold films and of the cuprous oxide layers to provide a reasonably convincing explanation of the behaviour of these cells.

I note that Messrs. Poole and Atkins found no reversal in a silver-sputtered cell. It may be of interest to mention that with a silvered cuprous oxide cell *without copper backing*, also prepared by the Westinghouse Co., I have found a reversal to occur at the blue end of the visible spectrum. The cell has only recently come into my hands and I have not carried out sufficient tests to see whether any return to the original polarity occurs at still shorter wave-lengths, but the indications are that this is unlikely. These cases differ from that of the gold—oxide—copper cell inasmuch as there is here only one rectifying surface, that between the metal film and the cuprous oxide. I would have preferred to say nothing about the matter until further work had been done towards its elucidation, but as the peculiarities of rectifying cells are apparently exciting a widespread interest, it may be as well to put these cases of reversal on record also.

J. GUILD.

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Jan. 31.

Reaction Cells in Chain Reactions

THE simplest material chain reaction would be of the type $H + H_2(para) = H_2(ortho) + H$, though no evidence has yet been brought forward for its existence. An energy chain would be one in which an excited molecule took the place of the hydrogen atom.

We may define the chain-length by the number of fruitful collisions made by a chain carrier between its production and disappearance, regardless of the total number of collisions. If we consider a mixture of h molecules of the reactant H_2, and a molecules of chain stoppers (for example, an aerosol of antiknock), the average chain-length L is given by the simple probability expression

$$L = \sum_{r=1}^{r=\infty} r \left(\frac{h}{a+h}\right)^r \left(\frac{a}{a+h}\right) \Big/ \Sigma \left(\frac{h}{a+h}\right)^r \left(\frac{a}{a+h}\right),$$

provided that the pressure is so low that the probability of collision of any two molecules is practically independent of their instantaneous position in the vessel considered.

As the pressure is raised, the movements of all the molecules are hindered by the increasing resistance to diffusion; the probability of collision with distant molecules is smaller, and with nearby molecules greater. In particular, for reactions where the average chain-length is large, collisions with the reaction products left in the path of a chain carrier will be relatively more numerous at higher pressures. This may greatly affect the average chain-length.

If D is the coefficient of diffusion of the gas, the mean square displacement of the carrier is given by $\overline{x^2} + \overline{y^2} + \overline{z^2} = 6Dt$, where t is the time elapsed since the chain began. It is thus impossible for the carrier to react with molecules originally outside a cell of radius $2(6Dt)^{\frac{1}{2}}$. If $1/Y$ is the collision frequency, λ the mean free path and d the density, η the viscosity, $D = \frac{1}{3}\lambda\bar{c}$ and $Y = \frac{\lambda}{\bar{c}}$ where $\bar{c}$ is the R.M.S. velocity. After r collisions of any kind whatsoever, $t = rY$ and the radius of the reaction cell is $\lambda(8r)^{\frac{1}{2}}$ and its volume $(8)^{3/2}\frac{4\pi}{3}\lambda^3 r^{3/2}$. Since $\lambda d = \frac{3\eta}{\bar{c}}$ the number of molecules in the cell is proportional to $d \times \frac{r^{3/2}}{d^3} = \frac{r^{3/2}}{d^2}$, which decreases rapidly with increasing density.

The chain carrier has a greater probability of repeated collisions with molecules near the centre of its cell, but the analysis is too long to give here. It follows, however, that if the reaction products, or even impurities, deactivate the chain carrier, or if this has a probability of spontaneous radiation, that the average chain-length will decrease as the pressure rises. The number of chains initiated per second will not in general increase sufficiently with rising pressure to compensate for the decrease in length, and we may expect the rate of such reactions to decrease with rising pressure.

It is tentatively suggested that the upper pressure limit to explosions, discovered in a number of reactions by Hinshelwood and others, may find an explanation in the facts discussed here. It must be noted, however, that in this case we should expect vigorous stirring to increase the average chain-length, and possibly to shift the upper limit to higher pressures. No evidence is yet available on this point.

A. R. UBBELOHDE.

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Oxford.
Jan. 28.

Dissociation of Acetic Acid in Water

IN the measurements of MacInnes and Shedlovsky[1] and Jeffery and Vogel[2] on the conductivity of acetic acid and its salts in water, which have recently been the subject of correspondence in these columns[3], the most noticeable divergence is in the values for dilute solutions of sodium acetate. Jeffery and Vogel find that their values, after deducting the conductivity of the solvent, are lower than those of MacInnes and Shedlovsky, and that a correction for hydrolysis according to the equation $Ac' + H_2O \rightleftharpoons HAc + OH'$ reduces their figures still further, which leads them to the view that MacInnes and Shedlovsky's values are in error. The reason for this discrepancy is that in Jeffery and Vogel's experiments the hydrogen with which the acetate ion unites comes not from the water but from the carbonic acid present in it. The proper

solvent correction for the salt of a weak acid has been discussed elsewhere[4] and can be calculated if the amount of carbon dioxide dissolved in the water is known. Applying it to Jeffery and Vogel's figures on the assumption that their water was saturated with carbon dioxide at a partial pressure of 0·00035 atm. gives values far *greater* than those of MacInnes and Shedlovsky, but the figures obtained in this way are undoubtedly too high, since Jeffery and Vogel's water (like that of the American workers) probably contained saline impurities as well as carbon dioxide. Without precise information on this point the correct extrapolation of Jeffery and Vogel's figures is impossible, but it can safely be concluded that the uncertainty fully covers the discrepancy of 1·6 units between the limiting conductivities derived in the two investigations.

It is to this discrepancy, together with a smaller

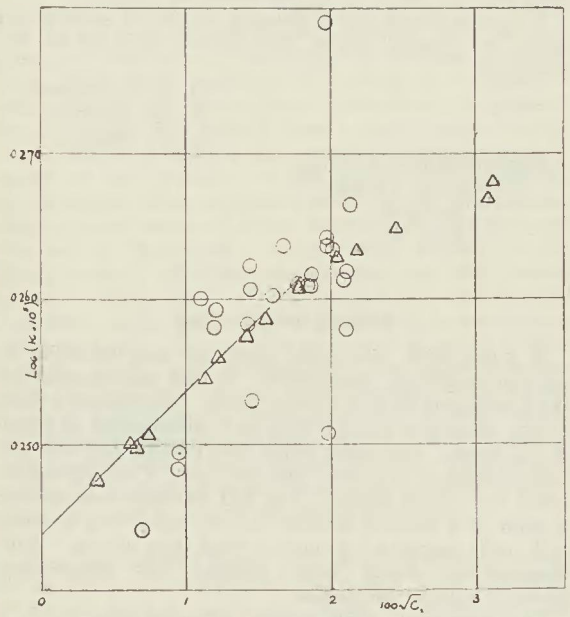

FIG. 1. Dissociation constant of acetic acid. ○, Jeffery and Vogel. △, MacInnes and Shedlovsky.

one in the same direction between the values adopted for the mobility of the hydrogen ion, that the differing values reported for the dissociation constant of acetic acid are mainly due; if both series of measurements are compared on a common basis, the same value of K_0 is obtained. This is shown in Fig. 1, in which the logarithm of the constant, uncorrected for activity changes, is plotted against the square root of the ionic concentration, using for both series the common value $\Lambda_0 = 390{\cdot}59$. The use of this common value neglects the small difference in cell constant bases, which Jeffery and Vogel regard as within the limits of accuracy that they claim for their measurements.

C. W. DAVIES.
W. H. BANKS.

Battersea Polytechnic,
London, S.W.11.
Jan. 17.

[1] *J. Amer. Chem. Soc.*, **54**, 1429; 1932.
[2] *J. Chem. Soc.*, 2829; 1932.
[3] NATURE, **130**. 435, 774; 1932: **131**, 27; 1933.
[4] *Trans. Faraday Soc.*, **28**, 607; 1932.

Artificial Control of Sex in the Progeny of Mammals

GENETICS and cytology prove that the sex of the progeny of mammals depends upon the sex of the spermatozoon fertilising the ovum; the ovum itself is not determined as to sex. The 'female' spermatozoon possesses an X-chromosome, the 'male' possesses a Y-chromosome (or no sex chromosome at all), while every ovum has an X-chromosome. Male-determining and female-determining spermatozoa are mixed irregularly in the sperm. Therefore there is only one way of controlling the sex of progeny in mammals, namely, by separating the male-determining from the female-determining spermatozoa.

Spermatozoa with X- and with Y-chromosome are derived from one asymmetric mother ($X + Y$) cell; it was accordingly natural to suppose that they would carry electrical charges of opposite sign. We accordingly tried to isolate them with an electric current. Most living cells during cataphoresis go to the anode, their surfaces being electrically negative. When we passed an electrical current through horse or rabbit sperm in physiological solution, we found that part of the spermatozoa went to the anode, part to the cathode, while the rest remained some time in the middle in the horizontal part of the Michaelis apparatus.

We have artificially impregnated three female rabbits with three portions of sperm after cataphoresis. The female impregnated with anode spermatozoa produced six young, all of the female sex; the second, impregnated with cathode spermatozoa, produced four males and one female; and the third, impregnated with the central fraction left between the two poles of the Michaelis apparatus, bore two males and two females. So far, this is the only experiment we have carried out on artificial impregnation with anode- and cathode-spermatozoa, and we propose to verify it on a larger scale. However, it is most improbable that the results were due only to chance. The only exception to what we expected, was a female born after fertilisation with cathode spermatozoa, which can be explained by the difficulty of obtaining complete isolation by mechanical means of three varieties of sperm in a Michaelis apparatus.

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Capacitance Hygroscopy

I AM obliged to Dr. Schofield for directing further attention to the subsidiary complications of capacitance measurements[1]. As E. B. Moullin says:[2] "We are again and again forced to remember that inductance, capacity, and resistance are attributes possessed simultaneously by all apparatus, and we cannot say that this is an inductance, or that is a capacity with the easy nonchalance of the power engineer". To avoid the accusation of such nonchalance, I used inverted commas for 'capacitance' in my article, made such cautionary remarks as the limits of space permitted, and used the word 'hygroscopy' instead of 'hygrometry' in its title.

Good demonstrations of these complications can be obtained by making various series and parallel

connexions between web-tube condensers in air, and then again in water, noting the discrepancies.

It still remains true, however, that with the lay-out described in my article, and under the limitations of use which I there set out, the 'capacitances' which I measured are predominantly due to capacity. For example, the soil-water experiment which I presented was preceded by trials of such condensers in liquids of varied conductivity; a typical set of readings was as follows:

Air	10	mμF.
Distilled water	44½	,,
Nitric acid, 0·001 per cent.	49	,,
,, 0·010 ,,	56	,,
,, 0·100 ,,	57½	,,
,, 1·000 ,,	59	,,

It follows that such changes in conductivity as are likely to be found in a soil might be expected to deflect the readings by some 5 mμF. at most, whereas the range shown in the actual soil-water experiment was around 50 mμF.

In his numerical examples, Dr. Schofield makes a slight mistake by calculating for resistances in series, whereas these are really in parallel, whether for the case of a web-tube or for a cotton-bale. Resistances of the order of 1,000 ohms in series would obviously dominate the situation, as he says. Actually the correct formula is:

$$\text{'Capacitance'} = \sqrt{C^2 + 1/w^2R^2},$$

and so long as R is not unduly small (for example, when the bale hoops are shorted by a saturated hessian covering) its variations are relatively not important.

In dealing with the physical properties of cotton we are on fairly well-known ground, and experiments on the changes in 'capacitance' of a perforated plate condenser containing cotton have been made similarly to those in which Slater[3] and Goshawk[4] measured the changes of conductivity and of dimensions under various moisture contents. The 'capacitance' changes are directly proportional in outline to the weight changes until very dry conditions are reached, less than 2 per cent of moisture content; at this point the phase change first discovered by Slater is clearly seen, as if the dielectric constant of the water had there altered to less than half its usual value. But the region of practical working conditions for testing freshly pressed cotton bales (around 8½ per cent moisture content) is far above this, and is equally far below the occurrence of such low resistances in parallel as would seriously deflect the readings.

In these circumstances, Dr. Schofield will forgive me if I venture to disagree with his contention that there is nothing in my article to show that I was not mainly engaged in measuring resistances. The article would not have been published if that were so. Of course, the absence of explicit references therein to elementary trials which were made with non-inductive resistances in circuit, as well as test-alterations of frequency, may well have misled him into thinking that the work was even more amateurish than my apologia indicated it to be.

W. LAWRENCE BALLS.

Cotton Research Board,
Giza, Cairo,
Egypt.
Feb. 1.

[1] NATURE, **131**, 96, Jan. 21, 1933.
[2] Moullin, E. B., "Radio-Frequency Measurements", Griffin, 1931, in preface.
[3] Slater, F. P., *Proc. Roy. Soc.*, A., 1906. See also (4).
[4] In W. L. Balls, "Quality in Cotton", Chap. iii.

Is Plasticine Edible?

WE were keeping some snails (*Helix pomatia*) without food, under a bell-jar with a wide tubulure at the top; in the tubulure was a cork bearing a thermometer. We found that the snails ate the cork, so, to protect it, we covered it with a thick layer of red Harbutt's plasticine. To our surprise, the snails ate away a large amount of the plasticine, and produced fæces consisting of plasticine 'mouthfuls' loosely stuck together into irregular cylinders.

At the time of eating plasticine, the snails had been hibernating in a cold store for 18 months, after which they were brought into a warm room and made to emerge by immersion in water. They were therefore extremely hungry. In 24 hours a snail weighing 25 gm. ate 0·5 gm. of plasticine and produced the same amount as fæces. This is as if a 10-stone man were to eat 3 lb. of plasticine in a day.

We have heard many strange stories of substances eaten by hungry snails, but believe this to be the strangest.

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N. H. HOWES.
G. P. WELLS.

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London.
Feb. 14.

Hermaphrodite Frog

A FROG with abnormal genitalia was brought to my notice during class work. A pad was present on the forefingers as in a normal male. The kidneys were longer than in a normal frog and reminiscent of those of the newt. The right testis was normal but the left had embedded in it very distinct ova. Vasa efferentia arose from both testes. The left oviduct was similar to that of a normal female but the right was thinner and only vaguely connected with the cloaca. The mesonephric ducts were normal but apparently lacked vesiculæ seminales.

The specimen, with others, was collected from a pond near Radley College, Abington, Berks, and it will be interesting to discover if others occur in this area.

A. A. M. GARDINER.

Radley College,
Berks.

Caution in Christening

THE names of public characters should be chosen circumspectly. To christen the antiscorbutic agent (granted, that we at last have it in hand) *ascorbic acid* is to do it slight justice—even to rob it of the public appreciation it deserves. The name, in fact, is a scurvy one: neither has it obvious significance nor can it well be transposed into either French or German; in no tongue will it have lilt.

Skorbut, whence scorbutic, apparently is of low German or Dutch origin. Why not call the spade a spade: simply, *antiscorbutic acid*—antiskorbutsäure —acide antiscorbutique? I hope the distinguished magician who has so deftly conjured one of the great mysteries of our being into tangible form will accept the suggestion.

HENRY E. ARMSTRONG.

Research Items

Omaha Secret Societies. Dr. R. F. Fortune in a study of the Omaha and their secret societies (Columbia Univ. Contrib. Anthrop., vol. 14) supplements, expands and sometimes corrects the material of previous observers—in such matters, for example, as the hereditary character, at disposal in the male line, of membership of the different classes of Omaha society, of chieftainship (excepting the lesser chieftainships) and of membership in the secret societies. Consequentially it may be shown that Omaha society is essentially aristocratic under democratic forms. The Omaha have four important doctoring societies, each under its own special supernatural patron, each with its own individual mode of curing, and its own special group of disorders. The first society, however, is peculiar in having two supernatural patrons, the grizzly bear and the rattle-snake, each of which has its separate set of votaries dealing with its own group of disorders. The two sets of votaries, however, have their method of healing in common—extraction of the illness from the body of the patient by sucking. The grizzly bear votaries treat rheumatism and local body pains, except stomach trouble, which is the province of the rattle-snake votaries, this disorder being supposed to be due to rattle-snake poison in the stomach which has been wafted through the air by 'influence'. The second society is the ghost society, of which the patrons are the human ghosts. They treat delirium, epilepsy and mental disorders, their method of healing being the sprinkling of warm water. The third society is that of the buffalo patron, which heals wounds only by blowing water from the mouth over the part affected. The fourth society, which has a water monster patron, treats any ailment not pre-empted by the other three, as well as specialities, such as child-birth. This society works by sleight of hand, removing material objects from the part in which the disease resides.

Eyes and Colour Change. At the December meeting of the American Society of Zoologists, Prof. Lloyd M. Bertholf read a paper in which he described the influence of eye extract upon body colours (Science Service, Washington, D.C.) He found that eyes acted as glands, secreting a substance which caused contraction of chromatophores. The hormone was found in the eye-stalks of Crustacea, but it was effective in producing colour changes when injected into the body not only of Crustacea but also of frog tadpoles and of several species of fishes.

Bird Migration in Tropical Africa. Little has been written about the regular movements of birds in the tropics of the Old World, so that the account of migration by James P. Chapin in his great work on "The Birds of the Belgian Congo" is of unusual interest (*Bull. Amer. Mus. Nat. Hist.*, 65, 1932). There are regions in Africa where bird life shows little change throughout the seasons, but the moist Congo basin lies between two wide drier areas of Africa from which the birds have good reason to move in the unfavourable season. The migrants from such African areas enter the Congo by the northern and the southern borders ; some even come from Madagascar. But the migrations are complicated by the arrival of many individuals from Europe and Asia which seek refuge from the northern winter, and by a certain number of native water birds which vary locally in abundance according to the level of the great rivers. In addition, there are birds of passage from Europe and Asia which tend to pass through the Congo to South Africa. There the conditions appear to be so favourable to some northern species that they have been found breeding in South Africa, and the presence of distinct geographical races of Eurasian birds points to a suitability of habitat which has led to the establishment of migrating individuals in earlier times.

Functions of Radiation in the Physiology of Plants. Under the above title, two papers (*Smith. Misc. Coll.*, vol. 87, Nos. 13 and 14) describe recent work from the Division of Radiation, Smithsonian Institution. A more than usually elaborate apparatus for growth of plants under controlled conditions with special attention to radiation is described in detail (F. S. Brackett and E. S. Johnstone, No. 13). Temperature, humidity, gas concentration and pressure and aeration of nutrient solution, are fully controlled. Either lateral or overhead illumination may be obtained at will. Standard incandescent filament lamps used in conjunction with various filters, or electric discharges through gases may be used as sources of radiation. The latter method provides sources of monochromatic radiation otherwise difficult to obtain. Using the technique described, an examination of the effects of infra-red radiation upon tomato plants has been made (E. S. Johnstone. No. 14).

Improvement of Colour of Apples. A method of improving the colour of dessert apples after picking, by means of a process termed 'sun-dewing', is described by H. Goude in the *Journal of the Ministry of Agriculture*, vol. 39, p. 904. The process, which has been practised for many years at the Burlingham Horticultural Station, is very simple, entails no expensive apparatus and, at the same time, adds greatly to the commercial value of the fruit. The maximum cost may be roughly estimated as 1*s.* per cwt. Cox's Orange Pippin, Ellison's Orange, Allington Pippin and Laxton's Superb are some of the varieties mentioned which have been treated successfully, but apples with a greasy skin do not respond and others, such as Worcester Pearmain and Norfolk Royal, are apt to develop a bleached appearance. The fruit, eyes upward, is packed on trays lined with clean wood wool or moss and placed in an exposed position preferably facing south, but protected from birds, slugs, etc. Water is then sprayed over the fruit, which must not be allowed to become dry at any time during the treatment or shrivelling will set in. Exposure at night forms part of the treatment; although damage from frost has never been experienced, if frost occurs it should be washed off the fruit before the sun's rays reach it. Colouring will probably be effected after ten days, and the resulting fruit can then be stored in the usual way. The keeping quality of 'sun-dewed' apples is improved, and further, they show a pronounced resistance to store-rot troubles.

Submarine Valleys. Submarine valleys are known on many continental shelves and the use of echo sounding has facilitated their accurate charting. Prof. F. P. Shepard discusses their origin in a paper in the

Geographical Review for January. Such valleys have been variously attributed to river-cutting with displacements of the continental borders, to faulting, to submarine currents or to collapse of submarine solution channels. Prof. Shepard suggests that the chief cause has been originally river action followed by submergence in the long past, after which the valleys have been filled in by sediment during the cutting of the present continental shelves and then reopened from time to time by submarine landslides of the accumulated deposits. This theory provides an explanation of the fact that several of the valleys do not penetrate to the coasts as submarine estuaries. The landward part of the valley would be less liable to landslides than the steeper seaward end; or furthermore, the landward end would be liable to disappear, as a valley, in the cutting out of the continental shelf. Valley-free shelves occur in those areas where landslides have not occurred owing either to the slope being too gentle or to rapid cementation in calcareous sediments.

Particle Size and X-ray Spectroscopy. In a limited number of elements a lower intensity of the $L\alpha$ doublet has been observed when the element was in the form of metallic powder rather than a polished plate or even an oxide, and the effect is present to a very much less extent with K-radiation. Fonda (*J. Amer. Chem. Soc.*, Jan.) shows that the effect occurs under the usual experimental conditions, when the emitted X-ray beam is examined at a different angle from that made by the exciting beam of electrons. These irregularities, which may introduce serious errors in applications of X-ray spectroscopy to quantitative analysis, are a consequence of too large particle size, which brings about an abnormal absorption of the emitted radiation, particularly when it is in the longer wave-length range. X-radiation is excited throughout a certain depth of material, depending on the penetration of the electrons, and consequently encounters, in emission, a corresponding amount of absorption by the material itself. If there are any irregular protrusions in the surface which lie in the path of the beam under investigation, then the radiation is subjected to additional absorption as it passes through them. The decrease of intensity was found to be proportional to the magnitude of the surface irregularities in the target and to the coefficient of absorption of the target material. Attention must, therefore, be paid to the fineness of the powdered samples, particularly when $L\alpha$-radiation is used.

A New Temperature Recorder. Dr. W. Cawood and Mr. H. S. Patterson, of the Department of Inorganic Chemistry of the University of Leeds, have designed, and Messrs. Reynolds and Branson Ltd., Leeds, have put on the market, an accurate temperature recorder possessing many advantages over existing types. It consists of a special mercury thermometer, an image of which is projected on to a strip of bromide paper rotated either by clockwork or by a synchronous electric motor. The drum carrying the bromide paper is mounted in a light-tight case which can easily be detached and taken to the dark room for development. Each strip is 24 in. long, corresponding to 24 hours running, and by means of spare drums a continuous record may be obtained. The main advantage of the instrument over others of a like design is that both the top edge of the mercury meniscus and the engraved divisions on the thermometer are photographed simultaneously. The divisions of the thermometer appear as parallel lines which are cut off by the top of the mercury thread. Thus the only calibration required is that of the thermometer, and moreover, any vibration or jolt will not throw the instrument out of adjustment, but will merely displace the image. The accuracy and range depends upon the thermometer which is used; 0·01° may be easily obtained over a range of 3° or 4° C., or 0·1° over a range of 30° or 40° C., but this range can be enlarged by a simple modification of the apparatus. It will be appreciated that an accuracy of 0·01° is difficult to attain on any other temperature recorder and involves the use of apparatus both complicated and costly.

Astronomical Topics

The Sothic Cycle. Mrs. A. S. D. Maunder has published a paper on this subject (*J. Brit. Astro. Assoc.*, Jan.). The paper was written in answer to M. Sundaram Ayyar, who asserted the identity of the Egyptian Sothis with Arcturus, called Svati in India. It examines the sources of early Indian astronomy, and conjectures that the traditional author of the Siddhantas, Ashura Maya, may be a corruption of the Persian deity Ahura Mazda, and that these astronomical tables came from Persia. Mrs. Maunder gives a high valuation of the accuracy of the early observations made in Persia, but a much lower one to contemporary observations in Egypt, considering that the Egyptians could not then have observed the culmination of Arcturus with any accuracy. The well-known fact that the Nile flood comes close to the heliacal rising of Sirius leads her to adhere to the traditional view that Sothis is Sirius.

Direct Observation of Solar Prominences. The observation of solar prominences has hitherto only been possible by the aid of spectroscopes with widened slits, or of spectroheliographs, except during moments of actual totality in solar eclipses. In 1931, however, at the Pic du Midi, M. B. Lyot succeeded in making direct observations of prominences without such aids, owing to the extreme clearness of the atmosphere which eliminated much of the diffused sky light in the neighbourhood of the sun. On clear days, the intensity of this light was only 5 millionths that of direct sunlight, and prominences could be both seen and photographed even without the aid of a colour filter. The use of a simple red glass filter enabled them to be seen with ease even on poorer days. M. Lyot has repeated these experiments at Meudon, and described the results recently (*C. R. Acad. Sci.*, Nov. 21, 1932). Owing to the poorer atmosphere of Paris, a different form of filter was required. The author has devised one consisting of a tube filled with a slightly acidified solution of neodymium nitrate and closed at one end with Schott *RG*2 glass (the other end being of plain glass). In addition to some unimportant light in the infra-red, this filter transmits light in a narrow band (about 80 A.) containing the $H\alpha$ line. With its aid he has been able to photograph prominences at Meudon even on misty days, with an exposure of only one second for a solar image of 8 cm. diameter.

Relation of Food to Disease*

MANY diseases, ranging from different types of poisoning to deficiency diseases, are caused by defects or impurities in the food supply of a population: at times they may even occur in epidemics. Cure may be brought about by changing the food supply or by adding a missing factor to the diet; in other cases, only medical treatment is of value. Prevention, as always, is better than cure. With an adequate dietary of pure foods, most of these diseases can be abolished or their incidence greatly reduced. A review of the disorders associated with the ingestion of food, which was given by Mr. S. Dixon, the public analyst of the City of Cardiff, to a joint meeting of the South Wales Section of the Institute of Chemistry and the local section of the Society of Chemical Industry, at Cardiff, in February 1932, has now been issued as a small brochure and provides a useful and interesting summary of our knowledge of the subject.

The deficiency diseases are first briefly referred to, especially those associated with a deficient intake of one or other of the vitamins, such as rickets and scurvy, or in other countries beriberi and pellagra. Chemical poisons of non-bacterial origin may be inorganic substances which have gained access to the food through faulty methods of manufacture, or organic compounds present in certain animals or plants which are not foods in the true sense but may be consumed through inadvertence. Mushroom poisoning still occurs, although epidemic ergotism is now rare. An epidemic of the latter, however, occurred in England five years ago among Jewish immigrants from Central Europe who lived on rye bread.

The chief metallic poison which may contaminate foodstuffs is arsenic, which may find its way into the food through the use of material prepared with the aid of impure sulphuric acid: it may also be found on fruit which has been sprayed with an insecticide containing lead arsenite and once was inadvertently used as a dusting powder for boiled sweets. Antimony, lead and zinc may also produce poisoning, but small quantities of tin and copper do not usually have any deleterious effects.

Various diseases are conveyed to human beings by food which contains pathogenic bacteria. Milk may be responsible for the spread of typhoid, scarlet fever, diphtheria, bacillary dysentery, tonsillitis, and undulant fever. Surgical tuberculosis in children, when caused by bovine tubercle bacilli, is due to the ingestion of these organisms in the milk. Other articles of food which may be infected with the organisms of infectious diseases are ice-cream, meat, and shell-fish, especially mussels and oysters. Another group of diseases is due to contamination of the food with organisms of the *Salmonella* group, dysentery bacilli or *B. botulinus*. These are classified under the term, "Bacterial Food Poisoning". It is not considered that 'ptomaine' poisoning has any scientific basis, although two types of poisoning are due to toxins formed by organisms, namely, botulism, and a rare form of mussel poisoning which appears to be due to chemical poisons elaborated in the shell-fish by the vital activity of bacteria derived from sewage-contaminated surroundings.

Animal parasites are not responsible for much disease in Great Britain, though they assume greater importance in the tropics and in countries where food is imperfectly cooked. Tapeworm infestations, in their larval or adult forms, and trichinosis, from the ingestion of infested pork, are the commonest.

In conclusion, attention may be directed to food idiosyncrasy, which illustrates in the modern manner that what is one man's food may be another man's poison.

* "The Relation of Food to Disease". By Stanley Dixon. Pp. 38. (London: The Institute of Chemistry of Great Britain and Ireland, 1932.)

Chemistry of Australian Timbers*

MESSRS. W. E. COHEN, A. L. Baldock and A. G. Charles have produced a useful pamphlet on the chemical composition of the woods of the ironbark group of eucalypts, which constitutes Technical Paper No. 4 of the Division of Forest Products of the Council of Scientific and Industrial Research. The important species upon which the study was based are the ironbarks *Eucalyptus sideroxylon*, *siderophloia*, *crebra* and *paniculata* together with a less important species *E. fergusoni* and the grey gums *E. propinqua* and *E. punctata*.

The first four mentioned are the commercially important ironbarks and have a wide geographical distribution, the group spreading over the eastern States, Queensland, New South Wales and Victoria; the remaining species have a more restricted distribution. The eucalypts are in great demand for all types of heavy structural works. They are used in railway and bridge construction, shipbuilding, coach and waggon building, houses, railway sleepers, wharf decking and so forth.

In a foreword to the pamphlet, Dr. Boas, chief of the Division of Forest Products, states that in this paper the authors describe the first extended chemical study of a group of timbers of the genus *Eucalyptus*. The importance now being attached to this chemical study of wood is summarised as follows: "There is a general trend in forest products research towards utilising wood substances after some form of chemical transformation. Other investigations involve altering the physical characteristics of wood to increase its resistance to fire, and to reduce in seasoned timber the absorption and loss of moisture with consequent shrinkage and swelling. Such proposals and those associated with converting wood into paper, artificial silk, lacquers, etc., must have their foundation in a fuller knowledge of the chemistry of timber. This Division has consequently planned work in this field, almost untouched as far as Australian timbers are concerned."

At present, in the systematic study of the chemistry of the timbers, consideration is being given to those groups containing woods, which, in addition to being very similar in general characteristics and therefore easily confused, are not easy to separate by means of their anatomical features. The object of the investigation discussed in the pamphlet, which was commenced in July 1930, was to obtain data on

* Commonwealth of Australia: Council of Scientific and Industrial Research. Pamphlet No. 32, Part 2. (Melbourne: H. J. Green, 1932.)

the proximate composition of sound, mature, true wood from authentic samples of the timbers with the view of studying (1) their general composition; (2) the possibility of constancy of chemical factors within a species, and of regular differences between species, so that these factors might be used in the identification of the timbers; (3) the variation of chemical composition within a tree; and (4) the applicability to Australian timbers of existing standard methods of wood analysis.

Some striking differences in chemical composition have been revealed between the eucalypts examined and the hardwoods of North America for which analyses are recorded. The eucalypts may be said to be characterised by the presence in their vessels, rays, and fibres of gum-like, brittle, extraneous substances which are not soluble in the usual organic solvents, but are readily soluble in alkaline solutions. The eucalypts possess definitely lower contents of cellulose and total pentosans than North American hardwoods do, even though due consideration is made for differences in extractives. It is interesting to note that the lignin content is much the same for both series in spite of the different analytical methods used, and, if it is assumed that the apparent lignin content of the North American woods will be decreased by initial treatment with $N/8$ sodium hydroxide, then the figures will probably be nearly the same.

The present study has revealed the fact that the standard methods for wood analysis employed in other countries are not readily applicable to the eucalypts. Here again the extraneous substances have played an important part. Their brittle nature has served to indicate that the so-called standard method of sampling wood in the form of sawdust, powder, etc., is inaccurate. Their insoluble nature and resistance to acid hydrolysis have resulted in the failure of the usual method for indicating the correct lignin content of woods. Consequently, the methods of analysis have had to be considerably modified, and it would appear that these modifications are applicable to wood analysis in general.

Developments in Highway Research

PROF. STEINBURG of University of Maryland gave a radio talk on January 13 under the auspices of Science Service over the Columbia broadcasting system on developments in highway engineering. Of the many problems confronting the engineer, the one in which the public is most interested is that of safety in the streets. In the United States there is a rapidly increasing motor-car annual toll of about 34,000 lives and a million injuries.

Although primarily an engineering problem, highway safety is very considerably affected by the psychological, as well as the physical, demands upon the driver of a motor-vehicle. Recent research has shown that the human factor is responsible for approximately ninety per cent of motor-vehicle accidents in the United States and that the causes attributed to defects in the highway or the vehicle are of small relative importance. A psychological study was recently made at the Iowa State College of 2,000 drivers. They were tested on a specially constructed outside road as to their action and reaction when lights, signals, direction and warning signs were encountered. The results showed that the drivers could be divided into three classes. The first class consists of the 'accident free' drivers and comprises about seventy-five per cent of those tested. This group causes little trouble in any ordinary circumstances. The second group numbers about twenty per cent of the total and contains the 'accident liable' drivers who give trouble from various causes. Some are irresponsible, some are preoccupied through illness or personal affairs, while others are careless. Their failure arises either from heredity or environment and renders it necessary for the highway engineer to provide fool-proof roads. The third small group and the individuals who compose it generally suffer from some defect such as colour blindness, restricted field of vision, double vision of a single object, or extreme nervousness and poor co-ordination. Now as half the total accidents are caused by only about seven per cent of all drivers, it is obvious that special consideration has to be given to this third class.

A recent study of road signal signs shows that in the central west of the United States they are well standardised as to form, size, colour and location, while in the east there is much diversity of practice. Delaware has recently experimented with a pictographic signpost showing the direction of the roads on the marker by drawings similar to those used in Canada. They were found much clearer and more easily understood than the type in general use. Experiments have shown that arrow pointers are superior to the marks *R* and *L* for indicating right and left, as many people are momentarily nonplussed when told to go to the right or to the left; and it has been found that for road markers, canary yellow is much the best colour, as it stands out well from surrounding objects at all seasons of the year, and, as the human eye is very sensitive to yellow light, it is good for low illuminations.

Experiments were quoted showing that the capacity of a two-lane road is 1,000 vehicles per hour, for a three-lane road it is 2,000 and for a four-lane 3,000 vehicles and that the risk of accident is greatest with the three-lane road. This research in highway engineering has been a valuable one and has led to many practical changes which will result in a very large saving of both highway funds and vehicle operating costs.

Nomenclature of British Marine Mollusca*

IN revising the "List of British Marine Mollusca" for his presidential address to the Conchological Society, Mr. R. Winckworth has, admittedly, attempted a difficult task which is bound to bring forth criticism. A new list was certainly wanted, for it is more than thirty years since a special committee of the Conchological Society published one (*J. Conchol.*, 10. No. 1. Jan.. 1901) which is now in many ways out of date. All workers on the group will be grateful for this well-authenticated revision, compiled by one who is an authority on the subject.

The greatest difficulty which one meets in

* "The British Marine Mollusca", by R. Winckworth. *Journal of Conchology*, 19, No. 7, June 1932 (Presidential Address, Oct. 1931).

deciding correct nomenclature is not now so much the weight of old literature which has to be perused in order to ascertain which authority has priority, heavy as this burden is, but the keeping up to date with new work constantly appearing which brings forward new facts necessitating alterations. Thus every day new data turn up, old names must be abandoned and new relationships admitted.

One of the obstacles to be met in making a natural classification is the absence of detailed knowledge of the life-histories of the various molluscs. A thorough acquaintance with the eggs and larvæ at all stages would do away with much that is obscure. Mr. Winckworth in his preliminary remarks refers to work lately begun at the Marine Biological Laboratory, Plymouth, which is an attempt to supply this want. Already it is proving useful in determining the natural relationships of gastropods.

Another serious disadvantage is the inability of workers in general to see a large enough series of shells. Work such as has lately been published by Mr. John Colman ("A Statistical Test of the Species Concept in Littorina". *Biological Bulletin*, 42. No. 3. June, 1932) is valuable.

In 1931 the Marine Biological Association published a second edition of the "Plymouth Marine Fauna" in which the nomenclature of the Lamellibranchiata and to a less extent the Gastropoda were revised by Mr. Winckworth. In his new list, however, quite a number of the names (family, genus and species) have been changed; for example, *Erato lævis* altered to *Erato voluta* on account of a few months priority of Montagu over Donovan: *Psammosolen candidus* (Renier) altered to *Solecurtus scopula* (Turton) and many others. This is a good example of the difficulties encountered in undertaking such an arduous piece of work.

The "List of British Marine Mollusca" can be purchased from the Secretary of the Conchological Society of Great Britain and Ireland, Manchester Museum, The University, Manchester, or from Messrs. Dulau and Co., Ltd., 32 Old Bond Street, London, W.1, price 9*d*.

The Iron and Steel Industry

THE last of the present series of lectures on industrial affairs at the Imperial College of Science and Technology was delivered on February 23 by Sir William Larke who took as his subject "The Iron and Steel Industry". He pointed out that although the smelting of iron ore with charcoal has been carried on since 2500 B.C. or even earlier, smelting with coal or coke was not established successfully until 1730–35. Between 1740 and 1840 the production of pig iron in Great Britain rose from 17,350 tons to 1½ million tons, but it was not until about 1860 that the 'iron age' gave place to the 'steel age'. This change was signalised by the rapid development of railways and by the substitution of steel for iron in shipbuilding. As the birthplace of the iron and steel industries and of the blast furnace, the steel furnace and the rolling mill, Great Britain was for many years the leading producer, but owing to intensive developments in other countries, especially the United States and Germany, it had fallen to third place in respect of pig iron production by 1913.

After the War, the important iron ores of Lorraine came under French control, and when Germany recovered her economic freedom in 1925 the products of this district were thrown upon the world markets. In the meantime, other countries were building up iron and steel industries and Great Britain was practically the only accessible free market for the huge surplus Continental production. It is noteworthy, however, that if the world consumption of pig iron had continued to increase at the average rate of 6 per cent a year which was maintained between 1810 and 1910, it would have reached 186 million tons in 1932: the actual production in that year was only 38 million tons and the productive capacity 120 million tons.

Sir William Larke believes that we are suffering to-day from under-consumption rather than from over-production. The organisation of the German iron and steel industry on a national basis was followed by the formation of a Continental steel cartel, but with contraction in demand, prices could not be maintained and fell eventually below the cost of production. The cartel ceased to function in 1930. The British market was the cockpit in which the price warfare was waged: after the introduction of protection Continental producers were endeavouring to maintain their sales at prices as much as 40 per cent less than the cost of production.

It might be supposed that the fall in prices of iron and steel would react to the advantage of those industries which use these commodities as their raw materials. Under pre-War conditions, when the general demand for goods was expanding rapidly, this would have been true, but it must be realised that these conditions no longer prevail. Undertakings involving the large-scale consumption of steel, for example, shipbuilding, are actually held back lest a further fall in price should render the enterprise uneconomic at the new level. In fact the present economic situation is probably unique in the history of mankind, and the solution of its problems cannot be found on pre-War lines. In Great Britain steps have been taken and are being taken towards the establishment of a strong national organisation of the iron and steel industry. Unrestricted competition, which was formerly advantageous in promoting efficiency and stimulating enterprise, now requires to be strictly limited. Since what we call the iron and steel industries really consist of about a dozen related industries, there are many conflicting interests to be reconciled; but much has already been done in the establishment of co-operation, not only at home, but also at Ottawa with the Dominions.

The next step is international co-operation to regulate production in relation to demand and to stimulate consumption. So long as the British market was open, little could be done in this direction. The adoption of a protectionist policy has, however, brought about conditions favourable for negotiations with foreign producers, and our co-operation is now being actively sought. In fact, at the beginning of this month an agreement was signed for a new cartel, which is to deal with export trade only. This cartel will be maintained only if sales agreements can be made and a stabilisation of price levels achieved.

In conclusion, Sir William Larke referred to the prospects for scientifically trained men in industry.

In the iron and steel industry there is scope for chemists, physicists, metallurgists and engineers—provided that they have the gift of establishing human relations. In industry, the understanding of one's fellow men is more important than technical knowledge. Sir William decried the modern pose that enthusiasm is 'bad form'. We live in an age of great difficulties and responsibilities, but also of great possibilities—and we need all the enthusiasm that we can muster.

Flora of East Anglia

"THE East Anglian Flora—a Study in Comparative Plant Geography" is the title of the presidential address by Prof. E. J. Salisbury to the Norfolk and Norwich Naturalists' Society, reprinted from the Society's *Transactions* (vol. 13, pt. 3, 1932, pp. 191–263).

While treating specially of the flora of East Anglia, Prof. Salisbury has extended the scope of his address to include a survey of the major problems of geographical distribution in Great Britain as a whole. Eight components are recognised in the British flora, four of which are further subdivided into eleven constituent elements, and stress is laid upon the importance of viewing these groups in relation to the distribution of the species on the continent of Europe. The largest components are the southern, the oceanic and the continental. The majority of the southern species exhibit in Britain a diagonal limit running in the south-west—north-east direction, indicative of their comparative intolerance of oceanic conditions, while in contrast to these, most of the oceanic species show a diagonal limit passing in a south-east—north-west direction. The continental component includes the steppe species, many of which are located in East Anglia, and it is held that their occurrence there is correlated with a combination of low rainfall and favourable edaphic conditions.

Two strikingly contrasted climatic areas are found in the East Anglian region, in which marked difference in rainfall is accentuated by differences of soil and topography, resulting in the juxtaposition of both continental and oceanic species. The general conclusion is reached that climate is the most important factor determining the distribution of plants in Britain, though evidence is adduced in certain cases to show that soil preferences and the competition factor may act as modifying influences.

A noteworthy feature of the paper is the large number of maps, 106 in all, clearly illustrating the range of individual species within the British Isles, while numerous photographs are included depicting certain interesting species in their natural habitats. Copies of the paper (price 5*s*.) may be obtained from Dr. S. H. Long, 31, Surrey Street, Norwich.

University and Educational Intelligence

BIRMINGHAM.—The annual meeting of the Court of Governors on February 23 presided over by the Chancellor (Viscount Cecil of Chelwood) was marked by a general feeling of regret at the retirement from the Council of Mrs. C. G. Beale (widow of the first Vice-Chancellor) and the resignation of his office as Pro-Chancellor by Sir Gilbert Barling after many years of highly valued service to the University. Mr. Walter Barrow was elected Pro-Chancellor and, after the Chancellor had signified his approval of the election, Sir Gilbert Barling rose from his seat and divested himself of his robes of office saying that these robes, originally worn by the first Vice-Chancellor, had been given to him by Mrs. Beale when he succeeded to the vice-chancellorship. Sir Gilbert now desired, with Mrs. Beale's approval, to present them to the University and he proceeded forthwith to invest with them the new Pro-Chancellor. The Chancellor paid a tribute to Sir Gilbert Barling, whom he described as a man possessed of a great faculty which he could only describe as the faculty of being right. His advice was always to be trusted.

Sir George Kenrick moved a resolution in which the Court gratefully acknowledged the services of the retiring Pro-Chancellor as demonstrator in anatomy in Queen's College in 1885, as professor of pathology in 1886–1893, joint professor of surgery in 1893–1913, dean of the Faculty of Medicine in 1905–1912, member of the Court of Governors since 1900 and of the University Council since 1903, as Vice-Chancellor and chairman of Council in 1913–1927 and Pro-Chancellor from 1927 until the present time. Prof. F. W. Burstall in seconding the resolution paid a tribute on behalf of the academic side of the University. The dean of the Faculty of Medicine (Dr. Stanley Barnes) spoke in very warm and appreciative terms of Sir Gilbert whom he characterised as a great surgeon, a great teacher and a great administrator.

The title of emeritus professor was conferred on Prof. W. S. Boulton (geology and mineralogy) and Prof. J. T. J. Morrison (forensic medicine and toxicology).

CAMBRIDGE.—A University demonstrator in geography will shortly be appointed. The duties will commence on April 1. Particulars can be obtained from Prof. F. Debenham, at the Department of Geography, to whom applications should be sent on or before March 7.

The Balfour studentship in biology has been awarded to F. R. Parrington of Sidney Sussex College.

It has been recommended that the plans prepared by Sir Herbert Baker for the Scott Polar Research Institute be approved.

EDINBURGH.—His Majesty the King in Council has approved of the ordinance providing for the affiliation of the Heriot-Watt College to the University.

Prof. Heinrich Wieland, of the University of Munich, has been invited to give the first Romanes lecture. These lectures are provided from an endowment fund in memory of Dr. Robert Romanes, and James Manners Romanes, brother of the late Miss I. D. Romanes. Part of the endowment is used to bring distinguished chemists from other centres to lecture in Edinburgh.

LONDON.—His Majesty the King, who will be accompanied by the Queen, will lay the foundation stone of the new University buildings on June 26.

The following appointments have recently been made: Prof. J. B. S. Haldane, since 1922 reader in biochemistry in the University of Cambridge and since 1927 head of the Genetical Department at the John Innes Horticultural Institution, to be professor of genetics at University College; Mr. W. P. Yetts, lecturer in Chinese art and archæology at the Courtauld Institute of Art, to be professor at the Institute; Prof. Cyril L. Burt, to the Heath Clark lectureship for 1933.

Calendar of Nature Topics

Protection of Wild Birds

On March 1 the annual close time for British wild birds began and will last until August 1. The importance of the 'close time' seems often to be ill-understood. Between March 1 and August 1, it is a punishable offence for *any person* to take or kill *any wild bird* in Great Britain; the only exception being the persons most likely to be affected by the depredations of birds, that is, owners or occupiers of land or persons delegated by them, who are restricted only as regards a long list of scheduled birds and additions which have been made to the original schedule by orders of the Home Secretary and the Secretary of State for Scotland.

The basic Act of British wild bird protection legislation was passed in 1880, but so many supplementary Acts have been passed extending the possibilities of protecting birds and their eggs by special departmental orders, that a new and comprehensive Act for the Protection of Birds is long overdue. There can be no doubt that British legislation has, on the whole, been effective in its main purpose, for although some species have been exterminated since its inception and the existence of others is still precarious, many rare species have been saved and many others have increased their numbers and extended their range in the half-century during which the Acts have been in operation.

Changed Standing of the Quail

Although quails do not belong to the legal group of 'game birds' properly so termed, they have long been ranged alongside them (at any rate since 1621 in Scotland) in company with woodcock, snipe and landrails. It seems strange to find quail still ranked with woodcock and snipe in a shooting season which closed with the opening of March, for quail have almost fallen out of the category of sporting birds. Yet once they must have been common, for in the middle of the sixteenth century (1551) a Scottish Act fixed their price at 2*d.* apiece, the price of a snipe, half the price of a woodcock. Nowadays they are much less abundant as breeding birds than they used to be, and, as winter visitors, their numbers have also greatly decreased; although occasional years, such as 1870, 1885, 1892, 1893, 1902, 1926, have seen an unusual but generally local influx of summer immigrants.

The changed standing of the quail is due to several causes. Drainage and intensive cultivation have destroyed the rough tussocky land where it formerly bred; the use of close-mowing hay-cutters and reaping machines destroys nests and young birds; and outside Great Britain the great slaughter of quails during their migrations has undoubtedly reduced the stock from which our breeding birds are derived. The practice of netting quails in the southern countries of Europe on their spring and autumn migrations from and to Africa, particularly on their main routes across the Straits of Gibraltar, to Italy, and across the Ægean Sea, has existed from time immemorial, and some idea of a fraction of the slaughter may be gathered from the statement that in 1898, 270,000 were sold in the Paris markets alone.

Spring Food of Brown Trout

Though many scattered references to the food of trout exist in angling and other literature, the subject has not been precisely studied in Great Britain to any extent. Scarcely anything at all is known of the food or feeding habits of trout in the winter months during what is legally the close season. During these months, recovery from spawning is slow, due apparently to a somewhat sparse diet including fixed caddis larvæ, molluscs, *Simulium* larvæ and miscellaneous bottom fare; until the earlier *Bäetidæ*, some of the smaller Plecoptera and the March Brown (*Rhithrogena haarupi*) make their appearance. Day (1887) records that among 52 Scottish river trout taken during March and the first half of April, 28 contained caddis or Ephemeroptera, 14 beetles, 4 *Gammarus pulex*, 1 *Piscicola geometra*, 1 *Limnea peregra*, 1 *Ancylus fluviatilis*, 1 *Cyclas flavescens*, and 5 vegetable fragments. The latter were probably swallowed incidentally by trout feeding on *Simulium* pupæ. Pentelow (*J. Animal Ecol.*, 1, 2) after investigation of trout from the River Tees and the River Itchen over the angling season found, out of 133 stomachs, only two items of a vegetablo nature. His results showed that the trout is purely a carnivorous creature that may eat almost any animal of suitable size which presents itself either in the water or on the surface, the diet depending chiefly on the nature of the fauna in any particular stream.

Range of Brown Trout's Diet

The catholicity of taste of the brown trout is confirmed by the varied nature of the diet of trout in a northern river during the first few weeks of the season of 1931. The stomach contents showed on an average 44 Ephemeroptera, 24 *Simulium* (larvæ and pupæ), 3 Trichoptera (larvæ), 2 Plecoptera, 2 Diptera, 1 Coleoptera, 0·2 Hemiptera, 0·1 Hymenoptera, together with 12 *Gammarus* and 0·15 small fish. The proportion of underwater to surface food taken was found to be 2 : 1 at this season.

General Gordon and the Double Coco-nut

In 1880 General Gordon, recalled from a peace mission in China by an uneasy Government, was induced by his friend Sir Howard Elphinstone to take over the command of the Royal Engineers at Mauritius. It was during his service there that he visited the Seychelles Islands and became interested in the remarkable endemic palm, coco-de-mer, or the double coco-nut (*Lodoicea sechellarum*). Gordon was a keen botanist; he was also a deeply religious man, with an absolute faith in the literal accuracy of the Bible, and in a letter to Sir William Thiselton-Dyer, dated December 9, 1882, and preserved in the files of the Royal Botanic Gardens, Kew, he seeks to identify this palm with the "Tree of the Knowledge of Good and Evil". The letter is accompanied by coloured drawings of the flowers and seeds, which he compares with the male and female human form. From this it is a small step to the recognition of the Island of Praslin, where the palm is native, as the site of the Garden of Eden, and Gordon sketches two maps showing the relationship of this island with the traditional site of the Garden in Mesopotamia. The letter concludes with the statement that "oddly enough there is a species of serpent at Praslin —none on any of the other isles in these seas", and also with the suggestion that the bread-fruit tree (*Artocarpus incisa*), "was set apart at the time of the fall as the Tree of Life".

A few days after this letter was written, Gordon

presented to Kew a model of the fruit of the double coco-nut. This model, together with some of his original drawings, is now on exhibition in Museum No. 2 at Kew, and a fine young palm, still attached to the huge seed, may be seen growing in the *Victoria regia* House (No. 10).

Greatest Strength of the Mistral

The Mistral, a northerly or north-westerly wind which is the scourge of the lower Rhône valley and the Mediterranean coast of France, blows throughout the year, but reaches its greatest frequency and force early in March. It is generally associated with clear skies and bright sunshine, but the coldness and dryness of the air are very irritating, and injure delicate plants. It may continue for a week, increasing in force during the afternoon and falling off about twilight. The Mistral is essentially a flow of cold air from the high ground of central France to the warm sea and coastal plains of the Mediterranean, which is favoured by the presence of an area of high pressure over western Europe or a depression over the Gulf of Lions.

Societies and Academies

London

Royal Society, Feb. 23. G. W. C. Kaye and G. C. Sherratt: The velocity of sound in gases in tubes. The velocity of sound at 18° C. and 100° C. has been determined by the resonating tube method in six different gases contained in six tubes of adjustable length and of different diameters and materials (glass, copper and carbon). A series of frequencies from 500 to 27,000 cycles per second were provided by a valve oscillator system controlled by a vibrating quartz crystal which also served as a resonance detector. The results indicate that for all the gases the Helmholtz-Kirchoff formula is quantitatively correct in its statement of the influence of tube diameter and frequency on the velocity. The formula does not, however, take cognisance of the influence of the wall surface. In the smooth tubes the reduction in velocity below the free space value was on the average about 10 per cent less and in the rough tubes about 30 per cent more than the formula would indicate. A. F. Hallimond (with E. F. Herroun): Laboratory determination of the magnetic properties of certain igneous rocks. Specimens from Leicestershire (Charnwood rocks) gave low values, but a measurable degree of permanent magnetisation and susceptibility was found for the Cleveland Dyke and for the dyke at Lornty in Perthshire. A method is developed for calculating the magnetic profile from the geological model assuming uniformity of magnetisation. Calculated and observed curves for the Lornty profiles show a fairly good agreement; they indicate that the north side of the dyke is south-polar, so that the magnetisation appears to be in the opposite sense to that recorded for certain dykes in Germany, and is opposite to that which would be produced by cooling in the earth's present field. L. C. Jackson: The principal magnetic susceptibilities of some paramagnetic crystals at low temperatures. An apparatus is described for the rapid determination of the principal susceptibilities of crystals at low temperatures with an accuracy of 0·5 to 1 per cent. Results are given for the following crystals: manganese ammonium sulphate, manganese sulphate (penta- and tetrahydrate) ferric acetylacetonate, potassium ferrioxalate, cobalt sulphate and potassium ferricyanide. In agreement with recent theory, the crystals containing ions with *s*-moment only present or effective are found to be magnetically isotropic to within about 1 per cent. Over the range of temperature employed, 290°—75° K, the $1/\chi$. T curves for the principal susceptibilities of cobalt sulphate are straight lines, but these are not all parallel.

Paris

Academy of Sciences, Jan. 16 (*C.R.* 196, 145–224). Marcel Brillouin: Plane domains with multiple connexion. Choice of co-ordinates of reference. Electrostatic co-ordinates. Maurice Leriche was elected *Correspondant* for the Section of Mineralogy in succession to the late Albert Durand de Grossouvre. Emile Ostenc: The zeros of stochastic matrices. C. Ehresmann: The topology of certain algebraic varieties. C. E. Winn: A relation between a given series and another derived series with the same interval of oscillation. S. Stoilow: Remarks on some topological theorems of the theory of functions. A. Tsortsis: The integration of a class of partial differential equations of the third order with an unknown function of n independent variables. Y. Rocard: The propagation of sound waves of finite amplitude. R. Mercier: The paramagnetism of the ion of dissolved cobalt. Measurements of the coefficient of magnetisation of very dilute solutions of cobalt chloride in methyl alcohol as a function of temperature were made. The values found for the magnetic moment were within the limits established by the theory of Van Vleck–Stoner. I. I. Agarbiceanu: The monochromatic excitation of the fluorescence of iodine. Mlle. E. Kalinowska: The line fluorescence of cadmium vapour. Pierre Auger: The diffusion of neutrons. Non-elastic collisions with nuclei. André Charriou: The influence of alkaline iodides on the tendency of photographic emulsions to solarisation. W. Broniewski and S. Jaslan: The influence of oxygen on the properties of copper. The experiments described suggest the presence of a solid solution of 0·8 per cent cuprous oxide in copper, and this is shown by the curves of variation of thermo-electric power, elastic limit, and elongation. Mlle. O. Hun: The cryoscopic study of paraldehyde, of ether and of acetone in solutions of sodium acetate. André Juliard: The retarding action of glass on Landolt's reaction. Landolt's reaction (interaction of iodic and sulphurous acids) is catalysed by iodine, and Liebreich's phenomenon, the period of induction, is due to the elimination of the ions by the glass. P. Job: The constitution of hydrochloric acid solutions of cobalt chloride. From spectrophotometric observations, the author concludes that hydrochloric acid solutions of cobalt sulphate at the ordinary temperature consist of a mixture of cobalt ion and two chlorine complexes: $(CoCl)^+$ and $(CoCl_3)^-$. Paul Bary: The causes of the thixotropy of certain salts. The property possessed by certain colloidal sols of setting when in repose and becoming liquid on shaking is called thixotropy. The theory of the phenomenon is discussed. G. Darzens and André Lery: A new method of synthesis of fatty $\alpha\alpha$-dimethylaldehydes of high molecular weight. Jacques de Lapparent: The extension of diaspore bauxites. Mme. Elisabeth Jérémine: Observations on the Devonian to the north of the Vosges. Georges

DUBOIS: The stratigraphic subdivision of the schistogreywacke complex of the Vosges. It is shown that, with or without the middle Devonian, the Visean and especially the lower Visean, holds an important stratigraphical place in the whole of the Vosges. MLLE. S. GILLET: An attempt at a classification of the upper Miocene and of the lower Pliocene of Rumania. The Dacic basin. PAUL FALLOT: Geological observations in the Djebel Kelti massif (Spanish Morocco). J. REPELIN: Observations on the tectonic of the western part of the Nerthe. RAYMOND CIRY: The lateral passage of the Cretaceous with so-called Wealdian facies of the province of Burges to the lower marine Cretaceous of the Cantabric provinces. D. SCHNEEGANS: The presence of the middle Jurassic (Dogger) in the sheet of Ubaye to the north of the valley of Barcelonnette (French Alps). MARCEL THORAL: The existence of the Georgian in the mountains of Lacaune. DAVID STENQUIST. The relation between the daily variations of the earth current and the terrestrial magnetic field. PH. FLAJOLET: The transparency of the atmosphere in the Lyons region. The visibility of the Alps. In a recent note, André Allix, discussing the observations of the visibility of the Alps made at the Observatory of Fourvière, concludes that there has been a progressive obscuring of the atmosphere near Lyons during the last thirty years. These results are now compared with observations at the Saint-Genis-Laval Observatory, made at the same altitude and about 8km. to the south. The two sets of observations are in general agreement, but, in the author's opinion, do not prove a progressive change in either direction. The visibility of the Alps does not appear to be capable of being influenced by the greater or less abundance of smoke. MLLE. MADELEINE FOURCROY: The indirect action of traumatisms on the evolution of the conducting apparatus (in plants). JACQUES MONOD: Demonstrating the axial gradient in the ciliated Infusoria by photolysis by means of the ultra-violet rays. The results entirely confirm those of Child: the ultra-violet rays exert a differential cytological action identical with that of chemical poisons. This shows that the differential susceptibility is not only a question of differences of permeability, but also expresses the fundamental physiological polarity of the cell. V. A. KOSTITZIN: Some quasi-periodic phenomena in closed basins. P. VLÈS: The correlations between the evolution of the weight of infants and the electrical properties manifested at their level. MME. Y. KHOUVINE and G. NITZBERG: The identification and biochemical oxidation of α-glucoheptulite. That α-glucoheptulite is not a mixture has been proved by X-ray photographs. Biochemical oxidation with *Acetobacter xylinum* gave α-glucoheptulose. R. WOLFF and MLLE. LAFRANCAISE: The action of pancreatic extract on glycocine in glycerol solution. J. LIGNIÈRES: The duration of immunity after vaccination against foot and mouth disease.

ROME

Royal National Academy of the Lincei. Communications received during the vacation, 1932. S. CHERUBINO: Classification of hyper-elliptic surfaces from the real point of view. The classification of these surfaces is completed in a manner that appears satisfactory and of useful application. Certain of the more simple and striking relationships between Scorza's nine types (1916) and Lefschetz's seven types (1919) are indicated. B. COLOMBO: An equation with partial derivatives of the fourth order. HANS HAMBURGER: Ribaucour's transformation and spherical representation (3): Ribaucour's cyclic systems. This theory of cyclic systems furnishes other applications of Ribaucour's transformation. On the basis of a deduction made by Bianchi, a formula is derived which determines all the cyclic systems normal to a given surface $x(u, v)$. V. HLAVATÝ: Projective curves of a curve in the projective space P_{n-1} (n = or >3). D. MANGERON: A problem of the contour for a non-linear differential equation to the partial derivatives of the fourth order with double real characteristics. MARIA PASTORI: Properties of conjugated hemi-symmetric tensors. B. SEGRE: Algebraic surfaces having the canonical system combined with an involution. M. PASCAL: The motion of a deformable body which remains similar to itself. (2) Instantaneous centre of velocity and its consequences. F. ZAGAR: The variation of the eccentricity in the problem of two bodies of variable masses. Two particular integrable cases are considered. C. CANNATA: An extension of Woo's formula: intensity of the light diffused by an electron in motion. For the case when the diffusing electron is moving in the same direction as the incident pencil, Woo has calculated the intensity of the diffused radiation on the basis of classical theory. Woo's result is now confirmed by an analogous but simpler method, and is extended to the case when the electron is moving in any direction whatever. C. DEI: Circuits with a capacity in parallel on a diode in saturation. A. FERRARI and G. TRAMPETTI: Investigations on the behaviour of mixtures of zinc oxide and anhydrous zinc chloride at high temperature. The solubility of zinc oxide in fused zinc chloride does not exceed 5 per cent (molecular). The existence of anhydrous zinc oxychlorides appears improbable, the hydrated oxychlorides undergoing decomposition in the fused mixture. C. GUARESCHI: First results of the combined method: differential susceptibility and vital colours, in the development of Amphibia. T. PERRI: Transplantation experiments with Amphibia. G. AMANTEA and V. FAMIANI: Further considerations on the possibility of obtaining permanent beriberi phenomena by exclusion of the *B* factor. The results previously obtained with pigeons have now been confirmed by similar experiments on hens. V. FAMIANI: (1) The capacity for food consumption after fasting. When pigeons which have fasted until they have lost 20 per cent in weight are fed, they are at first able to take only very little food, but the amount taken gradually increases to about double the normal quantity, at which it persists until, or even after, the original body-weight has been resumed. (2) Reconstructive food value of the embryos of various cereal and leguminous seeds. These embryos are not only of greater value than other parts of the seeds in normal nutrition, but also they result in more rapid resumption of weight when administered to fasting pigeons. G. MEZZADROLI and A. AMATI: Action of certain alkaloids on the development of *Aspergillus niger*. Quinine and strychnine, in small concentrations, favour the growth of this mould, but caffeine exerts an inhibiting influence. A. SALVATORI: Contribution to the knowledge of the nature and value of Bezssonoff's reaction for the *C* factor. Bezssonoff's reagent is not specific for the *C* factor, but merely reveals the presence, in all antiscorbutic materials, of a reducing factor.

Forthcoming Events

Monday, March 6

VICTORIA INSTITUTE, at 4.30—(in Committee Room B, Central Hall, Westminster).—Dr. J. Burnett Rae: "Psychology and the Problem of Inadequacy" (Dr. A. T. Schofield Memorial Paper).

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. C. Chibnall: "The Biochemistry of Plant Waxes".

ROYAL SOCIETY OF ARTS, at 8—(Cantor Lectures).—Arthur Stephenson: "Welding and Allied Processes for Engineering Purposes" (succeeding lectures on March 13 and 20).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Sir Douglas Mawson: "Kerguelen".

Thursday, March 9

CHEMICAL SOCIETY, at 7—(extra meeting at the University of Manchester).—Prof. E. K. Rideal: "How Chemical Reactions Go".

CHADWICK PUBLIC LECTURE, at 8—(at the Royal Sanitary Institute).—Dr. E. Killick Millard: "Housing".

Friday, March 10

ROYAL INSTITUTION, at 9.—Lord Rutherford: "Recent Researches on Transmutation of the Elements".

INSTITUTE OF METALS, March 8–9.—Annual General Meeting.

Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries. Report of the Reorganisation Committee for Milk. (Economic Series No. 38.) Pp. 228+xx. (London: H.M. Stationery Office.) 6*d*. net.

Economic Advisory Council. Tsetse Fly Committee Report: Developments in the Treatment of Animal and Human Trypanosomiasis and in Tsetse Fly Control in the Period 1925–31. Pp. 27. (London: H.M. Stationery Office.) 6*d*. net.

Census of Nigeria, 1931. Vol. 1: Nigeria. By S. M. Jacob. Pp. viii+155. 10*s*. Vol. 2: Census of the Northern Provinces. By N. J. Brooke. Pp. ii+234. 12*s*. Vol. 3: Census of the Southern Provinces. By H. B. Cox. Pp. ii+46. 4*s*. Vol. 5: Medical Census, Northern Provinces. By Dr. R. C. Jones. Pp. ii+92. 7*s*. Vol. 6: Medical Census Southern Provinces. By Dr. J. G. S. Turner. Pp. iv+101. 8*s*. (London: The Crown Agents for the Colonies.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 19: Notes on the Kidston Collection of Fossil Plant Slides. No. 1: The Anatomy of the Axis of Lepidodendron Brownii Unger sp., with Special Reference to the Relationship between this Stem and Lepidostrobus Brownii Unger sp. By Mary G. Calder. Pp. 547–555+3 plates. 2*s*. 3*d*. Vol. 57, Part 2, No. 20: The Metamorphism of the Deeside Limestone, Aberdeenshire. By Dr. Arthur G. Hutchison. Pp. 557–592. 4*s*. 6*d*. Vol. 57, Part 2, No. 21: The Restoration and Regeneration of the Epithelium and Endometrium of the Uterus of *Cavia* Post Partum in Non-Pregnant Animals. By William J. Hamilton. Pp. 593–600+1 plate. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh, Session 1932–1933. Vol. 53, Part 1, No. 4: On Properties of Null Geodesics, and their Application to the Theory of Radiation. By Dr. W. O. Kermack, Dr. W. H. M'Crea and Prof. E. T. Whittaker. Pp. 31–47. 1*s*. 6*d*. Vol. 53, Part 1, No. 5: Expansion and Contraction of Coal caused respectively by the Sorption and Discharge of Gas. By Prof. Henry Briggs and R. P. Sinha. Pp. 48–53. 9*d*. Vol. 53, Part 1, No. 6: On the Graduation of Data by the Orthogonal Polynomials of Least Squares. Pp. 54–78. 2*s*. 3*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

OTHER COUNTRIES

U.S. Department of Agriculture. Miscellaneous Publication No. 98: Market Diseases of Fruits and Vegetables—Potatoes. By Prof. George K. K. Link and Glen B. Ramsey. Pp. 63+15 plates. 30 cents. Miscellaneous Publication No. 121: Market Diseases of Fruits and Vegetables—Tomatoes, Peppers, Eggplants. By Glen B. Ramsey and Prof. George K. K. Link. Pp. 44+11 plates. 20 cents. (Washington, D.C.: Government Printing Office.)

Cornell University: Agricultural Experiment Station. Bulletin 541: Soils in relation to Fruit Growing in New York. Part 1: A Detailed Soil Survey of the Hilton Area, Monroe County. By A. T. Sweet and Joseph Oskamp. Pp. 16+1 map. Bulletin 542: Killing Perennial Weeds with Chlorates during Winter. By W. C. Muenscher. Pp. 8. Bulletin 549: An Analysis of the Loaning Operations of the Federal Land Bank of Springfield from its Organisation in March 1917 to May 31, 1929. By F. F. Hill. Pp. 107. (Ithaca, N.Y.)

Differences between certain of the North American Indian Tribes as shown by a Microscopical Study of their Head Hair. By George Woodbury and Edna T. Woodbury. Pp. 37. (Denver, Colo.: State Historical Society of Colorado.)

Bulletin of the Vanderbilt Marine Museum. Vol. 1, Art. 3: Scientific Results of the Yacht *Alva* World Cruise, July 1931 to March 1932, in Command of William K. Vanderbilt. Fishes. By N. A. Borodin. Pp. 65–101+2 plates. (Cambridge, Mass.)

Field and Laboratory: Contributions from the Science Departments of Southern Methodist University. Vol. 1, No. 1, November, 1932. Pp. 32. (Dallas, Texas.)

Bulletin of the Geological Society of America, Vol. 43. Gondwana Land Bridges, by Charles Schuchert; Isthmian Links, by Bailey Willis. Pp. 875–952+plates 24–29. (New York City.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. A New Species of Sailfish, *Istiophorus brookei*, from Tahiti. By Henry W. Fowler. Pp. 403–404+plate 20. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 16: Carbon Dioxide Assimilation in a Higher Plant. By W. H. Hoover, Earl S. Johnston and F. S. Brackett. (Publication 3186.) Pp. 19+2 plates. Vol. 87, No. 17: Absolute Intensities in the Visible and Ultra-Violet Spectrum of a Quartz Mercury Arc. By E. D. McAlister. (Publication 3187.) Pp. 18. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 6, December, Research Papers Nos. 501–511. Pp. 711–860. 25 cents. Vol. 10, No. 1, January, Research Papers Nos. 512–521. Pp. 149. 25 cents. (Washington, D.C.: Government Printing Office.)

The Felidæ of Rancho La Brea. By John C. Merriam and Chester Stock. (Publication No. 422.) Pp. xvi+231+43 plates. (Washington, D.C.: Carnegie Institution.)

Observatoire de Zi-ka-wei: Annales de Zô-Sè. Tome 17, Fasc. 5: Théorie approchée de la petite planète (113) Amalthea. By E. de la Villemarqué. Pp. D49. Tome 17, Fasc. 6: Observations photographiques d'Eros. Pp. E38. (Zi-ka-wei.)

Sveriges Geologiska Undersökning. Årberattelse för År 1931. Pp. 12. (Stockholm: P. A. Norstedt and Söner.) 0.50 kr.

Trinidad and Tobago. Notes on the Production of Sugar Cane. Taken by S. M. Gilbert at the Fourth Triennial Conference of the International Society of Sugar Cane Technologists held at Puerto Rico in March, 1932. Pp. 35+3 plates. (Trinidad: Government Printing Office.) 2*s*.

Carnegie Institution of Washington. Year Book No. 31, July 1, 1931, to June 30, 1932; with Administrative Reports through December 9, 1932. Pp. xi+392. (Washington, D.C.: Carnegie Institution.)

Proceedings of the United States National Museum. Vol. 81, Art. 17: The Helminths parasitic in the Amphibia and Reptilia of Houston, Texas, and Vicinity. By Paul D. Harwood. (No. 2940.) Pp. 71+5 plates. (Washington, D.C.: Government Printing Office.)

Education, India. Occasional Reports No. 16: A Report on the Use of the Mother-tongue as the Medium of Instruction and Examination in certain Subjects for the Matriculation Examination of the Bombay University. By M. R. Paranjpe. Pp. vii+47. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s*.

Memoirs of the Asiatic Society of Bengal. Vol. 9, No. 6: Geographic and Oceanographic Research in Indian Waters. Part 6: Temperature and Salinity of the Deeper Waters of the Bay of Bengal and Andaman Sea. By Lieut.-Col. R. B. Seymour Sewell. Pp. 357–424. 2.13 rupees. Vol. 11, No. 5: Algal Flora of the Chilka Lake. By Kalipada Biswas. Pp. 165–198+plates 25–32. 3.15 rupees. (Calcutta.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 26, 1930, No. 4. Pp. 419–588. (Calcutta.) 5.10 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 71: Investigation on Irrigated Pastures. 1: The Yield and Botanical Composition of an Irrigated Permanent Pasture under various Systems of Pasture Management, by Dr. A. E. V. Richardson; 2: The Chemical Composition of Irrigated Pastures at Wood's Point, South Australia, by H. P. C. Gallus. Pp. 45+7 plates. (Melbourne: H. J. Green.)

CATALOGUES

British Industries Fair, 1933: Birmingham Section, February 20th to March 3rd, 1933. Supplementary Guide to Electrical Exhibits: Plan and List of Exhibitors. Pp. 16. (London: The British Electrical Development Association, Inc.)

Newton's Epidiascopes: High Intensity Models fitted with Special Diffusion Reflectors. Pp. 6. (London: Newton and Co.)

Catalogue of Science and Technology, No. III. Annotated and Classified List of Rare and Standard Works on Exact and Applied Science. Part 10: XIII. 2, Civil Engineering. (No. 836.) Pp. 1017–1112. (London: Henry Sotheran, Ltd.)

The Notched Echelon Cell for Rapid Absorption Spectrophotometry in the Visual and Ultra-violet Regions. (Publication No. 178.) Pp. 11. The Spekker Ultra-Violet Spectrophotometer. (Publication No. 184.) Pp. 4. The Campbell Solution Calculator for rapidly calculating the Behaviour of Solutions. (Publication No. 177.) Pp. 4. (London: Adam Hilger, Ltd.)

Degussa Lilliput Gas-heated Laboratory Furnace for 600–1900° C. Pp. 4. Degussa-Lillitilt Furnace for Metal Melting. Pp. 2. High Temperature Furnaces for Gas-heating up to 2000° C. Pp. 8. (London: Bush, Beach and Gent, Ltd.)

Watson's Microscope Record. No. 28, January. Pp. 24. (London: W. Watson and Sons, Ltd.)

Lettres, Arts, Sciences. Pp. 32. (Paris: Librairie Delagrave.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 23.) Pp. 119–188. (Paris: Libr. Adrien-Maisonneuve.)

Catalogue of Scientific Books and Publications of Learned Societies. (No. 404.) Pp. 84. (Cambridge: W. Heffer and Sons, Ltd.)

A List of two recently purchased Collections of Botanical Books. (No. 205.) Pp. 16. (London: Dulau and Co., Ltd.)

Wild-Barfield Forced Air Circulation Furnaces. Pp. 8. (London: Wild-Barfield Electric Furnaces, Ltd.)