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Lord Haldane in Science and Education.

THE autobiography of Lord Haldane recently published throws a flood of light on several questions of scientific and educational interest. Mr Sidney Webb once expressed the view that men of science who had entered the field of politics had not as a rule distinguished themselves in Parliament, a judgment which, with commendable impartiality, he extended to historians and economists. This view was challenged at the time. Playfair and Lubbock, it was suggested, had rendered valuable services as members of Parliament, and Huxley as a member of the first London School Board. Ought we not to regard these instances as exceptions proving the rule ? To the man of science, groping with his taper along the rugged pathway towards truth, the eclectic arts, the rhetorical triumphs—and at times the overweening confidence—of the politicians make no strong appeal.

Whatever view may be taken on this question, it will be agreed that politicians who concern themselves with the promotion of science and education are fulfilling a useful rôle in our national economy. With increasing specialisation and increasing demands on both public and private funds for the promotion of research, science needs sympathetic interpreters, missionaries—propagandists, if you will—to whose warnings and exhortations the public will listen with due respect. Haldane, as a man of outstanding intellect and untiring industry, as a politician who attained the highest offices in the State, as an active participator in the gravest decision which our nation was ever called upon to make, had many of the qualifications for this essential work. That he discharged his duty with conviction and disinterestedness, the reader of the autobiography will admit. His success was partial, as he himself admits. A man is a hero to his autobiographer, one would suppose ; but Haldane writes candidly in his final chapter entitled " Looking Backwards " : " I have no sense of success on any very large scale in things achieved. But I have the sense of having worked and of having found happiness in doing so." That guerdon is not withheld from the humblest of the world's workers. " One touch of Nature makes the whole world kin." Haldane's posthumous candour should induce a tolerance which was not shown by the public during his life.

Asked by Cecil Rhodes, " What have you done in your life ? " Haldane replied, " I got the London University Bill through the Houses of Parliament " ; on which Rhodes remarked, " That seems to be a very curious thing." The reference was to the

Bill of 1898, introduced by the Conservative Government to transform the examining university into a teaching university. Haldane was justified in his proud boast. Politically, the subject was thorny; the supporters of the old system of impartial examinations exercised powerful political influence; and the proposed scheme of re-constitution bore many of the scars of compromise. Unless some politician of strength and honesty of purpose had espoused the cause, we can well believe that the reform would never have been accomplished. The tragedy was that Haldane so soon showed a sort of Red Queen animosity towards his own offspring. We must await the publication of further biographies and autobiographies before this mystery is fully explained.

An interesting chapter in the history of higher education relates to the breaking-up of the old Victoria University, the federal university seated at Manchester. In this important development, Haldane took an active part. Birmingham, under the influence of Joseph Chamberlain, had established the first civic university in 1900. Soon afterwards, Liverpool petitioned for a separate university. "Manchester somewhat half-heartedly supported the prayer of Liverpool, but Leeds strongly opposed it, and was backed by a number of persons who were eminent in the field of higher education in those days." The hearing of the petition by a Committee of the Privy Council lasted three days. Haldane was precluded from acting as counsel for Liverpool, as he had been appointed a member of the Privy Council a short time before the hearing; but he was able to plead the cause as a witness. His arguments for civic and educational personality were accepted. The Committee recommended the grant of university charters to Liverpool and Manchester, and the grant of a charter to the University of Leeds followed a year later. Haldane remarks with truth: "It has always seemed to me that the decision of the Government as advised by the Privy Council in 1903 was a step of the first importance in the history of higher education." But, as he says, little notice was taken of the matter at the time by the public or by writers about English education.

The decision gave a deathblow to the federal idea in higher education in its application to our great cities and started the growth to full university stature of institutions such as the Universities of Sheffield (chartered in 1905), Bristol (1909), of which Haldane was the first Chancellor, and Reading (1926). Several university colleges are in the later stages of adolescence, including those at Nottingham, Exeter, Hull, Southampton. No one would now be found to question the wisdom of the policy advocated by Haldane in this matter.

Haldane's work in the promotion of science and technology at South Kensington is well known. The entry in the index under the author's name states summarily—"Founds the Imperial College of Science and Technology." King Edward VII. inspired this great development in a spirit of filial piety, and Haldane was brought into close personal touch with his Sovereign. Haldane's original scheme of a 'London Charlottenburg' suffered a sea-change. No doubt he was offered a surfeit of 'expert' advice. Curiously, Haldane's investigations in Germany had impressed him unfavourably with the separation existing there between the universities and the technical colleges, and he tells us he decided to press for the application of a different principle in London. "The new college was to be fashioned so as to be brought as quickly as possible into a re-constituted University of London." There must be some lapse of memory here, for, in the letter which Lord Rosebery as Chancellor of the University of London addressed to the London County Council in 1903 to explain the Charlottenburg scheme—the letter, we may safely presume, was drafted by Haldane—there was no reference to the question of re-constituting the University and this issue did not arise until some years later. Lord Rosebery, indeed, expressed the hope that it might be possible to follow up the Charlottenburg scheme "by taking further steps towards developing the University in such a fashion as to make it worthy to be the University of the metropolis of the Empire"—but the reference here is obviously to other educational rather than to constitutional developments.

Exasperating delays occurred and an unhappy controversy arose as to the relations of the Imperial College with the University, a controversy which has not yet been brought to a final conclusion. It led directly to the appointment of the abortive Royal Commission on University Education in London over which Haldane presided. The autobiography does not indicate that Haldane derived much satisfaction from his attempt to re-constitute the University for a second time. He is singularly reticent on the whole subject. Nevertheless, he lived long enough to see the last stages of a re-constitution of the University which, the friends of the University hope, will remove some of the defects of the earlier compromise; and he must have watched with pleasure the recent purchase of the Blooms-

bury site by the University, aided by the Rockefeller Foundation, a site he had ineffectively recommended so long ago as 1912 for the great Imperial university he wished to see established in London.

Was science able to offer any return for all this effort and goodwill? We learn with pleasure from the autobiography that Haldane benefited from a great discovery in a university laboratory. He was a sufferer from diabetes and was treated in the first attack by a rigid diet, "the only palliative known in those pre-insulin days." Banting's discovery came at a happy moment, for Haldane would not have been able to count on good health without the discovery of insulin. He arranged to have an injection in his arm every morning, and this served admirably, he tells us, taking the place of the pancreatic secretion of the 'Islands of Langerhans.' Thus was prolonged a life which had rendered great services to the cause of science and had sounded the full gamut of human thought, emotion, and—may we not add, notwithstanding autobiographical diffidence—success, achievement.

T. LL. H.

A Neglected Genius.

The Collected Scientific Papers of John James Waterston. Edited, with a Biography, by Dr. J. S. Haldane. Pp. lxviii + 709 + 5 plates. (Edinburgh and London: Oliver and Boyd, 1928.) 25*s.* net.

IN 1892 the late Lord Rayleigh rescued from oblivion in the archives of the Royal Society a remarkable paper by John James Waterston which had been written in 1845 but had failed to obtain the approval of the Society, and had, therefore, not been printed in the *Proceedings*. So completely has his work been ignored that it will probably come as a surprise to the majority that his writings (published and hitherto unpublished), which have been collected and published by Dr. J. S. Haldane, extend to more than seven hundred pages.

Lord Rayleigh did ample justice to the 1845 paper on the physics of media that consist of perfectly elastic molecules in a state of motion. Concerning it he wrote: "What strikes one most is the marvellous courage with which he attacked questions, some of which even now present serious difficulties. . . . Waterston was the first to introduce into the theory the conception that heat and temperature are to be measured by *vis viva*. . . . In the second section the great feature is the statement that in mixed media the mean square molecular velocity is inversely proportional to the specific weight of the molecules. The proof which Waterston gave is doubtless not satisfactory, but the same may be said of that advanced by Maxwell fifteen years later." Boyle's law, Charles's law, Avogadro's law, and Graham's law of diffusion were all placed on a dynamical footing in this paper. The causes which contributed to it being denied publication in 1845 are difficult to find. At the present time it suffers from having been superseded in style and argument by the work of successors. When written, it apparently suffered from being in advance of its time. Joule's work on the dynamical nature of heat had been in part published, but the theory of conservation of energy was not authoritatively accepted until about six years later. Even so late as 1848, Thomson (Lord Kelvin) wrote: "The conversion of heat (or caloric) into mechanical effect is probably impossible, certainly undiscovered. In actual engines for obtaining mechanical effect through the agency of heat, we must consequently look for the source of power, not on any absorption and conversion, but merely in a transmission of heat."

Who was the man whose scientific insight drew from Lord Rayleigh such high praise? In answer, Dr. Haldane prefaces his collection by a short biography. His grandfather was founder of an important (still existing) firm of manufacturers of sealing-wax and other stationery; his grandmother was a niece of Robert Sandeman, a well-known religious leader and founder of the body known as Sandemanians—to which Michael Faraday and his blacksmith father belonged—and sister of George Sandeman, who was founder of the well-known firm of port wine merchants.

Waterston himself went from school to the University of Edinburgh and studied mathematics and physics under Sir John Leslie, and was medallist of his year in Leslie's class. He also attended lectures on anatomy and surgery—probably drawn to these subjects by his father's and his own interest in phrenology. His first published paper was written in his student days when he was nineteen years of age (*Phil. Mag.*, 1831). It was an attempt to explain gravitation on dynamical principles. It is interesting, because in it there is the germ of the ideas which he developed afterwards in his more important paper. No further publication occurred until 1843, when an anonymous volume appeared entitled "Thoughts on Mental Functions." Here he sought to study metaphysics as a branch of the physiology of the nervous system. Dr. Haldane remarks: "The book is a very acute essay, far ahead of its time. . . . The idea which guided him

was that human behaviour can only express itself in material changes which must, in so far as they are intelligible, be dependent on previous material changes."

In the interim Waterston had become a pupil of James Walker, F.R.S., a leading civil engineer and president of the Institution of Civil Engineers, and was employed in connexion with the rapidly developing railway system of England. He contributed to the Institution a paper on a graphical method of estimating the earthwork in embankments and cuttings. He felt, however, that his heart was in pure science and he obtained a post in the Hydrographer's Department of the Admiralty under Captain (afterwards Admiral) Beaufort, who encouraged his scientific ambitions, and later obtained for him the post of naval instructor at Bombay to the East India Company Cadets. He held the post, except for a brief period, until 1857, when he returned to Edinburgh, where after some changes he ultimately settled down and remained until his death in 1883.

Various papers were submitted by Waterston to different societies and not all of them were accepted; this seems to have embittered him. His brother wrote of him: "He showed a restlessness and dislike at the mention of scientific men, except Faraday, and he used very strong language in respect to some who bulk largely in public estimation." Dr. Haldane surmises that his real antagonism did not arise from the non-publication of his papers, but that he was critical of the leading physicists of his time, especially in regard to their thermodynamic reasoning. The chief support brought forward for this surmise is the mention in his will of an unpublished manuscript; but as this manuscript was never found, it is rather idle to speculate as to what the subject matter of it might have been. The reviewer finds it very difficult to follow Dr. Haldane's argument in the pages he devotes to this question. Quite certainly there is nothing in Waterston's published writings to justify attributing to him the views which his biographer puts forward.

It is unnecessary to dwell on this aspect of Waterston's life. He succeeded in getting papers published after his return, and there are many interesting questions dealt with by him. In 1858 (*Phil. Mag.*) he describes experiments on capillarity. The argument he kept in view is that if the capillarity of a liquid is the exhibition of part of the cohesive force of the superficial stratum of molecules, numerical relations with the latent heat of its vapour ought to be demonstrable. The paper needs to be translated into modern language, but it is sound in idea. It may be recalled that Dupré later (1886) developed a similar question, and in recent years E. T. Whittaker has displayed the close parallelism that exists between surface *energy* and the internal latent heat of evaporation. Waterston made a large number of experiments to bring out the connexion, and he deduced, for example, $1{\cdot}45 \times 10^8$ as the number of layers of molecules in one inch in the case of liquid alcohol.

Again, Waterston describes a number of experiments on the transition (that is, critical) point of liquids in sealed tubes after the manner of Cagniard de la Tour. The tubes were filled to different amounts with the same liquid, and he found the densities of the liquid and vapour when the liquid state terminates. He found that the cup shape of the upper surface of the liquid, caused by its capillarity, ceased at a temperature considerably under the point of transition and while the densities of liquid and vapour were very different. These observations suggest Prof. Callendar's recent experiments on steam (*Proc. Roy. Soc.*, Sept. 1928), where about six degrees' interval is found between the two temperatures—the meniscus disappearing when the density of the vapour is only 0·6 of that of the liquid. Waterston further claims to have observed that between these temperatures the surface became of 'a sugar-loaf aspect,' that is, convex upwards. He argues from the data that the rate at which the latent heat diminishes with rise in temperature must augment with the temperature, otherwise the critical point would be much higher than it is. He observes that Regnault's curve for the latent heat of steam is discontinuous at 100° C.; this is now a well-recognised fact.

Waterston put forward views on chemistry of which Prof. McLeod has said that they "shadow forth many of the ideas of modern chemistry which have been adopted since 1845."

Altogether, from the historical point of view, it is a good thing that Dr. Haldane has done in editing these papers. Crude they may seem to-day in many respects; but "nothing awakes on its hundredth year without both looking (and feeling) queer"; and it is almost a century since Waterston's first paper appeared. What he did, he achieved by very simple means, and modern progress has demonstrated that often elaborate means are essential: so that his work was really pioneer work. We may sum up by again quoting Lord Rayleigh: "To say that he was not always successful is only to deny his claim [not made by himself] to rank among the very foremost theorists of all ages."

A Biologist as Ethnologist.

L'Industrie des pêches au Cameroun. Par Dr. Théodore Monod. (Commissariat de la République Française au Cameroun, Mission Monod (1925–1926): Première partie, Généralités.) Pp. 509+25 planches. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1928.) 90 francs.

RENAISSANCE of interest and pride in their colonial possessions are outstanding and most satisfactory features among the French of to-day. Prior to the War few Frenchmen went abroad, apart from Algeria, as colonists and planters, and, with some brilliant exceptions, the officials sent overseas were men of inferior quality, of whom their political party or their departmental chiefs were anxious to be quit. Their salaries were often mere pittances, and their numbers, judged by the British standard, out of all proportion to real requirements; the sum total of their salaries was frequently excessive as compared with the revenue of their particular colony and a distinct impediment to development and progress. Bureaucracy strangled enterprise even among their own countrymen, and French colonial administration was a synonym for inefficiency and red-tape.

To-day much of this is changed. A superior class of official is in evidence; better-class families in France no longer frown upon a colonial life as a career for their more adventurous sons. The Colonial Administration at headquarters is correspondingly enlightened and has had the wisdom to obtain the co-operation of the scientific staff of the National Museum of Natural History in their efforts to develop colonial resources. The outcome has been the establishment of the Laboratoire des Pêches et Productions Coloniales, under the able direction of Prof. A. Gruvel; nothing quite comparable with this very useful institution exists in Britain, though by one means or another the needs of the British colonies in this respect do get fairly well met through the willing co-operation of various scientific and technical institutions.

So far as British West African colonies are concerned, no work has been published comparable with the fine monograph by Dr. Théodore Monod upon the fishing industry of the Cameroons, of which the first volume has recently appeared. A bulky tome, it gives in great detail a vast mass of information, technical, ethnological, and linguistic, touching the existing fisheries of the various hydrographic regions into which the territory is divided—the coastal, the riverine, and the lacustrine. The present volume deals mainly with the technical and economic aspects; the next will contain the systematic reports of specialists upon the scientific collections made during the various tours. The investigation carried out by M. Monod, the delegate of the Colonial Fishery Laboratory, lasted rather less than one year; the results reflect the greatest credit on his energy; their presentation is on the whole admirable, but suffers, alas! from the absence of any index or detailed table of contents. Comparative references in consequence are made with difficulty, and the trouble is accentuated by lack of sufficient correlation between the text and the numerous illustrative line figures, charts, and diagrams.

The facts recorded are probably of even greater value and interest to the ethnologist than to the fishery expert, and the lack of index is a serious handicap when comparing the methods and appliances of the various tribes. The extraordinary variety of the fishing devices in daily use and the complexity of several reveal the intellect of certain tribes as much more versatile and adaptative than is generally credited. The ingenuity shown is often surprising; perhaps even more remarkable is the parallelism between many of the more specialised of these methods with those in India. It is needless to particularise. Practically every device from the simplest to the most complex employed on the rivers and lakes of this part of Africa has its counterpart under similar conditions in India. M. Monod appears not to appreciate this; he envisages the *local* evolution of such a complicated engine as the great balanced dip-net (*zemi*) worked from large canoes by the Kotokos, from the triangular hand-net used for dipping out prawns and small fish, a conclusion which does not take account of the presence of the counterparts of this *zemi* on the Ganges. Complex devices are seldom evolved separately; through cultural contact they are passed from people to people, and the facts recorded in this volume support the view of the close relationship of certain of the pre-Aryan peoples of India with the Hamites of Arabia and Africa, through whom part of the common material culture has filtered to the Bantus and to a slight extent even to the Sudanese negroes.

Such ethnic problems are, however, of academic interest; another aspect of local ethnography has extreme practical importance, and ethnography is inextricably mixed up in the fishery problems of the Cameroons. Certain tribes have neither aptitude nor inclination to utilise the fishery

resources of their tribal territories; others are extremely skilful and resourceful in fishing and make the most of their opportunities. But prejudice and tribal ties restrict their operations to a definite area, and many stretches of fecund waters are neglected for want of a population interested and adept in fishing. Natural indolence is another factor in limiting fishing in many localities to a minimum; there, the people fish only when they feel inclined for a change of occupation. No real or professional fishing exists among such people, whose attitude is typified by the remark of a Duala—"This fish-work live for kill man, Massa."

The author's conclusions do not encourage the hope of the successful establishment of any extensive fishing enterprise undertaken by Europeans, except perhaps in deep-water trawling, about which data are too inadequate to permit of a definite verdict. Here, by the way, M. Monod has been misinformed in regard to trawling off the Sierra Leone coast (footnote on p. 33); in 1912 a steam trawler worked very successfully off this coast, but the enterprise ended in failure through mismanagement and boycott by the market people.

The present methods of the indigenous population are usually well adapted to local conditions, and it is rather initiative and application that require to be fostered than the introduction of new appliances. Where improvement is most desirable is in the curing of the product. As is usual in West Africa, the ordinary cure is a combination of desiccation by artificial and intense heat with concurrent smoking. Little was done to investigate the lines on which improvement may be effected; M. Monod is a biologist who worked single-handed on an inquiry of extremely wide scope, and it is obvious that this industrial phase of the subject should be taken in hand by one who, besides possessing intimate acquaintance with curing methods, has had a scientific education as a bio-chemist. JAMES HORNELL.

Detection of Poisons.

Laboratory Manual for the Detection of Poisons and Powerful Drugs. By Prof. Dr. Wilhelm Autenrieth. Authorised translation by Prof. William H. Warren. Sixth American edition from the fifth German edition, completely revised with extensive Additions. Pp. xxvi + 698. (London: J. and A. Churchill, 1928.) 30*s*. net.

TOXICOLOGY is admittedly one of the most difficult subjects to handle adequately. The student is faced with three serious obstacles: toxicology requires a considerable period of uninterrupted study, a period which he can seldom afford; the necessary laboratory facilities are not easily found; and finally, after mastering the principles of his art, he is rarely fortunate enough to come across sufficient opportunities of practising them. In the East, of course, where from time immemorial the professional poisoner has been rivalled by the gifted amateur, there is no lack of scope for the toxicologist, both in his chemical and also in his forensic capacity.

Autenrieth's well-known manual, now appearing in English as the sixth American edition, suffers somewhat from the failure of the translator to bring it completely up-to-date. The author gives general methods of handling cases, wisely stressing the impossibility of conducting a toxicological examination on any fixed plan, and rightly indicating that all details connected with the case, such as the medical history—especially a list of all drugs administered—and the results of the post-mortem examination, should be given full consideration. The method of examination to be adopted depends in many cases upon the toxicologist's experience.

The reviewer believes that the book would have been rendered still more useful by including a really comprehensive summary of recent work published in the technical press, with fuller references to that done elsewhere than in Germany. The following detailed criticism is offered in support of this belief: Under the head of prussic acid poisoning, no mention is made of the delayed form caused by eating cyanogenetic glucosides. The symptoms and post-mortem appearances are very puzzling until the cause is recognised.

Poisoning due to the absorption of nitrobenzene from shoe polishes has been mistaken, clinically, for poisoning by prussic acid, and might be mentioned under the appropriate head. Death from drinking formalin may take place in *less* than three hours. The reviewer saw one case where a man swallowed one ounce of so-called '40 per cent formalin' and died in about twenty minutes. The stomach resembled a tough fibrous mass the size of a cricket-ball.

It is somewhat surprising that in a book revised by an American so little is mentioned about the toxic effects of methyl alcohol, and that only German references are given. Under the head of picric acid, surely some of the information available since the War on this substance and dinitrophenol might have been incorporated.

The one-sided nature of the references is illus-

trated by the fact that the Crippen case is not even mentioned under the mydriatic alkaloids group, and the method described in the text of identifying cocaine by the potassium permanganate test is quite useless when really small quantities have to be identified. Hankin's modification of the test, published in 1911, is not mentioned, although it is extraordinarily delicate. The reviewer has used it for years and cannot speak too highly of it. The methods of detecting and estimating arsenic might be condensed with great advantage, and the section on the toxicology of lead would be more valuable if adequate references were given to the enormous literature of the subject. Lead tetraethyl is not even mentioned; in fact, the section dealing with metallic poisons is very unsatisfactory.

The treatment is quite inadequate elsewhere, as illustrated by the section on boric acid as a food preservative, the only reference being to a dissertation published in Munich in 1883: as so much of the valuable work on this subject was done in America, it is quite extraordinary that, in an American translation, no mention is made of Dr. Harvey W. Wiley. In like manner the section on carbon monoxide poisoning might have been written twenty years ago. Surely references might have been made to the large amount of recent work.

Another example is that of aconitine, the treatment of which is not up-to-date, the well-known test for which, first described by the late Sir Thomas Stevenson, is ascribed to Führer in 1911! The comparison of frog heart tracings on a kymograph is not described. No mention is made of the identity of yohimbine and quebrachine, and the importance of detecting oxydimorphine in certain cases of suspected morphine poisoning is neglected. The section on blood stains and the detection of human blood suffers from the same defects, and requires extensive re-writing. The amazing statement is made that "if the blood stain is perfectly fresh, it may be recognised by observing blood corpuscles with the microscope. Human blood may be differentiated from animal blood by comparing blood corpuscles with those of animal blood as to size, only when the corpuscles are still intact." Further on, however, the biological detection of human blood is dealt with, although in a most inadequate manner, no mention being made of Nuttall, or of Dale's anaphylaxis method.

The index is poor, and the apparatus described is in most cases archaic. The printing is very good, but the binding is not strong enough to withstand the amount of handling such a book would receive as a constant laboratory companion. K. C. B.

Our Bookshelf.

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicine, etc. Vol. 6: *Colorimetry, Dyes and Colouring Matters, the Synthetic Dyestuffs, and the Analysis of Colouring Matters.* By the Editors and the following Contributors: W. A. Gallup, Hans Edward Fierz-David, A. W. Joyce, and V. E. Yarsley. Fifth edition, revised and in part rewritten. Editors: Samuel S. Sadtler, Dr. Elbert C. Lathrop, C. Ainsworth Mitchell. Pp. ix+658. (London: J. and A. Churchill, 1928.) 30*s.* net.

THE seventh volume of this work is considerably different from the corresponding volume in the previous edition. Such subjects as tannin, natural colouring matters, and inks, which were included with synthetic dyestuffs in the old edition, have already been dealt with in Vol. 5 of the new edition. The new book, therefore, is confined practically to an exhaustive study of the preparation, structure, and analysis of synthetic dyestuffs. In addition, there is, however, a small well-written section on colorimetry, which might with advantage have been considered in the same volume with other physico-chemical determinations.

The largest section of the work consists of an article on dyes and colouring matters, in which dyes are classified on chemical lines on the method of Schultz's "Farbstofftabellen" and of the "Colour Index." Importance is placed on absorption spectra as the quickest method of identifying a particular compound. Synthetic dyestuffs, the next largest section, are concerned with the constitution of various dyes by their reduction products. The remaining chapters deal briefly with the analysis of colouring matter on the lines of A. G. Green's "Analysis of Dyestuffs," which the authors use as the main source of reference.

The editors have been careful to prevent much overlapping, especially in the closely connected second and third sections, and the work as a whole is well up to the standard of the previous edition. There is, however, a slight tendency for it to take the character of a book on special branches of organic chemistry for the specialists, rather than a book of commercial organic analysis of particular value to the analyst. The general production of the present volume, both with regard to printing and paper, is excellent, and comparatively few misprints have been noticed. J. REILLY.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 266. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 8. *Die Methoden der Erdbebenforschung.* Von Friedrich Errulat. Pp. 2151-2262. (Berlin und Wien: Urban und Schwarzenberg, 1928.) 6 gold marks.

THE first work in which the modes of investigating a great earthquake were described was Robert Mallet's report in two large volumes on the

Neapolitan earthquake of 1857 (published in 1862). Since then, though methods of studying perceptible earthquakes have been given in various papers, there has been a great want of a more complete treatment of the subject, such as is attempted in this part of Abderhalden's "Handbuch." About two-thirds of it is devoted to microseismic methods, to descriptions of the various instruments employed, and to the interpretation of seismograms. Two useful diagrams (on pp. 2156-57) illustrate the advantage of damping, one showing the similarity of the records of the same earthquake by two damped pendulums (Wiechart and Mainka), the other giving records of the same earthquake by undamped and damped pendulums.

The next section, on the investigation of perceptible earthquakes, is slighter than the other. The author quotes Sieberg's list of questions, the Sieberg and Mercalli-Cancani scales of intensity, and the Sieberg scale of sound-intensity. The questions seem too numerous for general use, the Sieberg scale of intensity contains too many tests for each degree, leading to the irregular construction of isoseismal lines, while a scale of sound-intensity depends on a very variable instrument—the human ear—and can only be of service when the number of observations is very large. In the remaining sections are described very briefly the investigation of submarine earthquakes, of the causes of earthquakes and related subjects (such as periodicity), of the geographical distribution of earthquakes, of microseismic motions, and of the methods of applied seismology. If, in parts, the treatment is somewhat scanty, this is a defect that may easily be remedied in a later edition of a very useful work. C. D.

Buried Treasures of Chinese Turkestan: an Account of the Activities and Adventures of the second and third German Turfan Expeditions. By Prof. Albert von Le Coq. Translated by Anna Barwell. Pp. 180+52 plates. (London: George Allen and Unwin, Ltd., 1928.) 18*s.* net.

PROF. A. VON LE COQ gives a vivid account of two expeditions to Eastern Turkestan on an archæological mission from the Berlin Ethnological Museum. After giving a historical survey, the labours and excitements of the expeditions are narrated, and incidentally there are ethnographical observations and descriptions of archæological remains. At one place the expedition arrived too late to save some remarkable Sassanian-Hellenistic paintings, and cartloads of Manichæan manuscripts had been thrown into the river by peasants; as paintings of persons are an abomination to Moslems, they are usually destroyed whenever found. Another library of priceless manuscripts had been destroyed in the course of time by water. Though there were frequent disappointments, various sites offered a rich harvest of frescoes and other objects which can now be seen in Berlin.

The narrative is illustrated by beautiful photographs of scenery, people, monasteries, rock-temples, and the like, and especially of Hellenistic statuary and wonderful frescoes. A reader desiring more detailed information than the somewhat slight amount supplied in this book is referred to the large number of publications which are mentioned in an appendix.

The Great Chemists. By Dr. Eric John Holmyard. (The Great Scientists Series.) Pp. vi + 138. (London: Methuen and Co., Ltd., 1928.) 3*s.* 6*d.* net.

THIS interesting work is essentially a short history of chemistry, written in a very attractive and informative manner. Dr. Holmyard has shown great skill in weaving the story of the 'Divine Art' about the lives and works of outstanding alchymists, chymists, and chemists, as he follows his pleasant path down the ages from ancient times to the present day. Each of the 'great chemists' is chosen as typical of his period, and the names are: Jabir, Razi and Ibn Sina, Roger Bacon, Paracelsus, Boyle, Stahl, Priestley, Lavoisier, Dalton, Avogadro, Davy, Liebig, Kekulé, Pasteur, Arrhenius, Mendeléeff, and Ramsay. Few readers are likely to cavil at this selection, which manifestly fulfils the author's purpose of imparting a sense of historical continuity to his narrative. It is interesting to notice in passing that the list includes five Englishmen and one Scotsman. As would be expected, other names are to be found in the text: the index refers to more than thirty workers in the cause of chemistry, the most notable absentees which occur to us being the enigmatical Basil Valentine and that potential Lavoisier of the seventeenth century—John Mayow. The authoritative chapter on Jabir is to be particularly commended. J. R.

Elements of Optics. By Prof. Joseph Valasek. (General College Physics.) Pp. xiii+215. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 10*s.* net.

THIS is an attractive little book on 'light' which would form a good introduction to the subject for those who will not be concerned with technical applications of geometrical optics. The sign convention employed by the author would be very confusing in the treatment of any problems but those of thin lenses, and no attempt is made to discuss more complex optical systems on Gaussian lines, except for a short paragraph on thick lenses. The discussion of aberrations is limited to brief notes on spherical aberration, chromatic aberration, and astigmatism in their geometrical aspects.

Apart from these deficiencies, the chapters on physical optics are well written, and the sections on colour, radiation, double refraction, and the like, bring the older material into co-ordination with modern ideas. The mathematics used is confined to elementary algebra and trigonometry.

In a book on optics which discusses quanta and spectral series, etc., it is a little surprising that some of the results of the electromagnetic theory should not be used to discuss such topics as reflection. Material of this kind should replace the interesting but unnecessary account of 'relativity.'

Letters to the Editor.

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

Spectrographic Chemical Analysis.

METHODS devised for the spectrographic analysis of mineral substances were described and results given by the late Prof. Sir W. N. Hartley and myself in a series of papers published in the period 1897–1901 (*Trans. Chem. Soc.*, **71**, 583; 1897, and elsewhere). Those methods, however, do not appear to have been utilised by any other workers except one, the late M. A. de Gramont.

In the simplest method then described, a weighed quantity, up to half a gram, of the powdered mineral (the exact weight depends on the type of spectrograph and the type of mineral) was tightly rolled in one half of an ashless filter paper and the roll burnt in an oxy-hydrogen or oxy-coal gas flame before the slit of a quartz spectrograph, a quartz lens being used to focus the image of the flame on the slit. The elements which may be detected by this method when present in small quantities are: All the alkalis, copper, silver, magnesium, calcium, strontium, barium, gallium, indium, thallium, lead, chromium, manganese, iron, cobalt, nickel, palladium, ruthenium, rhodium, phosphorus, bismuth, and iridium. Other elements which may be detected when larger quantities are present are: Gold, beryllium, zinc, cadmium, boron, aluminium, yttrium, tin, arsenic, antimony, sulphur, selenium, tellurium, etc.

The list, however, may be extended by placing the poles of an arc lamp horizontally in the flame, a little higher than the point at which the roll of filter paper is being burnt, and adjusted so that the image of the arc is focused on the slit. The delicacy of the test is greatly increased on striking the arc, and, in addition, elements such as titanium, molybdenum, and tungsten, etc., give lines instead of only a continuous spectrum. Experiments so far made indicate that this is a promising field for investigation.

The spectrograph used by me since 1913 is a Size C Hilger quartz spectrograph (purchased with a grant from the Royal Society Government Grant Fund) and it gives very satisfactory results. The photographic plates generally used have been Ilford panchromatic coated on thin glass. Plates 5 in. × 4 in., suitably placed in the holder, cover the region required in most work, namely, from the red to beyond λ2800, that is, when no arc is used. The filter papers recommended are Munktell's Swedish, No. 00, diameter 12·5 cm. This spectrograph and method have been used, qualitatively and quantitatively, in the analysis of flue dusts containing gallium and in extracting gallium from flue dust. It is seldom necessary to take more than 0·1 gm., and smaller quantities usually suffice.

The method has also been applied to the analysis of vegetable and animal substances. In examining vegetable material, the twig, straw, leaf, or other part is held by forceps and burnt in the flame without introducing any impurity, even in the form of ashless filter paper. By taking weighed quantities, usually 0·1-0·25 gm., the quantities of the mineral constituents can be compared, as, for example, in plants grown in different soils, etc., or in plants such as wheat at different stages of growth, or before and after watering with mineral salts. Many interesting results have been obtained in this way.

As an example: it has been established that rubidium is very widely distributed in soils and in the plants grown on them. Further, the growing point of cereals is relatively richer in rubidium, as compared with potassium, than the other parts of the plant. It is possible that rubidium is more freely absorbed than potassium, as potassium seems to be more freely absorbed than sodium, but it seems more probable that potassium and rubidium pass up in the sap with equal freedom and that the potassium diffuses or transfuses more readily away from the growing point.

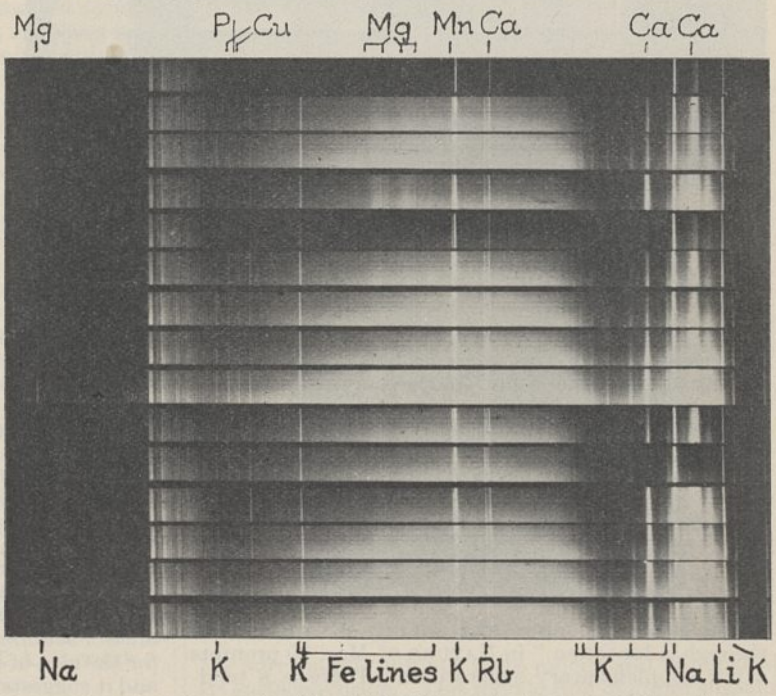

FIG. 1.—Stem of wheat grown in soil to which lithium, potassium, and rubidium salts were added. Top four spectra: leaves; next four: sheaths; next three: grain, stem, and chaff of ear; last four: straw sections. The first of each set of four was the oldest and the others follow in order of age. Cut when the ear was nearly half filled.

Animal matter, or soft vegetable substances, may be examined by rolling 0·5 gm. in ashless filter paper, but it is better in most cases to dry them in a steam oven and to take 0·05 gm. of the powdered dry residue in a smaller piece of filter paper. The various organs of an animal may easily be compared for mineral constituents in this way.

In some experiments a wheat straw with ear has been divided into eighteen parts: grain, leaves, sheaths, and sections of straw, and the eighteen spectra photographed on one plate so that comparison is easy and the record is permanent; the burning occupies twenty to twenty-five minutes.

During the recent vacation, experiments were made with measured quantities of blood, and it was found that the best results for comparison were obtained by taking 0·1 c.c. on ashless filter paper. Samples of

normal blood and two samples from anæmic patients, kindly supplied by Dr. G. P. Claridge of Norwich, were analysed and distinct differences were noted in the iron, calcium, magnesium, and potassium content. Further, the rubidium line λ4202 was present in the spectrum of the normal blood; rubidium, in fact, is present in most parts of the body, and it is present in both human milk and cow's milk.

It will be seen that there should be many applications for methods of spectrographic analysis on the lines described above. The spectra contain few lines as compared with arc or spark spectra, and the lines are easily identified in practice. The methods are worthy of more attention than they have received and they should be especially useful, and possibly prove indispensable, to those interested in the detection and distribution of the metals essential to life, and even of phosphorus, in the parts of plants and animals.

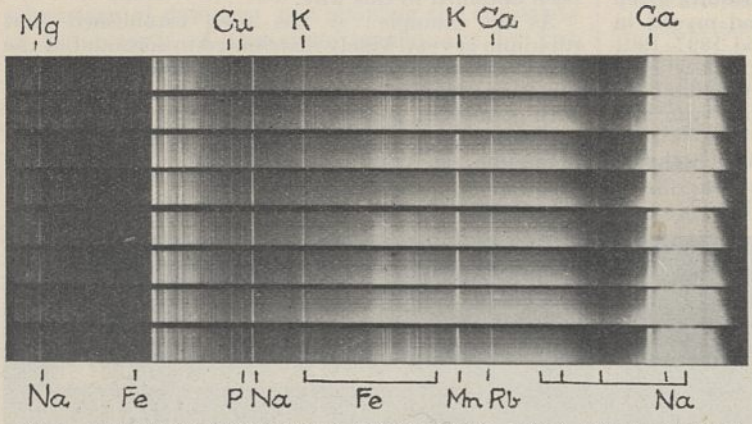

FIG. 2.—Parts of body, dried at 100° C., 0·05 gm. of each. 1 (top), cartilage, epiglottis; 2, spleen; 3, kidney; 4, lung; 5, abdominal muscle; 6, heart muscle; 7, brain; 8, liver.

HUGH RAMAGE.

Municipal Technical Institute,
Norwich.

Evolution through Adaptation.

DR. BATHER'S interesting survey of "Evolution through Adaptation" in NATURE of Mar. 30 prompts a few supplementary suggestions. There is a tendency in writing upon this subject to think of 'a variation' appearing in the soma under some stimulus which, if maintained for a sufficient number of generations, may produce in the germ a mutation in harmony with the variation in the soma. The concept of a mutation of the germ, arising in such a way as to harmonise with an alteration in the soma that has already appeared, is a concept which strains probabilities in many, though not necessarily in all, types of cases. Dr. Bather's illustration of an animal with defective pigment and sight skulking in dark corners, where alone it is likely to escape its enemies, is used by him to suggest selection of environment by organism, but it is also a reminder to come back to thought of the organism as a whole.

Experiment and observation have shown that considerable alterations in the balance of growth can be produced in a population through alteration in environmental influences. Such influences operate in Nature generally; we have clear evidences of secular variations of climate through the geological periods, and we know that, in spreading, a form of life encounters modified conditions as its range extends itself.

Observation and experiment further show that for various stocks there are 'fringing conditions' under which the individual can indeed live, and even, it may be, grow, but the race cannot reproduce itself, or can do so only very exceptionally. The sensitiveness of the reproductive process is a noteworthy fact.

If now we set these two points side by side, we may picture a 'marginal case.' Let us suppose that the changed conditions of the environment have induced changes of growth, but that the germs remain as before. These germs are presumably like all living things in that no two are alike. Some variations in them may be towards greater, and some towards lesser, viability in the altered environment. It will be from the former that the survivors will be bred. We thus think of a process of selection operating on the germs, and operating so as to eliminate, very probably, quite a large proportion of them. It is a selection not of a germ that has mutated so as to produce a change in harmony with some change that has appeared in the soma, but a selection of a germ viable in an altered environment. The plea here is one which to some extent supplements Dr. Bather's suggestions, or, for that matter, Prof. Lloyd Morgan's concept of organic selection, for it demands less in the matter of variation of the germ. It looks upon variation of the environment of a stock, whether because that stock spreads in space, or lasts through phases of climatic change, as in some sort the initial factor, and it suggests that the extra sensitiveness of the reproductive process, as compared with the other vital processes, is one of the main determinants of the viability of a stock in a fringing zone of distribution. It looks upon the germ as basic capital undergoing slow modification, less through the addition of particular mutations corresponding to changes already in the soma than through the selection under marginal conditions of viable variants.

These suggestions are in no way in opposition to Dr. Bather's, nor does the point of view here developed conflict with that of the advocates of organic selection. It merely attempts to supplement them by burrowing under the problem of the inheritance or non-inheritance of acquired characters. It leaves abundant room for the idea of evolution by germ-mutations and so on, and it suggests that growth changes may be essentially physiological responses, some of which may increase, others decrease, viability. It leads on to the suggestion that, as cumulative growth changes occur as responses to cumulative environmental change, and are themselves followed, at a long interval, by attunements of the germ which are attunements to environmental changes, the germ in the course of its evolution becomes more and more highly specialised the more and the more recent and the more rapid have been its attunements. Thus, if a new series of environmental changes should afterwards supervene, such a highly specialised organism would be less likely to be able to respond than would a less specialised form, a form which had had a longish record of relative evolutionary passivity.

H. J. FLEURE.

Aberystwyth.

PROF. FLEURE is careful to explain that his remarks are not in criticism of anything said by me; yet they seem intended to evade the difficulty that I have found in certain beliefs for which there does appear to be some evidence—the difficulty, namely, of understanding why and how a germinal mutant does appear sometimes to accord with a previous modification of the soma. Prof. Fleure says this "is a concept which

strains probabilities." Many biologists of no less distinction have regarded the concept as more than probable. It is by no means clear that such examples of the transmission of impressed characters as Prof. Przibram brought to our notice the other day fall within this concept: they seem to be instances of reversible modification. Among facts that do support the concept are those genetic analyses of populations adapted to a special environment which have shown that the adaptive characters of some individuals are due to somatic modifications, while those of others are inherent in the germ. Cuénot ("L'Adaptation," 1925) cites in illustration *Centaurea jacea*, forma *humilis*, in the Swedish salt-marshes; Gregor and Sansome (*Jour. Genetics*, **18**, p. 349; 1927) have traced a similar mixture of mutants and modifications in wild grasses. The bearing of these observations on adaptive evolution was discussed in my presidential address to the Geological Society (1928).

In the explanation of adaptation now put forward by Prof. Fleure it is not easy to detect anything more than the old Darwinian idea of indefinite continuous variation and selection of such forms as can live in the changed environment. Let the environment change ever so greatly, some of the germs will be able to persist; and so the line alters from species to species, and from genus to genus (or grade to grade), without any actual change in the germ. The original germ has in it the potentiality of all this development. If this is what Prof. Fleure means, surely he is basing his conclusions on a view long since discarded. It is generally agreed now that there are limits to fluctuation, just as there are to individual modification.

A palæontologist can produce no evidence for or against such a view; he is bound to consider the evidence of workers in other fields, and this, at present, indicates that change (mutation) does affect the germ, and that successive mutants, by however little they are distinguished, are actually discontinuous. Evolution is by quanta. Accepting this, the palæontologist applies it to the phenomena with which he is familiar, and his analysis, if carried far enough, will lead him to those questions to which my Royal Institution discourse attempted to suggest an answer. When Prof. Fleure writes of "attunements of the germ . . . to environmental changes," he merely states in metaphorical language a fact which—if it be a fact—demands an intelligible mechanism. F. A. BATHER.

Spiral Markings on Carborundum Crystals.

THE phenomenon described by Prof. A. W. C. Menzies and Mr. C. A. Sloat in NATURE for Mar. 9, p. 348, can, I think, be explained from some results I obtained in 1925 in connexion with the banded crystallisation of sulphur films.

The inside of a test-tube was covered with a film of molten sulphur by vigorously boiling some of the substance inside. The test-tube was then lightly plugged with cottonwool and allowed to stand upright. After the draining film had cooled almost to room-temperature in a few minutes, centres of crystallisation appeared at various points, and rings could be seen growing in succession outwards from the central points. The accompanying enlarged photograph (Fig. 1) of the test-tube shows the result.

I found that good rings were obtained in hard glass test-tubes, or soft glass which had been cleaned with concentrated sulphuric acid, but that only poorly developed rings could be got in ordinary soft glass test-tubes, particularly if alkali was present.

I also found that by counting the number of rings from a centre and measuring the distance also from the same centre occupied by these rings and then plotting the logarithm of the number against the logarithm of the distance, an excellent straight line was obtained in every case. In one experiment I counted 89 rings or parts of rings in one direction from the centre.

The general equation for these straight lines is

$$\log N = a \log r + \log K$$

where N = number of bands, r = distance, $\log K$ is the intercept on the axis of $\log N$, and a is the slope of the line to the axis of $\log r$. This gives

$$N = Kr^a$$

as the law of formation of the rings.

The explanation of the formation of the rings I had arrived at and considered satisfactory was that the first small crystal formation at the centre caused evolution of latent heat which consequently rendered

FIG. 1.

the surrounding sulphur more mobile and diminished its surface tension. This mobile ring of liquid sulphur was then drawn outwards away from the centre to form a circular ridge, which, however, very quickly crystallised with liberation of more latent heat and formation of another mobile ring, and so on. That the sulphur is drawn away from the centre by surface tension is clear from the photograph, because the centre is a depression, not an elevation. Also the flow can actually be witnessed by means of a lens during crystallisation.

It seems that the sulphur has to be in the labile state for these rings to form. If it is in the metastable state, then only large crystals grow slowly in the film. Some of these can be seen as irregular patches in the photograph.

I have measured the rings in the photomicrograph reproduced in Messrs. Menzies and Sloat's communication (*loc. cit.*), both in the direction west of the centre and in that N.N.W. of the centre, and find that the logarithm of number against logarithm of distance give beautifully straight lines. In the case of the latter direction (N.N.W.) a is very nearly unity and K 0·417 mm.$^{-a}$.

I would therefore suggest that the spiral formation observed by them has been produced in a similar manner to the sulphur rings described above. Further-

more, there appears to be no particular significance in the spiral nature of the markings. It may be noted that Hedges and Henley (*J.C.S.*, October, p. 2725; 1928), in connexion with their work on Liesegang rings, describe spiral formations as anomalies due to accidental external conditions.

WILLIAM HUGHES.

King Edward School,
Southampton.

A Principle of Duality and the Causal Law.

THE possibility of a causal space-time description of experience has recently been often denied, and emphasis has been laid upon the purely statistical validity of quantum-theoretical relations. This denial of a possible causal space-time description has aroused suspicions and diffidence in regard to the newer physics. The purpose of this note is to show that there is no need for the above denial and that we have not only one possibility of a causal space-time description of experience, but actually two of them. This superabundance of possibilities of description is the very reason, as we shall see presently, why some relations can have only statistical validity.

It is well known that light can be described either as a propagation of spherical electromagnetic waves or as the linear translation of corpuscles of energy and momentum (light-quanta); that electrons appear sometimes as point-charges and at other times as matter-waves; that the atom itself can be pictured, in the case of hydrogen, either as a planetary system of attracting particles (Bohr's theory) or as a system of stationary waves (De Broglie, Schrödinger). Furthermore, it is easy to show, as will be done more fully elsewhere, that the process of emission of light can be described either as the sudden spontaneous ejection of a light corpuscle, a finite time (*Verweilzeit*) after the excitation, or as the continuous radiation of a set of spherical damped waves beginning at the very moment of excitation, the inverse of the damping coefficient of which is equal to the extinction-time (*Abklingzeit*); that absorption can be interpreted either as the sudden jump of the molecule from one stationary state to another owing to the impact of a light quantum, or as a classical damped resonance of the molecule with the on-coming wave; that optical resonance appears either as sudden absorption with subsequent sudden emission after a time determined by a coefficient of 'spontaneous' transition or as continuous scattering (dispersion), in which the secondary radiation is coherent with the primary (Wood's experiment showing regular reflection of mercury vapour for $\lambda 2537$). Moreover, Schrödinger (*Ann. d. Phys.*, **82**, 257; 1927) has shown that the Compton effect can be described from the point of view of waves as well as of corpuscles, and Heisenberg (*Zs. f. Physik*, **40**, 501; 1926) has made clear that both points of view are equivalent in explaining the phenomena of fluctuation. Photo-effect and electron-collisions can also be described equally well from either viewpoint.

All of the examples given above show clearly that there are many physical phenomena which can be described in two ways, using either one of two essentially different systems of concepts and definitions. The two systems by no means complement each other; *they exclude each other*. Every attempt to superpose the two descriptions in order to reach a unified one leads necessarily to breaks in the laws of conservation of energy and momentum, as has been shown by the many unsuccessful attempts to describe light as energy-momentum centres moving along the Poynting's vector of a wave-field (virtual or probability waves).

Now it is easily seen that a space-time description is readily possible using either one of the two systems of concepts and definitions (waves or corpuscles) so long as we keep inside of one of them, and that in this case there is possibility of predicting the future of a physical aggregate, which is limited only in the case of a corpuscular description by the principle of indetermination of Heisenberg and Bohr. The classical claim of causality can be maintained in each system. In the corpuscular system we must realise that it is impossible to determine all of the initial conditions of a physical aggregate beyond a certain degree of accuracy. This limitation is unnecessary in a wave-description, since the principle of indetermination is superfluous in this case. The classical claim of causality is met here without restriction.

The causal space-time description of the whole of physics remains for the present only a programme, in spite of the dual possibility, owing to the fact that certain phenomena, like interference, can be described satisfactorily as yet from only one point of view. In an all-embracing quantum theory, therefore, it is necessary at present to make use of both systems of concepts at the same time and to jump from one to the other according to the exigencies of the case. At the instant of the jump, every possibility of a space-time description disappears, and the magnitudes calculated in one system can have only statistical validity in the other. This is the deeper reason for the purely statistical validity of some relations of quantum mechanics.

The breaks in the space-time description of experience are only a sign of the times, and we may hope in the near future to be enabled to make a causal description of physics in space and time, using a single set of concepts and definitions.

E. GAVIOLA.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Feb. 11.

Diffraction of X-rays by Two-dimensional Crystal Lattice.

IN usual experiments with diffraction of X-rays by crystals, an effect of space-lattice is always observed owing to the penetration of the rays into the depth of the crystal. The thin layers, however, in which one

FIG. 1.

could expect the appearance of diffraction by the two-dimensional lattice, scatter the rays too little, and therefore the experiment becomes impossible. The matter is different in a crystal cleft into very thin layers in such a manner that the orientation of separate layers is not destroyed. This may be well

done in mica simply by heating it to red heat and then cooling; but not so well by carefully crushing plates of other crystals. When a thin beam of X-rays passes through such a plate, the effect of two-dimensional lattices will be added, whereas the space effect will be destroyed by the incoherence of waves produced by scattering from incorrectly spaced layers.

On the photograph (Fig. 1) obtained by this method with Cu-radiation from mica, is seen a system of spectra corresponding to a series of two-dimensional lattices making different angles with each other.

From the measurement of these spectra the distribution of molecules in the layers of mica may be determined. All the spectra obtained may be explained by assuming that the molecules are distributed in the summits of equilateral triangles the sides of which are equal to 5·2 A.

The phenomenon is quite analogous to the diffraction of cathode rays from mica obtained by Kikuchi (*Japanese Journal of Physics*, vol. v. No. 2).

Somewhat more diffused photographs by the same method are obtained from gypsum and Iceland spar.

A photograph taken of a crystal before cleavage gives the usual Laue figure.

Owing to the facility of interpretation of the spectra of a two-dimensional lattice, this method may be of service in the study of crystal structure.

W. LINNIK.

Leningrad Optical Institute.

High Frequency Discharge in Gases.

FOR some time past we have been studying the problem of high frequency discharge through air and other gases. In the course of our investigation we found that whether the electrodes are of external metal sleeves or are of internally sealed aluminium wires, steady striations always appear in the tube under suitable experimental conditions. Recently

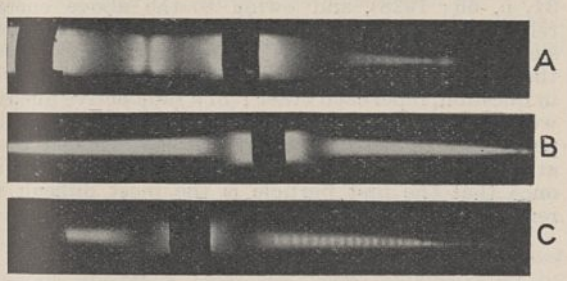

FIG. 1.

Heidemann (*Ann. d. Physik*, **85**, Nr. 6; 1928) and Dr. S. P. McCallum and Mr. W. T. Perry (NATURE, Jan. 12, 1929) have observed striated discharges in hydrogen and argon with external electrodes. The general nature of the striated discharges appears to be the same in all gases. Over and above what they have noted we have been able to observe certain new characteristic features of the discharges.

(1) There is a striking difference in the nature of striations with internal and external electrodes. Whereas with external electrodes the striations are generally of the nature of 'double-layers' (Heidemann and McCallum and Perry), with the internal electrodes they have always a comb-like appearance excepting at very low pressures.

(2) As the pressure is lowered the thickness of the striæ increases. At a still lower pressure the glow extends *beyond* the electrodes and striations can be observed in this region also (Fig. 1A).

(3) The same glow discharge can be obtained with only one external electrode. In this case the discharge is always of the form of two convergent beams with their apexes away from the electrode (Fig. 1B). The beams after converging, however, again begin to diverge from the apexes. It will be noticed that there are two very prominent dark spaces in the region beyond the electrode. Beginning from this the discharge generally passes into a uniform glow. But, with suitable pressure and power regulation the glow can be made to break up into striations (Fig. 1C). It will be seen from the photographs that these striations become more prominent as the distance from the electrode increases.

BHABESH CHANDRA MUKHERJEE.
ATUL KRISHNA CHATTERJI.

Wireless Laboratory,
University College of Science,
Calcutta, Feb. 21.

Magnetic Behaviour of Organic Crystals.

THE interesting observations of Sir William Bragg on the deportment of crystals of naphthalene in a magnetic field (NATURE, Supplement, May 7, 1927) have been followed up quantitatively in this laboratory, and some very significant results have been obtained. It is found that the diamagnetic anisotropy of naphthalene is extremely pronounced, the susceptibilities along the three magnetic axes of the crystal being approximately in the ratios 16 : 7 : 4. That such a high degree of anisotropy is to be expected in aromatic compounds is indicated by the data for magnetic birefringence in liquids, as had indeed been shown earlier (C. V. Raman and K. S. Krishnan, *Proc. Roy. Soc.*, A, vol. 113, p. 511; 1927). Mr. S. Bhagavantam, who made the measurements, finds that the axes of maximum diamagnetic susceptibility and of minimum optical dielectric constant in naphthalene crystals are approximately coincident. This observation explains why organic liquids derived from naphthalene, and indeed also aromatic liquids generally, exhibit a strong *positive* magnetic birefringence. We may further expect to find that in aromatic compounds generally, the magnetic and optical characters are linked together more or less in the same way as in naphthalene crystals.

The magnetic behaviour of organic crystals of the aliphatic group of compounds is different. Not only is the anisotropy, in general, less pronounced, but also the relation between the magnetic and optical characters is more varied. In some crystals, for example, iodoform, Mr. Bhagavantam finds the axes of maximum magnetic susceptibility and optical dielectric constant are parallel; while in others, for example, urea, they are crossed. These facts have a bearing on the explanation of the fact that liquids of the aliphatic class exhibit a magnetic birefringence which is usually much feebler than in aromatic liquids, and further that in some of them the magnetic birefringence is positive and in others negative. An extended series of measurements of magnetic birefringence in liquids of the aliphatic class is now being made by Mr. Ramanadham here, and is serving to elucidate the relationships between the optical and magnetic characters of organic compounds and their dependence on chemical constitution.

Since the position of the magnetic axes of a crystal depends on the orientation of the molecules in the unit cell of the lattice, it is clear that the studies of magnetic behaviour of organic compounds will form a powerful auxiliary to X-rays in the analysis of their crystal structure.

C. V. RAMAN.

210 Bowbazar Street,
Calcutta, India, Mar. 7.

Effect of X-rays on Seeds.

THE effect of X-rays on growth and development is a subject which has always caused considerable interest. It can be studied most easily in plants where cell division takes place so rapidly that daily growth can be observed.

We irradiated various kinds of seeds, chiefly broad beans, barley, and mustard, the effects on these forms being dissimilar although the conditions and the dosage were exactly alike. It would appear, therefore, that a specific dose is required. We used approximately three times the dose of X-rays which would cause the human skin to redden, at 120 kilovolts. In every case the seeds were covered with black paper to protect them as much as possible from the light and heat from the tube.

The broad beans gave the most rapid and striking results. Seeds which had been planted for different lengths of time, varying from one week to a few hours, and also dry seeds, were employed, an equal number of seeds in each case being used as controls. Stunting followed irradiation in all those which had been growing for more than 24 hours. The changes were not observable for some days (two or three) and were first seen in the oldest seeds, but beans which had been growing for 48 to 72 hours appeared to be most sensitive. In addition to being stunted the roots appeared to become slightly bulbous at the tip. In most cases the shoots appeared later than in the controls, but sometimes failed altogether. Side roots never appeared in the stunted X-rayed specimens.

In mustard seedlings the only detrimental result was the failure of the side roots to develop, and that only in the seeds which had been growing for more than 72 hours before they were irradiated. An extremely small dose (about $\frac{1}{20}$ of above) appeared to cause more rapid growth.

Little alteration was found in the roots of the barley, as in this plant the shoots were most radiosensitive and showed very much less growth than the controls.

RUTH E. P. PATTEN.
SYLVIA B. WIGODER.

The Department of Zoology,
Trinity College, Dublin,
Mar. 11.

Local Extinction of a Recently Abundant Lamellibranch.

THE Lamellibranch *Spisula subtruncata* (Da Costa) is reported in various old records as occurring abundantly in parts of the Clyde Sea Area. For example, in "The Mollusca of the Firth of Clyde," 1878, p. 33, A. Brown writes: "Exceedingly abundant a little above low water in Ettrick and St. Ninian's Bays, Bute; and in Fintry Bay, Cumbrae. It is common also all along the Ayrshire coast, and in most sandy bays throughout the district. In Cumbrae they are known as 'Aikens,' and are used both for food and bait." Further confirmation is found in the *Medusa* records and in the fauna and flora published for the British Association in 1901—records of almost thirty years age and older.

By contrast with these records of abundance one of us (R. E.) cannot recall ever having seen a living *S. subtruncata* in the course of twenty years. In recent years we have made a very careful search for this species in Cumbrae, Bute, and the Ayrshire coast, etc., without finding a single living specimen, although the shells occur in millions in Kames Bay, St. Ninian's Bay, and Hunterston sands.

Further, inquiries amongst fishermen reveal the facts that old men (70-80 years) immediately recognise *S. subtruncata* as 'Aikens,' and assert that they knew them and used them in youth and middle life, but "have not seen a single full one for thirty years or more." Similar evidence is got from younger men, until we reach men of 45 or so, who say they have never seen or used them although their fathers did.

In short, there is good evidence that *S. subtruncata* died out in this district about thirty-five to forty years ago. Type samples of the dead shells have been sent to the Royal Scottish and British Museums and the Fisheries Laboratory at Lowestoft.

RICHARD ELMHIRST.
A. C. STEPHEN.

Marine Station,
Millport.

Successive α-Transformations.

IT is well known that, in such parts of the radioactive transformation series as are not disturbed by β-emissions, the successive α-particles are shot out with ever-increasing energy. The paradox that, although the probability of emission increases so enormously with the energy, it is the slowest particles that first come out, has once again come to the fore now that wave mechanics has led to a theoretical connexion between energy and decay-period. It seems worth while to point out that this difficulty can be very simply explained if we assume that all the α-particles in question are originally in the same quantum state. For if N interacting particles have the total energy NE they will not each fly away with the energy E; it will depend on the nature of the forces acting between them whether the first ones take more than their share or less.

A simple example is provided by the helium atom; the removal of one electron involves binding the other closer, and the remaining electron has less energy than it had before the removal. If a helium atom is placed in an electrical field it has, according to wave mechanics, an intrinsic probability that it will become ionised (Oppenheimer, *Phys. Rev.*, **31**, p. 66; 1928), and owing to the above energy relation the second ionisation will take place more slowly than the first. In the helium atom we have the case that the particles in question, at the distances in question, repel each other; in a radioactive nucleus we have the opposite case. For by hypothesis the particles here are so close to one another that their attractions outweigh their repulsions; it follows at once that the first particle is the most difficult to remove.

G. GAMOW.

Institute for Theoretical Physics,
Copenhagen.

Astrophysical Estimate of Ionisation Potential of Vanadium.

IN a previous letter (NATURE, June 9, 1928) I outlined the method by which estimates of ionisation potentials might be derived from the spectra of Cepheid variables. Many of the lines emitted by ionised atoms are intensified at or near maximum luminosity phase and diminish in intensity as the star passes through the phase of minimum light. Many arc lines, on the other hand, show the reverse tendency. By comparing the behaviour of certain ionised lines with spark lines due to titanium, scandium, strontium, and barium, the ionisation potentials of which are known, it has been possible to estimate this constant for iron, yttrium, and lanthanum (loc. cit.), and quite recently for vanadium. From the periodic changes in intensity of the ionised line λ4205·07 I have obtained for the *ionisation potential of vanadium* 6·74 *volts*, the final figure being extremely uncertain.

In a recent letter from Dr. W. F. Meggers, Bureau of

Standards, Washington, I am reminded that Prof. H. N. Russell (*Ap. J.*, 66; 1927) has obtained the principal ionisation potential of vanadium from spectral series relations to be 6·76 volts. I am unaware of any laboratory determination of this quantity, but the close agreement between the spectroscopic and the present astrophysical determination is very satisfactory.

As before, I am under obligations to the Director of the Dominion Observatory, Ottawa, for the loan of the spectrograms from which my microphotometer graphs have been made.

A. VIBERT DOUGLAS.

McGill University,
Montreal, Feb. 28.

Raman Effect and Fluorescence.

SIMPLE probability considerations reveal an interesting relation between fluorescence and the modified scattering of light. If N_r, N_s, etc., be the number of systems in the energy levels of energy values E_r, E_s, etc., the induced probability of transition $E_s \longrightarrow E_r$ may be denoted by W_{sr}. If $E_s > E_r$, this causes the emission of a quantum $h\nu_{sr} = E_s - E_r$, which fuses into an external quantum $h\nu$, so as to form a new quantum $h(\nu + \nu_{sr})$, giving rise to negative or anti-Stokes lines. The total energy so radiated is $N_s \cdot W_{sr} \cdot h(\nu + \nu_{sr})$.

Similarly, the transition $E_r \longrightarrow E_s$ gives rise to the positive lines of frequency $\nu - \nu_{sr}$, and its total energy is $N_r \cdot W_{rs} \cdot h(\nu - \nu_{sr})$. As a result, the s^{th} level acquires a surplus number $(N_r - N_s)W_{rs}$ systems ($W_{rs} = W_{sr}$). We postulate that thermal agitation restores the normal distribution so that this surplus number reverts to the r^{th} level, emitting total energy $(N_r - N_s)W_{rs} \cdot h\nu_{rs}$, of frequency ν_{rs}. We identify this radiation with fluorescence. Of course it is in the infra-red, when the modified lines are visible. When ν_{rs} nearly equals ν, it will be shown with the help of Born's formulæ, in a paper appearing elsewhere, that the factor W_{rs}, since it involves a term $1/(\nu^2 - \nu_{rs}^2)$, becomes very large, so that the intensity of a fluorescent line (now visible) is much greater than a modified visible line, as is actually the case.

PAUCHANON DAS.

72 Srigopal Mallick Lane,
Calcutta, India, Feb. 28.

Indication of Hydroxyl in a Water Vapour Discharge Tube.

THE presence of OH in the gas coming from a water vapour discharge tube has been demonstrated by photographing the exit tube with a quartz spectrograph; the well-known band at 3060 A. was obtained. Addition of a small quantity of oxygen to the water vapour has the effect of increasing the intensity of the bands; a larger amount of oxygen causes the appearance of the green oxygen afterglow. This glow is continuous in the visible and is accompanied by the OH bands in the ultra-violet. The active gas appears to possess both reducing and oxidising properties. This is illustrated by the simultaneous reduction of copper sulphate to copper oxide and metallic copper and the oxidation of metallic silver. In both instances heat effects have been observed. The glow appears to be unaffected by the copper sulphate, but is removed by the silver. An extensive study of the conditions determining the production of OH, its separation from any other active constituents which may be present, and its chemical properties are now under way in this laboratory.

G. I. LAVIN.
FRANCIS B. STEWART.

Princeton, New Jersey, Mar. 15.

The Green Flash.

HERE at 700 feet above the sea the green flash at sunset may be seen whenever the horizon is clear of clouds. At times the air is so clear that the mountains of St. Vincent, 110 miles to the west, can be clearly seen at about the time of sunset. On such evenings Venus may be followed right down to the sea horizon when, as now, it is near its maximum brightness.

A few nights ago I watched the planet setting through a pair of field binoculars. About five minutes or so before it set there was a great deal of change of colour from red to peacock green, but it was quite evident that the red colour was on the whole below and the green above, showing that the image of Venus was being drawn out into a short spectrum. When the planet was very nearly on the horizon the colour changed several times from red to green and vice versa, but just as it disappeared the image was of a distinct peacock green.

This observation shows that the explanation of the green ray is physical (refraction) as now generally admitted, and not physiological, for the light from Venus was not nearly intense enough to produce an after-image.

C. J. P. CAVE.

St. Nicholas Abbey,
Barbados, Mar. 12.

African Pluvial Periods.

THE interesting remarks in the News and Views columns of NATURE for Mar. 16, with reference to Bushveld man and Mr. Leakey's discoveries in Kenya, direct attention once again to the 'Pluvial periods of Eastern Central Africa.' I should like to be permitted to point out that while the theory which finds reason for a genetic connexion between these 'pluviations' and glacial episodes of higher latitudes is sound enough, and although there is evidence to show that in all probability some such connexion existed, the correlation of Kenya pluvials with definite periods of the Pleistocene, as recently set forth, is purely hypothetical. There is room for discussion concerning them; and according to my showing, which may of course be wrong, the Kenya archæological expedition's third 'pluvial' is, so to say, an epi-pluvial, and is (if anything) Bühl and not Würm in date; and so *mutatis mutandis* with the others. The Expedition's ground in the Rift Valley is likely to be full of pitfalls, and in my opinion a great deal of work must be done there before one can say with confidence which of certain deposits are pluvial and which are not.

E. J. WAYLAND.

Beryllium and Helium.

IN a letter on the "Transmutation of the Lighter Elements in Stars" (NATURE, April 13, p. 567), R. d'E. Atkinson and F. G. Houtermans remark that "the isotope Be^8 . . . is probably unstable (it does not occur on the earth) and will then almost certainly break up into two helium-nuclei. . . ."

I am reminded of an observation made many years ago. It was found (*Proc. Roy. Soc.*, A, vol. 80, p. 587; 1908) that specimens of the mineral beryl always contained helium without appreciable quantities of radioactive matter to explain its presence.

Can it be that this helium has originated from the isotope Be^8? If so, it would indicate that the isotope in question, even if it does not exist now, *has* existed within geological times, and subsequent to the formation of the mineral.

RAYLEIGH.

Terling Place, Chelmsford,
April 14.

Geological Aspects of the Channel Tunnel Scheme.

By JOHN PRINGLE.

THE numerous advantages that will result from the making of a tunnel between England and France have long been recognised; but it may not be generally known that in support of such a scheme legislation dealing with the preliminary procedure passed both the French and British Parliaments so long ago as 1875. Less than five years later a start was actually made and headings were commenced on both sides of the Channel, but the failure of the French Channel Company, followed by an order issued by the British Government to close down the work of the British engineers, brought the project to a standstill. Now that the scheme has been revived it is hoped that the undertaking will be pushed through to a successful issue. Geologists agree that the excavation of the tunnel is practicable, and no obstacles which will defeat the ingenuity of engineers are likely to arise in the course of its construction.

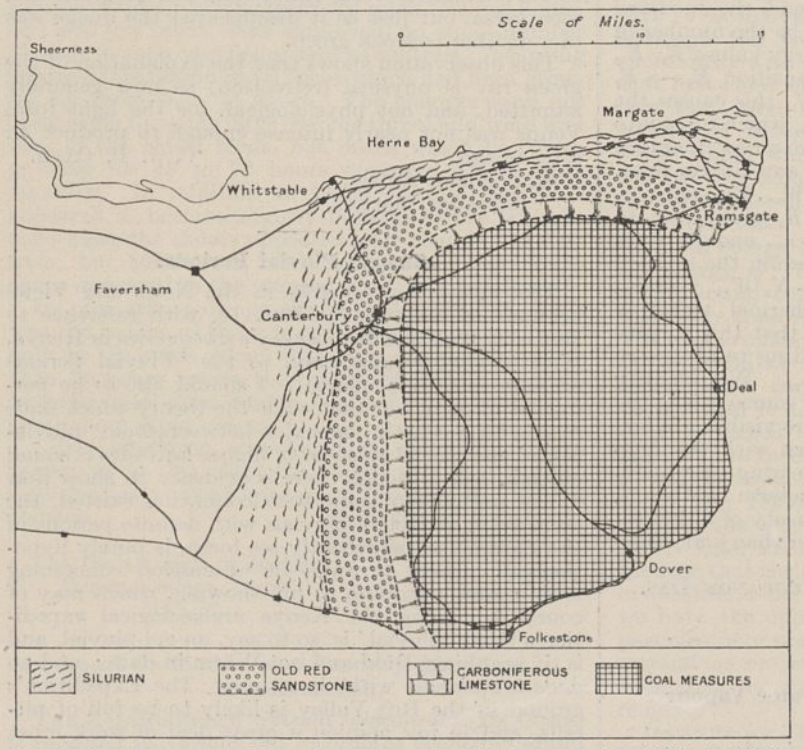

FIG. 1.—Sketch map of the Palæozoic strata proved at depths varying from 900 ft. to 1400 ft. below Ordnance Datum in East Kent.

During the years that have elapsed since the heading was stopped at Dover, much has been learned concerning the deep-seated geology of East Kent and of the opposite shore of France; and some of the results obtained may not be without interest at the present juncture.

It seems scarcely necessary here to relate the views held by early geological observers concerning the physical identity of the coalfields of Somerset with those of the north of France, and the continuity of the higher formations in both countries; nor does it seem needful to do more than merely mention that the theories advanced in 1855 by Godwin-Austen, in a remarkable paper "On the Possible Extension of the Coal Measures beneath the South-Eastern part of England," gave rise to considerable interest in the problems connected with deep-seated geological structures. It is sufficient to say that most geologists were so certain of the occurrence of Coal Measures under Kent that Prestwich in 1873 maintained that these old rocks would be found sufficiently near the surface at Dover to allow submarine tunnelling. Picturesque accounts of the excavations of a tunnel by working the coal made their way into the columns of the newspapers. When the boring made alongside the Channel Tunnel shaft at Shakespeare Cliff proved the presence of Upper Carboniferous Rocks with seams of coal, a great impetus was given to further exploration by the boring-tool, and since 1886 more than forty borings and shafts have been carried down to the Palæozoic rocks in East Kent.

The information obtained by many of the companies carrying out these explorations was, however, jealously guarded for commercial reasons, and had it not been necessary to seek the advice of geologists, perhaps few details of the borings would have become public knowledge. Fortunately, the advice of the officials of the Geological Survey was sought, and they were permitted to examine the cores of nearly all the boreholes. The excellent use made of these opportunities resulted, when publication was allowed, in contributions to geological science of the highest value. These borings have demonstrated that Kent, instead of being an area of simple geological structure, as was thought, is one of considerable complexity, and more geological formations have been proved underground in that county than in any other in England.

As an outcome of the work of the Geological Survey, it is now possible to map the Palæozoic platform, and to show the area occupied by the Silurian, Old Red Sandstone, and Carboniferous rocks (Fig. 1). Further, a plan can also be made of the disposition of the Jurassic rocks on the Palæozoic floor and the general arrangement they would present, if all the strata down to the base of the Wealden were removed (Fig. 2). Fig. 2 is based on that published by the Geological Survey, but certain modifications of the outcrops of the

formations have been made by me to incorporate later information. All of these formations are buried beneath a great thickness of Cretaceous and Tertiary deposits, some of which are depicted on Fig. 3, and the great anticline of the Weald has been shown to be a purely superficial structure superimposed on an underlying syncline.

In Northern France borings have also been made since the heading was driven at Sangatte near Blanc Nez. Here the Cretaceous rocks are nearly identical with those of Kent, but the Wealden anticline, which is prolonged into France, has been denuded down nearly to the oldest Jurassic strata. These occupy the low-lying tract known as the Boulonnais, and they are surrounded by chalk hills. In places, inside the ring of chalk, Palæozoic rocks are exposed at the surface, and this fact gave rise to the idea that a Channel tunnel might be excavated throughout in the older strata. At Dover, however, the discovery of Coal Measures at the depth of 1158 ft. below Ordnance Datum showed such a scheme to be impracticable, quite apart from other difficulties arising from the heavily watered Hastings Sands and Inferior Oolite.

The most important formations to be considered in the making of this tunnel are the Gault and the Lower Chalk. The lithological similarity of these rock-groups as exposed in the cliffs of Kent and in the bold headland of Blanc Nez is so close as to make it certain that no important change in mineral characters takes place in the beds immediately underlying the floor of the Channel. For example, the thickness of the Lower Chalk remains practically constant: in Kent it is 193 ft., at Blanc Nez, 189 ft. The work on the Channel Tunnel can thus be carried out with the advantage that identical strata are to be penetrated at each end.

The chief and, one might say, the only engineering difficulty likely to be encountered in constructing a tunnel in the Chalk would arise from the presence of water, and regarding the question of the amount and distribution of water in this formation many useful data have been obtained from the borings, shafts, and other works made in Kent and in northern France during the past forty years. The knowledge may be summarised as follows: in the Upper Chalk there is a great amount of water, in the Middle Chalk and perhaps in the higher part of the Lower Chalk there is a smaller quantity, but in the remaining portion of this lowest subdivision, the Grey Chalk and Chalk Marl of older writers, except in fissures, little or no water is found, in consequence of the increased amount of argillaceous sediment in this part of the series. Thus, the lower part of the Lower Chalk, which has generally been considered the most advantageous position in which to drive the tunnel, is favoured by all recent experience as the driest and most homogeneous part of the Chalk for this purpose.

At the same time, the relative dryness of the Lower Chalk does not preclude the possibility of meeting water in some quantity in that subdivision. The Chalk, like most other formations, has been subjected to pressure and folding, giving rise to faults and fissures. These have a west-north-westerly trend in Kent, and a similar direction has been noted in France. They allow the passage of a considerable volume of water, even in the Lower Chalk. Thus, for example, a strong spring is given off from a fissure in the Lower Chalk at Lydden Spout, west of Shakespeare Cliff.

Obviously, therefore, much will depend on the relation of the tunnel to the trend of the fissures. Where the headings run parallel with the fissures little or no water need be expected. This was clearly demonstrated by the experience gained in driving the headings at Dover and at Sangatte on the French side of the Channel. At Dover a heading 7 ft. in diameter was driven for a distance of more than 2000 yards, in a direction approxi-

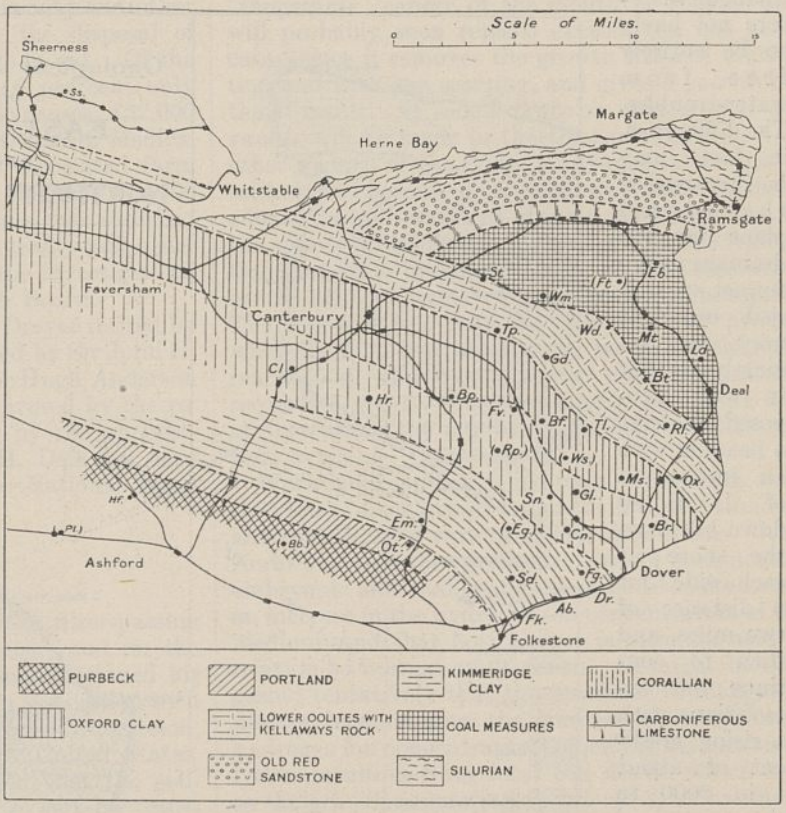

FIG. 2.—Sketch map showing the disposition of the Jurassic strata on the Palæozoic floor in East Kent. Boring sites shown thus: Dv., etc.

mately parallel to the lines of faults and fissures. A small amount of sea-water made its way into the workings, but a hand-pump was found sufficient for dealing with the flow; the water caused no inconvenience, and was easily kept out by a ring of tubing. After an interval of nearly thirty years the heading was reported to be dry in 1912. On the French side, however, the engineers experienced much trouble in dealing with the water coming from a fault in the lower part of the shaft, and in a length of the heading driven nearly at right angles to the fissures a fair amount of water was also tapped.

The excavation of the lower part of the Lower Chalk is therefore not likely to be entirely free from water-troubles. The difficulties, in fact, may be increased if the original plans for the drainage of the tunnel are carried out. It may be remembered that it was proposed to drive a heading with an inclination of 1 in 80 down-hill from the shore at each side for a distance of two miles, and then to continue the excavations with a rising gradient of about 1 in 2000 to the centre of the Channel. This would probably mean that part of the tunnel situated under the sea would lie within the Middle Chalk, and would, therefore, cross the fissures at a rather low angle in strata known to allow the passage of water in increased quantities. This difficulty might perhaps be overcome by driving the tunnel at each end into a lower geological formation, namely, the Gault Clay. This is a point worthy of serious consideration by the engineers. If this plan were followed, the highest point at the centre of the tunnel would probably lie within the drier Lower Chalk.

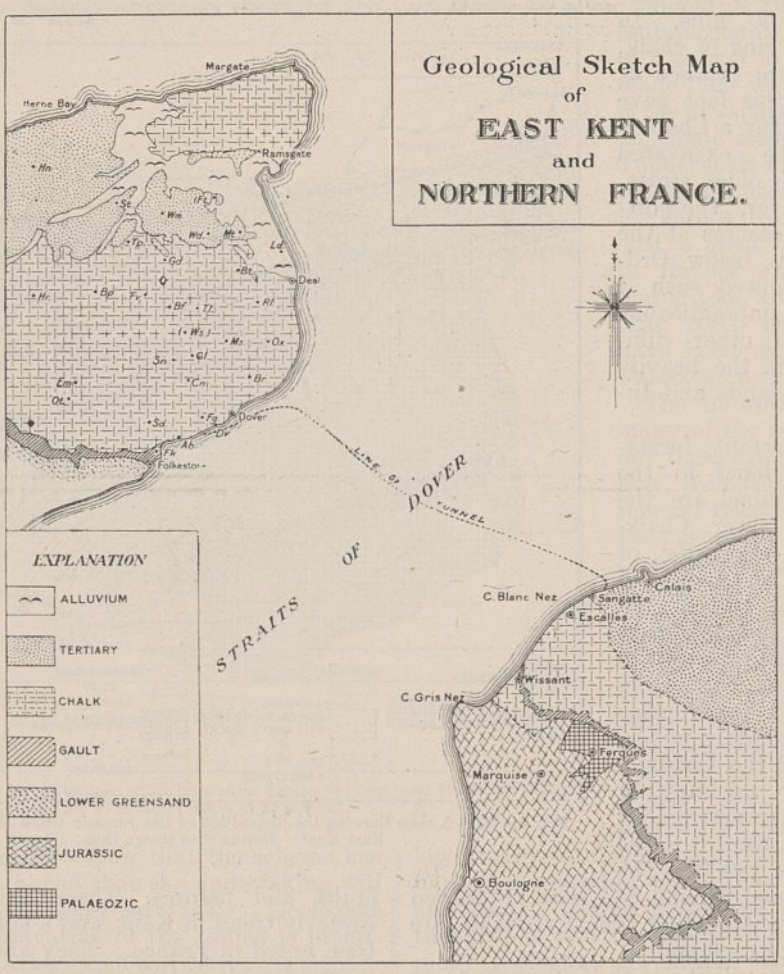

FIG. 3.

It is probable that in earlier discussions the Gault formation was given less consideration in the belief that it was overlain by water-bearing Upper Greensand; in fact the majority of existing plans show a narrow stippled band between the Gault and the Lower Chalk to represent a supposed outcrop of Upper Greensand. Now it has been clearly shown as a result of palæontological investigation that the clay-beds IX to XIII of later classifications of the Gault at Folkestone, and their equivalents at the south end of Blanc Nez, represent in argillaceous facies the sandy beds of the Upper Greensand of the west of England. Consequently, if the headings at Dover and Blanc Nez were to be driven in the Gault at about the horizon of Bed IX, the workings would lie in argillaceous beds, and the risk of meeting a considerable volume of water would in this way be greatly reduced.

As a final remark, it may be suggested that precautionary measures should be taken by the engineers against the possibility of meeting drift-infilled valleys in the Chalk underneath the Straits of Dover. The geological chart showing the outcrops of the subdivisions of the Cretaceous rocks on the floor of the Channel, which was made by MM. Potier and A. de Lapparent as a result of more than 7000 soundings, certainly does not reveal any trace of former valleys in this region, nor has any recent evidence of their existence been obtained; but the fact that many such infilled valleys in the eastern counties of England have been shown to reach depths of more than 300 feet below Ordnance Datum emphasises the need for caution, since such a valley would probably carry a considerable body of water.

Work of the Medical Research Council.[1]

THE report of the Medical Research Council for the year 1927–28 again indicates the wide range of the researches initiated or helped by the Council. As in previous years, the work carried out has been aided by grants from various public bodies, including the Dental Board of the United Kingdom, the Miners' Welfare Fund, the Empire Marketing Board, the British Empire Cancer Campaign, and the Distemper Research Council of the *Field* newspaper, as well as by private benefactions. At the same time the economy and efficiency with which the available funds are expended are greatly increased by the facilities of the university and other laboratories which are placed at the disposal of workers receiving salaries or grants-in-aid. Of the Parliamentary grant of £148,000, 6 per cent only was absorbed by administrative expenses, £52,000 was provided for the National Institute for Medical Research at Hampstead and the associated farm laboratories at Mill Hill, whilst £86,500, with £18,000 from private and public benefactions, was absorbed by research grants in various university and other centres in Great Britain and by the investigations of the Industrial Fatigue Research Board.

Sir Archibald Garrod and Prof. Dreyer retired by rotation, and their places were filled by Sir John H. Parsons and Dr. Robert Muir. Sir Hugh Anderson died after the close of the year covered by the report, and the vacancy was filled by the appointment of Prof. Leathes. Dr. H. H. Dale has been appointed director-in-chief of the National Institute for Medical Research.

Virus Diseases.

Work has been continued on the filter-passing viruses and their relation to cancer, and on the treatment of this disease. Gye has continued his work on the fowl tumour, in part in association with J. H. Mueller of the Harvard Cancer Commission, both in Great Britain and in the United States. The original experiments indicated that the cell-free filtrate by which the growth can be transmitted contains a self-propagating virus and a chemical factor: the virus could be destroyed by chloroform or acriflavine in serum, whilst the chemical factor disappeared on keeping or warming the filtrate. Unfortunately, more recent experiments have failed to give consistent results, treatment of the filtrate either destroying both virus and chemical factor, or failing to destroy the former: the inconsistency is presumably caused by the difficulty of obtaining filtrates with uniform properties. The disappearance of potency in the filtrate on incubation is due to the presence of an oxidising ferment: it can be checked by the addition of hydrocyanic acid, cystein, or reduced glutathione. Gye has also found that the filter-passing organism of pleuro-pneumonia of cattle is destroyed by acriflavine and that the antiseptic's action is aided by the addition of serum, which has an inherent destructive action upon the virus.

During the past seven years the outlook for the radium treatment of cancer has been quite transformed: definite technical methods have now been worked out for almost every region of the body except the stomach. It is already possible to say that early cancer of the neck of the womb can be removed by a course of radium treatment as surely as by the knife, and of course with less suffering and risk. Radium is also the best means of treating 'inoperable' cancer of the mouth or tongue, and will probably soon replace excision for the early cases, since it removes the growth without mutilation and with less scarring, and gives a good functional result. It seems probable that similar advances will be made in the treatment of cancer in other regions of the body. Advance in the use of radium will become more rapid as confidence in its efficacy in the treatment of early cases is gained, as the supply of radium is increased and as the realisation that every treatment centre must be a research centre also and vice versa is generally accepted. The report states that the time has now arrived when radium treatment must be put within the reach of all whose lives depend upon it; but this requires a greatly increased supply of radium and an increase in the number of skilled operators and beds available.

Work has been continued upon cell growth with the view of elucidating further the nature of tumours and the effects of various agents upon them. J. A. Andrews found that growth *in vitro* of both normal embryonic and malignant tissue is associated with an increase in the hydrogen ion concentration of the medium, and that both tissues *in vitro* are acid in relation to normal adult tissue. It might be suggested tentatively that the incidence of malignant disease depends upon the presence of an optimum hydrogen ion concentration coinciding with an autolysate resulting from focal cell death, which acts as the growth-promoting agent. Helen Chambers, in investigations on the effects of tumour products upon tumour growth, has shown that if the tumour is excised three or four days after irradiation with a lethal dose of the X-ray *in vivo*, the animal has absorbed something which confers protection, although the blood contains no immunising power for another animal, and a cell-free extract of the excised tumour cannot confer immunity. It appears that the antigen producing immunity is absorbed in minute quantities over a period of several days, so that its isolation in concentrated solution is difficult.

J. R. Perdrau has studied that form of encephalomyelitis which is occasionally, though very rarely, associated with vaccinia, as in the ordinary vaccination against smallpox. This type appears to be quite distinct from encephalitis lethargica (sleepy sickness) and from poliomyelitis (infantile paralysis), but is identical with that associated with certain

[1] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the year 1927–28. (London: H.M. Stationery Office, 1929.) 3s. net.

acute infections such as measles or smallpox, and with results, also rare, found after antirabic inoculations by Pasteur's method. Hence the rare post-vaccinal encephalitis is not directly due to the vaccinia virus.

The work on canine distemper, already referred to in these columns, by P. P. Laidlaw and G. W. Dunkin, has reached the stage of practical application, and numbers of dogs have been inoculated against the disease: 73 animals from various packs of foxhounds and 300 dogs of other breeds have been inoculated, but only one contracted the disease in a mild form, although most were exposed to infection. Of 170 uninoculated foxhounds which caught the disease, 74 died.

The investigations on virus diseases have had another application in quite a different direction. Yellow fever is now known to be a virus disease: Hindle, adapting the methods devised by Laidlaw and his colleagues, succeeded in protecting monkeys against the disease, and the method has already been used in stamping out a local epidemic in Brazil. Such a result justifies fully the experimental investigations on canine distemper, quite apart from any practical benefits gained for the dog.

Artificial Light Therapy.

Some carefully controlled experiments on treatment by artificial light have been carried out by Dora Colebrook on school children. No beneficial results were observed: light had no influence on gain in weight, height, or 'spirits,' and the incidence of 'colds' was slightly higher among those receiving the treatment. The report critically reviews the results of light therapy, and concludes that its sole justifications are in the treatment of rickets and chronic infections such as tuberculosis and, by local application, in cases of corneal ulcer or lupus, and possibly varicose ulcers. Irradiation of the skin produces vitamin D, from the ergosterol present, and increases the bactericidal power in shed blood; but this increased power has not been correlated with any permanent effects of value to the body, and in any case is quickly followed by a decrease, and the bactericidal power may actually fall below the normal level. Moreover, exactly similar effects can be produced by other skin irritants such as a mustard plaster. In the case of rickets, the administration of vitamin D by mouth has exactly the same effect as irradiation of the skin by ultra-violet light; and since the vitamin can now be prepared synthetically by irradiation of ergosterol and administered in highly concentrated solution, there appears no reason to use artificial light to supply what can be given in the food or as a medicament, especially as the method of oral administration is very much cheaper and more generally available.

Sunlight therapy in surgical tuberculosis is undoubtedly very beneficial, but this treatment includes exposure to the open air and also to the longer light and heat rays of the sun, and cannot be strictly compared with a treatment indoors from a source of ultra-violet rays. It appears urgent that light clinics should carry out carefully controlled trials of the effects of exposure in the treatment of various conditions.

The volume of work on the vitamins carried out during the past year will be separately reviewed later in these columns.

Tuberculin Test.

The method of detecting tuberculosis in cattle has been improved. The 'subcutaneous' tuberculin test has been found to be inconvenient, often fallacious, and always difficult to interpret. The 'double intradermal' test is simple and convenient, trustworthy and unambiguous, and has now been generally adopted. As a by-product of this work, G. W. Dunkin has devised a diagnostic agent for Johne's disease of cattle, a slow wasting disease leading to emaciation, loss of milk, and finally death. There is no known cure and no effective means of control except early detection and removal of infected animals. The test can be made concurrently with the tuberculin test and has revealed the great prevalence of the disease among stocks in Great Britain: its chief danger is in the diminution of the milk supply which results from infection. By early diagnosis infected animals can be removed and fattened for killing, and herds kept free from the disease. The Council points out that, apart from its indirect hygienic value, this work will save to the agricultural community, in the future, more in a year than has been expended on all forms of medical research supported by the Council during all the years of its work from the beginning.

Epidemiology.

In investigations on experimental epidemiology carried out on a mouse population kept under continuous observation for eight years, W. W. C. Topley and M. Greenwood have found that in each epidemic period the expectation of life of the survivors has been more closely correlated with the length of previous exposure to risk than with the severity of that risk as judged by the average death-rate. This suggests that the active immunisation from non-fatal infection is a more important factor in increasing the average resistance of survivors than the elimination, by death, of susceptible animals. It has also been found that pasteurellosis, an infection primarily of the respiratory tract, and mouse typhoid, a typical intestinal infection, show a definite difference in their epidemiological behaviours, which may be of great significance.

L. Hill and his colleagues have found that spraying hypochlorite solution into the air of a room or circulating the air through oiled baffleplate filters definitely diminishes the number of microbes present: the experiments provide justification for the use of sprays in crowded public rooms.

H. Burt-White has found that there is a close correlation between a positive Dick test and subsequent puerperal sepsis in pregnant women. The test is used to indicate susceptibility to scarlet fever, but also indicates susceptibility to the toxins of other strains of streptococci, including those from puerperal fever. Arrangements have been made

to carry out an extensive trial of the results of rendering Dick positive subjects immune to puerperal fever before labour.

BIOLOGICAL STANDARDS.

In concluding this review of some of the important subjects dealt with in this report, reference may be made to the work on biological standards, which has an international importance. The first British standard tuberculin has been adopted as the international standard by the Permanent International Standards Commission of the League of Nations Health Organisation: its strength is equivalent to that of the standard originally created by Ehrlich. The adoption of an international standard of dried scarlatina antitoxin necessitated the production of an equivalent British standard: but the method of measuring the potency of an antitoxic serum by its neutralising action on the toxin, as tested by the human skin reaction, cannot discriminate between antitoxins differing from each other by less than 100 per cent. Recently, Hartley has succeeded in concentrating the toxin so that its lethal dose for the rabbit can be accurately measured and an adequate number of lethal doses used in the neutralisation test. A British standard digitalis powder is in course of preparation and will be made to conform with the international standard already in existence. An international physical unit of X-ray dosage has also been defined and adopted and agreement reached on the principles governing its standardisation: the connexion between physical dosage and biological effect is still being studied.

Obituary.

DR. T. B. OSBORNE.

THOMAS BURR OSBORNE, who died on Jan. 29, was the last of the small band of pioneers who laid the foundation-stones of modern protein chemistry. Born in New Haven, Connecticut, on Aug. 5, 1859, of old New England stock, he graduated after the usual course in arts at Yale College in 1881. Turning his attention to analytical chemistry, he took the degree of Ph.D. in 1885, and a year later joined the staff of the Connecticut Agricultural Experiment Station in New Haven. Prof. Samuel W. Johnson, director of the Station and professor of agricultural chemistry at Yale, suggested that Osborne should extend Ritthausen's early work on vegetable proteins, and in 1888 he started investigations which continued without interruption until his retirement in 1928.

From 1890 until 1901 Osborne's chief interest was in the preparation of pure specimens of the seed proteins, and his initial investigation of the oat kernel, published in 1891, was the forerunner of a series of papers in which the proteins of thirty-two different seeds were described. These researches demonstrated that proteins could be regarded as definite chemical individuals, and that many substances formerly grouped together under such terms as 'legumin,' 'conglutin,' and 'vitellin' differed in chemical composition as well as in physical properties. His conception of the protein molecule as a definite chemical entity was strengthened by his work on the acid-binding power of edestin, published in 1899, and by later papers in which it was shown that proteins in general could form salts with both acids and bases, and that they were capable of electrolytic dissociation.

Working as he did in close contact with agriculture, Osborne early realised the need of a chemical characterisation of proteins which would give some index of nutritive value, but characteristically deferred any such research until he was convinced that he could first obtain proteins in the highest state of purity. Taking full advantage of the developments in analysis due to Kossel and Fischer, he commenced in 1906 a series of protein analyses which demonstrated that wide differences existed in the amino-acid composition of many proteins of economic importance. These analyses were made with Osborne's usual extreme care, and were the basis of his future work on the nutritive value of the proteins, begun in collaboration with Prof. Lafayette B. Mendel of Yale, in 1909, and continued with the generous support of the Carnegie Institution of Washington until the time of his death.

The results of Osborne's protein investigations were summarised in a monograph, "The Vegetable Proteins," which was published in 1909, and extensively revised in 1924. His life was devoted almost entirely to his research, and, unlike most investigations, increasing years and fame brought no increase in administrative responsibility, consequently until the last his working hours were spent in the laboratory, and those who were privileged to work with him and gain his confidence found in him not only a genial friend and stimulating critic, but also a man with an unsurpassed wealth of practical experience in his own particular field of science.

Osborne was a member of the National Academy of Sciences, an honorary Sc.D. of Yale, and an honorary fellow of the London Chemical Society. Last year the American Association of Cereal Chemists instituted the periodic award of the Thomas Burr Osborne medal for distinguished research in cereal chemistry, and he was himself the first recipient.

WE regret to announce the following deaths:

Dr. Paul Dvorkovitz, a well-known petroleum technologist, aged seventy-two years.

His Highness Sir Bhawani Singh Bahadur, K.C.S.I., Maharaj-Rana of Jhalawar, who was well known in scientific circles in Great Britain and was a delegate from India at the two hundred and fiftieth anniversary of the Royal Society, on April 13, aged fifty-four years.

Prof. John MacCunn, emeritus professor of philosophy in the University of Liverpool, on Mar. 24, aged eighty-two years.

News and Views.

PROF. D'ARCY THOMPSON'S presidential address to the Classical Association on April 8 at Cardiff is a welcome reinforcement of the plea so often advanced in these pages for a closer alliance between the humanities and science. It is the more welcome because it approaches the subject at an unaccustomed angle and in a fresh spirit of hopefulness and enjoyment. Whereas we are always thinking, and have often said, how necessary is some knowledge of history to the man of science and some knowledge of science to the historian and man of letters, and how deplorable is the general lack, Prof. Thompson boldly takes the cheerful line. "From time immemorial science and the humanities have gone hand in hand. Aristotle wrote on poetry and Plato loved astronomy. And at the Renaissance all the scholars read Galen and Hippocrates." It was the natural thing, and, though the vast extension and specialisation of knowledge now make it more difficult, it is still the most stimulating and pleasurable way to widen and deepen our intellectual associations. It is, of course, all that, on the side of personal culture, and far more on the side of civilised life and social continuity. Nothing is more important for the future, if mankind is to rise above the pleasures, the problems, and the whirl of the present, than to go back and find the roots of our thought, the first impressions of the wonder and order of the world, in the works of the earliest thinkers who have expressed them for us. Socially and philosophically, this sense of filiation and indebtedness is even more valuable than the idea of solidarity with those now living which is now constantly dinned into our ears by the multitude of international associations, from the League of Nations downwards.

IN spite of his cheerful tone, one must sorrowfully admit that Prof. D'Arcy Thompson is one of a very small band of persons now alive qualified to act as liaison officers between the two camps of science and humanity. Scholar and naturalist, he has written a glossary to the 'Birds' of Aristophanes, of which he spoke at Cardiff with such well-merited enthusiasm. Prof. Arthur Platt was another, approaching the matter with the outlook of the Greek scholar. The essay which occurs to us as most in sympathy with Prof. D'Arcy Thompson's address, and worth reading after it, is Platt's chapter on "Aspects of Biological and Geological Knowledge in Antiquity" in "Science and Civilization," the sixth volume in the Unity Series. Unfortunately, it was not reprinted in Platt's posthumous Nine Essays, but it is delightful in style and fits in admirably to the sketch which Prof. D'Arcy Thompson gave last week. Some day perhaps the Classical Association will form a subsection for the study of classical science.

EVERY year marks a further advance in the steady progress of civil and military aviation. In great measure this is due to the fact that, almost alone in the field of applied science, research and practice in this case can run hand in hand. While the expenditure on air armaments, however, has been bounding up in other parts of the world, the net expenditure of Great Britain for the fourth year in succession, according to the Air Minister in introducing his estimates for 1929, shows a decrease; this in spite of the ease with which it has been demonstrated how vulnerable England is to attack from the air. At the end of the year the strength of the Air Force will have been raised from 75 to 82 squadrons, a figure considerably below that of several other great powers. On the civil side, this year will mark a notable stage in the development of imperial air communications. A regular air service to India has already begun, the first outward journey being completed within 150 minutes of the scheduled time, and the return journey almost exactly on time. It is intended to run a weekly service, doing the journey in from six to seven days. Meanwhile steps have already been taken for the inauguration of the other great trunk line service—London to the Cape. For some years past, units of the British and South African Air Forces have been making service flights over the routes and collecting data, while particularly during the last twelve months much pioneer work has been done by Sir Alan Cobham, Lady Heath, Lady Bailey, and Captain and Mrs. Bentley. The result has been to provide experience and information without which the regular flight of 6245 miles from north to south would be quite impracticable. Every colony and dominion in South Africa is certain to derive great benefit from this venture. North and South Rhodesia, for example, at present three weeks from London, will come within ten days' journey, and the Union Parliament at Cape Town will be within twelve days of Westminster. The ultimate success of the scheme depends on the financial aid forthcoming from the other Governments concerned.

THIS year's air estimates for Great Britain provide for a number of developments of a technical nature. Two aircraft are to be specially constructed to test the relative merits of monoplane and biplane, particularly for civil aviation. The all-metal plane, which has been the subject of intensive study for some time, is now coming into its own. Four years ago the Air Ministry was ordering one metal machine for every nineteen of wood construction. To-day the orders are seven metal machines for one wood, so swift and complete has been the revolution in the methods of construction during the past four years. In introducing his estimates, Sir Samuel Hoare paid a tribute to the brilliant work of the experimental pilots at Farnborough and Martlesham and the special efforts of the Aeronautical Research Committee. Not the least significant of his announcements was his statement of a proposed grant to the recently formed National Flying Services Company, a step, it is hoped, that will stimulate the air sense of the nation. This grant is dependent on the provision, directly or indirectly, of one hundred new aerodromes and landing grounds. There can be no doubt that the next few years will witness an enormous speed-up of civil and commercial flying in Great Britain.

AT the meeting of the Royal Meteorological Society on April 17, Dr. J. Glasspoole gave some details of the scanty rainfall of the first three months of the year. The total precipitation over the British Isles during these months was only half as much as usual and less than that of any similar period in the last sixty years of comparable data, the nearest approach being that of 1891, with 60 per cent of the average amount. The drought of 1929 was most intense in Great Britain in four well-marked areas, each of which received less than one-third of the average. These areas included a narrow strip across the Thames Valley from Gloucester to Margate, Central Wales, the English Lake District, and much of the northern half of Scotland. The fall at stations in these regions was as follows :

	Rainfall (in.).	Per Cent of Average.
London (Camden Square) . .	1·5	29
Borrowdale (Seathwaite) . .	9·7	27
Rhayader (Tyrmynydd) . .	4·2	25
Alness (Ardross Castle) . . .	2·2	22

AT Ardross Castle the period included both the driest January and the driest March of the last sixty years, and the total rainfall was less than that of any other three consecutive months. The total for January to March at Gloucester was only 1·27 in., and at Shoeburyness only 1·18 in. Less than 2 in. was recorded at stations in the Midlands, near Oxford and London, and in the neighbourhood of the Moray Firth. There was less than 3 in. during the three months over nearly half the total area of England and Wales, including central and south-eastern districts. One of the main features of the weather was the marked weakening of the south-west winds and consequent deficiency of rainfall in the mountainous regions. Parts of the English Lake District and the Western Highlands of Scotland received 25 in. less than usual during this period.

HOLBORN recently acquired an unenviable notoriety in being, on Dec. 20 and 21 last, the scene of a series of street explosions and fires which took place on a line beginning at the junction of Kingsway and High Holborn, and proceeding westwards along High Holborn, Broad Street, and High Street to St. Giles's Circus. With commendable promptitude the Home Secretary on Dec. 21 appointed a Commission consisting of Mr. R. G. Hetherington, Lieut.-Col. R. A. Thomas, and Mr. E. H. Tabor, with Mr. A. S. Hutchinson as secretary, to inquire into the circumstances of the explosions and fires ; the Commission, which commenced its investigations on the following day, has now issued its Report (H.M. Stationery Office, Cmd. 3306, 1*s.* 6*d.* net). It is concluded that the explosion occurred in the Post Office tube (an old pneumatic parcels tube now otherwise employed) ; that it was due to a mixture of coal gas and air ; that the gas probably resulted from gradual accumulation, together with an escape sufficient to increase the concentration to the explosion limit ; and that the gas became ignited in a manhole through some action (probably the use of a petrol lighter) by a workman.

IN its investigations concerning the nature of the explosive agent, the Commission examined three theories : that the gas was coal gas, petrol vapour, or gas arising from anaerobic fermentation. The petrol vapour theory was rejected after elucidation of the facts that no odour of petrol was perceptible. and that there was no black smoke or luminous flame. The theory that the explosion was due to the presence of fermentation gas was carefully studied. Evidence regarding the odour was conflicting ; none of the samples of gases collected from the ground after the explosion, however, contained methane and carbon dioxide as the chief constituents, whilst all contained oxygen in quantities which negatived the possibility of anaerobic conditions. Moreover, examination of the subsoil demonstrated that the conditions were aerobic, and the production of anaerobic gas on the requisite scale would have involved sewage decomposition in unacceptably large quantities. Alone, the coal gas theory was consistent with all the facts. Recommendations concerning ventilation and gas leakage are made, it being suggested that underground cavities, including manholes, should be either continuously ventilated or filled in, that the use of a continuous gas detector would be desirable, and that the gas company concerned should strengthen its organisation for the detection of leakage.

DR. A. D. LITTLE, president this year of the Society of Chemical Industry, who intends to sail for England on June 15 in order to preside over the annual general meeting at Manchester on July 9, has sent a personal message to American and Canadian members of the Society expressing the hope that many will take advantage of the opportunity of consolidating the friendships so happily begun at the meetings of last year and establishing new ones under peculiarly favourable auspices. The Raymond and Whitcomb Co., which is dealing with transport arrangements, points out that June 28 and 29, the last sailing dates which will assure members reaching Manchester in time for the opening meetings, are the heaviest of the entire season, so that early notification of probable requirements is necessary. The programme in connexion with the annual general meeting commences on Monday, July 8, and continues until Saturday, July 13 ; it includes addresses by the president, by Prof. Pear, and by Sir Richard Threlfall, visits to works, excursions, the annual dinner, and a number of social gatherings. American chemists and chemical engineers who may find it possible to visit Great Britain in connexion with these meetings may be assured of a cordial welcome from their British colleagues, by whom the occasion is being anticipated with much pleasure.

IN opening a discussion at the Society for the Study of Inebriety on alcohol in therapeutics on April 9, Dr. J. D. Rolleston said that from the earliest times the subject has given rise to acrimonious discussions in the medical profession. On the introduction of distilled liquors into medicine in the thirteenth

century, the new remedy was regarded as a panacea and as an elixir of life, as was shown by the terms *aqua vitæ* and *eau de vie*, though the designation of *eau de mort*, used by Voltaire several centuries later, appeared more applicable. The remarkable decline in the therapeutic use of alcohol within the last thirty years is best illustrated by the fall in the alcohol bill in various hospitals, but is also shown by the practice of individual physicians and the small place which alcohol now occupies in modern text-books of medicine compared with those of forty years ago, when the writers, still imbued with the medieval doctrine, extolled the therapeutic value of different alcoholic beverages in a great variety of diseases. At the present time in the United States only a minority of practitioners have applied for a licence in those States in which the right to prescribe alcohol is granted. The conditions in which alcohol is still chiefly employed are pneumonia, enteric fever, diphtheria, and other acute infections, diabetes, heart disease, tuberculosis, inoperable cancer, and senility, but it does not appear to be indispensable in any of them. In conclusion, Dr. Rolleston maintained that the factors chiefly responsible for the undeserved esteem which alcohol still enjoys as a therapeutic agent are tradition, rather than scientific evidence, extra-medical influences, and personal considerations.

ALL cities in the world with populations of more than half a million are being faced with the problem of transporting large numbers of workers daily from one section of the city to another. For London, Captain Swinton and Col. M. O'Gorman are advocating a raised ring road 15 miles in circumference which would pass near the eleven railway termini and Earl's Court. According to an article in the *Westinghouse International* for May, considerable relief for congested traffic can be obtained by using modern electric cars operating in subways or on overhead tracks. Some of the new cars are more than 42 feet long and weigh 15 tons. No other vehicle can haul so many people with equal safety at such a low fare. In America, in one city alone the inauguration of a new electric rapid transit system is calculated to save one hundred thousand passengers one hour daily. Cars are now made to accommodate 104 passengers comfortably, fifty-horse-power motors being used. Trackless trolley buses are also successfully operated in many cities in the United States. They are of the six-wheeled type, weighing about 8 tons, using fifty-horse-power motors and taking their power from an overhead 600-volt trolley wire. A large number of petrol buses are now being supplied with electric equipment, which usually consists of a generator and one or two motors. It is claimed that these petrol-electric vehicles have many advantages over those operated purely mechanically. They accelerate much more smoothly, and owing to the absence of gears there is very little noise. These improvements are the result of long-continued experimental researches.

THE Manson Medal of the Royal Society of Tropical Medicine and Hygiene, awarded triennially, is to be presented this year to Sir Ronald Ross. It was founded in memory of Sir Patrick Manson in 1922, and has been awarded to Sir David Bruce and Senator Ettore Marchiafava. Qualifications for the medal are contributions of outstanding merit to knowledge of tropical medicine and hygiene. The Chalmers Medal, which was founded in 1921 by Mrs. Chalmers in memory of her husband, Dr. Albert J. Chalmers, is awarded every second year to the younger workers in the field of tropical medicine and hygiene, who must be under forty-five years of age on June 1 of the year of award. It is to be presented this year to Major J. A. Sinton; previous awards have been to Prof. E. Roubaud, Prof. Warrington Yorke, and Dr. H. Lyndhurst Duke. Though the Manson Medal was founded in memory of Sir Patrick Manson, the Society is endeavouring to found a more substantial memorial in the shape of a permanent home for the Society. To this end the "Manson House" Fund was started, and already donations have brought in £4373, while £3000 have been promised on loan without interest. It is hoped that a sufficient sum will now soon be raised to enable the Society to purchase suitable premises which will form the headquarters of the Society and will be named after Sir Patrick Manson, the first president of the Society.

THE tenth annual meetings of the American Geophysical Union and of its sections will be held in the National Academy and Research Council Building, Washington, D.C., on April 25 and 26. Following the business meeting of the general assembly of the Union on the afternoon of April 26, the Union will hear the five following general-interest papers, all relating to current or recent work, presented by the Section of Oceanography. The expedition of the submarine S21 to the Caribbean Sea and Gulf of Mexico, by C. S. Freeman; oceanography and the fisheries, by Henry B. Bigelow; the international ice patrol, with special reference to its economic aspects, by Edward H. Smith; the co-operative survey of the Great Lakes, by Charles J. Fish; the work of the *Carnegie* to date, by W. J. Peters. The six sections, dealing respectively with geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, and volcanology, will hold short business meetings to be followed immediately by progress-reports and scientific papers. The scientific sessions will be open to persons interested in geophysics, whether members of the Union or not. These annual meetings are increasingly interesting each year, not only because of the stimulus afforded the study of problems concerned with geophysics, but also by reason of the co-operation of the corresponding geophysical organisations of Canada and Mexico, which is making for initiation and co-ordination of geophysical researches depending upon international and national co-operation.

IN the course of his presidential address to the Institution of Professional Civil Servants at the annual general meeting on April 12, Sir Richard Redmayne dealt with the position of the technical expert in the civil service. He referred to the claim which the Institution is putting forward on behalf of scientific

members of the Civil Service, of whom, thanks to the understanding it has recently reached with the Association of Scientific Workers, it is fully representative. The claim is not just a demand for 'more money'; it is based upon the thesis that a modern State must accord to the scientific worker a status and a sphere of influence as high and as extensive as are enjoyed by those whose duty it is to take what is usually known as 'the decision.' The case of the scientific worker is, however, only one aspect of a much larger problem, namely, the status of the technical expert in public administration. The Institution is of opinion that the watertight division between 'administrators' and 'technical advisers' is leading to inefficiency and waste owing to the absolute power placed in the hands of the administrator to determine matters of policy in regard to which technical considerations may be paramount. At the present time the organisation of the Civil Service is on the basis of the needs of departments of State some two generations ago. The reorganisation of the Service in the light of scientific progress is of such vital public importance that it calls for an inquiry by a public body. The Institution, the chief aim of which is increased efficiency of the public service, will not rest content until such an inquiry has been made.

SIR HUBERT WILKINS intends to return to the Antarctic in September to continue his explorations by aeroplane. He has given an account of his plans in the *Times*. From Deception Island, where his Lockheed machines are now stored for the winter, he and Lieut. Eielson will fly south to Hearst Land along the western coast of Graham Land. On this long flight no landing-place is assured, for the coasts are rugged and the sea will be open, but strewn with ice. Sir Hubert suggests that tabular icebergs might afford emergency landing-places. On the other hand, they may not be available. On Hearst Land a depot will be made, and there the aviators will await reports of favourable weather conditions from the whalers and Commander Byrd in the Ross Sea before starting on the flight of 2000 miles to King Edward Land along the unknown coast-line of Antarctica. This must be a risky flight, for conditions are entirely problematical, but it should be possible to cover the distance between successive blizzards. Sir Hubert hopes to locate a suitable site for a meteorological station, and in any event he will, if successful, add a considerable stretch to the coast-line of Antarctica.

MR. A. M. DANIEL, director of the National Gallery; Dr. Cyril Norwood, headmaster of Harrow School; and Mr. W. J. Tapper, president of the Royal Institute of British Architects, have been elected members of the Athenæum under the provisions of Rule II. of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

WE are informed that, as a result of a recent meeting, a body has been constituted under the title of the "Ultra Violet and Allied Trades Association," consisting of a number of the leading firms engaged in the design, manufacture, and marketing of ultra-violet, physio-therapy, and other electro-medical apparatus in Great Britain. The Secretary of the Association is Mr. C. Rodgers, and the offices are at Kern House, 36 Kingsway, London, W.C.2.

THE Swedish Government has placed an order with the Marconi Company for the supply of a 60-kilowatt aerial energy transmitter for installation at Stockholm. The fact that this contract was obtained by the Marconi Company in the face of keen competition is a tribute to the excellent design and performance of British broadcasting transmitters already installed in more than twenty countries outside Great Britain. The new Swedish broadcasting station will be effective over a very large area. It will be operated on the low-power modulation system, with deep and distortionless modulation; and will be worked direct off a three-phase public electric power supply.

MR. H. V. GARNER and Capt. E. H. Gregory will again be available to demonstrate the Rothamsted and Woburn Experimental Plots during the summer to farmers' and other bodies interested in agriculture or market gardening. At Rothamsted the soil is heavy. The experiments deal with the manuring of arable crops, grazing land, and hay land, with crop diseases and pests, and with new methods of laying down of land to grass. At Woburn the soil is light. The experiments there are concerned more particularly with the manuring of potatoes, sugar beet, wheat, malting barley, and the use of green manures. Communications should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

A CATALOGUE (No. 167) of second-hand books of science, ranging over most branches, has just been published by Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1. It can be obtained free upon application. There are upwards of 1400 items listed and the prices asked appear very reasonable.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A general engineering master at the Acton Junior Technical School—J. E. Smart, Municipal Offices, Acton, W.3 (April 27). An inspector under the Ministry of Agriculture and Fisheries for the purposes of the Diseases of Animals Act, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (April 29). A second assistant in the County Analyst's Laboratory, Derby—The County Analyst, County Offices, St. Mary's Gate, Derby (April 29). Two assistants on the higher technical staff of the Victoria and Albert Museum—The Director and Secretary, Victoria and Albert Museum, South Kensington, S.W.7 (May 4). A lecturer in civil engineering and building trades work in the engineering department of the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth (May 4). A lecturer in economics at the City of Birmingham Commercial College, with special qualifications in transport subjects—The Principal, City of Birmingham Commercial

College, Suffolk Street, Birmingham (May 4). A workshop instructor in carpentry and joinery at the Birmingham Central Technical College—The Principal, The Central Technical College, Suffolk Street, Birmingham (May 6). A technical officer for the Air Ministry Technical Development Staff, primarily for work at the Royal Air Force Base, Gosport, in connexion with the development of torpedoes for aircraft use—The Secretary, Air Ministry (S.2) (quoting B.335) (May 11). A research assistant in the department of coal gas and fuel industries of the University of Leeds, for work in connexion with the Joint Research Committee of the Institution of Gas Engineers and the University—The Registrar, The University, Leeds (May 12). A post in the zoological department of the University of Manchester—The Registrar, The University, Manchester (May 14). A professor of physiology in the University of Bristol—The Secretary, The University, Bristol (May 16). An assistant lecturer in physiology in the physiological department of the University of Birmingham—The Secretary, The University, Birmingham (May 31). Probationers for the Indian Forest Service—The Secretary, Services and General Department, India Office, S.W.1 (July 1). An assistant in the mechanical engineering section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A medical woman with experience in teaching anatomy, to act for the professor at the Lady Hardinge Medical College, New Delhi—The College Principal, Lady Hardinge Medical College, New Delhi, India. A laboratory steward in the physics department of the Military College of Science, Woolwich. A qualified technical chemist at the Stores Inspection Department of the Office of the Crown Agents for the Colonies—The Crown Agents for the Colonies, 4 Millbank, S.W. (quoting O/Sec. Office 91).

Our Astronomical Column.

THE RADIUS OF SPACE—The following cablegram (which has been somewhat expanded from its very concise telegraphic wording) was received from Dr. Ludwik Silberstein on April 10: "A star formula which is developed in the course of my monograph 'The Size of the Universe,' now in course of publication at the Oxford University Press, when applied to 35 stars of type O yields for the radius of space the value $3{\cdot}2 \times 10^{11}$ astronomical units; when applied to 29 Cepheids, $3{\cdot}0 \times 10^{11}$, and when applied to the 246 more distant stars of Young and Harper's list, $3{\cdot}4 \times 10^{11}$ units. The latter computation was completed on April 7; its agreement with the two former ones definitely establishes that space is finite, and that its radius is thirty trillion miles (in the British use of the term), or about five million light-years."

The Einstein theory has familiarised us with the idea of space being limited and re-entrant into itself; the surprising point in the above communication is the much smaller value that is assigned to the radius than has been found by other methods. It is, indeed, only a small fraction of the estimates of the distances of the fainter spiral nebulæ that have been assigned in recent years by Profs. Hubble and Shapley; these go up to 140 million light-years. The acceptance of Dr. Silberstein's value would mean a drastic revision of the whole method of determining distances by the periods and apparent magnitudes of Cepheid variables; assuming its truth for the moment, we note that the two spirals, the distance of which Hubble found to be about a million light-years (the Andromeda nebula and Messier 33), should also be visible in the opposite direction, since their distance by that route would be only nine times as great as by the shorter route; it so happens that there are conspicuous nebulæ very near the opposite points—*h* 3433 and Messier 83 respectively; their positions for 1860 are respectively R.A. $12^h\ 44^m\ 37^s$, S. Decl. 40° 18·7′, and $13^h\ 29^m\ 9^s$, S. 29° 9·0′. The appearance of Dr. Silberstein's monograph will be awaited with interest, but in the meantime his announcement will necessarily be received with some reserve.

THE SPECTROHELIOSCOPE.—Prof. G. E. Hale, the inventor of the spectrohelioscope, contributes an article upon it to the *Scientific American* for April; he shows that it is not a mere toy, designed to enable the eye to discern features that could be equally well studied by photography; in fact, in several respects it gives the observer powers of study much greater than those afforded by the photographic plate. This only records the aspect at a single instant, whereas the observer with the spectrohelioscope can quickly detect the most active regions of the disc, and follow the changes continuously. Prof. Hale says: "I have frequently seen the swift flow towards sunspots of masses of hydrogen larger than the earth, adequately recorded with the spectroheliograph only once in twenty years."

Prof. Hale goes on to describe a further improvement, the 'line shifter'; this is an adjustable plate of plane glass behind the second slit, which permits the observer to set different parts of the width of the line on the slit in quick succession; this gives information about the radial motions in different regions of the formation. One side of an arch may be seen to be rising, while the other is falling. Prof. Hale has prepared instructions whereby a handy person can construct a spectrohelioscope at a cost "comparable with that of a fine radio set."

GREENWICH OBSERVATIONS OF THE SUN AND PLANETS.—The Astronomer Royal and Mr. R. T. Cullen contribute a paper on this subject to the January number of the *Monthly Notices* of the Royal Astronomical Society. The study of the solar observations is carried back to those of Bradley, beginning about 1750. It was found that early observations of the sun in right ascension were subject to large errors; those in declination appeared to be more satisfactory. Accordingly, the error in longitude has now been deduced from the observations of declination made near each equinox; this is a similar process to the well-known method of Flamsteed for determining the equinox. The 'secular acceleration' of the sun is clearly shown by the residuals. The coefficient of T^2 is deduced as $+0{\cdot}78''$, which is comparable with that found by Dr. Fotheringham. The solar residuals show oscillations which accord fairly well in period and phase with those of the moon, but are about one-tenth of the amplitude.

As regards the outer planets, the residuals of Saturn changed abruptly from + to − at the date of the introduction of the moving wire, 1915. Those of Neptune have been changing fairly uniformly from zero early in the century to $-3''$ in 1928. Its latitude also shows progressive change, but not quite so regular.

Research Items.

A PREGNANCY CUSTOM IN WEST AFRICA.—Dr. J. Maes describes in *Man* for March a recent acquisition of the Musée du Congo Belge from the Katanga which is connected with a child-birth custom distributed through a wide area in West Africa. The object is a clay figurine of a seated female figure holding on her lap a disproportionately large bowl. The stylisation of the hair indicates that the figure represents a woman of the Bena Kanioka. It is the first record of this custom among these people, though figures of this type are common among the Baluba. These figures are made by men during the pregnancy of their wives. When the time of delivery approaches, and the woman is no longer able to work in the fields, the figure is placed at the door of the hut and all passers-by place alms in the bowl. These gifts are shared among the woman's friends when they return at night in return for the produce of their fields which they give the expectant mother, and for labour which they have expended on her garden. This custom is found among the Yoruba, and clay figures made by the peoples of the Gulf of Guinea exhibit exactly the same characters as these from the south of the Belgian Congo.

THE TASMANIAN SKULL.—Prof. Wood-Jones (*Jour. Anat.*, vol. 63, pt. 2, pp. 224-232) in a recent paper gives a group of four graphic reproductions of the average or composite skull of the Tasmanian, the first of a series of racial types with which he proposes to deal in turn. The reproductions include the normæ lateralis, facialis, occipitalis, and verticalis, and are based on ninety skulls. The author finds that the whole cranium presents a rounded and well-filled contour which is considerably in advance of that shown in figures usually given in works on physical anthropology. The temporal fossæ are well filled and the vault of the skull evenly rounded in facial view. The forehead is not markedly narrow nor is the vault of the cranium low or long. The cranial capacity, using Lee's formula, averages 1353 c.c., or, using the formula of Broca and Manouvrier, 1424 c.c. This is high compared with the previous estimates of 1220-1230 c.c. The author concludes that the commonly accepted low average cranial capacity in this race, like the reputedly humanly low-class features of the cranium, has been wrongly emphasised, with the result that the Tasmanian has been ascribed a lower place in the human scale than the examination of his cranium warrants.

SPAWNING MIGRATION OF SALMON.—A report just received from Russia ("Physico-chemical characteristic of breeding migration fast of Keta Salmon," by Prof. B. P. Pentegoff, U. N. Mentoff, and E. F. Kurnaeff. *Bulletin of the Pacific Scientific Fisheries Research Station*, vol. 2, part 1. Vladivostok, 1928) contains an interesting study of the breeding migration fast of the Keta salmon. It is stated that the total distance traversed by the Amur River autumn salmon during the spawning migration is about 1200 kilometres in the river alone. The information upon the sea portion of the migration is meagre, but on the basis of a single marked fish liberated from the Island of Unda and later recaptured in the River Pankara, Kamchatka, the authors conclude that the sea migration is similar to the river migration, that is to say, in a contranatant direction and towards increased temperature. During this portion of its migration the fish travelled at a rate of 70 kilometres per day for 34½ days, without food. Perhaps the main value of the paper lies in the detailed physical and chemical studies of the fish at all stages of the journey up-river, during which the speed of the fish is said to be on the average 115 kilometres per day, and to be in inverse ratio to the speed of the current. A total of 172 fishes (equal numbers males and females) were subjected to minute analysis. From the sea to the time of death after spawning, the males lost 77·21 per cent of their reserves of energy, and females 78·75 per cent. At first the proportion of energy expenditure from the destruction of fat to that from the destruction of protein increases, but this relation is later reversed. It is calculated that the average daily expenditure of energy in their passage up the river is 25,810 small calories for males, and for females, 28,390 small calories, for each kilogram of live weight. Among the more important chemical changes in the muscular tissue are the following: From the sea to the time of death at the spawning ground, the loss of fat was 98·72 and 97·27 per cent in males and females respectively; of proteins, 57·29 and 57·68 per cent; of ash, 47·03 and 47·07 per cent; and of water, 15·18 and 20·74 per cent respectively.

BRYOZOA AND ALGÆ OF MUTSU BAY.—Dr. Yaichiro Okada reports on the cyclostomatous Bryozoa and Mr. Yukio Yamada on the marine Algæ of Mutsu Bay ("Cyclostomatous Bryozoa of Mutsu Bay" and "Marine Algæ of Mutsu Bay and Adjacent Waters, II," *Report* of the Biological Survey of Mutsu Bay, 8 and 9. *Science Reports of the Tôhoku Imperial University*, 4th Series (Biology), Sendai, Japan, vol. 3, No. 4, Fasc. 1, 1928). Both papers are contributions from the Marine Biological Station, Asamushi, Aomori-Ken. The Bryozoa in their zoogeographical distribution combine the characteristics of the Pacific boreal sub-region and the Indo-Pacific coastal region. In continuing his work on the marine algæ, Mr. Yamada has himself made extensive collections, adding very appreciably to the knowledge of the flora of the district. Not only does he record and describe many rare forms, but, what is really more important, he also shows that many species are common which were not before known to live there at all. Some of his most interesting finds belong to the Elachistaceæ, growing in pools on fronds of *Sargassum* and *Phyllospadix*. Fifty species of algæ are recorded in the present report, making 86 in all, 6 of which are new.

NON-PROLIFERATING BACTERIA.—In two papers (*J. Hygiene*, **28**, pp. 139-46; 1928; and *Ann. de la Brasserie et de la Distillation*, Dec. 10, 1928), Dr. J. H. Quastel sums up the interesting results which he and his colleagues have obtained at the Biochemical Laboratory, Cambridge, by the study of non-proliferating, or, as they were at first less happily termed, resting bacteria. The organisms are used in the form of a suspension under such conditions that practically no growth occurs during the observations, and the chemical changes can thus be studied without complication. The properties of such organisms have been intensively investigated in the case of *B. coli*, which has the power of activating a very large number of substances, that is, rendering them capable of performing chemical reactions, such as reducing methylene blue, which they cannot perform in the absence of the cell. The degree of activation produced varies greatly with different substances, and, moreover, the activating powers towards different substances are very differently affected by varying modes of treatment of the organism. Thus, after treatment with toluene, glucose is no longer activated,

whereas formic acid is as powerfully activated as before the treatment. Facts of this kind have led the author to the view that activation of the substrate is not necessarily due to the existence of specific enzymes. He suggests that activation, which consists in a polarisation (an internal electrical change) of the substrate molecules, occurs at particular regions or centres on the surface structures (interfaces) of the cell. Activation is conditioned by the specific adsorption of the substrate at the activating centre, the constitution of the substrate molecule and the nature and strength of the polarising field. This theory is successfully applied to the explanation of the observed phenomena of activation and of the conditions necessary for anaerobic growth.

SUGAR BEET TRIALS.—The report of the second year trials of sugar beet carried out by the University of Bristol on some thirty-three local farms adds very little indeed to the information already available as to the cultivation and manuring of that crop. As a widespread demonstration, this experiment may have served its purpose in giving the farmers illustrations of the cultivation and manuring of what is after all a comparatively new crop, but the results obtained must not be regarded too seriously. The trials had a wide range, and covered cultivation, time of application of nitrogen, and the form of nitrogen to be applied, and on the results one draws the general conclusion that a moderate application of one or other of the soluble nitrogenous fertilisers will produce an increase in yield which is sufficiently great to make the practice profitable. This cannot be considered as new information, but it may serve to confirm over a considerable area of cultivation the results of smaller individual trials carried out in various parts of Great Britain from about 1877 until the present time. It is interesting to notice that the yields obtained in the trials now described are relatively high. Even without nitrogen, and over a range of soils including Greensand, Bunter crag, and Old Red Sandstone, an average of 12·2 tons of washed beet per acre was obtained. The average obtained by Great Britain as a whole during last season was about 8 tons of washed beet per acre. Within this margin, between the eight and the twelve, lies the future of sugar-beet growing in England, for unless the return per acre improves it is almost certain that the reduction of acreage which was seen last year will continue in future years and the factories will be unable to find acreage to support themselves. If such trials as those reported upon from Bristol serve only the purpose of showing the growers how increased yields may be obtained without undue increase of expense, then they may well find justification for their continued existence.

NEW GASTROPOD FROM THE SILURIAN OF ALASKA.—From the same Upper Silurian horizon in Alaska whence he obtained the remarkable bivalve *Pycnodesma* (see NATURE, Oct. 22, 1927, p. 600), Mr. Edwin Kirk has now described (*Proc. U.S. Nat. Mus.*, vol. 74, art. 18) an equally interesting new gastropod to which the name of *Bathmopterus liratus* has been given. The shell superficially resembles *Euomphalopterus*, but has a well-defined slit band and is apparently referable to the Pleurotomaridæ, or possibly the Euomphalidæ. The specimens here described and depicted came from Willoughby Island in Glacier Bay.

MOLLUSCA FROM THE GULF OF CALIFORNIA AND THE PEARL ISLANDS.—Mr. H. P. Bingham, of New York, following in the footsteps of the late Prince Albert of Monaco, has been conducting expeditions in his yacht *Pawnee* and forming a collection for the purpose of oceanographic research at the Peabody Museum of Natural History, Yale University, while a *Bulletin of the Bingham Oceanographic Collection* is published in connexion therewith. Although the primary object has been ichthyological research, other branches have not been passed by altogether, and Lee Boone describes in the *Bulletin* (vol. 2, art. 5) the mollusca dredged in 1926 during an expedition to the Gulf of California and the Pearl Islands of the Gulf of Panama. Considering the faunal richness of the region as revealed by Carpenter, Adams, and Dall, the list is a small one, but several of the species now obtained were rare, and one, *Tellina barbaræ*, from the Pearl Islands, is new. Six of the species are figured, by half-tone process from photographs, on three plates, which are distinctly works of art.

TRINIDAD WELL-WATERS.—It is seldom that a study of oilfield waters is of less significance, either in itself or in its bearings on exploitation problems, than the study of petroleum in any region, and Trinidad has shown itself to be no exception to this statement. The technical data requisite to geochemical interpretations of the various waters encountered in oilfields here, have taken time to accumulate; although developments have been in progress for several years past, not until now has it been possible to present a co-ordinated account of the hydrology of these oilfields as a basis of geological and economic considerations. Messrs. J. S. Parker and C. A. P. Southwell's recent paper, read before the Institution of Petroleum Technologists, emphasises such considerations by showing that, as in most other cases, chemical investigations of associated waters with oil, lead to anticipation of water-bearing strata likely to be penetrated by drilling wells; with such fore-warning, casing programmes can be arranged accordingly and preparations for water shut-off at specified depths be initially made; the data are also available, when correctly interpreted, as confirmatory evidence of subsurface structure, particularly when the strata involved are unfossiliferous; in the event of salt water invading a well or flooding an oil-sand (through leaky casing or faulty seating), the source of such water may be determinable; while the discrimination between different waters (top, intermediate, bottom, edge), when possible, elucidates both extent and trend of oil-reservoir rocks and of oil accumulation therein. In short, the authors demonstrate that, now the essential chemical data are available to operators in Trinidad, solution of existing problems concerned with different waters in different fields should be possible, and future developments will have an advantage of the geochemical interpretations which their researches on the subject have made possible.

TRUE BEARING AND DISTANCE DIAGRAM.—A true bearing and distance diagram has been devised by Mr. E. A. Reeves and published by the Royal Geographical Society (price 7*s.* 6*d.*). The diagram consists of the network of a hemisphere on the stereographic projection. By its aid the true bearing of any point on the earth's surface from any other point can be easily found. It also gives the distance between the two stations and allows the drawing of the arc of a great circle between them. The diagram should prove of great value in survey expeditions obtaining wireless time signals in connexion with longitude determination. Along with the diagram and pamphlet of instructions, there is given a spare unfolded copy on strong cartridge paper with a radial pointer.

THERMIONIC VALVE POTENTIOMETER FOR E.M.F. MEASUREMENTS.—Most of the applications of thermionic valves to the determination of E.M.F. measurements have the disadvantage that they depend upon the constancy of the valve characteristics and require constant sources of filament and plate potentials. An apparatus described by H. M. Partridge in the *Journal*

of the American Chemical Society for January is claimed to be free from these limitations and may be used with cells of very high resistance, such as a cell containing two glass electrodes, since it is essentially electrostatic in operation. A four-electrode valve, together with a three-electrode valve, is used, the second valve acting as an amplifier giving greater sensitivity. No calibration of the valves is necessary, and the E.M.F. is read directly from a voltmeter in the grid circuit of the first valve. The accuracy depends largely on the degree of precision of the voltmeter.

MOLECULAR HYDROGEN.—Diatomic hydrogen (H_2), although regarded until recently as a simple substance, has been shown by the new mechanics to be capable of existence in two modifications, which have been termed ortho-hydrogen and para-hydrogen by analogy with corresponding helium atoms. Considerable support for this idea has already been found in spectroscopic and thermal data, and in a recent issue of *Die Naturwissenschaften* (Mar. 15) it has been reported independently by A. Eucken, and by K. F. Bonhoeffer and P. Harteck, that a separation of the components can be effected. A. Eucken has employed the simple device of holding hydrogen under pressure for some days, at liquid air temperatures, changes in the relative amounts of the two forms present being followed by the increase in the rotational component of the specific heat of the gas. In addition to this method, the other investigators appear to have made use of fractional condensation on charcoal at the temperature of liquid hydrogen, as well as direct liquefaction of the gas. They claim to have prepared practically pure para-hydrogen, and state that it is moderately stable if stored in glass vessels under normal conditions of temperature and pressure, reverting only very slowly to the equilibrium mixture on standing, but that the change can be accelerated by an increase in pressure, and that it takes place rapidly under the influence of an electric discharge, or in the presence of platinised asbestos.

A PORTABLE ELECTRIC HARMONIC ANALYSER.—R. Thornton Coe gave a demonstration at the Institution of Electrical Engineers on Mar. 21 on an electric harmonic analyser for electric waves. The operation of the instrument depends on the principle that a dynamometer instrument only gives a steady reading when the currents in the fixed and moving coils have the same frequency. A small current of about the fifth of an ampere is obtained from the voltage or the current to be analysed, and passes through the moving coil of the instrument. Through the fixed coil a current which follows accurately the sine law and the frequency of which can be varied is passed. At the harmonic frequencies large deflections may be produced, and as the analysing current is read on a thermal ammeter the amplitude of the harmonic can be found. The chief feature of the apparatus is the method of producing the analysing current by using a special contact disc driven by a small synchronous motor actuated from the alternating current circuit. One ring of contacts is used for each harmonic. A tuned circuit is used for improving the wave shape of the analysing current. The instrument obtains each harmonic separately from steady readings on two instruments. It is claimed that by its use alternating current waves can be analysed up to the forty-ninth harmonic. It is of importance in practice to determine the wave shapes produced by electric generators. If an appreciable harmonic be present in the limits of audition, annoying interference with neighbouring telephone circuits may ensue. This can generally be remedied by slightly modifying the generator circuits.

ATOMIC WEIGHT REPORTS.—A correspondent points out that the German values for atomic weights given under the above heading in the issue of NATURE for Mar. 9, p. 390 (in which the value for phosphorus should read 31·02, and not 31·62) are mainly identical with the values adopted in 1925 by the International Commission on the Chemical Elements in its atomic weight report, which, though not an annual publication, was the successor to the former annual report of the International Committee on Atomic Weights. It thus appears that the German Commission has retained the international values for the elements mentioned (*loc. cit.*), whilst the English sub-committee has used F. W. Clarke's values.

DISTILLATION OF WOOD-TAR IN HYDROGEN.—Many years ago the interest of the Russian school of organic chemists in pyrogenic reactions was well known, and that this interest still continues has been shown by the work which has been published in recent years by W. N. Ipatiev from the Academy of Sciences in Leningrad. The effect of heating organic substances under pressure in the presence of hydrogen and of alumina and iron catalysts has been investigated, and the results of this treatment on wood tar and tar oil are now described (*Berichte*, vol. 62, p. 401, February 1929). It is found that the use of hydrogen results in an increase in the yield of liquid products, which are richer in hydrocarbons and low-boiling fractions than the products of ordinary 'cracking.' Correspondingly, there is a decrease in the proportion of unsaturated compounds formed, and this is reflected in the loss of the unpleasant smell which is a disadvantage of the ordinary product, and in the absence of a tendency to darken on keeping. The authors, Ipatiev and Petrov, suggest that the new products might be used for extraction or lubricating purposes.

THE NICKEL-CHROMIUM PLATING PROCESS.—Chromium is being extensively used instead of nickel as a protective coating for iron, not only for the purpose of producing a highly lustrous and durable surface, but also for the surface-hardening of bearings. That it has not yet displaced nickel is due to the difficulties encountered in electroplating. In an article in the *Chemiker-Zeitung* of Mar. 13, Prof. Pfanhauser, director of the Langbein-Pfanhauser-Werke A.-G., Leipzig and Vienna, deals with these difficulties and describes how they have been overcome by a method which is protected by the patents of the Chrom-Interessen Gemeinschaft. By using a high current-density, the time required to produce a stable and highly resistant coating of chromium has been reduced to five or ten minutes, the original iron or brass having previously received a layer of nickel 0·02-0·025 mm. thick. The advantages of using an intermediate layer of nickel are twofold, for not only is the cost of plating very greatly reduced, but also the risk of corrosion of the iron or brass by traces of chromic acid, deposited with the metal, is obviated. The chief disadvantage has hitherto been the tendency for both metals to peel after a short time. The reason for this is that some hydrogen is deposited with the metals at the cathode. In order to overcome this defect, it is necessary in the first place to pay special attention to the deposition of the nickel, which must be sufficiently thick, and at the same time poor in hydrogen, to be able to absorb by diffusion the gas which is associated with the chromium layer. Old-fashioned nickel-plating processes may be quite unsuitable for the purpose, and the solutions require very careful control. A further source of trouble is due to traces of grease or oxide on the original metal, particularly on brass, which will ultimately cause blistering.

Geological History of the Atlantic Ocean.[1]

THE Atlantic is the best test case for the theory of the permanence of the ocean basins. According to one view, the Atlantic trough is a primeval geographic feature and dates back to the pre-Palæozoic. According to an alternative view, it has been repeatedly so broken up by lands trending east to west across it that there has often been no sea entitled to the name of the Atlantic.

The Icelandic Ridge, the northernmost of these cross lands, is generally accepted, and it was probably finally severed between the Upper Palæolithic and the Neolithic. This land is shown by varied evidence from different geological periods to have extended as far south as a line from Newfoundland to Ireland, or to the Azores. It formed the northern shore of the Tethys.

The main issue regarding the Atlantic relates to the southern side of the Tethys and the Brazilio-Ethiopian land. That the South Atlantic was occupied by land in the Palæozoic era is indicated by the absence of marine rocks from most of both coasts. From Upper Carboniferous to Lower Jurassic times, Brazil and Africa were parts of Gondwanaland, and a southern fauna and flora ranged through both. The invasion of this land by the sea began in the Middle Cretaceous Period, with gulfs from the Mediterranean which reached Brazil and Angola: they were closed to the south, as the marine fauna of Cape Colony is distinct and ranged westwards through Chile, and as the fresh-water fauna was continuous between Africa and South America.

This continuity is shown by the river fish, porcupines, lizards, snakes, and many invertebrates, of groups that were in existence in the Lower Kainozoic era. The evidence shows that the connexion lasted until the end of the Oligocene; but it cannot have lasted much later, as the more specialised mammals and birds—for example, the humming-birds—did not use it as a land bridge.

The existence of this land-connexion in Oligocene times is shown by the occurrence of the same shallow-water marine animals in the West Indies and in the Mediterranean. Some of them might have crossed by a chain of islands, but that the land was continuous is shown by the marine mollusca of the West Indies and the Mediterranean being distinct from those in the south. The first commingling in South America was in the Upper Miocene (Entrerios Beds), according to H. von Ihering. A slight temporary land-connexion was established in the Upper Miocene, as shown by the migration of *Hipparion gracile* to Europe and of African antelopes to the United States.

This land-connexion was severed too early to have served as Atlantis, though the Canaries may have been joined to the mainland up to the Pleistocene. There is no geological evidence of any land-connexion of Africa and South America in the time of man.

The Atlantic is a relatively young geographical feature and due, as held by Suess, to the growth of two gulfs, which projected northwards and southwards from the Tethys. These gulfs were formed by subsidences which began in the Middle Cretaceous and have continued to the Pleistocene, and they finally united the Arctic, the North Atlantic (Poseidon), and the Nereus or the South Atlantic. The Atlantic trough is the greatest of meridional geographical features, and is due to the collapse of a belt of the crust along faults and tensional fractures connected with the pressure of South America westward against the Andes.

[1] From the presidential address to the Geological Society of London, delivered by Prof. J. W. Gregory, F.R.S., on Feb. 15.

Cylinders for the Storage and Transport of Gases.[1]

THE publication of the third and fourth reports of the Gas Cylinders Research Committee of the Department of Scientific and Industrial Research completes the work of that Committee. The first report dealt with ordinary commercial cylinders for permanent gases, the second with the periodical heat treatment of carbon steel cylinders, and recommended that such cylinders should be made of 0·45 per cent carbon steel as an alternative to the 0·25 per cent carbon steel approved in 1895, whereby the working stress in the cylinders would be raised from 8 to 10 tons per square inch, while the weight would be reduced by about 20 per cent. The first report (see NATURE, **109**, 460; 1922) is now out-of-print, but a revised summary of the recommendations it contained has been issued lately.

A further reduction of weight to one-third of that recommended by the 1895 Committee is possible by the use of alloy steels. This is called for in the case of cylinders used for medical, aeronautical, and mine-rescue work, and the question of constructing cylinders of duralumin and alloy steels containing nickel, chromium, and molybdenum has been examined by the Committee. The third report gives details of this investigation. Commercial and mechanical difficulties rather restricted the scope of the work, and alloy steel cylinders alone have been investigated properly. The Committee recommends the use of nickel-chromium-molybdenum steel cylinders for the storage and transport of 'permanent' gases, the steel to have the following composition: Nickel, 2·5 per cent; chromium, 0·6 per cent; molybdenum, 0·6 per cent; manganese, 0·6 per cent; carbon, 0·3 per cent; silicon, 0·15 per cent; sulphur, 0·4 per cent (max.); and phosphorous, 0·03 per cent (max.), and the remainder iron, and to have the following mechanical properties: Ultimate tensile strength, 55-65 tons per square inch; yield stress, not less than 45 tons per square inch; an elongation not less than 18 per cent on 2-inch gauge length. Seamless and weldless finished cylinders of about 20 cubic feet of gas capacity are required to be subjected to a hydraulic proof pressure of 2700 lb. per square inch; to stand a pressure of 2550 lb. per square inch and show no sign of leak, and to withstand the impact of an armour-piercing bullet (Mark vii. P) without bursting when filled with air at a pressure of 1800 lb. per square inch. The thickness of the cylinder wall for cylinders of 4 inch outside diameter must not be less than 0·080 inch, and particles of shale, oil, grit, filings, etc., must be carefully removed from the cylinder. They are to be subjected to the hydraulic test at least once in every two years.

The considerations that are of importance in the case of cylinders used for the storage and transport of *liquefiable* gases are radically different from those ruling in the case of permanent gases. In the former case, so long as the cylinder is not *completely* filled with liquefied gas, the internal pressure is the saturation pressure, and this in general is quite low and

[1] Department of Scientific and Industrial Research. Ordinary Commercial Cylinders for the Permanent Gases. Summary of Recommendations (Revised). Pp. iii+7. 4*d*. net. Third Report of the Gas Cylinders Research Committee (Alloy Steel Light Cylinders). Pp. iii+74+13 plates. 2*s*. 6*d*. net. Fourth Report of the Gas Cylinders Research Committee (Cylinders for Liquefiable Gases). Pp. v+151. 4*s*. net. (London: H.M. Stationery Office, 1929.)

increases *relatively* considerably, but *absolutely* only slightly with rise of temperature. Liquefied gas, however, has a relatively high coefficient of thermal expansion, and unless a sufficient free space is left in filling a cylinder, dangerous pressures may be developed owing to the cylinder becoming filled with liquefied gas on rise of temperature. Cylinders for the permanent gases are designed on the basis that the stresses in a cylinder wall due to internal pressure are limited, say, to one-quarter of the ultimate strength of the material. The same basis, applied to cylinders for liquefiable gases, would result in the production of cylinders altogether too fragile for commercial purposes.

These considerations and others are set out in detail in the very interesting fourth report of the Committee. The storage and transport of liquefied sulphur dioxide, ammonia, chlorine, methyl and ethyl chlorides, hydrocyanic acid, phosgene, carbon dioxide, nitrous oxide, and ethylene are considered. Acetylene was excluded from the Committee's terms of reference. It is recommended that cylinders for the transport of these gases should be made of seamless tubes of carbon steel produced by the acid or basic open hearth process and having the following approximate composition: Carbon, 0·20–0·25 per cent; sulphur, not exceeding 0·045 per cent; phosphorus, not exceeding 0·045 per cent; manganese, 0·45–0·75 per cent; silicon, not exceeding 0·2 per cent, and the rest iron. Alloy steel is not to be used. The thickness of the cylinder wall is to be dependent upon the maximum internal pressure and the external diameter of the cylinder, and formulæ for deducing such thickness are given in the report. After manufacture, cylinders are to be heated uniformly at 860°-890° C. and allowed to cool in still air.

Filling ratios for various pressures in temperate and tropical climates for each of the gases are tabulated. Finished cylinders are to be subjected to specified tensile and hydraulic stretch and flattening tests and are to be provided, as in the case of cylinders for containing 'permanent' poisonous or inflammable gases, with completely protected valves, which must be left-handed in the case of cylinders containing inflammable gases. Hydrocyanic acid must not be stored for more than 8 months; its purity must be at least 98 per cent and it should be stabilised to prevent polymerisation. The valves of cylinders for storing carbon dioxide may be fitted with a safety device, for example, a copper or vulcanite disc forming a gas-tight joint with the valve seat.

The reports contain valuable appendices relating to tests of cylinders, the determination of some of the physical properties of commercial samples of sulphur dioxide, ammonia, chlorine, methyl chloride, carbon dioxide, nitrous oxide, ethylene, hydrocyanic acid, and ethyl chloride.

Vertebrate Fossils from Glacial and Later Deposits in Scotland.[1]

THE work referred to below is an important contribution to our knowledge of the vertebrate fossils from the glacial and associated post-glacial beds of Scotland in the Hunterian Museum, University of Glasgow. This monograph was planned twenty years ago. Various causes have contributed to the delay in publishing, but Prof. Gregory and Dr. Ethel Currie are to be congratulated on finally bringing the work to conclusion.

Several eminent specialists have collaborated in examining and naming different parts of the collection. The resulting publication, however, is more than a catalogue of fossils. Detailed and critical descriptions of specimens are first of all given, all the more important examples being figured either in the text or on plates. There follows a series of notes on the localities and geological horizons of the different occurrences. In one or two instances the views expressed herein are matters of controversy, but the authors have been careful to direct attention to other opinions. It may be noted, for example, that Prof. Gregory's belief in the marine origin of Boulder Clay is not generally accepted in Scotland. In addition, the interpretation of the evidence as to the exact position of the Cowdon Glen deposits is at variance with that of some other eminent Scottish geologists. It appears in this connexion that Craig's description of the glacial sequence in this locality has been slightly misread. Prof. Gregory classes the deposits as Neolithic, but the alternative reading would make them older.

The next section of the monograph contains a table showing the distribution in time of the characteristic Scottish mammal remains, with a proposed correlation with the Thames Valley sequence. No Scottish mammals earlier than Lower Mousterian are known. Deposits of this age in Scotland are correlated in time with the Late-Middle Terrace of the Thames Valley, and the period of maximum glaciation in both Scotland and England. It must be noted, however, as the authors point out, that vertebrate fossils in the glacial and later deposits have been found in very few localities in Scotland, and consist only of isolated fragments. Nothing occurs corresponding to the rich Pleistocene vertebrate faunas of south-east England.

The monograph concludes with a comprehensive bibliography. We agree with the authors in hoping that its publication will stimulate interest, and result in further chance discoveries being carefully recorded and the specimens placed in suitable keeping.

[1] Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 2: The Vertebrate Fossils from the Glacial and Associated Post-Glacial Beds of Scotland in the Hunterian Museum, University of Glasgow, and their Evidence on the Classification of the Scottish Glacial Deposits. By Prof. J. W. Gregory and Dr. Ethel D. Currie. Pp. vi+26+3 plates. (Glasgow: Jackson, Wylie and Co.; London: Simpkin Marshall, Ltd., 1928.) 7*s*. 6*d*. net.

H.M. Dockyard Schools and Naval Architecture.

MR. A. W. JOHNS concludes a series of six articles in *Engineering* for Mar. 29, on "The Dockyard Schools and the Second School of Naval Architecture," a series which fills in a gap in the history of the Admiralty system of training shipwrights and naval architects. Though all Boards of Admiralty have not been possessed with equal zeal in such matters, generally speaking the Admiralty has been a pioneer in technical education. Mr. Johns' articles necessarily present but one aspect of their activities, which to-day range from the training of bandsmen to courses of strategy for captains and admirals. Only so recently as September 1925, Sir W. J. Berry and Engineer-Vice-Admiral Sir Robert Dixon gave an account of the Admiralty system of higher education for naval constructors and engineers officers to the British Association, and they stated that it is no exaggeration to say that during the last half-century nearly all advances in warship design have been originated by officers who have passed through the training at Kensington or Greenwich.

Not only have Admiralty students been responsible for advances in warship design, but also many of them have become associated with great shipbuilding firms,

with Lloyds' Register, and with foreign navies, while nearly all the occupants of the various chairs of naval architecture in Great Britain have been held by men whose professional training began in H.M. Dockyards or at one of the schools maintained by the Admiralty.

The dockyard schools at Portsmouth, Devonport, Chatham, and elsewhere for the education of apprentices, have a continuous history from 1843; and Mr. Johns says they "may be placed amongst the most efficient technical institutions in the country." In the first years of their existence they were inspected six times by Canon Moseley, the mathematician, and to his suggestions may be traced many of the improvements afterwards made. The Schools of Naval Architecture were separate institutions, the first (1811–1832) and the second (1848–1853) being at Portsmouth, the third (1864–1873) at South Kensington, the fourth and still existing one being founded at Greenwich Royal Naval College in 1873. Of the first, Mr. Johns gave an account in *Engineering* in 1926; the third was the subject of an article by Sir William Smith in the same journal in July 1923, and Mr. E. L. Attwood read a paper to the Institution of Naval Architects in 1905 on the work at Greenwich. Sir William White also referred to the work done at South Kensington and Greenwich in a paper read at the jubilee meeting of the same body in 1911.

Mr. Johns in his articles gives an interesting account of the development of the dockyard schools and of the Second School of Naval Architecture, otherwise known as the Central Mathematical School, and recalls some of the important work done by the professors, masters, and pupils, such as Dr. Woolley, Rawson, Sir Edward Reed, and Sir Nathaniel Barnaby, the last two of whom held the responsible post of Chief Constructor of the Navy. A review of the progress of the various schools and of the careers of those who have passed through them bears eloquent testimony to what can be accomplished by a government department desirous of encouraging talent and industry and of obtaining for itself and the nation at large, workmen and officers with a high standard of professional and technical knowledge.

Studies on the Polysaccharides.

AT a meeting of the London Section of the Society of Chemical Industry on Mar. 4, Prof. A. R. Ling, director of the British School of Malting and Brewing, University of Birmingham, described results of recent researches into the structure of starch and glycogen, conducted by himself and his collaborators.

In addition to amylose and amylopectin, the two main constituents of the starch of potatoes, arrow-root, etc., the granules obtained from cereals contain a third substance, amylohemicellulose. Amylose and amylopectin are hexa-amyloses partially esterified as calcium phosphate esters, whilst amylohemicellulose is a silicic ester of amylose. Hydrolysis of starch paste with barley diastase converts amylose quantitatively into maltose, whereas amylopectin yields soluble $\alpha\beta$-hexa-amylose, which is resolved in turn by malt diastase to various glucose derivatives. Amongst these are found glucosido-maltose and isomaltose. Recent study of enzyme action upon these two products has revealed the fact that both possess α-linkages, and not β-linkages as was hitherto supposed.

Prof. Ling has also produced evidence to show that if glycogen, a polysaccharide widely disseminated through the animal kingdom and found also in fungi and in yeast, is not identical with amylopectin, as suggested by Pringsheim, the two compounds are certainly very similar. Samples of glycogen after hydrolysis by malt diastase gave products which could be investigated with the help of the osazone reaction. Two compounds were isolated, namely, a disaccharide and a non-reducing sugar. The former agrees in physical properties with isomaltose and possesses a γ (1 : 4) ring. It seems probable that all the oxide-rings in glycogen and amylopectin are of this type and that the conversion of glycogen into lactic acid in the muscles during contraction is best explained by assuming that the glucose involved possesses the γ-structure.

The lecture was followed by an account by Dr. F. W. Norris, of Prof. Ling's department, of recent researches on pectin, an important constituent of fruit jellies. After reviewing earlier work on the subject, Dr. Norris referred to Ehrlich's resolution of pectic acid into arabinose, galactose, and tetragalacturonic acid. In 1925, Nanji, Paton, and Ling proved that these substances are linked in the proportion of 1 : 1 : 4 as anhydrides in a ring structure, the acid carboxyl groups being free. An attempt to remove the acid groups, in order to produce a hemicellulose, gave an unexpected result, the product actually obtained being pure galactose-galacturonic acid. The adoption of the ring or hexagon formula helped to throw some light upon the interpretation of analyses of methoxyl-groups, and it seems probable now that the predominating unit in soluble pectin is trimethylpectic acid, which is present in fresh orange juice. Reference was made to recent work by Candlin and Schryver, who obtained a hemicellulose by the action of alkali on pectic acid. Schryver has suggested a new class-name—the polyuronides—for all these compounds.

A wide and interesting field of research has been opened up and much remains to be done to clear up many existing perplexities.

University and Educational Intelligence.

LONDON.—The annual dinner of the fellows of University College will be held at the College on Tuesday, April 30, in commemoration of the laying of the first stone of the College buildings by H.R.H. the Duke of Sussex on April 30, 1827. Prof. F. W. Oliver, Quain professor of botany in the University, who was elected a fellow of the College so long ago as 1886, will preside.

The following courses of free public lectures are announced: at Bedford College for Women, at 5.15 on April 29 and May 1, "Abolishing the Arctic," and "The Northward Course of Empire," by Dr. V. Stefansson; at University College, at 5.30 on April 29, May 7 and 13, "Geometry: a Brief Review," by Prof. H. F. Baker; at University College, at 5.15 on April 29 and 30 and May 1, "Drug-like Actions of Some Food Constituents," by Prof. E. Mellanby; at University College, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Special Sense Physiology," by R. J. Lythgoe; at St. Thomas's Hospital, at 5 on May 2, 9, 16, 23, and 30, and June 6, "Dietetics," by Prof. S. J. Cowell; at University College, at 4 on May 3 and 10, "Some of the Sequels of Epidemic Encephalitis (Lethargica)," by Prof. A. J. Hall.

APPLICATIONS for agricultural scholarships and agricultural and veterinary research scholarships are invited by the Ministry of Agriculture and Fisheries. Form A.472/T.G. for the former and form 900/T.G. for the latter may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1. The completed forms have to be returned by June 15.

Calendar of Patent Records.

April 22, 1823.—The first patent for a roller skate was the English one granted to Robert John Tyers, fruiterer of Piccadilly, on April 22, 1823. The skate had a single line of wheels or rollers, which either were of graduated diameter or were so fitted that their lower edges lay on the line of a circle.

April 23, 1784.—The well-known cabinet lock of Joseph Bramah—the first of the revolving barrel type—was patented on April 23, 1784, and remains unaltered to the present day. It was one of the first to give real security against being opened by a false key, but that it, like most locks, could be picked by an expert was proved when the American A. C. Hobbs took up Messrs. Bramah's challenge in 1851 and succeeded in opening the lock, though only after 53 hours' work.

April 23, 1793.—Sir Samuel Bentham—a brother of Jeremy—is one of the most noted of English inventors. His many inventions, not all of which were patented, cover a wide field, but most of his important work was done in connexion with the naval dockyards, where he introduced reforms not only in the methods of shipbuilding but also in office and workshop administration and practice. His most famous patent is No. 1951, dated April 23, 1793, the specification of which is a valuable treatise on the application of machinery to the working of wood and metal.

April 23, 1884.—April 23, 1884, is the date of Sir Charles Parsons' patents for the steam turbine. The engine was first used for driving dynamos in electricity works, where within a few years its use decreased the coal consumption by one-half. The first application to steamships was in the *Turbinia*, which was built in 1894 and attained a speed of more than 32 knots. The engine of the *Turbinia* is now in the Science Museum.

April 25, 1793.—On April 25, 1793, there was granted to Captain Joseph Huddart a patent for his new method of making rope cable, in which all the yarns are disposed in concentric cylindrical layers about a centre yarn, an arrangement designed to give a more equable distribution of strain upon the yarn.

April 25, 1863.—Linoleum—both the material and the word—was the invention of Frederick Walton, who made his first application for a patent for the new floor-cloth on April 25, 1863. There has been little change in the process of manufacture since its first commercial production at Staines.

April 26, 1814.—The sewing-machine did not become commercially successful until Elias Howe's United States patent of 1846, but there were several prior inventors who can claim consideration. One of these is Josef Madersperger, of Vienna, who applied to the Emperor Francis I. for an Austrian patent for a sewing-machine on April 26, 1814. A patent for six years was granted to him early in the following year, but the machine was never put into practical use. Madersperger's original model was shown at a meeting of the Nied. Österreichischer Gewerbe-Verein in 1840 and secured for the inventor the society's medal, but in spite of this recognition Madersperger died in extreme poverty. The model is now in the Technical Museum at Vienna.

April 27, 1879.—Electricity was first used for lighting railway carriages by the London, Brighton, and South Coast Railway, which in 1881 fitted up a Pullman car with an accumulator installation. A system employing a belt-driven dynamo on one of the carriages for supplying current to Geissler tubes throughout the train had, however, been patented in Germany by E. Hinkefuss and Gustav Wesel, engineers of Breslau, on April 27, 1879.

Societies and Academies.

LONDON.

Geological Society, Mar. 20.—**Sir Douglas Mawson**: Some South Australian algal limestones in process of formation. A record of three different types of limestone, now actually in process of formation under the influence of plant-growth, occurring in the south-eastern region of South Australia. In each of the localities examined, whether inundated in winter only or permanently inundated, the formation of limestone is being determined by blue-green algæ.—**Arthur W. Groves**: The unroofing of the Dartmoor granite, and an outline of the distribution of its detritus in the sediments of southern England. A systematic outline mineralogical survey has been made of the sediments of southern England, from the base of the Permian in Devon (Watcombe Clay) up to the Lenham Beds of the North Downs. The minor intrusions above the granite were being rapidly eroded in Permo-Triassic times, but there is no evidence of the actual granite being exposed at that period. No proof has been obtained of direct derivation of detritus from the Dartmoor granite in the Jurassic rocks. The earliest evidence of the exposure of the granite is in late Wealden times. Throughout Upper Cretaceous times—particularly during the Selbornian epoch—the Dartmoor granite contributed enormous quantities of detritus to the sediments of southern England, reaching as far afield as Kent and Oxfordshire, and perhaps farther. The Cornish Pliocene was largely derived from the Cornish granites. The St. Keverne outlier is mainly derived from the Falmouth and Bodmin masses, and yields no evidence of Dartmoor detritus. A number of new occurrences of dumortierite are recorded.

Society of Public Analysts, April 3.—**L. H. Lampitt, E. B. Hughes, and H. S. Rooke**: Furfural and diastase in heated honey. Modifications of Fiehe's test and the aniline acetate test for furfural have been devised. If honey gives pronounced reactions with both of these tests it is probably adulterated, unless there is evidence that it has been strongly heated. Such honey has usually been found to be caramelised and unfit for use. Honey contains two diastatic enzymes, for it reacts with starch, yielding both dextrins and reducing sugars. If it is heated above 85° C. its diastatic activity is very rapidly destroyed.—**J. W. Haigh Johnson**: Further notes on methods of sewage and water analysis; anti-oxidation and stabilisation of pollution. Comparative results on river waters have shown that the Graph Standard method is much to be preferred to the Royal Commission's test. Three main types of biological oxidation curves are recognisable for polluted liquids: (1) Unstable type, characterised by very rapid, fairly uniform absorption of not more than five days' duration, followed by: (2) semi-stable type, having greatly diminished but very uniform oxidation rate, of indefinite duration, until: (3) nitrification supervenes. From one-third to two-thirds of the chemically determined organic matter is recovered from sewage during purification without any appreciable absorption of oxygen. The effect of oxygen is apparently to oxidise unstable substances, whilst semi-stable substances are stabilised and precipitated as a relatively non-oxygen absorbing mud of increasing stability.—**B. J. F. Dorrington and A. M. Ward**: Potassium cyanate as a reagent for the detection of cobalt. Potassium cyanate reacts with cobalt to form a blue complex. The test, which is most sensitive when the reagent is used in alcoholic solution, will detect cobalt in a one-hundredth molar solution of cobalt nitrate.

EDINBURGH.

Royal Society, Mar. 4.—Hans Przibram: Quanta in biology. The movements of cold-blooded animals follow van 't Hoff's law; so also do many other processes of the living organism. It is suggested that the dissociation of ultimate particles to which the characteristics of life are attached is responsible for the exhibition of this phenomenon. A statistical conception which accounts for the decrease of the temperature coefficient with the raising of the temperature is developed. Przibram's work on the discontinuous growth of the Mantidæ and the conclusions of Koltzoff and Heidenham lead to an attempt to introduce a more systematic notion of fundamental quanta in biology.

PARIS.

Academy of Sciences, Mar. 11.—R. Bourgeois: Concerning the programme of the expedition organised by the Bureau des Longitudes for the observation of the total eclipse of the sun of May 9, 1929. The station chosen for the observatory is the island of Bai-Kan: an outline of the scheme of observations proposed is detailed.—Jules Richard was elected *correspondant* for the Section of Geography and Navigation in the place of the late Roald Amundsen.—Jacob: Addition to the note "The application of the generalised integrals of Fourier to the calculus of probabilities."—A. Th. Masloff: An application of the theorem of Eisenhart.—Bertrand Gambier: Imaginary deformations of real surfaces: cyclic systems.—Marcel Vasseur: The relations between the two focal sheets of a rectilinear congruence.—C. Popovici: Functional equations and their parallelism with differential equations.—Georges Giraud: The solubility of the generalised problem of Dirichlet.—Georges Calugaréano: The calculation of the M exceptional values of integral functions of finite order.—Victor Vâlcovici: Generalisation of the theorem of Kœnig.—Benjamin Jekhowsky: Calculation concerning the positions of the minor planets.—L. d'Azambuja: The structure of the solar chromosphere.—L. Driencourt: The choice of the projection to be adopted for aerial navigation maps.—Vasilesco Karpen: Demonstration of the relations of Maxwell-Clausius and of Clapyron.—S. Piña de Rubies: The arc spectrum of samarium. Measurements made at the normal pressure between 3100 A. and 2750 A.—Jean Savard: The ultra-violet absorption spectra of the ortho-, meta-, and para-cresols.—G. Jausseran: The evolution of the latent image. The relations between the density of the image and the time elapsed between the exposure and the development are shown graphically. The effects of the evolution of the latent image are considerable and must be taken into account in the photographic comparison of two non-simultaneous luminous intensities.—G. Athanasiu: The inversion of the photovoltaic effect by the OH and H ions.—Eugène Cornec and Henri Krombach: The ternary system: water, sodium nitrate, potassium nitrate. This system has been studied through a wide range of temperatures: a general outline of the results is given.—Horacio Damianovitch: The action of helium upon platinum. The product obtained by the action of helium upon platinum under the influence of a moderate electric discharge at low pressures presents properties clearly distinct from those of the metal itself, and it retains helium in a fairly stable form.—Ed. Bayle and L. Amy: The estimation of the hydrofluosilicic anion and that of fluorine in general.—Marcel Godchot and Mlle. Cauquil: The methylation of cycloheptanone. This ketone, treated with sodium amide and methyl iodide, gives rise to α, α-dimethyl-cycloheptanone and an α-methylcycloheptanone, the first being formed in relatively small quantity.—M. Battegay, H. Buser, and E. Schlager: A crystallised acetin and diglycide.—R. Cornubert and Ch. Borrel: Contribution to the study of the ketonic function.—Mlle. E. Jérémine and P. Fallot: The presence of a variety of jumillite in the neighbourhood of Calasparra (Province of Murcia).—Alberto Betim: The theory of Wegener in the light of some geological observations concerning Brazil.—G. Baeckeroot: The extension of the *Pierre de Stonne* in the Grand Duchy of Luxemburg.—Albert Michel Lévy: The existence of a level characterised by touchstones with Radiolaria at the base of the marine Carboniferous, in le Morvan.—M. Couvreur: The general structure of the shells of gastropods.—C. E. Brazier: Actinometric data for the region of Paris from measurements made at the Observatory of Parc Saint-Maur. The average quantity of heat received in one year by one square centimetre of the earth's surface in the climate of Paris is 93 large calories.—Marcel Mascré: New remarks on the fixation of the chondriome of the plant cell.—Guilliermond: New observations on the vital coloration by neutral red in plant cells.—Georges Montandon: An ape of anthropoid appearance in South America.—Ph. Joyet-Lavergne: The relations between metabolism and cytoplasmic sexualisation.—Raymond-Hamet: Tropine and atropine.—René Hazard and Michel Polonovski: The rôle of the tertiary amine function in the dipiperidine nucleus.—Raymond Poisson: *Paracoreomyces Thaxteri*, a parasite of *Stenocorixa protrusa*.—F. Diénert and P. Etrillard: The sterilisation of water by chlorine. The experiments described are opposed to the view that the sterilisation of contaminated water is due to an abiotic radiation, but are in agreement with the older hypothesis of direct action of the chlorine on the micro-organism.

GENEVA.

Society of Physics and Natural History, Feb. 7.—Ed. Parejas: Geological observations in Corsica. (1) The Razzo Bianco near Venaco. The alpine dynamic metamorphism has determined in the limestone elements of the base of the nummulitic conglomerates of Venaco a fibrous texture of the calcite, and this is again met with in the limestones of Razzo Bianco. The latter must therefore have been marmorised during the Tertiary Alpine paroxysm. A later and weaker thrust has carried the Razzo Bianco limestones on to the granite.—R. Wavre: A new method in geodesy. The author shows that, starting with a method that he has given in his earlier communications, some important classical results of higher geodesy can be co-ordinated and new results obtained. This method consists essentially in employing a development in a convergent series where Laplace and Poincaré made use of a divergent development. Hence the method conforms to the desideratum formulated by Tisserand. The exact formula for the flattening is also given by M. Wavre.—W. Schopfer: Theoretical remarks on the question of the metabolism of the sexes. The author examines the old theory of the metabolism of the sexes (♀ anabolism and ♂ catabolism); he shows that if, when expressed too rigidly, it appears inexact, nevertheless modern researches give it some experimental support. The sexual metabolic differences occur even in the Mucorineæ, where the morphological differentiation of the sexes is scarcely noticeable.

VIENNA.

Academy of Sciences, Jan. 17.—A. Zinke and N. Schniderschitsch: Researches on perylene and its derivatives (22).—A. Pischinger and D. Boerner-

Patzelt: The sarcosome problem. When the surviving thorax muscle of insects was observed fresh, there was no trace of granulations until Ringer's solution was run under the cover-glass. But all sections of fixed insect thorax muscles showed sarcosomes.—**H. Hahn**: The integral concept.—**K. Menger** (1): The new definition of arc length.—(2) A further generalisation of the concept of length.

Jan. 24.—**A. Tornquist**: The perimagmatic lead-copper-silver-zinc ore deposits from Offberg in the Remschnigg.—**L. Kober**: The Salzberg of Hallstatt.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 1, Jan. 15).—**Arthur G. Scroggie** and **George L. Clark**. The crystal structure of anhydrous silicotungstic acid and related compounds, and their probable molecular formulæ. Acids with 7, 8, and 10 tungsten atoms have been isolated. Those with 8, 10, and 12 tungsten atoms crystallise as body centred cubes, there being a central stabilising SiO_4 group.—**Wilder D. Bancroft** and **H. L. Davis**: Binary solutions of consolute liquids.—**Herbert J. Brennen**: A new equation of state. A mathematical development of van der Waals' equation.—**Duncan A. MacInnes** and **Irving A. Cowperthwaite**: The effect of diffusion at a moving boundary between two solutions of electrolytes. In measuring the transfer number of an electrolyte by timing the moving boundaries, interrupting the current for periods up to 30 min. has no effect on the results. The boundary fades away, but gradually reappears on switching on the current. Diffusion occurs, but the potential gradient set up quickly restores the sharp boundary.—**Carl Barus**: Adiabatic expansion in case of vanishing increments.—**Paul S. Bauer**: The condition of self-oscillation of a general triode system. A mathematical discussion.—**Benedict Cassen**: On the symmetry of protonic wave functions.—**W. Uyterhoeven**: Positive ion currents in the positive column of the glow-discharge in the noble gases.—**E. L. Kinsey**: Note on the *D* line excitation by the green sodium band and the dissociation potential of sodium vapour (see NATURE, June 9, 1928, p. 904).—**Einar Hille** and **J. D. Tamarkin**: On the summability of Fourier series (Second note).—**H. S. Vandiver**: Summary of results and proof concerning Fermat's last theorem (Third paper).—**Dietrich C. Smith**: The direct effect of temperature changes upon the melanphores of the lizard *Anolis equestris*. Between 8° and 43° C. their behaviour in isolated pieces of skin is controlled by illumination. Outside these limits, cold generally produces 'expansion,' and further heat 'contraction,' independently of illumination.—**Henry B. Ward**: Further studies on the influence of a power dam in modifying conditions affecting the migration of the salmon. Sockeye salmon migrating up the Baker River seem to avoid the fish ladder provided at the dam, possibly owing to some bad quality of the water. The down-stream movement of young sockeyes seems to be decreasing; they may be forming a physiologically landlocked race in the artificial lake caused by the power dam.—**David I. Macht**: Pharmacological synergism of stereoisomers. When the effect of a combination of two or more drugs is different from the added effects of the separate drugs, this is termed synergism. Many drugs show the effect. The different optical forms of nicotine, epinephrin, camphor, hyoscyamin, hyoscin, quinin, and cinchonin were tested. Generally the combination of an optical pair gives a much greater effect than either separately. If animal or plant cells have receptor groups of a lævo and dextro type, mixtures of optical pairs have two points of attack, thus accounting for the effect.

Official Publications Received.

BRITISH.

Report of the Department of Industries, Madras, for the Year ending 31st March 1928. Pp. vii+103. (Madras: Government Press.) 12 annas.

Journal of the Indian Institute of Science. Vol. 11A, Part 19: i. Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.), Part 4: Chemical Composition of Healthy and Spiked Sandal Stems, by D. A. Rama Rao and M. Sreenivasaya; ii. Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.), Part 5: Transmission of Spike by Budding, by M. Sreenivasaya and G. Gopalaswami Naidu. Pp. 241-247+8 plates. (Bangalore.) 1 rupee.

Legislative Assembly (Second Session), New South Wales. Report of the Director-General of Public Health, New South Wales, for the Year 1927. Pp. vi+208. (Sydney, N.S.W.: Alfred James Kent.) 10*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19, N.S., Nos. 14-18. 14: On the Structure of *Palæacis*, by Dr. Louis B. Smyth; 15: William Higgins, a Pioneer of the Atomic Theory, by Dr. J. Reilly and D. T. MacSweeney; 16: The Integration of Light by Photo-electrolysis, by Dr. W. R. G. Atkins and Dr. H. H. Poole; 17: A Note on Gas Analysis, by James T. Donnelly, C. Hamilton Foott and Dr. J. Reilly; 18: The Photo-electric Measurement of the Illumination in Buildings, by Dr. W. R. G. Atkins and Dr. H. H. Poole. Pp. 125-188+plates 6-8. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 5*s*.

The Realist: a Journal of Scientific Humanism. Published for the Realist Publishing Co., Ltd. Vol. 1, No. 1, April. Pp. 192. (London: Macmillan and Co., Ltd.) 2*s*. net.

Far Eastern Association of Tropical Medicine. Transactions of the Seventh Congress held in British India, December 1927. Edited by Lieut.-Col. J. Cunningham. Vol. 1. Pp. xl+865+61 plates. (Calcutta: Thacker's Press and Directories, Ltd.)

Transactions of the Optical Society. Vol. 30, No. 2, 1928-29. Pp. iv+49-100. (London.)

The Institute of Physics. List of Members, January 1, 1929. Pp. 24. (London.)

Transactions of the Rochdale Literary and Scientific Society, with a Record of the Proceedings of the Jubilee Celebrations. Vol. 16, 1926-1928. Pp. 128+xlvi. (Rochdale.)

Journal of the Chemical Society: containing Papers communicated to the Society. March. Pp. iv+357-589+x. (London.)

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1928. (No. 77.) Pp. 84+3 plates. (Marlborough.) 5*s*.; to Members, 3*s*.

Transactions of the Royal Society of Edinburgh. Vol. 16, Part 1, No. 8: The Oogenesis of Carcinas mœnas Penn., with special reference to Yolk Formation. By L. A. Harvey. Pp. 157-174+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3*s*.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 10: The Health and Nutrition of Animals. Reports by Sir Arnold Theiler and Dr. J. B. Orr. Pp. 76. Bulletin No. 40: Observations on the Hydatid Parasite (Echinococcus granulosus) and the Control of Hydatid Disease in Australia. By I. Clunies Ross. Pp. 63. (Melbourne: H. J. Green.)

The Indian Forest Records. Entomology Series, Vol. 13, Part 6: On some New Indian Coleoptera, Hemiptera and Thysanoptera. Part i: Neue Indische Lycidae, nebst faunistischen Bemerkungen (Lycidae, Col.), von R. Kleine; Part ii: A new Agrilus from India (Buprestidae, Col.), by A. Thery; Part iii: New Species of Cicadidae and Fulgoridae from India and Burma (Hemip.), by O. C. Ollenbach; Part iv: A new Subgenus and Species of Tingis from Burma (Tingitidae, Hemip.), by Carl J. Drake; Part v: New Thysanoptera from India, by Dudley Moulton. Pp. iii+48+5 tafeln+2+12+1 plate+2+8. (Calcutta: Government of India Central Publication Branch.) 1.6 rupees; 2*s*. 3*d*.

Department of the Interior, Canada: Topographical Survey. Bulletin No. 60: A Study of the Dominion Standard Yard and other Standards of Length. By R. H. Field. Pp. 40. (Ottawa: F. A. Acland.)

Rhodesia Museum, Bulawayo. Twenty-seventh Annual Report, 1928. Pp. 14. (Bulawayo.)

FOREIGN.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 4, No. 1, Fasc. 1. Pp. 182+11 plates. (Tokyo and Sendai: Maruzen Co., Ltd.)

Journal of the Faculty of Science, Imperial University of Kyoto. Section 4, Zoology, Vol. 1, Part 5: Studies on the Calcareous Sponges of Japan. By Prof. Sanji Hôzawa. Pp. 277-389+plates 12-23. (Tokyo: Maruzen Co., Ltd.) 8.00 yen.

Scientific Papers of the Institute of Physical and Chemical Research. No. 177: Experimental Studies on Form and Structure of Sparks, Part 5. By Torahiko Terada, Ukitirô Nakaya and Ryûzô Yamamoto. Pp. 43-68+18 plates. 70 sen. No. 178: Katalizeca malkombiniĝo de karbono unuoksida. 1: Fero kiel katalizanto. De Hirosi Tutiya. Pp. 69-82+plate 19. 30 sen. No. 179: Untersuchung der Dekahydrochinolderivate. 5 Mitteilung: Synthese des trans-o-Dimethylamido-n-propyl-cyclohexans und die Wasserspaltung des o-n-Propyl-cyclohexanols. Von Shin-ichiro Fujise. Pp. 83-89. 20 sen. No. 180: Physico-chemical Studies on Bioluminescence. 7: The Solubility of Cypridina Luciferin in Organic Solvents. By Sakyo Kanda. Pp. 91-98. 15 sen. No. 181: Stark Effect of Helium 2P-6D line by Quantum Mechanics. By Yoshio Fujioka. Pp. 99-106+plate 20. 25 sen. (Tôkyô: Iwanami Shoten.)

Department of Commerce: Bureau of Fisheries. Bureau of Fisheries Document, No. 1045: The Public Aquarium; its Construction, Equipment and Management. By Charles Haskins Townsend. (Appendix 7 to the Report of the U.S. Commissioner of Fisheries for 1928.) Pp. 249-337. (Washington, D.C.: Government Printing Office.) 25 cents.

United States Department of Agriculture. Technical Bulletin No. 77: The Host Plants of the European Corn Borer in New England. By Benjamin E. Hodgson. Pp. 64. (Washington, D.C.: Government Printing Office.) 30 cents.

Observations and Investigations made at the Blue Hill Meteorological Observatory in the Year 1928 under the direction of Prof. Alexander McAdie. Pp. 29+36 plates. (Cambridge, Mass.)

University of California Publications in American Archaeology and Ethnology. Vol. 25, No. 2: Mentawei Religious Cult. By Edwin M. Loeb. Pp. 185-247+plates 69-73. 80 cents. Vol. 25, No. 3: Tribal Initiations and Secret Societies. By Edwin M. Loeb. Pp. 249-288. 50 cents. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

Deutsche Seewarte. Aus dem Archiv der Deutschen Seewarte. Band 46, Nr. 3: Gezeitenuntersuchungen in der Deutschen Bucht der Nordsee. Nach Beobachtungen an Bord des Vermessungsschiffes *Panther* im Juni 1924. Im Auftrage der Deutschen Seewarte bearbeitet von Dr. H. Thorade. Pp. 85+4 Tafeln. (Hamburg.)

Department of Commerce: Bureau of Standards. Research Paper No. 45: Apparatus and Methods for the Separation, Identification and Determination of the Chemical Constituents of Petroleum. By Edward W. Washburn, Johannes H. Bruun and Mildred M. Hicks. Pp. 467-488+5 plates. 10 cents. Research Paper No. 46: Recombination Spectra of Ions and Electrons in Cæsium and Helium. By F. L. Mohler and C. Boeckner. Pp. 489-500. 5 cents. Research Paper No. 49: Discharge Coefficients of Square-edged Orifices for Measuring the Flow of Air. By H. S. Bean, E. Buckingham and P. S. Murphy. Pp. 561-658+2 plates. 20 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 74, Art. 13: Tschermigite, Ammoniojarosite, Epsomite, Celestite and Paligorskite from Southern Utah. By Earl V. Shannon. (No. 2758.) Pp. 12. Vol. 74, Art. 15: The Fossil Crinoid Genus *Vasocrinus* Lyon. By Edwin Kirk. (No. 2760.) Pp. 16+2 plates. Vol. 74, Art. 21: Miargyrite Silver Ore from the Randsburg District, California. By Earl V. Shannon. (No. 2766.) Pp. 10. Vol. 74, Art. 24: Notes and New Species of American Moths of the Genus Scoparia Haworth. By Harrison G. Dyar. (No. 2769.) Pp. 9. Vol. 74, Art. 25: A New Salamander from Southern California. By Emmett Reid Dunn. (No. 2770.) Pp. 3. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

FRIDAY, APRIL 19.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Presentation of the Guthrie Medal to Dr. C. E. Guillaume.—Prof. W. R. Bridgman: The Properties of the Elements under High Pressures (Guthrie Lecture).

BRITISH INSTITUTE OF RADIOLOGY (Medical), at 5.—Informal Discussion on Bone-Diseases (especially Multiple Myeloma).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. Reavell: The Standardisation of Keys and Keyways.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section) (Annual General Meeting), at 6.15.—V. E. Connor: The Manufacturing and Testing of Submarine Cables.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—B. Chambers and F. W. Sharp: Carbon and Carbro.

SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at 7 Gordon Street, Glasgow), at 7.15.—Annual General Meeting.

WEST BROMWICH ENGINEERING SOCIETY (at Kenrick Technical College, West Bromwich), at 7.30.—D. G. Mackintosh: The Erection of Steel Bridges.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: Early Aviation (Lecture).

INSTITUTE OF BRITISH FOUNDRYMEN (Sheffield Branch) (Annual Meeting) (at Albany Hotel, Sheffield), at 7.45.—Recent Developments in Cupola Control.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. S. G. Scott: Myeloma—Differential Diagnosis.—Dr. J. D. White: Bone Lesions in Tropical Diseases.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. Owen T. Jones: History of the Grand Canyon, Yellowstone National Park.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Annual General Meeting.

SATURDAY, APRIL 20.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Southern District) (at Council House, Bristol), at 10.30 A.M.—H. F. Proctor: Description of the New Power Station, Portishead.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—C. H. Leeds: Boring against Workings likely to contain an Accumulation of Water or other Liquid Matter, and a Method of Negotiating a Fault.—C. N. Kemp: The X-Ray Analysis of Coal: the Radiographic Variables and their Control.—Papers open for discussion:—Roof Control on Longwall Faces, J. F. C. Friend; Diamond Boring Applied to Tapping Drowned Areas Underground, F. E. Smyth; Land Drainage, H. C. Pawson; The Laws of Motion of Particles in a Fluid, R. G. Lunnon.

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow).—Annual Meeting.

MONDAY, APRIL 22.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 4.—Miss E. R. G. Taylor: Roger Barlow: an Early XVIth Century Geographer.

VICTORIA INSTITUTE, at 4.30.—Dr. A. T. Schofield: Humanity.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.30.—Informal Discussion on The Engineer as a Salesman.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Loughborough College), at 7.—H. M. Smith: Steering Gears.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Sheffield University), at 7.—Dr. H. J. Gough: Recent Developments in the Study of the Fatigue of Metals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Kinematograph Group), at 7.—H. A. Carter: The De Vry 16 mm. Synchronised Sound Motion Picture Apparatus, with Projection of Films and Synchronised Gramophone Records.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—J. Begg: The Work of George Wittet.

ROYAL SOCIETY OF ARTS, at 8.—Sir E. Denison Ross: Nomadic Movements in Asia (Cantor Lectures) (II.).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—G. Northcroft: The Migration of a Foreign Body.—S. Friel: The Relation of Function to the Size and Form of the Jaws.

ROYAL GEOGRAPHICAL SOCIETY (at Polytechnic, Regent Street), at 8.30.—G. M. Dyott: The Search for Col. Fawcett (with Kinematograph Films).

TUESDAY, APRIL 23.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. O. Leyton: How can we decide whether a case of Glycosuria should be treated?—Dr. W. T. Munro: Pulmonary Tuberculosis due to Bovine Tubercle Bacilli.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: (*a*) Report on the Additions to the Society's Menagerie during the month of March 1929; (*b*) Exhibition and Note on the Society's Scientific Publications.—S. G. M. Ramanujam: The Study of the Development of the Vertebral Column in Teleosts, as shown in the Life-history of the Herring.—Prof. E. B. Poulton: British Insectivorous Bats and their Prey.

INSTITUTION OF CIVIL ENGINEERS, at 6.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.) (Bacot Memorial Meeting), at 6.30.—R. S. Bagnall: Plants and their Insect Associates.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. R. Ward: Some Continental Zoos.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—H. W. Pitt: Central Lubrication of Chassis Bearings.

WEDNESDAY, APRIL 24.

EUGENICS SOCIETY (at Royal Society), at 5.15.—C. J. Bond: Hemilateral Asymmetry in Animals and Man, and its Relation to Cross-breeding (Lecture).

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Caxton Hall), at 5.30.—C. F. Dendy-Marshall: The Rainhill Locomotive Trials of 1829.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—R. Murray-Hughes: The Geology of Part of North-Western Rhodesia; with Petrographical Notes by A. A. Fitch.

ROYAL SOCIETY OF ARTS, at 8.—Lynton Fletcher: Recent Developments in Educational Broadcasting.

THURSDAY, APRIL 25.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—S. D. Chowla: Some Formulæ Connected with Gauss's Sums.—Doris M. Hirst: On Expansions which are Formally Reduced to Zero by the Operator Sinh $D-cD$.—Prof. E. W. Hobson: On a Generalisation of Watson's Expressions for Legendre's Functions.—Prof. R. L. Jeffery: The Continuity of a Function Defined by a Definite Integral.—J. Tennant: Nasik or Pandiagonal Squares of the Order of any Odd Prime.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, W.2), at 5.—Sir Almroth E. Wright: The Experimental Method in Medicine.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Sir Harold Hartley: Theodore W. Richards Memorial Lecture.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 5.30.—Dr. P. J. Cammidge: Prostatectomy in Diabetics.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. G. C. Simpson: Lightning (Kelvin Lecture).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Squadron-Leader C. L. Scott: By Flying Boat to India.

FRIDAY, APRIL 26.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—T. Smith, Dr. G. F. C. Searle, Instructor-Capt. T. Y. Baker, Dr. J. W. French, W. E. Williams, C. G. Vernon, H. H. Emsley, C. W. Hansel, H. Tunley, L. Moore, Conrad Beck, V. T. Saunders, and Dr. C. V. Drysdale: Discussion on The Teaching of Geometrical Optics.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 7.—E. A. Salt: Platinotype.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at University College, Dundee), at 7.30.—W. Holmes: Load-levelling Relays and their Application in connexion with Future Metering Problems.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. J. G. Thomson: Endemic Malaria in Southern Rhodesia.

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at National Institute of Industrial Psychology), at 8.—J. N. Langdon: Evidence of a Central Factor in Tests of Manual Dexterity.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. R. W. Chambers: English Civilisation from Alfred to Harold, 900–1066.

PUBLIC LECTURES.

MONDAY, APRIL 22.

THE UNIVERSITY, GLASGOW, at 5.—Sir Norman Walker: Medical Education and Qualification in the United States.

TUESDAY, APRIL 23.

GRESHAM COLLEGE (Basinghall Street), at 6.—A. R. Hinks: Latitudes and Longitudes (Gresham Lectures). (Succeeding Lectures on April 24, 25, and 26.)

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—C. E. Stromeyer: What Health and Civilisation owe to Engineering (Chadwick Lecture).

WEDNESDAY, APRIL 24.

UNIVERSITY OF BIRMINGHAM, at 4.30.—Dr. C. Singer: Epochs of Medical History. (Succeeding Lectures on May 1 and 8, June 19 and 26.)

MANSION HOUSE (arranged by British Science Guild), at 4.30.—Developments of British Chemical Manufactures. Lord Melchett in the chair.—Sir Frederick Keeble: Fertilisers from the Air.—A. B. Shearer: Rayon (Artificial Silk).—F. H. Carr: Synthetic Drugs.

FRIDAY, APRIL 26.

WORLD ASSOCIATION FOR ADULT EDUCATION (16 Russell Square, W.C.1), at 8.30.—Miss R. M. Fleming: Soil and Civilisation in Russia.