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The Great Barrier Reef.

ELSEWHERE in this issue an account is given of the expedition shortly to visit the Great Barrier Reef, one of the chief natural wonders of the world, a breakwater built by still-living organisms along a continental coast for 1300 miles. Starting from Harvey Bay, 120 miles north of Brisbane, the reef extends from lat. 25° S. to join up to New Guinea in 9° S. Much broken in its southern two degrees, where is the great Capricorn Passage, by which ships enter, the barrier soon becomes more marked, until in places it forms an almost continuous breakwater, the edge becoming again less defined as the influence of the water of the Fly River is felt. Its distance from the mainland varies from more than 100 miles in the north and south to an average of not more than 30 miles over a long stretch in the middle, though in places outstanding capes reduce the enclosed channel (lagoon) to less than ten miles in breadth. Cairns, the chief town near the proposed headquarters of the expedition, is situated at the south end of this area about lat. 16° 30′ S. Near it are broad channels through the great seaward reef, and a fairly clear lagoon, though with reefs exposed at low tide. About half-way to the outer barrier lies a small reef with an islet, upon which the members of the expedition will camp, absolutely in the centre of their work.

The Barrier Reef was first explored by Capt. Cook, and it was a little north of Cairns where he ran on to a reef, afterwards careening his ship for repair in Endeavour River, now the site of Cooktown. His course thence was inside the reef for about 70 miles, but navigation for sail was difficult within the narrowing lagoon, and he passed out to seaward, afterwards re-entering through Providential Channel, 150 miles north, and exploring Torres Straits. The coast bristles with his names, among which may be cited Capes Upstart, Flattery, Capricorn, and Tribulation, Repulse and Trinity Bays, Possession Island and Thirsty Sound. Other explorers were King, Flinders, and Bligh, but the first systematic survey was by H.M.S. *Fly* and *Bramble* in 1842–6 under Capt. Blackwood, with J. Beete Jukes as naturalist to the survey. This was merely carrying on the generous hospitality of the Admiralty to scientific men, so profitable in the association of Banks with Cook, and continuous from then for 160 years to the present day. This survey followed on that of the Maldive Islands by Capt. Moresby in the previous decade, and laid the foundation of the accurate knowledge of the topography of great reef areas.

Both surveys were remarkable achievements

with the instruments and means at that time at the disposal of the surveyors, and that of the *Fly* materially assisted in the opening up of Queensland. Some of the barrier was shown to consist of linearly extending reefs, while in other places it was represented by a series of ring- or atoll-shaped structures. The passages through this reef have clearly no close correlation with the drainage of the land, for the north of Queensland drains rather to the west than to the east. The enclosed lagoon has nowhere a greater depth than 50 fm., and in few places more than 30 fm. It was found to be studded with many shoals, most of which reach the surface and there spread out, submerged ridges and patches being comparatively scarce. Outside, in the Coral Sea, were discovered a whole series of reefs, some with cays, all within the 1000 fm. line and extending towards New Caledonia. To the north is a deep of about 2500 fm., lying south of the eastern horn of New Guinea, just north of which is the tiny Planet Deep (4998 fm.), surrounded on three sides by land. Lastly, it was shown that an elevation of less than 10 fm. would join Australia to New Guinea, and that shallow water extended far west, the north of Australia having indeed one of the largest areas of shallow sea in the world.

The views of Darwin on the formation of coral reefs were published in 1837, and his wonderful book on the subject in 1842. The suggestion of subsidence as the predisposing cause in the formation of reefs met with almost universal acceptance, and for the Barrier Reef was endorsed by Savile Kent, who presented a book of delightful photographs rather than of scientific consideration. Indeed, he only sought spots for his hobby, and we have to fall back upon Jukes for accurate and studied observations. Murray doubted whether Darwin's views had the general applicability demanded, and Alexander Agassiz differed *in toto* after visiting the Barrier Reef in 1896 in very bad weather. The first boring at Funafuti was then being undertaken, and a subsequent boring showed a vertical thickness of 200 fm. of limestone material. Other workers proved that this could not have been directly formed by upgrowth at a greater depth than 50 fm., for 'reef-building' corals were shown to depend for their nutrition on commensal algæ, and all plant growth stops below this same depth owing to an absence of sufficient light. At the same time, heavy, stony algæ (Lithothamnioneæ) were seen to be the main reef builders in shallow water under heavy seas, with other herbaceous calcareous forms to provide small material to fill up any hollows. It was stated that the lagoon topography was not consistent with subsidence and that lagoons are being added to by solution of limestone. To this was added the removal of fine material in suspension to form vast areas of coral mud covering some millions of square miles of the ocean floor in coral regions.

Research was mainly directed on the subsidence side to the study of the embayments of islands, and Prof. Davis has pointed out the extraordinary resemblance between the coasts within the Great Barrier Reef with its numerous capes and outlying islets to those of Fiji, Tahiti, and other groups, which he claims proves his contentions. On the whole, the geological study of elevated reefs in Fiji, West Indies, and other lands is said to help on the same side; but anomalies exist, and there is often difficulty in settling the geological periods of the limestones. Meantime the history of Falcon Island, Tonga, has given striking proof of the possibility of the views of Wharton that many of the isolated atolls and submerged atoll banks of the world have foundations produced by submarine eruptions, the products of which are loose material, easily cut down to 40 or 50 fm. by the waves.

A discovery of volcanic ash off Providence Reef, between Madagascar and Seychelles, gives confirmation of this view, and indeed is the first definite indication of the foundations of any existing reef. Next came the gradual appreciation of the fact that most coral islands largely owe their existence to a change of level of at least 10 feet in the sea, a change usually explained by polar glaciation. Finally, Daly suggested that by the same means an alteration of as much as 250 ft. was possible, and that land, cut down to sea-level by oceanic agencies, might, by the melting of the polar ice caps, be submerged to this depth and so provide foundations for extensive post-Pleistocene reefs. This view would seem peculiarly attractive as applying to the Great Barrier Reef area, but Prof. Davis points out that the broadness of the continental slope off Queensland as compared with its narrowness in the southern half of the same coast is not consistent with the view, and that there are also material differences in the two coast lines.

Thus the controversy went on until the Governor of Queensland (the Right Hon. Sir Matthew Nathan), Prof. Richards, and others, formed the Great Barrier Reef Committee of Australia, recognising that the problem could only be solved by repeated observations on a coral reef area, preferably connected with a great land mass, the geological conditions of which could be studied for hundreds of miles inland. The Great Barrier Reef lies near the centre of the disturbance of earth movements,

which, according to one theory, produced arcs of reefs and islands on the crests of earth waves flowing over the Pacific. It also fringes part of a continent where the newer problems of weight pressures (isostasy) are being considered. The committee studied the geology of coastal areas, examined reefs and islands, and finally put down a boring on a reef near Cairns in the lagoon channel. It met with very great difficulties, owing to the loosely coherent nature of the material in the bore, but reached 100 fm. The bottom part contained many foraminifera and other organisms, which occur under quite shallow water conditions and on reef flats, so that, if the living forms are confined to such depths and are in their place of growth in the bore, there has been a subsidence of 600 ft.

In 1913 the late Dr. A. G. Mayor had made an ecological survey of Murray Island at the north end of the Great Barrier, mapping out the zones of life and correlating the distribution of species of corals with physical conditions. These he continued from 1915 until 1920 in Samoa, testing his conclusions experimentally by transplantation and other experiments. The biological work of the Australian committee had cognisance of this, but all the plans for further development were held up by the death of Mr. Charles Hedley, the biological director, and also, no doubt, by the universal scarcity of competent marine biologists. In these circumstances the committee invited the formation of a British committee to send out a biological expedition for the study of the many problems that arose as to the feeding, the rate of growth, the seasonal reproduction, the distribution, etc., of corals, foraminifera, sponges, and marine algæ, and as to the interrelations of these forms to one another in the building of reefs.

A study of the organisms together should lead to conclusions as to whether surface reefs are growing out, either seawards or lagoonwards. Linear surface changes can be perhaps better ascertained by aerial photography with three fixed permanent marks on some small reefs, these being repeated each decade; but unfortunately the changes are often subsurface, and sounding and dredging have to be undertaken as well. These should also give an account of upgrowth and loss on the lagoon floor, and for the former the association of the organic complex with temperature, with salinity, with acidity of the sea (pH) and with currents acting as food carriers, is all-important. Half-a-dozen genera of foraminifera, forming part of the cementing sand, live in the floating plankton of the outer ocean and pass within the reefs to destruction. Many of the building animals feed on small animal and plant organisms of the same habitat, and the plant builders depend on nitrates, largely produced there, as well as upon sunlight. The nutrition of the organic life is ultimately a matter of the chemical constituents and of the physical conditions of the water, and the governance of the varied seasons of reproduction is almost certainly the same, phenomena never up to the present studied in tropical seas. The expedition is to camp in its little area and to make weekly observations on such matters for twelve consecutive months. In its plan is revealed the advance of science, research directing its aims to the basal conditions governing all organic life, the period of general explorations being largely passed.

Finally, the Great Barrier Reef, with its 100,000 square miles of area capable of being developed for economic ends, may well be a matter of importance to the Empire in the future, and the close study of coral growth should at once yield results of value to navigators in all coral seas. Fish become of value in proportion to their quality, to their quantity, and especially to the distance of the fishing grounds from dense areas of consumption. As yet they may be of little importance, but the advance of freezing processes has brought to the fore the catching and distribution of fish from all seas. There is also the sea slug (trepang), an elongated starfish, dried and exported to China for soup. Good eating oysters are to be found in places, as well as many other edible molluscs. Next comes the pearl shell, used for buttons, for inlay, and for all sorts of beautiful ends, its value increased almost half by its contained pearls. There is a world shortage now in this, and the supply can no longer be left to Nature, since its possibilities of cultivation are proved; and Torres Straits is the home of its most valuable species. The uncontested sovereignty of the British Empire over the Great Barrier Reef from shore to ocean, however broad, suggests peculiar potentialities for such farming. Depths, too, are suitable for sponges, which likewise have to be grown by man, and there are other shells and products that can be sold. For all these—and indeed for fisheries of all classes—the first knowledge required is that of the water and its contained food, for these are fundamental to the knowledge of the optimum conditions of growth, of reproduction, and of distribution, on which commercial success depends.

We need say no more except to commend most highly this new development in research, the co-operation in equal partnership towards the highest scientific aims of committees thoroughly representative of Great Britain and Australia. We

feel that this is as things should be, and we trust that no questions of finance or of personnel will hinder the successful prosecution of this expedition. The sunshine of the tropics brings into prominence biological processes, such as the metabolism of lime, which in our northern climate are weakly developed and intermittent. The great Pacific Ocean forms a vast reservoir of water which ensures a constancy never to be found in the North Sea and the fluctuating English Channel. The co-ordinated work of zoologist, botanist, physiologist, chemist, and geographer for twelve consecutive months on the Barrier Reef should furnish results giving a new point of departure for our knowledge of the conditions of all life.

Science and Theology.

(1) *The Way of Modernism: and other Essays.* By the Rev. J. F. Bethune-Baker. Pp. vi + 150. (Cambridge: At the University Press, 1927.) 6*s.* net.

(2) *The Creator Spirit: a Survey of Christian Doctrine in the Light of Biology, Psychology, and Mysticism.* The Hulsean Lectures, Cambridge, 1926–27: The Noble Lectures, Harvard, 1926. By the Rev. Canon Charles E. Raven. With an Appendix on Biochemistry and Mental Phenomena, by Dr. Joseph Needham. Pp. xv + 310. (London: Martin Hopkinson and Co., Ltd., 1927.) 8*s.* 6*d.* net.

(3) *Life in the Stars: an Exposition of the View that on some Planets of some Stars exist Beings higher than ourselves, and on one a World-Leader, the Supreme Embodiment of the Eternal Spirit which animates the Whole.* By Sir Francis Younghusband. Pp. xiv + 222 + 4 plates. (London: John Murray, 1927.) 10*s.* 6*d.* net.

(4) *Contributions of Science to Religion.* By the Rev. Shailer Mathews, with the co-operation of William E. Ritter, Robert A. Millikan, Edwin B. Frost, Edward B. Mathews, C. Judson Herrick, John M. Coulter, Ellsworth Faris, Charles H. Judd, John M. Dodson, Charles B. Davenport, E. Davenport, C.-E. A. Winslow, Horatio Hackett Newman. Pp. xi + 427 + 5 plates. (New York and London: D. Appleton and Co., 1927.) 12*s.* 6*d.* net.

(1) THE theological readjustments which seem called for in consequence of an acceptance of evolution have recently been prominently discussed. Thus the time is opportune for the appearance of Prof. Bethune-Baker's essays. The writer's qualification is that he is an expert in the history of the development of Christian theology, who thus knows exactly what meaning orthodox dogmas originally had for those who formulated them. The importance of the theory of evolution for Christian theology cannot be exaggerated, since it supplies entirely new views both about man and about creation.

"I need not remind you that in our doctrine of Christ we are stating a doctrine both of God and of Man. We interpret Christ according to the ideas we have of God and Man, and our ideas to-day of God and Man are very different from those of Christians of the fifth century" (p. 13).

Man is no longer to be regarded as the victim of a 'fall,' but as the result of a long and painful struggle upwards. Thus, if the traditional anthropology is wrong, the traditional scheme of redemption requires revision. With regard to the traditional doctrine of creation, it depended on a view of God which regarded Him as apart from the world, whereas we tend to conceive of Him as immanent both in the world and in man. The traditional doctrine of the incarnation was framed to fit in both with the idea of fallen man who was apart from and distinct from God, and of a God who was, so to speak, outside His creation. It had to explain how two such incompatible natures could ever come to be combined.

"We do not get much help from our tradional statements of doctrine. Our technical definitions are frankly dualistic. They treat God and Man as two distinct real existences ('substances'), each with its own special characteristics, which are incapable of being blended or fused into one" (p. 100).

Prof. Bethune-Baker holds that the new evolutionary theology must present Christ as the consummator, that is, as one in whom the divine design for man finds expression. This design, which in Christ emerged in fullness, "is at the heart of the universe, the secret of its process, and its goal." This idea is found in the Fourth Gospel, with its doctrine of the divine 'logos,' or purpose, which was visibly embodied, so that "the ideal was seen, full of grace and truth, in all its attractiveness and power of revealing their true selves to men." It is found also, in language of astonishing modernity, in the famous eighth chapter of *Romans*, and elsewhere in the writings of St. Paul. This means that, although in Christ we have "an emergence of a new consciousness and a new quality, a new type, as it were, of manhood," yet the divine purpose which emerged in Him is one with the purpose that has emerged in Nature and in man. That is to say, there is no gulf between man and God; they are not incompatible substances. This is the sort of Christian theology, essentially orthodox as it is, which students of

science can understand ; and Prof. Bethune-Baker deserves their gratitude.

(2) Canon Raven's book contains his Hulsean and Noble Lectures. As a distinguished naturalist as well as theologian, he speaks with authority for students of natural science. As Prof. Bethune-Baker's book is a protest against the antithesis between God and man, so Canon Raven's is a protest against a dualism of God and Nature. The manifestation of God in His creation has been neglected.

" There has been a general tendency in Christian thought to regard nature and the natural order, if not as inherently evil, at least as spiritually meaningless, a mere stage on which the divine drama of regeneration was to be played, or even a hostile environment from which men were to be set free " (p. 6).

Yet the modern outlook does not appear to make things easier :

" To earlier generations it was easier to assume that as God had made the world, it must all be very good, save where His plan had been upset by the wiles of Satan. . . . Of the awful indifference and machine-like fixity and terrifying scale of things, as of the evidences of struggle and cruelty and waste and suffering in the animal world, there was little consciousness. The outlook was frankly anthropocentric " (p. 9).

Canon Raven cannot reconcile modern cosmic pessimism with Christian theology. The God who is revealed in Nature must also be the God revealed in Christ (that is, in theological terms, " the Father " and " the Son " must be " of one substance "). This can only be grasped by thinking in terms of creative process. Its lower products may seem incongruous with its higher, but the process is one, and its purpose one. In other words, the unity of the world lies in the law of its development, and what that law is may be seen in the highest product of the process. Here Canon Raven brings us to the same point as Prof. Bethune-Baker, *i.e.* to the Johannine christology. The Word, or Purpose, was in Christ ; in Him " the Word became flesh." Canon Raven interprets the evolutionary process, following Profs. Lloyd Morgan and Alexander, in terms of ' emergence,' and quotes the former as saying that " Emergent evolution is from first to last a revelation and manifestation of divine purpose " (p. 85).

What will specially appeal in this book to working biologists is the well-documented criticism of Weismannism in Chap. ii. ; but the whole work may be said to be the ablest attempt made in recent years systematically to interpret the results of biological science in terms congruous to Christian belief.

(3) Sir Francis Younghusband's speculations about the possibility of life on the stars and of its nature, will interest many. Very few astronomers, perhaps, will have spent night after night, as has Sir Francis, in the waste and silent places of the earth under the vast vault of heaven, beholding " the terrors and splendours of the night." After all, if one star in a million were attended by such another planet as our own, " there would be at least five thousand suitable abodes." The poetic imagination of Dante led him to believe in the existence of such beings as Sir Francis suggests to us : beings far higher than ourselves, who may somehow shed abroad influences to reach as far as ourselves. This book, though speculative, is one of very great charm ; it provides a pleasant antidote to the austere mathematical abstractions to which modern astronomy must confine itself.

(4) Dr. Shailer Mathews has edited a valuable collection of essays by experts in the different branches of natural science. The first part of the book gives us the facts, and the second part tells how this knowledge can be used for the benefit of humanity. The third and final section, written by Dr. Shailer Mathews himself, shows how science justifies the religious life and gives content to religious thought. Altogether a most valuable book, which ought not to be without its effect on the Fundamentalist controversy in America.

J. C. HARDWICK.

Coal Carbonisation.

(1) *Coal Carbonization, High and Low Temperature : a Treatise on the Principles and Processes of Manufacturing Coke and Semi-Coke.* By John Roberts. (The Specialists' Series.) Pp. xvi + 406. (London : Sir Isaac Pitman and Sons, Ltd., 1927.) 25*s.* net.

(2) *Oil and Retortable Materials : a Handbook on the Utilisation of Coal, Torbanite, Cannel and Oil Shale.* By George W. Halse. Pp. vii + 146. (London : C. Griffin and Co., Ltd., 1927.) 7*s.* 6*d.* net.

THESE two books exemplify the activity which is now being displayed in following up the possibilities of the carbonisation process in various directions, and the results of operating by methods removed in varying degrees from the standards of normal coke-oven and gas-works practice, including the treatment of raw materials other than ordinary coal.

In the first and longer work, the stress is laid upon carbonisation as a means of producing different varieties of solid fuel which can be grouped under the name of coke, while Mr. Halse's smaller book is inspired by the purpose of discussing what may be done to increase the production of liquid fuel in Great Britain by the utilisation of such materials as torbanite, cannel, and oil shale.

(1) Mr. Roberts's book sets out to deal with coal carbonisation at high and low temperatures, and there are several features in it which are noticeable and give it a character of its own. In the first place, more than in any other book with which the reviewer is acquainted, special attention is directed to the nature of the changes which coal undergoes in its transformation into coke, and the different factors which operate in determining the character of the final solid product of carbonisation. It is only during the last decade that our want of knowledge under this head has been properly appreciated, so that much of the experimental work which Mr. Roberts calls upon in his account of the coking process is quite recent, and has not come into book form before. He has marshalled his facts and arguments well, and reproduces a number of useful illustrations of coke formation under various conditions.

It would, however, be a mistake to suggest that this study of coke formation is the only outstanding characteristic of the author's treatment of his subject. Equally remarkable is the amount of ground which has been covered in gathering material of another kind bearing upon the numerous plants and processes which have been described in technical literature, and in patent specifications, for the carbonisation of coal at low and high temperatures. The book is packed with information of this kind, and it is given, so far as the reviewer has been able to see, with accuracy and clearness, collecting a mass of descriptive detail into a comparatively small volume of 400 pages.

This mode of treatment, to which we have become accustomed in books on technical subjects, although not always followed out with the same care and knowledge as is forthcoming from the author, has, however, its accompanying disadvantage. So many processes are described that the author plainly cannot claim first-hand knowledge of all, and is compelled to retail the claims made with little comment. The critical examination of processes necessary for their real evaluation is out of the question, from space considerations alone. The quantitative thermal and chemical aspects are necessarily given very little attention, partly from this want of space, and partly because the requisite data have never been acquired or never published.

Such a work as this should be read, however, by the serious student with the limitation above outlined clearly in mind, and that being taken for granted, he will find both interest and profit in following up the many ramifications of technical practice brought to his notice.

The newer developments are naturally in the main those associated with processes of low temperature carbonisation, and that for a very good reason. The success of such processes, if and when attained, depends largely upon their power of speeding up the transformation of carbonisation (as compared with the standard high temperature processes), so lowering installation and working costs per unit of coal carbonised. The fact that lower temperatures of working are employed permits the use of steel instead of fire-clay as the principal material of construction in the plant, and consequently permits also the use of new mechanical devices. This principle is employed in many of the plants of which descriptions are given by the author.

One feature of the book which is interesting, although it does not seem to find a natural place under the title, is a complete account of the author's views on the origin of anthracite, according to which the assumption has to be made that bituminous coal has been converted into anthracite by attaining a temperature of from 500° to 550° in the earth's crust while subject to great pressure. It should not be understood by the reader that the actual development of so high a temperature has been so far demonstrated as to be generally accepted.

Summarising, one may say that Mr. Roberts's book may be welcomed as treating the process of carbonisation comprehensively and well from a viewpoint which is not that of the gas engineer or the coke-oven manager, but has its advantages in making for originality and breadth. It is well printed, and the illustrations are numerous and well chosen for the author's purpose.

(2) Mr. Halse's book is much smaller and, as stated above, its range is much more limited. No attempt is made to describe processes in detail or to discuss the chemistry of them in any critical spirit. Its chief point of usefulness is in bringing together information, which until now has been scattered, on torbanites, cannels, and oil shales, in explaining what are the characteristics of these materials, and what processes have so far been

employed in utilising them for the supply of liquid fuel. The work of a number of authorities has been drawn upon in order to bring out the distinctions between coals, lignites, torbanites, etc., and this information has been usefully tabulated.

At the end of the book is a two-page glossary, but some of the information contained therein, such as that gels are "stable colloidal aggregations," does not in itself carry the average reader very far, while surely the definition of a British Thermal Unit and of a calorie might be taken for granted. The author claims quite rightly in justifying his book that "the importance of liquid fuel to national life cannot be over-estimated, and a right understanding of what has been accomplished towards making additional supplies available is of great moment." J. W. C.

Magnetism and the Electromagnetic Field.

Handbuch der Physik. Herausgegeben von H. Geiger und Karl Scheel. Band 15: *Magnetismus; Elektromagnetisches Feld.* Redigiert von W. Westphal. Pp. vii + 532. (Berlin: Julius Springer, 1927.) 43·50 gold marks.

IN a comprehensive treatise in many volumes there is a great danger of lack of co-ordination between the parts. Few individuals, and unfortunately not all scientific libraries, however, are likely to purchase all the twenty-four volumes of the "Handbuch der Physik," and in practice the utility of the work will depend largely on the independent value of single volumes. These suffer considerably from the general tendency to avoid any overlapping in the 'Handbuch' as a whole. Co-ordination is partly obtained by the systematic subdivision of the subject matter—in this respect the 'Handbuch' has been carefully planned—but the value both of the work as a whole and of the single volumes would have been greatly enhanced by a much more lavish use of cross-references. The lack of an author index is a considerable drawback. There are numerous footnote references, but short selected bibliographies to the separate sections, which would have been a useful feature, are only given in a few cases.

The 'Handbuch' may perhaps best be regarded as an ordered series of short monographs. Those in the present volume fall into two groups, dealing with magnetism and the electromagnetic field. In the first chapter, on magnetostatics, P. Hertz, using the conception of magnetic charge, develops in great detail the mathematical theory which may be built up on a few simple fundamental laws. The action at a distance and medium viewpoints are adopted successively and shown to lead to equivalent results. The treatment proceeds in stages of increasing generality—from the case where the permeability is unity to that where there is hysteresis—in a way which conduces to clearness but not to brevity. The second chapter, also by Hertz, is on the magnetic fields due to currents.

W. Steinhaus gives an account of the magnetic properties of materials in Chap. iii. The section on dia- and para-magnetism, which occupies 15 pages out of the total of 270 on magnetism in this volume, is very inadequate as an account of the present state of knowledge. The description of ferromagnetic phenomena, however, in particular of hysteresis and of temperature and magneto-mechanical effects, is excellent. It is unfortunate that the important investigations of the last few years on single crystals of iron could not receive notice. The specific heat of ferromagnetics, and the magneto-caloric effect, might have been briefly discussed in connexion with the molecular field hypothesis.

A most interesting chapter on ferromagnetic substances is contributed by E. Gumlich. The extensive material is admirably summarised. The effect of thermal and mechanical treatment, and of impurities, on the magnetic properties of iron and steel is fully described. A short section follows on cobalt and nickel, and 'cryptoferromagnetic' manganese. Finally, alloys of ferromagnetic metals and Heusler alloys are dealt with.

G. Angenheister gives an account of the observations on terrestrial magnetism and their interpretation in Chap. v. (The measuring instruments and methods, as for magnetism generally, are described in another volume.) The observational results are presented with the aid of a number of recent world and regional magnetic charts. The formal analysis of the results is given, and the various theories of the earth's permanent magnetism—none of them satisfactory—are considered. The character of the periodic changes is described, and then that of the aperiodic, and the two theories which connect these with the emission of electrically-charged particles, and of radiation from the sun, are discussed.

The second part of the volume opens with a chapter by S. Valentiner on the fundamental phenomena of electromagnetic induction, essentially those described by Faraday, presented clearly in the light of later developments. Coefficients of induction are worked out for a number of

special cases, and a most useful list of references is given.

R. Schmidt deals clearly and very completely with the analytical and graphical methods for the treatment of alternating currents in Chap. ii. In the third chapter, on electric oscillations, E. Alberti considers the behaviour of single and coupled closed circuits, the effect of iron cores, and also oscillations in open circuits.

The last chapter, on the dispersion and absorption of electric waves, is by W. Romanoff. An outline of the theories and of the experimental methods is first given. It is only in the last few years that convenient valve methods for the production of short undamped waves have become available, which will enable satisfactory experiments to be carried out in this difficult region of investigation. Much of the older work is of doubtful value, but the coherent account of some of the more satisfactory results, and their comparison with theory, will form a valuable basis for further research.

Although the volume suffers from the drawbacks which have been mentioned, it is a mine of information on those particular aspects of physics with which it deals. As an example of book production the standard is high. The printing of both the text and diagrams is admirable. E. C. S.

Our Bookshelf.

The Druids: a Study in Keltic Prehistory. By T. D. Kendrick. Pp. xiv + 227. (London: Methuen and Co., Ltd., 1927.) 12*s.* 6*d.* net.

IN this book Mr. Kendrick is decidedly an iconoclast. Ideas relating to the Druids which have taken a firm hold on the popular imagination are carefully weighed and found wanting. First among them is the tradition which connects the Druids with Stonehenge and other megalithic monuments. Mr. Kendrick shows that this connexion cannot be traced back to a period earlier than the seventeenth century, when Aubrey claimed Stonehenge for the Druids and interest in these functionaries was beginning to revive after their eclipse dating from the Saxon invasion. It is to be noted that Geoffrey of Monmouth in his well-known description of Stonehenge makes no allusion to the Druids.

Mr. Kendrick's aim is to clear away the cloud of misunderstanding and vain imagining which has gathered round the Druids by bringing together in a critical synthesis all that is known positively from historical records of their organisation, ritual, and beliefs, together with such inferences as may legitimately be drawn from the archæological data relating to the period. A recital and examination of the multitudinous theories which have been formulated on the subject is therefore beyond his purpose, and his own speculations on the subject have been reduced to a minimum. It is to be noted that although he rejects the responsibility of the Druids for Stonehenge and megalithic monuments, necessarily as the monuments must for the most part belong to an earlier period, he suggests that they may possibly have used them at some later period for their ritual observances. Gratitude is due to Mr. Kendrick for his admirably judicious and judicial sifting of the material, even if he has dispelled some cherished illusions in the cold light of reason.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. *System-Nummer* 2: *Wasserstoff.* Pp. xvi + v + 273. (Berlin und Leipzig: Verlag Chemie G.m.b.H., 1927.) n.p.

MORE than half this volume is devoted to a detailed description of the physical properties of hydrogen, which is perhaps not astonishing when one considers the exceptional interest which belongs to the simplest of the elements. In the discussion of atomic structure the term hydrogen-nucleus (*H-Kern*) is generally used, but Rutherford's convenient term 'proton' is mentioned as being preferable to other suggested names. Atomic weight estimations are given in detail from the time of Berzelius to the year 1926.

Mechanical, thermal, optical, magnetic, and electrical properties of hydrogen and also hydrogen-electrodes are discussed fully. Considerable space is also devoted to the technical preparation of hydrogen on a large scale. The chemical section deals with the behaviour of the gas towards metallic compounds and aqueous solutions of salts, with catalytic hydrogenation and with analytical methods. There is also a special account of the hydrides, which are classified as (*a*) *metallic* hydrides, in which varying amounts of the gas can be absorbed into a homogeneous phase, the character of the metal itself and its lattice structure remaining intact; (*b*) *salt-like* hydrides, which are definitely polar, in which the hydrogen possesses the character of a negative ion (*e.g.* hydrides of the alkali and alkaline earth metals); and (*c*) *gaseous* hydrides, which are either gases or volatile liquids at ordinary temperatures. This class includes hydrides of bismuth and lead. The volume closes with an account of triatomic hydrogen, H_3 produced with the aid of positive rays.

Theoretical Mechanics: Statics and the Dynamics of a Particle. By Prof. William Duncan MacMillan. Pp. xviii + 430. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 25*s.* net.

As the author of this book remarks, mechanics is a difficult subject not merely for the student but also for the race, as is evident by the fact that it came into existence two thousand years later than its allied subject geometry. In our time, however, it has also become a difficult subject for the text-book writer. Torn as he is between the practical

necessity of retaining the framework and development of the Newtonian viewpoint and a desire to disavow the older conceptions of mass, energy, and force, this attempt to keep a foot in each camp is often more amusing than successful.

Admitting the difficulty, however, as more or less inevitable at the moment, this text-book is undoubtedly one to be recommended. Its style and its manner of presentation convey the impression that it is written by a good teacher. Wherever possible vectorial methods are utilised, and the fundamental principles are clearly and deliberately stated.

Part 1 deals with vectors and kinematical and geometrical concepts; Part 2 with statics of particles, rigid bodies, and deformable bodies, very clearly and easily developed; Part 3 with the dynamics of a particle, including a treatment of least action, Hamilton's principle, and Gauss's principle of least constraint. There are in all sixteen chapters, most of which are supplied with copious examples.

The British Journal Photographic Almanac and Photographer's Daily Companion: with which is incorporated The Year Book of Photography and Amateurs' Guide and The Photographic Annual, 1928. Edited by George E. Brown. Pp. 788 + 63 plates. (London: Henry Greenwood and Co., Ltd., 1928.) 2*s*. net.

THIS *Annual* continues to move in the direction of the character of other photographic annuals, though it remains unique as it preserves all its old features, except, indeed, that it is no longer an almanac. It contains twice as many pictorial photographs as last year's volume, and these are excellently reproduced in photogravure by the Vandyck Printers, Ltd. The special editorial article refers to the world-wide applications of photography, and other articles are on snapshots, amateur kinematography, and printing borders on development papers. The epitome of the year's progress, classified formulæ, tables, directories, legal details, and other useful information follow. It is worthy of note that the tables—optical, weights and measures, concerning exposure, and many other matters—are so numerous that for very many years it has been the custom to give a selection only of what would be possible and useful, but a classified and dated list is given of those published in past annuals that are not included in the present. The volume is practically indispensable for those who are in earnest in their photography, whatever the character of their work may be.

The Industrial Chemistry of the Fats and Waxes. By Prof. T. P. Hilditch. (Industrial Chemistry Series.) Pp. xv + 461. (London: Baillière, Tindall and Cox, 1927.) 18*s*. net.

THIS work is divided into ten sections, to each of which is appended a useful and up-to-date bibliography. An account of the chemical nature, analytical examination, and composition of fats and waxes is followed by a description of methods used in the extraction, refining, hydrogenation, and hydrolysis of fats. More specialised sections deal with the edible fat and soap industries; the use of fats in the manufacture of candles, illuminants, paints, linoleums, etc.; the production of glycerine; and the nature of fatty lubricants. The text contains a large number of useful tables and summaries, but illustrations and diagrams have been dispensed with. The book, written by an author possessing first-hand knowledge, provides a sound, workmanlike, and remarkably compact survey of an important field of applied organic chemistry, and it may be recommended to the student and research worker as well as to the industrial chemist.

Fogs and Clouds. By W. J. Humphreys. Pp. xvii + 104 + 96 plates. (London: Baillière, Tindall and Cox; Baltimore, Md.: Williams and Wilkins Co., 1926.) 18*s*. net.

CLOUDS have special importance to all who are interested in weather, now that forecasts are no longer based almost entirely on the movements of cyclones and anticyclones; we realise that the conditions are dominated by warm and cold parts—the boundary surfaces between air-masses at different temperatures; and so ability to recognise the clouds which mark these surfaces may give invaluable information. The different types of clouds are here systematically arranged, with a promising suggestion for an abbreviated nomenclature, and there are useful discussions of the physical processes involved, such as that of the mode by which 'the moon eats the clouds.' The author has also included a number of less familiar types, such as 'helm bars,' 'crest clouds,' 'cumulus boas,' and 'scarf clouds.'

Nature lovers will congratulate the author on the extent to which the photographs render the glory of a cloud-flecked sky; and there are excellent reproductions of lightning, of a rainbow, and of a halo with a parhelic circle.

Chambers's Encyclopædia: a Dictionary of Universal Knowledge. New edition. Edited by Dr. David Patrick and William Geddie. Vol. 10: Teinds to Zyrians. Pp. iv + 819. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1927.) 20*s*. net.

THE concluding volume of the new edition of this encyclopædia has been revised up to the date of issue. As in the earlier volumes, there is a number of new maps, among which the orographical layer-coloured maps illustrating the article on the world-war may be mentioned for their special excellence. The completed encyclopædia forms an almost indispensable addition to modern works of reference. It is the custom in this encyclopædia to preface each volume with a list of the authors of only some of the articles: the others are anonymous. By way of criticism it is suggested that the authorship of the longer articles should be given, as is not always the case, while that of many short ones that afford no scope for original treatment could well be omitted if space is the chief consideration.

Letters to the Editor.

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

The Distribution of Ionised Oxygen in the Gaseous Nebulæ.

THE suggestions made by Bowen in NATURE of Oct. 1 as to the probable origin of the well-known 'nebulium' doublet λλ5007, 4959, and of the strong radiations sometimes occurring at λλ3727, 9, have been confirmed by Prof. A. Fowler (NATURE, Oct. 29), and so generally accepted that it may not be premature to discuss the actual distribution of these radiations in the gaseous nebulæ on the assumption that the first doublet represents O III (twice ionised oxygen) and the second O II (once ionised oxygen). It is first of all important to note that there is no recorded evidence of the existence of the neutral atom of oxygen in the gaseous nebulæ, although some of the strongest lines, being in the extreme red, are beyond the reach of the apparatus usually employed. Neither can I find any references which support Bowen's statement that "the [gaseous] nebulæ are known to emit the well-known spectra of highly ionised nitrogen and oxygen." The most exhaustive study yet published of the nebular lines is that by W. H. Wright in *Lick. Obs. Pub.*, vol. 13, but although one line each is ascribed to neutral carbon and nitrogen, there is no identification with oxygen. On the other hand, the doublet λλ5007, 4959 is present in all cases considered, a total of 47 planetaries and the Orion nebula.

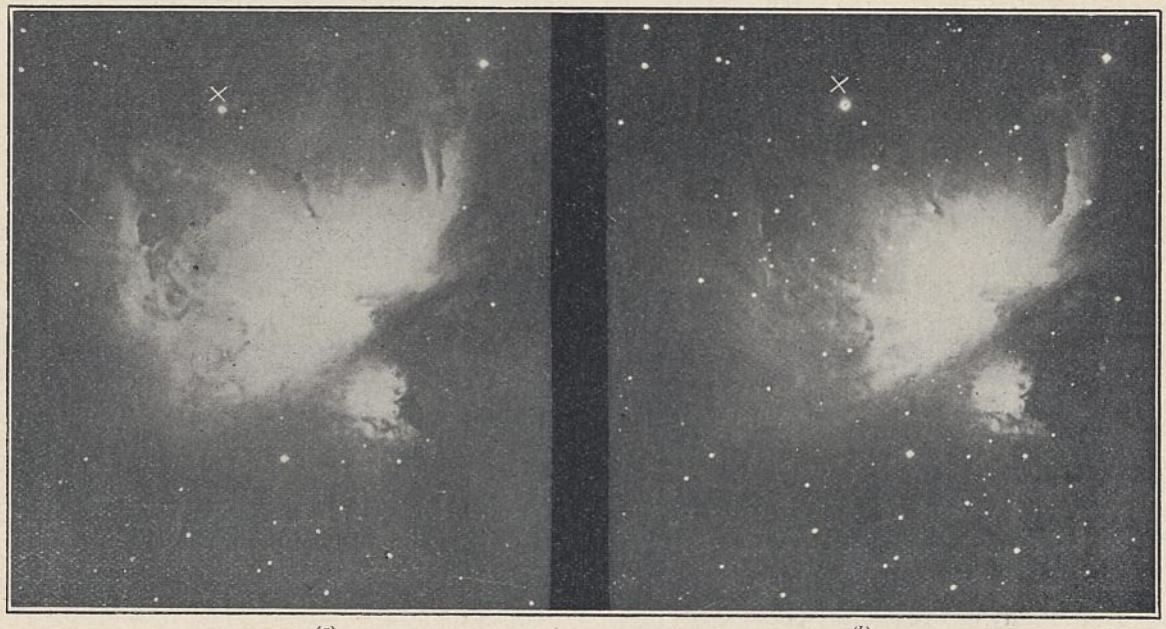
It was noted in the case of the Orion nebula visually by Campbell at the Lick Observatory in 1893 that these lines, although invariable with respect to each other, varied considerably in intensity in comparison with the neighbouring line H_ε. In the regions round θ Orionis, λ5007 was four times as bright as H_β, but as the slit was moved away from the trapezium region the comparative intensity changed until H_β was much brighter of the two. The same concentration of λλ5007, 4959 within the inner regions is also marked in the planetaries photographed with a slitless spectrograph appearing in the Lick volume already mentioned.

In 1905, Hartman attempted to isolate the doublet by means of a green screen and an isochromatic plate, but it is doubtful whether the hydrogen radiations H_β and H_γ were satisfactorily eliminated in the direct photograph of the Orion nebula he obtained, as my own results with greater precautions to get rid of these radiations did not give such an extended image, although the Huyghenian region came out very strongly, in this respect agreeing with Campbell's visual observations.

It is, of course, only to be expected that the doubly ionised state of the oxygen atom should be found principally in the regions of the nebula most influenced by the B type stars of the central region.

The distribution of O II in the Orion nebula is, on the other hand, remarkable both for its great extent and for its intensity. The image ordinarily obtained when an exposure is made with an undyed rapid plate is to a large extent produced by this radiation in the ultra-violet, as such a plate is practically insensitive to the radiations λλ5007, 4959. The only other important radiations in the sensitive range are the hydrogen radiations from H_γ to the head of the Balmer series, and as these decrease in intensity rapidly towards the ultra-violet, the main radiations are H_γ, H_δ, and H_ε. If, therefore, an exposure is made with an æsculine screen cutting off the ultra-violet beyond λ4000, an image is obtained which consists almost entirely of hydrogen radiations.

On the other hand, an exposure with a screen of thin nickel oxide glass, transmitting 70 per cent. at λ3800, but cutting off the visual spectrum except at the extreme red, gives an image consisting almost entirely of λλ3727, 9. This piece of work was undertaken some years ago by me at Harborne, and at Helwân Observatory with the 30-in. reflector, and the results obtained are here reproduced. There can be no doubt that the differentiation of the hydrogen



(*a*) (*b*)

FIG. 1.—Screened photographs of the Orion nebula. (*a*) λ3727; 47 min. exposure. (*b*) Hydrogen; 40 min. exposure.

and O II images has been actually attained, as there are marked differences of detail as well as of distribution in the two images. Take, for example, the long scimitar-like projection on the right-hand side of each photograph with its companion, or the star, indicated by a cross in Fig. 1, on the outskirts of the nebula, which is surrounded with hydrogen nebulosity, but is clear of O II.

It has already been remarked that the stars involved in the central regions of the Orion nebula are B type stars, and the radiations λλ3727, 9 exceptionally strong. As a matter of fact, these radiations are either very faint or absent altogether in many of the planetary nebulæ, where the stars are almost invariably O type of much higher temperatures, although a radiation of shorter wave-length at λ3426 is often present. A conspicuous radiation at λ3869, as yet unidentified, sometimes appears in place of λ3727, although both are present in a few cases.

A comparison of the intensities of λ5007 (O III) with λ3727 (O II) in the list of planetaries given by Wright (*loc. cit.*) brings out certain features of interest.

The spectrum of N.G.C. 40 is unique, for although the slitless quartz spectrograph shows a conspicuous image at λ3727 there is no image at λ5007, but there is a trace of this radiation in the slit spectrograph exposure.

In three other cases (I.C. 418, N.G.C. 6720, and B.D. 30° 3639) λ3727 is brighter than λ5007. In ten instances λ3727 is absent altogether, with a trace only in two cases, altogether about 25 per cent. of the whole. In nine objects also λ5007 is ten times the intensity of λ3727, so it appears that the conditions favourable for the continuous existence of O II in any comparative quantity are absent in many planetaries. In all the planetary nebulæ the governing factor is undoubtedly the surface temperature and physical condition of the nuclear stars. Thirty of these stars are bright enough to yield a spectrum, and all these show the characteristic extension into the extreme ultra-violet denoting O type stars. Half of them contain bright bands, the other half are absorption spectra. There seems, however, to be no correlation between these divisions and the presence or absence of λ3727.

J. H. REYNOLDS.

Low Wood, Harborne.

The Affinity of Different Types of Enzyme for their Substrates.

IT is well known that as the concentration of substrate molecules is increased, other conditions being kept constant, the rate of catalysis of a reaction by an enzyme reaches a maximum value. On the view that the enzyme-substrate complex is a chemical compound, this is due to the combination of every enzyme molecule with the substrate or its products; on the theory that the union is adsorptive, it is due to saturation of the enzyme surface. On either hypothesis the substrate concentration at which half the maximum velocity is reached furnishes a measure of the affinity between enzyme and substrate. If, as is often the case, the law of mass action is followed, it is, of course, the dissociation constant of the enzyme-substrate compound, and the reciprocal of the affinity constant.

I have collected from the literature such apparent dissociation constants for 44 enzymic reactions. When these are expressed in molar concentrations, the enzymes fall fairly sharply into three groups. Group 1, of low affinity, includes the hydrolytic enzymes acting on crystalloidal substrates, and also yeast carboxylase and liver catalase. Ten of these enzymes, catalysing 21 different reactions, give dissociation constants ranging from 0·003 M up to at least 0·7 M. Their affinities for substances related to their substrates which inhibit the reactions are of the same order of magnitude, but on the whole less. Two hydrolytic enzymes, bone phosphatase and liver lipase, yield values at present undetermined, but less than 0·003 M and 0·005 M respectively.

Group 2, of medium affinity, consists of the enzymes which hydrolyse colloidal substrates, namely, the proteins and higher polysaccharides. The rather dubious dissociation constants for these substances mostly, if not all, lie between 5 per cent. and 0·1 per cent., or, taking probable molecular weights, in the neighbourhood of 10^{-4} M.

Group 3, of high affinity, consists of the only oxidising-reducing enzymes other than catalase so far studied from this point of view. The values are:

Plant peroxidase . .	5×10^{-6}M	[Willstätter & Weber[1]].
Milk xanthine-oxidase	$<3\times10^{-5}$M	[Dixon and Thurlow [2]].
Yeast oxygenase .	$<6\times10^{-7}$M	[Warburg[3]].

The substrates were hydrogen peroxide, xanthine or hypoxanthine, and oxygen, respectively. It should be added that xanthine oxidase also slowly catalyses the oxidation of acetaldehyde, but in this case the apparent dissociation constant is of the order of 1 M. In the case of laccase, the concentrations of guaiacol giving half the maximum velocity vary with *p*H between about 0·1 M and 0·003 M [Fleury[4]]. But laccase is probably a mixture of enzymes including peroxidase, in which case Willstätter and Weber's results make it unlikely that such observations furnish a measure of enzyme-substrate affinity. Biological surfaces which act as catalysts of oxidation, but cannot be brought into colloidal solution, and are, therefore, probably best not included under the designation of enzymes, yield apparent dissociation constants covering a wide range.

While the moderately high affinities of the amylases and proteases may be regarded as an adaptation to the colloidal nature of their substrates, it seems likely that the very high affinity of the oxidases is due to a real difference in the mode of their union with their substrates and that of other enzymes.

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Pleochroic Haloes and the Age of the Earth.

DR. LOTZE offers the suggestion, in NATURE of Jan. 21, that the effect of the alpha ray in promoting, according to Mügge, "isotropy in minerals, loosening of the crystal lattice, and alterations in cohesion," would account for the unexpectedly large radius of the inner ring of palæozoic uranium haloes.

The stopping power, as all know, is dependent upon the atomic weight of the atoms encountered (Bragg and Kleeman). The density of the medium is therefore involved; and I assume it is to changes in this, brought about by the rays themselves, that Dr. Lotze refers his suggested explanation.

Now the observed discordance of the radius of the inner halo ring with the ionisation curve for uranium and its derivatives is more than 10 per cent. of the estimated radius (*Phil. Trans.*, **217**, pp. 51-79). Can the changes which Dr. Lotze postulates be responsible for so great a reduction of density? It seems very improbable. If this considerable loss of density existed, we would expect some optical indications of its existence. But nothing abnormal, compared with the other halo rings, is visible.

[1] Willstätter and Weber, *Ann. Chem.*, **449**, p. 156; 1926.
[2] Dixon and Thurlow, *Biochem. Jour.*, **18**, p. 976; 1924.
[3] Warburg, *Biochem. Zeit.*, **189**, p. 354; 1927.
[4] Fleury, *Jour. de Pharm. et Chim.*, **8**, p. 105; 1925.

Dr. Lotze does not specially refer to the emanation halo. In this case there is a single steep curve of ionisation rising to more than half the height of the crest responsible for the inner uranium ring. That is to say, rather more than half the ionisation intensity is operative in the formation of the emanation ring. Moreover, these emanation haloes are often of exceptional delicacy of definition and in the mica of Ballyellen are abundant. But no outward displacement of these rings is observable: but rather there is a tendency in the opposite direction—very slight, it is true.

Again, in the case of the thorium halo, the intensity of the ionisation upon which the effect should depend is about half that of the first uranium ring, but no irregularity is detectable (*loc. cit.*).

Papers in the January and February numbers of the *Philosophical Magazine* of the current year, by Dr. J. H. J. Poole, deal with a theory of the mode of formation of haloes in biotite, which should be considered in connexion with Dr. Lotze's suggestion. According to this theory, the formation of the halo in biotite is due to the decomposition, by the alpha ray, of the water which enters into the composition of the mica. It is assumed that the liberated and ionised oxygen combines with the ferrous iron present, thereby deepening the colour of the mica. That this theory, or some modification of it, adequately accounts for the genesis of the halo is, I think, very probable.

Now, variations in the density may attend these chemical changes, for it is possible that a part of the hydrogen might gradually escape by diffusion. At first sight this might seem to support Dr. Lotze's theory. But it is easy to show that the loss of the whole of the hydrogen would not suffice to reduce the specific density by as much as one per cent. This very probable theory of the inner mechanism of halo-formation therefore gives no support to Dr. Lotze's suggestion.

J. JOLY.

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Luru Vopo Vir Can Utriet.

EVERY now and then a fresh attempt is made to solve this cipher attributed to Roger Bacon in the "Epistola de secretis operibus artis et naturæ et de nullitate magiæ" (see for example, NATURE, Sept. 4, 1926, p. 352). These words have no manuscript authority whatever; they appear for the first time in an edition of the "Epistola" printed in Paris in 1542 from a poor MS., and seem to be due to an attempt to reproduce the text before him by the editor, Orontius Finé. The passage reads thus:

"Sed tamen salis petræ LVRV Vo Po Vir Can Vtriet sulphuris et sic facies tonitruum . . ." (f. 52).

All later printed versions are corrected from this.

Only two manuscripts of this part of the "Epistola" are known—both in the British Museum, Harleian 3528 (1) and Sloane 2156 (2). A third at Quaracchi, of which I have obtained photographs, leaves a blank where the cipher should be. As will be seen from the reproductions (Figs. 1 and 2), the cipher was originally written in Greek characters, which in the course of two centuries of copying have become entirely transformed. It is probable that if any cipher was used at all, certain of the letters were altered to those immediately preceding or following them, for example, blchkmkb—alchimia.

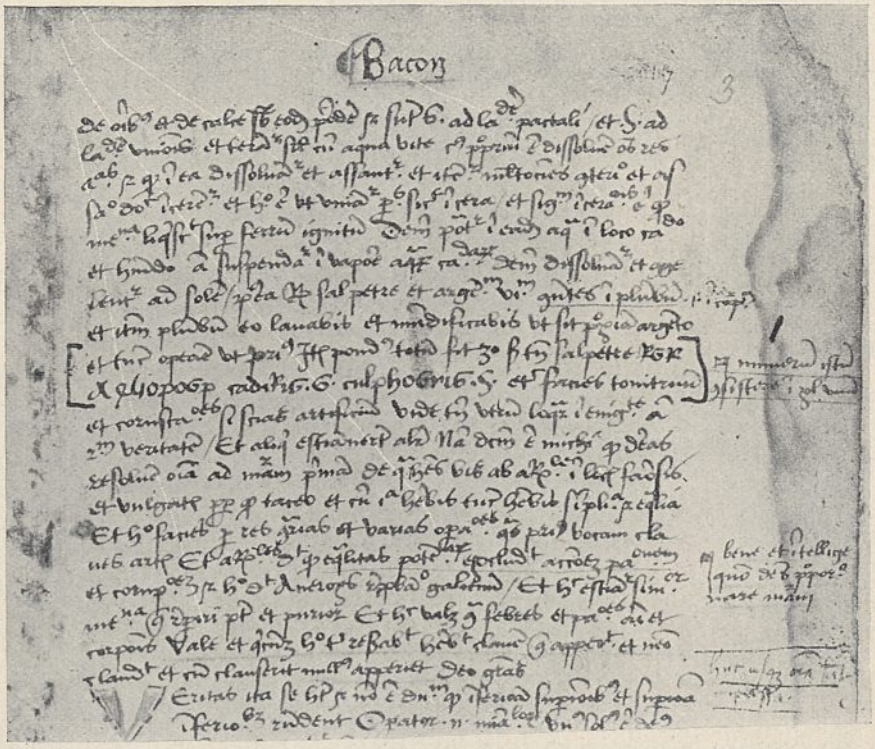

FIG. 1.—Harleian Manuscript. The passage containing the cipher is marked 1.

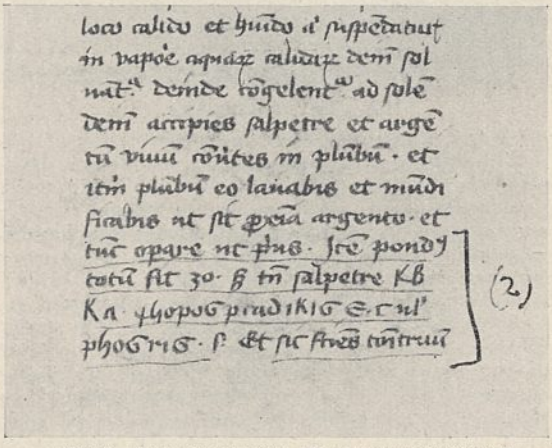

FIG. 2.—Sloane Manuscript. The passage containing the cipher is marked (2).

The relevant words in these reproductions are:

"Item pondus totum sit 30; set tamen salpetre . . ." The next signs read K 6, K 7—the K may

be R. Prof. Minns, who has kindly studied these photographs, writes that the following group of six signs may suggest *ανθρακ*; the sixth sign is, however, the number 6, which with another 6 and the final 5 make up the 30 of the text. The þ following the group does not suggest any meaning. The following group of seven letters is read as salikis, followed by 6. The last group is read sulphouris, 5. It is obvious that this first attempt at reading the cipher is unsatisfactory, and as the "Epistola" must be reprinted with Bacon's alchemical works, I should be grateful for any help that can be given. Brewer in 1859 read No. 2 as KB/KA/*φho*þos þca*δικις* *ε*.Γ. vel PHOSRIS. S.,

Another interesting question is the equation of LVRV Vo Po, etc., to the letters of the Greek as a help to the reconstruction of the original passage.

ROBERT STEELE.

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London, W.C.

The Pharmacological Action of Chloralose.

CHLORALOSE was introduced some years ago by Richet for experiments on animals. The chloralose used in our experiments was obtained from Messrs. Baird and Tatlock, Ltd., but its origin is unknown. We have been informed that it is prepared by heating an anhydrous mixture of chloral and glucose at 100° C. for about one hour. The residue is treated with a little water and then boiling ether, and the toxic isomer, parachloralose, is eliminated by crystallisation. The formula is $C_8H_{11}O_6Cl_3$.

When a solution of chloralose saturated at 40° C. is injected intravenously into the decerebrate cat, we have observed an extraordinary action on the nerves. On stimulation of the splanchic nerve, the normal rise of blood-pressure is increased to an almost incredible degree. Repeated injection of 10 c.c. of the solution at intervals results in still further increasing the rise.

Its action on the somatic nerves is apparently of an opposite nature; for example, stimulation of the sciatic and anterior crural nerves gave no reflex results, thus demonstrating an inhibitory effect.

The full effect of chloralose in the respects mentioned is not manifested immediately. There is a gradual exaggeration of the rise with the lapse of time, the maximum result being obtained approximately thirty minutes after the injection.

This remarkable effect of the increase of the rise of blood-pressure due to stimulation of the splanchnic nerve is not seen if clips are placed on the adrenal veins. It is thus evident that the action of the drug is through the medium of the adrenal bodies, and it seems likely that it is that part of the rise of blood-pressure normally due to liberation of adrenin which is increased by the action of chloralose.

When the semi-lunar ganglia on both sides are removed and the fibres to the adrenal bodies are stimulated, the rise of blood-pressure is very markedly increased by the injection of chloralose into the adrenal bodies. Thus it appears we have in chloralose a marked stimulant to the adrenal bodies, and the action appears to be on a local mechanism consisting of the gland itself, and the nerve fibres reaching it from the semi-lunar ganglia.

Intravenous injection of a mixture of chloralose solution (saturated at 40° C.) and adrenin (1 in 100,000) causes the ordinary transitory rise of blood-pressure obtained by injection of adrenin alone to be converted into a large and long-sustained rise of blood-pressure. A similar curve is obtained when adrenin is administered to a decerebrate animal under chloralose.

It has been suggested to us that this 'stabilising' of adrenin action by means of chloralose may be of therapeutic value.

SWALE VINCENT.
J. H. THOMPSON.

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Dug-out Canoe in Algoa Bay.

WITH regard to the recent correspondence in NATURE on the derelict canoe washed ashore in Algoa Bay, I have now received information from Lieut.-Col. M. L. Ferrar, Chief Commissioner, Andaman and Nicobar Islands, that it was reported in October 1925 that the sailing ship *Sree Shanasckthi* picked up three Nicobarese who were found clinging to a submerged canoe, which would have been of the ordinary size, holding six to eight people. These men belonged to Lapati, Car Nicobars. In the Albany Museum, Grahamstown, there are pieces of pumice from the Krakatoa eruption, that were washed ashore in South Africa; they have been preserved with all the barnacles and seaweed adhering, just as they arrived. I saw the Port Elizabeth canoe shortly after it had been pulled out of the water, and the encrusting material was identical in kind, showing both had been submerged for the same time, under similar conditions. Some part must have been above the sea for them to have caught the monsoon wind that drove them across. If the boat is from Car Nicobars, then it took sixteen months to come to South Africa, and somehow I think that four months is more likely correct. I am still inclined to place the origin in the Mergui Archipelago, because of the spoon-shaped fore-foot, and general shape.

E. H. L. SCHWARZ.

6 Boundary Road,
Swiss Cottage, N.W., Jan. 16.

The Two Calories.

THE suggestion made by Dr. Russell in his letter in NATURE of Feb. 4, that the kilowatt hour with its multiples and submultiples is the best unit of heat, is not new. Some years ago Ostwald proposed the unit of a kilojoule, and recalculated all the thermal data to the new unit. The figures will be found in his "Grundriss der allgemeinen Chemie," 1909. The reason why such a unit is not adopted in thermochemistry is that all the data would then depend on each redetermination of the mechanical equivalent of heat. The accuracy with which the latter is known probably does not, as yet, exceed one in a thousand, and thermochemists prefer not to have an error of this magnitude involved in determinations which are claimed to have an accuracy of one in ten thousand.

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Eyeglasses and the Microscope.

WITH reference to T. H. T.'s suggestion (NATURE, Jan. 28, p. 137) for dealing with eyeglasses while using the microscope, I find it quite sufficient to remove the cap from the eyepiece of the microscope; this allows the eye to approach to the right distance and at the same time keep the vision corrected for astigmatism. Of course with modern students' microscopes, which usually are not fitted with eye caps, this cannot be done, and astigmatism has to be put up with.

T. J. BRIANT.

The Bicentenary of John Hunter.

By Sir ARTHUR KEITH, F.R.S.

CONSIDER for a moment the unenviable position of John Hunter's two executors in the year 1793—his nephew Dr. Matthew Baillie and his young brother-in-law, Mr. (later Sir) Everard Home. Hunter's sudden death on Oct. 16, 1793, in his sixty-sixth year, left on their hands a huge establishment running from Leicester Square to Charing Cross Road—just to the south of the site now occupied by the Alhambra Music Hall. The income of the establishment had suddenly ceased; a sum of more than £10,000 a year was needed to keep it going. A brief search showed them that the place was in debt; bills had to be met. Hunter's carriage 'blood-horses' and coach had to go; Mrs. Hunter, brilliant and fashionable, had also to part with her coachman, her carriage, her horses, and sedan chair. Pictures, books, furniture had to be sold to provide Mrs. Hunter and her daughter with a modest shelter in Brighton. The weekly wage bill had to be reduced; the staff, numbering more than a score, was reduced at a stroke to one —Mr. Hunter's young museum assistant, William Clift.

FIG. 1.—The statue of John Hunter, executed by Weekes and erected in the Royal College of Surgeons, London, by public subscription in 1858.

What was to be done with the Museum which Hunter had erected in the yard or garden of his premises? On this treasury he had lavished every sovereign he could earn or borrow, and every hour he could steal from practice, hospital, and sleep. It was the harvest of an intense lifetime. After seven years of 'lobbying,' the two executors succeeded in persuading a government in search of money to wage successful war with France, to buy Hunter's museum for £15,000. The collection was handed over to the Corporation of Surgeons in 1800; that body obtained at the same time a new charter, became the College of Surgeons, and established itself and its museum on the south side of Lincoln's Inn Fields—where both still flourish.

The two executors continued to believe in Hunter's greatness, as may be seen from the following quotation taken from the issue of the College calendar for the present year:

"In the year 1813, Dr. Matthew Baillie and Sir Everard Home, Bart., executors of John Hunter, 'being desirous of showing a lasting mark of respect' to the memory of the late Mr. John Hunter, gave to the College the sum of £1684 : 4 : 4, three per cent. Consolidated Bank Annuities for the endowment of an annual oration, to be called the Hunterian oration, and to be delivered in the theatre of the College on the 14th of February, the Birthday of John Hunter, by the Master, or one of the Governors for the time being, or such other member of the Court of Assistants as should be appointed—such oration to be expressive of the merits in Comparative Anatomy, Physiology, and Surgery, not only of John Hunter, but also of all such persons as should be from time to time deceased, whose labours may have contributed to their improvement or extension."

The first oration was given in 1814 by Sir Everard Home; last year it was delivered by the president of the College, Sir Berkeley Moynihan; this year Sir Holburt Waring is Orator, and will take the opportunity of measuring the debt which modern surgery owes to discoveries made by chemists and by physicists. Hunter's two executors were interested

parties; were they justified in launching on succeeding generations this act of Hunter worship? Is Hunter's memory being kept alive by a species of 'artificial respiration'? Many younger surgeons would return a frank affirmative; what Hunter thought and did, they hold, has no bearing on the surgical problem of the twentieth century. With whom lies the truth? With the executors, or with these modern critics?

Before seeking to measure our indebtedness to Hunter, let us first inquire how a youth—the youngest of a family of ten, bred on a bleak upland farm some eight miles southward of Glasgow, succeeded in establishing himself in London as the leading surgeon of his day. John Hunter's career was determined in 1736; "Jockie," then a spoiled boy of eight, was running wild at home, while his brother William, ten years his senior, had finished with the University of Glasgow and was thinking of the Church as a career. It was in this year that a young practitioner — William Cullen by name— settled in the neighbourhood. In due time he was to become the great Dr. Cullen and hold in medicine much the same position as his contemporary Samuel Johnson held in literature, but in the meantime we are concerned with him merely as medical attendant on the Hunter family. He recognised William's ability; took him into his house as pupil-apprentice; put him in touch with the medical problems of the time, and showed him how the leading minds of Europe were seeking to solve them. We are indebted to Cullen for the medical Hunters.

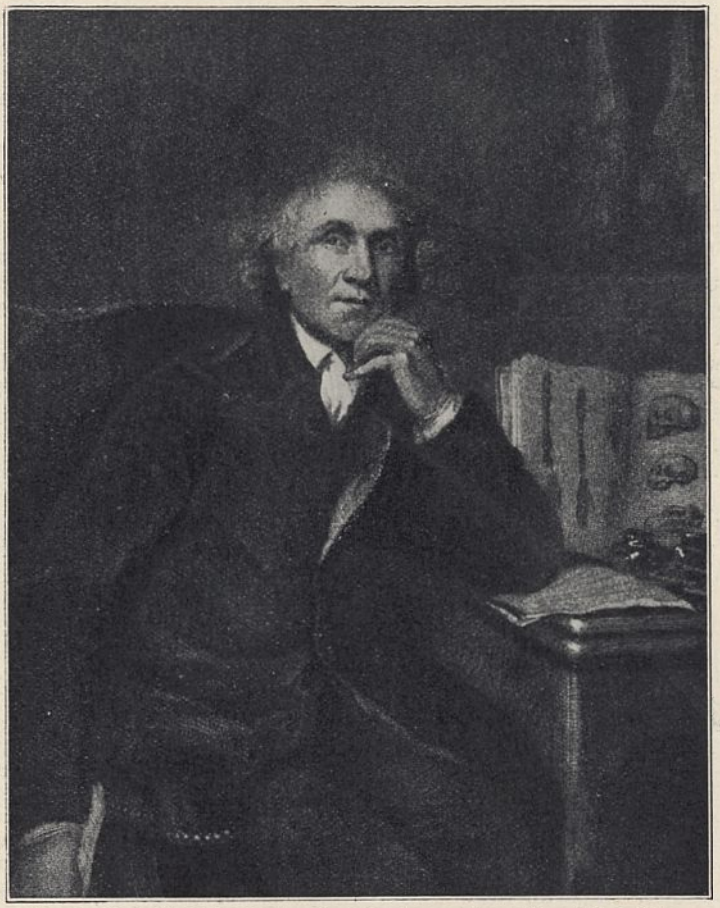

FIG. 2.—Portrait of John Hunter, from Sharp's engraving of the original picture painted by Sir Joshua Reynolds in 1788, when Hunter was sixty years of age.

William Hunter's ambition was thus fired; in October 1740 he visited London and found a pretext for not returning to Scotland. There were great hospitals in London then, but no medical schools were attached to them as is the case now. Such schools as existed were in private hands. William established one in Covent Garden, laying himself out for practice at the same time. He was careful in dress, suave in speech, and cultured in manner; he had an eye on Court and on the main chance; he was a scholar, a brilliant teacher, kept himself closely in touch with the best that was being thought and done in medical Europe, and made observations for himself at first hand.

In October 1748, William found his school in a prosperous state; his dissecting room was crowded; the preparations which he had made and preserved to illustrate his lectures began to form an imposing museum. His youngest brother, John, although twenty years of age, was still idling at home; he had grown into a short, thick-set fellow, with sandy hair and freckled face. William brought him to London and set him to work in the dissecting room. John took to the life as a duck takes to water; he had hands and could use them; he never really cared for books; he preferred to decipher the hieroglyphics of life at first-hand; he chose to register his discoveries in museum jars rather than in printed pages. It was only when he turned lecturer that he was compelled to reduce his observations, thoughts, and experiments to words. He was careless of dress, unconventional in manner, and uncompromising in speech. An unceasing search into the nature of life became his religion. He was resolved to win on merit; and in the long run, sheer merit was victorious. Cullen launched William on the sea of medicine, and in due course William launched his brother John—now the subject of seventy-four Hunterian Orations.

So I come back to my main question: What did Hunter do for medicine that we should continue to be mindful of him? Great men, as a rule, are so easily labelled—Jenner, Hunter's pupil, discovered the efficacy of vaccination; Charles Bell demonstrated the action of spinal nerves; Marshall Hall discovered reflex action; Lister, antiseptic surgery. In not one of these cases is the label adequate, but the public demands that its great men must be ticketed. There is no tag for John Hunter; to do him justice we must give him a hundred.

It has been said that Hunter was the founder of scientific surgery. If by this is meant that surgery will become a science only when all the secrets of life have been revealed and mastered, then Hunter has a just right to such a title. For the obsession of his life was the discovery of the mechanism of living matter; he perceived that life was the same in all its forms; an organised blood clot in a patient in St. George's Hospital was for him the same thing as the hydra which he grew in his vivarium at Earl's Court. He applied the same method of study to both. He knew nothing of oxygen, oxidation, or of the chemical nature of combustion, but he measured the 'amount of life' by the 'vital' heat generated, using the most delicate thermometer obtainable, to give him a standard for comparison. He knew nothing of those living units we now call cells or corpuscles; he measured the processes of 'simple life' in the mass. He subjected it to all degrees of temperature and noted its reactions.

In this way Hunter tried to get at the secrets of that reaction of living matter which is called inflammation. He used his thermometer to tell him what was happening in the hibernating hedgehog, his beehives in winter, and the trees of his garden when frost was deep in the ground. He realised to the full that if we are to understand life we must first study growth, and that of all the tissues of the animal body, bone was the one which best lent itself to an exact inquiry. He carried out an experimental study of the growth of bones, extending over many years, in fowls, pigs, asses, and deer; he used the modern methods of vital staining and of experimental operation. He regarded antlers as bony tumours; he sought to understand how Nature produced them and particularly he desired to discover the secrets of the bloodless operation by which she removed them annually—without fee. Living matter, by itself, had mastered the art of healing; if men were ever to become surgeons they must learn their art by studying the surgical ways of living matter. That was Hunter's message to his day and generation; for this reason he turned experimental embryologist, experimental botanist, experimental zoologist, experimental physiologist, experimental pathologist, and experimental surgeon. What he did and what he thought can never cease to be a source of inspiration to those who inquire at first hand, for the problems he sought to solve are still those which envisage us—the basal problems of life.

Why, then, do the younger surgeons of to-day neglect Hunter or brush him aside as out-of-date? It is because of the unbounded success of Lister's discovery; the Listerian revolution has led them to concentrate their whole attention on the cleanliness of their wounds and the technique of their operations. Their attention is occupied with the organisms which may invade wounds and they forget a fact ever present in Hunter's mind—that the powers of healing are resident in the living flesh. No one who notes what is happening now in the most progressive lines of biological inquiry—experimental embryology and experimental biology, as represented by tissue culture, tumour grafting, transplanting of living organs and parts—can fail to see that after a century and a half we are again returning to the Hunterian outlook and the Hunterian methods of approach.

Hunter's published works are contained in six volumes—the four volumes which are included in Palmer's edition (1837) and the two precious volumes of "Essays and Observations" published by Sir Richard Owen in 1861. A study of these volumes shows how dangerous it is to say wherein Hunter was wrong or mistaken; he made many grave errors of inference—none of observation. But in the majority of instances time has proved that it was not Hunter who was in the wrong, but his editors.

There is one aspect of Hunter's life which his annotators have refused to mention, or if they have alluded to it, explained it as an aberration of a great mind. The truth is that Hunter's inquiries had made him a pagan; he could not harmonise what he found in the realms of Nature with what his inquiries revealed to his own eyes. He silently and resolutely thought and wrote as if the book of Genesis had never been in existence. The last paper he ever penned was "Observations on the Fossil Bones presented to the Royal Society by His Most Serene Highness the Margrave of Anspach." In this paper the council of the Royal Society was alarmed to find that Hunter, in order to explain certain changes, postulated "thousands of *centuries*," and ultimately succeeded in getting the estimate reduced to thousands of *years*, thus bringing the estimate within the limits of Biblical chronology. In the meantime Hunter died, and his brother-in-law, Sir Everard Home, readily sanctioned the desired change. Even Sir Richard Owen in 1861 is an apologist for Hunter's heretical beliefs. In the 'advertisement' to "Essays and Observations" he wrote:

> "Some may wish that the world had never known that Hunter thought so differently on some subjects from what they believed, and would have desired him to think. But he has chosen to leave a record of his thoughts and, under the circumstances in which that record has come into my hands, I have felt myself bound to add it to the common intellectual property of mankind."

There would have been no record left if Sir Everard Home had had his way. That any record was preserved at all of Hunter's real thoughts is due to Owen's father-in-law, William Clift. Home burned Hunter's original manuscripts, the usual explanation being that he had pilfered from them. A close study of the conventional character of Sir Everard Home and of the circumstances which surround this infamous act of vandalism have convinced me that the accepted explanation is not the true one. Home shared implicitly in the religious beliefs of his time and never doubted that by destroying all evidence of Hunter's heretical convictions he was performing an act of piety on behalf of the world in general and for the memory of his brother-in-law in particular. The world has still much to learn from John Hunter.

British Association Expedition to the Great Barrier Reef.

By Dr. C. M. YONGE.

MARINE biology has advanced greatly of recent years. It is becoming quantitative in its methods, beginning to demonstrate cause as well as effect, while, as the result of co-ordinated research by plankton workers and chemists, the full story of the annual cycle of life in the sea is gradually being elucidated. Practically all this work has, however, been done in temperate seas, and the extent to which similar conditions prevail in tropic waters is entirely unknown. Here is a great and open field for the application of modern scientific methods and one in which a rich harvest cannot fail to be reaped. Hitherto, opportunities have been lacking; there are no big marine laboratories in the tropics, while deep-sea expeditions have only been able to make isolated observations.

This long-desired opportunity has at last been provided by the Australian Great Barrier Reef Committee, which two years ago invited Great Britain to send out an expedition to make a thorough biological investigation of the Great Barrier Reef of Australia. The organisation of this expedition was undertaken by the British Association at the recent meeting at Leeds, and a committee, consisting of members of the Sections of Botany, Geography, Geology, and Zoology, to which were later added several Australian representatives, was instituted for this purpose.

If the necessary funds can be raised, the expedition will leave this spring, and work on the reef will be carried on continuously for at least a year. The leader of the expedition will be Dr. C. M. Yonge, Balfour Student in the University of Cambridge. Mr. F. S. Russell, of the Plymouth Marine Biological Laboratory, will be in charge of the plankton investigations and other work of the boat party for the first six months. Mr. Tandy, of the British Museum (Natural History), is expected to be the botanist, concerned especially with the calcareous algæ; and the Royal Geographical Society is considering how best to provide the services of a surveyor for the expedition. The full plan also includes a chemist and hydrographer, who will study the chemical and physical conditions of the sea water, while an experienced zoologist has expressed his willingness to take charge of the reef work. In addition, there is the promise of considerable assistance from the Universities of Brisbane and Sydney, and from the Australian Museum at Sydney; the British Committee lays the greatest stress on this, in view of the continuation of such studies in subsequent years.

With the exception of the work of the geographer, the investigations proposed will be purely biological. The geology of the reef has already received considerable attention from Prof. H. C. Richards, of the University of Brisbane, who has been the prime mover in all recent work on the reef. It is hoped that the surveying ship of H.M. Australian Navy will be able to assist in the accurate surveying and charting of the region where the expedition will work.

The plan of operations may be conveniently summarised under four headings. First, there is work on the reef, and this will include an ecological survey of the corals and their associated organisms, both animal and plant, their food and mode of feeding, their rate of growth, and their seasons of reproduction. Conditions on various parts of the reef, exposed to very different factors, will be compared and correlated with differences found in the plankton and the sea water. This work will be conducted by a 'reef' party of probably two zoologists and the botanist.

Closely connected with the above work will be an examination, as detailed as conditions will allow, of the bottom fauna and flora and the deposits, between the reef and the mainland and, so far as possible, on the outer side of the reef. For this purpose dredges and the Agassiz trawl will be used, and also quantitative grabs and bottom samplers. An important part of this work will be the determination of the zoning of life at increasing depths, information which is urgently needed for the proper working out of the contents of the bores made into reefs.

This work, and that of the third set of investigations, concerned with plankton and sea water, will be carried out from a powerful motor-boat which has been kindly offered, together with a smaller boat for work round the edge of the reef, by the Navy Yard at Sydney. The variations of the plankton—seasonally, diurnally, and at different depths—will be studied by means of samples taken with water-bottles, fine and coarse silk tow-nets, and stramin nets. Mr. Russell, who will have assistants, will employ the methods which have yielded him such excellent results in Great Britain, so that the findings will be directly comparable with those obtained in our temperate seas. A series of stations will be selected for this work, and water samples will be taken at the same time from which accurate determinations of temperature and salinity, of the nitrate, phosphate, silica, calcium, and oxygen content, and of the hydrogen-ion concentration will be made by the chemist. Variations in these will be correlated with variations in the plankton.

The fourth line of research will, it is hoped, tie together all the work into one connected whole. It will consist of a detailed study of the mode of feeding and digestion in the different corals, and of their food throughout the year. The relative extent to which corals depend upon plankton for food or are nourished by the unicellular algæ which live symbiotically in their tissues will be investigated. This is a matter of fundamental importance and one on which our knowledge is extremely scanty. The method of calcium deposition in corals, as a result of which the skeleton is formed, will also be studied.

Finally, the economic possibilities of the reef will

receive thorough attention. At present there is an extensive trade in pearl shell and trochus, in bêche-de-mer and in turtles, and the possibility of increasing these by methods of cultivation and of establishing a sponge fishery—of native or, if feasible, imported sponges—will be examined. The commercial potentialities of the fisheries will be estimated so far as opportunities permit. The Great Barrier Reef is immensely rich in life and should prove a source of vast wealth if properly exploited, and for this a thorough biological survey is the essential preliminary.

Obituary.

Mr. R. A. Herman.

CAMBRIDGE mathematicians of the past forty years will have learnt with deep regret of the sudden death of Mr. Herman, of Trinity, on Nov. 29 last, at the age of sixty-six years. Versatile and skilful, Herman devoted to teaching powers that were ample to have made him one of the celebrated mathematicians of his time, and his monument must be sought in the multitude of his pupils who have won distinction for themselves.

Herman took the Tripos in 1882, and was described at the time as the last 'real' Senior Wrangler, for the Tripos was about to be divided, and the title, though surviving until 1909, depended after Herman's year on only the first part, the second part being a postgraduate examination. After gaining in due course a Smith's Prize and a Trinity fellowship, Herman went to Liverpool as professor, but he stayed there only two years, and returned in 1886 to Cambridge, where he spent the rest of his life. He was given the honorary degree of LL.D. at St. Andrews in 1920.

At the time of Herman's return, and until 1909, mathematical teaching in Cambridge was of two kinds: in theory the ground for the Tripos was covered by college lectures, but in practice success depended on the private coach. Herman served a full period of office as a college lecturer, and he was a University lecturer for many years, but it was as a coach that he became famous. Reputation in this field was difficult to acquire, but Herman had a genius for teaching which won its reward when J. E. Wright was Senior Wrangler in 1900, and from 1903 until 1909 one or more of his pupils, alone or bracketed, headed the list: of the last eleven Senior Wranglers, he coached nine.

For a few years after 1909, force of custom still sent the best scholars to be coached, but the new regulations put the premium on specialisation, and the use which Herman could make of his powers under the changed conditions was still uncertain in 1914. During the War he was engaged on various routine tasks; he lost his only son, reported missing and never heard of again, and suspense and grief affected his subsequent career. After the War he continued to read and to enjoy mathematics, but his diminished energy found sufficient scope in his University lecturing.

Herman was beyond question a great teacher, at once conscientious and inspiring, methodical and brilliant. His revision papers were miracles of thoroughness, and by means of weekly problem papers he imparted all that it was possible to impart of his own facility in the problem-solving that was formerly essential to distinction in Cambridge examinations. As a mathematician he was an artist to the finger-tips, scrupulously rigorous, little satisfied by a mechanical solution, and quick with praise when he saw beauty. There was no branch of Tripos mathematics in which he was not proficient, and there were many subjects in which his knowledge extended far beyond the range of any examination. He was an astronomer in a university where astronomers flourish, his only book was on geometrical optics, and he was an authority on the most difficult problems of discontinuous motion in fluids, but it was to differential geometry as investigated by kinematical methods that he was most devoted.

A teacher's fame is local and ephemeral, but so long as any of Herman's pupils are alive he will be remembered with gratitude and affection.

Mr. J. H. Durrant.

Through the death at his residence at Putney on Thursday, Jan. 19, of John Hartley Durrant, entomological science loses a worker who has long been known for his extensive knowledge, not only of the Microlepidoptera, but also of entomological literature and matters in general connected with taxonomy and nomenclature. Mr. Durrant was born at Hitchin on Jan. 10, 1863. He was one of the few remaining fellows of the Entomological Society of London who could date their association with that Society back to 1883, when he became a member. In 1886 he took charge of the late (the sixth) Lord Walsingham's extensive collection of Microlepidoptera at Merton Hall, Norfolk, and when this collection, which comprised some 260,000 specimens, was transferred, together with the Walsingham entomological library, to the British Museum (Natural History), he became a member of the scientific staff there.

Mr. Durrant was closely associated with the late Lord Walsingham in the preparation of the Microlepidoptera volumes of both the "Fauna Hawaiiensis" and the "Biologia Centrali-Americana," and he was personally responsible for the completion of the latter work after the transfer of the Walsingham library and collections to the British Museum. He was a most careful worker, and one has only to look at the manner in which the extensive synonymies given in the "Biologia" are drawn up, to be impressed by the evidences of painstaking care and sound judgment there exhibited. In an interleaved copy of the volume on the Microlepidoptera of the "Biologia Centrali-Americana," as well as in his note-books, there is also evidence that he was an accomplished artist, many of his sketches

being remarkable for both their accuracy and their beauty.

Mr. Durrant was intensely interested in all matters concerning entomological nomenclature, and he was responsible, with Lord Walsingham, for the compilation of what are now familiarly known as the "Merton Rules." Herein is displayed such evidence of acute insight and sympathetic appreciation of the needs of the systematist as could only be manifested by minds accustomed to face and overcome obstacles inherent in a science that has made steady and comparatively rapid progress through many changes, during a period of nearly two hundred years, since its firm establishment by Linnæus. On the formation of the British National Committee on Entomological Nomenclature in 1913, Mr. Durrant fittingly became its first secretary, retaining that office until 1924.

Mr. Durrant was one of the foremost authorities in Great Britain on the Microlepidoptera, and always showed a keen interest in small moths of economic importance, even when outside the scope of his special work. He was particularly attracted to the Pyralid genus Ephestia, the species of which are injurious to various food-stuffs, and his knowledge of these destructive pests resulted in his association with Major-General Sir W. W. O. Beveridge in the "Army Biscuit Enquiry," a report on which was published in 1913, and, in consequence of the value of the results obtained, reprinted during the War by the Trustees of the British Museum. It has been asserted on good authority that improved methods of preparing and baking Army biscuits, adopted as the result of these researches, have resulted in the saving of a considerable sum of money annually.

For ten years Mr. Durrant was on the editorial board of the *Entomologist's Record and Journal of Variation*, and his extensive knowledge of obscure scientific literature was always at the service of his fellow-editors and the many others who consulted him. Well known to all who visited the Entomological Department at the British Museum, he was an equally familiar figure at the meetings of the Entomological Society, which he attended regularly until the last year or so, when failing health made him avoid venturing out at night. Although apparently a man of strong constitution, his strenuous activities in connexion with the work of the British Red Cross Society during the War, when he served with the Natural History Museum Section of the 31st London V.A.D., added to the loss of his only child during the same period, seem to have affected his health, and to some extent to have hastened his end. Of genial disposition, friendly to a degree, his warm greeting will long be missed by all who knew him, and not least by those who were most closely associated with him in his various activities. W. H. T. T.

Dr. William W. Fyvie.

THROUGH the death, from pneumonia, of Dr. W. W. Fyvie, at Aberdeen on Jan. 17, after a short illness, the science of physics, particularly in the branch of radio communication, has lost one who gave his best in her service; and his Alma Mater, whom he served throughout practically the whole of his graduate career, mourns a son who by his labours enhanced her prestige and brought honour to her name.

Dr. Fyvie was essentially an experimentalist. He showed his ability in this direction very early in his career, for when he graduated in 1904 he did so as the most distinguished graduate of his year in practical physics. Six months after graduation he joined the staff of the Natural Philosophy Department of the University of Aberdeen, then under the supervision of the late Prof. Niven. For some years, owing to his time being mainly occupied with the routine work of the Department, he had little opportunity of developing any particular line of research of his own. Gradually, however, he began to devote more and more time to the study of radio telegraphy. This interest was fostered by Prof. Niven, who had himself done much work in this subject in its earlier stages. As a result the Department became one of the then comparatively few stations permitted both to send and receive radio signals. The outbreak of the War put an end temporarily to their activities, but with the cessation of hostilities the work was again resumed.

The problem which interested Fyvie most at that time was that of telephonic reception, and his energies were turned towards finding the best method for accomplishing this end. Within more recent years he applied himself assiduously to the explanation of the variation of signal strength at sunrise and sunset, and to the problem of 'fading' in general. About twelve months ago he evolved a theory of 'fading' in terms of the interference of reflected waves which accounted excellently for a large number of observations, but he refrained from publishing it until he could satisfy himself of its applicability to all conditions, and he was still working actively on the problem when he died.

The loss of Dr. Fyvie will be felt by many generations of students, to whom he was always a popular and inspiring teacher; while those who knew him intimately, knew him for a man of sterling worth, always ready and willing to spend himself on behalf of his friends.

WE regret to announce the following deaths:

Mr. Miller Christy, author of a "Handbook of Essex," "Birds of Essex," and other publications on the archæology of Essex, on Jan. 25.

Prof. J. L. Heiberg, of Copenhagen, the historian of Greek mathematics and natural science, a corresponding fellow of the British Academy, on Jan. 4, aged seventy-two years.

Prof. H. A. Lorentz, For. Mem. R.S., and Copley medallist in 1918, for many years professor of theoretical physics in the University of Leyden and one of NATURE's "Scientific Worthies," on Feb. 4, aged seventy-four years.

Dr. T. Adrian Palm, who put forward the view that rickets is due to deprivation of sunlight so long ago as 1890, and was the author of contributions to medical literature on diseases and customs in Japan.

News and Views.

IN his presidential address to the fifteenth Indian Science Congress, delivered at Calcutta on Jan. 2, Dr. J. L. Simonsen outlined the early history of the Congress, the first meeting of which was held in 1914. Reviewing the present position of education and research in India, he found matter for congratulation in the advance of the spirit of research in the Indian universities, but deprecated the fact that, with few exceptions, the degree standard has been considerably lowered during the last few years. He attributed this change to the recent University Acts, which have transferred the detailed control of courses of study and standards of examination from the professorial staffs to bodies of laymen. In order to overcome the difficulty of coping with large numbers of students who regard a collegiate career merely as a stepping-stone to government appointments, Dr. Simonsen advocated the extension of Civil Service examinations to all grades in the clerical departments of government. Such a competitive system, although not free from defects, "would liberate the universities from their present thraldom and enable them to devote themselves to their true function, the advancement of learning."

IN the special section of his address, Dr. Simonsen directed attention to the importance of the study of natural plant and animal products. He instanced the work of Annett and his collaborators on the relationship of the alkaloidal content of poppy juice to the age of the plant and to external features, such as the nature and previous treatment of the soil. While commending work of this kind, he deplored the general neglect in India of the chemical study of natural products: "Is it presumptuous to suggest to the organic chemists of India that they should study intensively the unique wealth of material which lies at their door, and devote less time to the study of problems of theoretic interest only?" As an example of the value of collaboration between organic chemists and botanists, he alluded to the two grasses known as 'Sofia' and 'Motia'; although these are both classified as *Cymbopogon Martini*, Stapf, the first yields the valuable palmarosa oil, while the second gives a comparatively valueless ginger-grass oil. Dr. Simonsen suggested that a detailed botanical and chemical examination of the many Indian Cymbopogon grasses would probably lead to results as interesting as those obtained by Baker and Smith in their work on the differentiation of closely related species of Eucalyptus, and that such work might throw light on possible relationships between the chemical constituents of a specific oil and characteristics of soil and climate.

THE annual report presented on Dec. 8 to the Regents of the Smithsonian Institution of Washington recorded active progress in all departments, limited only by lack of funds. Thus more than thirty expeditions took the field, and among their chief results were the obtaining of first knowledge of Dutch New Guinea, one of the few unknown areas remaining on the earth's surface; an archæological and anthropological reconnaissance of Alaska, during which a plan of more intensive exploration was prepared; the collection from Tanganyika of some 2000 live animals combining interest to the public and scientific importance; the inauguration of a third solar observatory for the measurement of solar radiation in the eastern hemisphere; the systematic collection of mineral specimens from Mexico, of ferns from Jamaica, of natural history material from Haiti. This in spite of the fact that, as the report says: "Almost no unrestricted funds for field work were available, each expedition being separately financed either by the generosity of some friend of the Institution or through a co-operative arrangement with some other organisation whereby the costs and collections were shared. Such a programme of field work is of necessity haphazard."

IT is to be hoped that some increased support from the Government as well as from individuals may be the result of the conference of distinguished men of science and leaders of industry held at the Smithsonian a year ago under the chairmanship of Chief Justice William H. Taft. As an organiser and leader of work in pure science, and as the controller of the national collections in art and science, the Smithsonian fulfils a national duty. Its international services are appreciated in all civilised lands. During the past year the International Exchange Service handled 590,879 packages, an increase of 110,103 over the previous year's total. We note with more interest than sympathy that the Smithsonian still has hopes of re-starting the International Catalogue of Scientific Literature. The bibliographers who met at the International Institute seem to labour under no such delusion and are the more practical in consequence.

THE Manchester Geological Society was founded in 1838, and the earlier volumes of its *Transactions* contained a large number of important papers dealing with pure geology. In course of time, however, the Society devoted its energies more and more to mining matters, and eventually came to be one of the bodies incorporated in the Federated Institute of Mining Engineers. Not unnaturally, the people of Manchester and district continued to feel a desire for a local geological society; a proposal to form a geological section of the original society was not found practicable, and finally the Manchester Geological Association was founded as an independent body, but nevertheless in close touch with, and with the full benediction of, the older society, and the rooms and library of the latter at Queen's Chambers, 5 John Dalton Street, Manchester, were placed at its disposal on very liberal terms.

THE first number of the *Journal* of the new Manchester Geological Association has recently appeared. It includes a presidential address by Prof. O. T. Jones, and three detailed papers on various Carboniferous topics. Prof. Jones's address, entitled "The Foundations of the Pennines," is of high interest. By a series

of ingenious deductions he arrives at the conclusion that this foundation must be chiefly pre-Cambrian, but the argument cannot be summarised in a few words. Father Waddington, S.J., dealing with the district round Stonyhurst, offers some trenchant criticism of the validity of the stratigraphical term Pendleside Series, both locally and generally. He shows that the only true Pendlesides are conterminous with the Bowland Shales of Phillips : the Pendleside Limestone, from which the group was named, lies outside it according to modern zonal work, and the name should be dropped altogether. Mr. J. W. Jackson describes the succession below the Kinder Scout Grit in North Derbyshire, and Mr. A. Bray deals with the carboniferous sequence in the Colne district. This publication gives evidence of much energy and enterprise on the part of the new society, which also conducts excursions to places of geological interest. We wish it a long and successful career.

THE impression of persistent stormy, mild, wet weather, with a preponderance of south-westerly winds over Great Britain since the severe frosts of last December, is reflected in the weather summary for January issued by the Meteorological Office as a supplement to the *Daily Weather Report*. This weather was due to an unbroken succession of depressions, the majority of which followed a north-easterly track outside the Hebrides, although a few moved nearly due east across the northern districts of Great Britain and dispersed on approaching an anticyclone over northern Europe. For dwellers in towns, where shelter from rain is so easily secured, and a few hours of strong wind afterwards suffices to give dry conditions under foot, this stormy type of weather is perhaps the least unpleasant at a time of year when anticyclones, if accompanied at first by clear skies, soon lead to dull or foggy weather. The sunny periods that normally occur with the arrival of polar air behind a retreating depression can give a monthly duration of sunshine well above the average, as the figures for last month prove. At Ross-on-Wye it was the sunniest January for at least fourteen years, and in many other parts of the country sunshine was also in pronounced excess. The general mildness, resulting from an almost complete absence of easterly winds, is shown by the mean temperatures for Kew, Aberdeen, and Valentia. Gales giving rise to gusts of upwards of 75 and even 80 miles an hour were unusually frequent. It was one of these, blowing from between west and north-west across the southern part of the North Sea, that was partly responsible for the disastrous floods in London on the night of Jan. 6.

THE excess of rainfall, which was the most remarkable feature of the weather for the month of January, appears to have been particularly marked in Scotland : at Stornoway the total of 268 mm. was the highest for January since records began there in 1873; and at Eskdalemuir, where 394 mm. fell, it was the wettest month of any since at least 1911. New monthly rainfall records were also made at various places in the Lake District. According to the *Westmoreland Gazette* of Feb. 4, the highest gauge of the Manchester Waterworks at Ullscarf registered 683 mm. ; at The Wray, Grasmere, the rainfall was 620 mm., the previous highest being 575 mm. in February 1894 ; at Ambleside it was 595 mm. for the first 28 days, the previous record being 578 mm. in October 1903 ; at Windermere it was 421 mm. ; and at Sedburgh it was 376 mm., the previous record being 369 mm. in August 1891 ; at Kendal it was 368 mm. for the first 28 days, the previous record being 319 mm. in October 1874. It is stated that January has easily passed all rainfall records for the first month of the year.

WE learn from the Kew Observatory that on Jan. 22, at about 6.12 P.M., a rather strong shock (which may be classed as an earthquake of intensity 5 on the Rossi-Forel scale) was felt in a small district including Hanley, Burslem, and Cobridge in North Staffordshire. A typical experience was that of Mr. F. J. Rathbone, of 321 Waterloo Road, Hanley, who wrote in a letter to the Meteorological Office : "I was lying on a couch in the living-room when there came a terrific 'Bump' and the whole house rocked. A large mirror, hanging over the mantelpiece (which I was facing), quivered violently, and light on the tiles round the fire-place shimmered rapidly, showing, I think, evidence of considerable disturbance at the foundations of the house. The shock was of very short duration, just as though a giant, using a mammoth hammer, had struck one mighty blow at the earth right under me : it might have been the result of a mine explosion or of a great subsidence of earth, but I have not heard of either of these latter happening." The brevity of the shock, its comparatively high intensity, and its small disturbed area (probably not more than a mile or two in diameter) indicate that the focus was small and at a very slight depth below the surface. They suggest that the tremors were caused by a small slip of the strata along a fault between Burslem and Hanley, a slip due to the withdrawal of the coal or of water from the mines. Such local earth-shakes are frequently felt in the mining districts of Great Britain.

MR. HOWARD CARTER has now dismantled the great canopic shrine in the innermost recess of the tomb of Tutankhamen and has examined the magnificent canopic chest and its contents. The result is shown in a series of illustrations which appear in the *Illustrated London News* of Feb. 4. In the accompanying letterpress, it is stated that the shrine was more than six feet in height and occupied a floor space of some five by four feet. It stood on a sledge. The canopy was supported by four uprights, and on each of the four sides was a statuette of a tutelary goddess with outstretched protective arms. Within was a canopic chest of semi-translucent alabaster standing upon a silver-handled sledge, and with a tutelary goddess carved in relief at each corner. The massive lid in the form of an entablature was fastened down with four seals attached to gold staples. Within were four receptacles with human-headed covers in alabaster sculptured in the likeness of the king. Within these

again were the four exquisitely inlaid golden coffins which contained the viscera. These miniature coffins are exact replicas of the great gold coffin that enclosed the body of the king, but are even more elaborately inlaid in the feather design. Each bears the formula of the goddess and genius to which it belongs, and the texts pertaining to its protectors are engraved on the inside. It is interesting to note that owing to the carelessness of those who were responsible for erecting the canopy the protective deities were misplaced, Nephthys being placed on the east side where Selket should have been, and Selket on the south side in the place of Nephthys.

ON Feb. 2, Sir William Bragg gave the first of a course of lectures at the Royal Institution on "Faraday's Note-books," and dealt with ice and regelation. Sir William stated that the manuscript note-books of Faraday, which have not yet been published in full, show that in September 1842 he made a number of experiments on certain curious properties of ice. He had noticed that pieces of ice put together into a bowl may be melting as a whole, while at the same time they freeze the water just round their points of contact, and so join themselves together by solid bridges of ice. It is well known that ice is crystalline, and when a crystal grows, the new molecules have to take their places in correct alignment. Molecules of water are apt to hold back from crystalline arrangement, unless there is something to make the first step easy; a molecule near a piece of ice may be induced to join up to the crystalline structure already existing, and still more so if ice surrounds it. In the long arguments on glacier motion which took place in the middle of last century, much use was made of Faraday's experiments and ideas. But it was then believed that a single crystal of ice could not be distorted. It was not until 1890 that M'Connell showed that a single crystal of ice can be made to yield, certain layers of atoms sliding over one another. Just so with a metal; single crystals of various metals are remarkably pliable. A copper bar can be so made as to yield easily in one's fingers; yet if so moved once or twice, the single crystal breaks up into many small crystals and the bar regains the strength which is usually the property of a copper bar. The problem of the glacier closely resembles the problem of the flow of a metal. When this new fact is taken into account, the importance of Faraday's early work is more readily understood.

IN a Friday evening discourse on "Photosynthesis," delivered by Prof. E. C. C. Baly at the Royal Institution on Feb. 3, he stated that the conversion of carbonic acid directly into sugars and starches is one of the simplest of all the vital processes from the chemical viewpoint; yet, although it is known that it is effected by means of sunlight, there have been apparently insuperable difficulties in the way of its explanation. The greatest difficulty of all, perhaps, is that on any theory based on previous knowledge gained from the study of light reactions in the laboratory, the plant cannot absorb directly from sunlight sufficient energy for the synthesis to take place. Experiments in the University of Liverpool have shown that the explanation is in reality very simple; the definite factor is the existence of a surface on which the synthesis can take place. It has been found that if a coloured surface capable of absorbing carbonic acid is present, then on exposure to sunlight the carbonic acid is converted into sugars and more complex carbohydrates; the energy is supplied partly by the surface and partly by the sunlight. Thus photosynthesis of sugars is closely analogous to that achieved by the living plant, since it is known that a suitable surface exists in the leaves and, moreover, for the same area of surface the quantities of sugars produced in the leaf and in the laboratory are very similar. Furthermore, the same sugars are produced in both. Not only do these results offer an explanation of vital photosynthesis, but they also suggest that the key to the mystery of all vital chemistry has been found, and that this differs from the chemistry of man's achievement by virtue of the very large amounts of energy involved. The chemistry of life would seem to be one of high energy, whilst that of man's endeavour is the chemistry of low energy.

GREAT BRITAIN was the first to give a single authority the responsibility for the conduct of a national service of broadcasting. Since it started in November 1922, a large number of nations has adopted similar systems. The United States, however, is a notable exception, as it clings to systems based on private enterprise. In a paper on the design and distribution of radio broadcasting stations for a national service, read by Captain P. P. Eckersley to the Institution of Electrical Engineers on Feb. 1, the progress made is discussed and future possibilities are pointed out. It is estimated that 90 per cent. of the listeners in rural areas in Great Britain rely upon Daventry. A listener in an area close to the station, that is, within the 'wipe-out' area, can be guaranteed a continuous and perfect service, but those outside this area are liable to interference. The Swedish engineers have proved that waves travelling over forests attenuate much more rapidly than waves passing over water. The provision of alternative programmes more than doubles the value of a broadcasting service. It not only tends to satisfy a larger number of persons, but each programme also can be given artistic unity as there is no need to consider any compromise. Telephone lines have proved most valuable in this connexion, and probably give the best solution for interlinking distant stations. The British Broadcasting Corporation, in conjunction with the Marconi Company, is considering the feasibility of short wave transmission. Many technical problems are discussed in the paper, the low power choke-modulation methods being shown to be the most satisfactory. Since it started, the performance of 5 G.B. has given every satisfaction. The B.B.C. is at present engaged in considering methods of improving the service.

THE electrodeposition of nickel, silver, and gold were amongst the earliest applications of electricity

to practical purposes. Recent researches have not only greatly speeded up the times required for the processes, but have also produced a far superior type of deposit. In addition, many new metals are now being deposited on a commercial scale, several of which have special valuable properties. A thin layer of zinc or cadmium protects steel from corrosion. Tin produces a silver white surface, and is used for improving the appearance of a metal. The metal, however, which is most experimented on at present is chromium. Its most important properties are its great hardness and its ability to keep bright and clean for long periods. Stainless steels and rustless irons are indebted to this element for their freedom from tarnish. In the *Electrical Review* for Jan. 13, S. Wernick gives a useful survey of the applications, properties, and the methods of deposition of chromium. It appears that chromium gives the hardest deposit that has yet been produced, being harder than hardened steel. Chromium plate has been found useful in prolonging the life of steel gauges. It has a faint bluish tinge, but takes a brilliant polish, the colour being somewhat similar to polished aluminium. The various solutions used for the deposition generally consist of chromic acid with the addition of a salt. A high current density is employed, and the temperature of the bath should be maintained at about 50° C. The heavy current rapidly heats the bath, so water cooling by lead pipes is necessary, and the rapid evolution of hydrogen produces an objectionable chromic acid spray in the atmosphere. Lead forms a useful and insoluble anode. The present cost of chromium plating is several times greater than nickel plating. Before long a standard specification will doubtless be agreed on, and chromium plating will become a commercial operation.

THE example of Mr. Charles Enderby, who a hundred years ago owned a fleet of sealing vessels sailing from the Thames for Antarctic waters and encouraged his captains to combine discovery with commerce, is now being followed by Mr. Lars Christensen, of Sandefjord, Norway, one of the leaders in modern whaling enterprise. One of Mr. Christensen's whale-catchers, the *Odd I.*, made a most successful dash into the Antarctic west of Graham Land in January 1927, when she reached and circumnavigated Peter I. Island, which had previously only been sighted from a distance by its discoverer, Bellingshausen, in 1821, and by Charcot in 1912. The island was photographed from all sides, and attempts were made to land on it at several points, but no beach could be found beneath the vertical cliffs of volcanic rock which alternate with glacier faces to form its coast.

IN September 1927, Mr. Christensen dispatched a small sealer named the *Norvegia*, under the command of Capt. H. Horntvedt, with a scientific staff of four, including Prof. Olaf Holtedahl and Dr. O. Olstad, for a scientific expedition in sub-Antarctic and Antarctic waters. The *Norvegia* reached Bouvet Island in the South Atlantic on Dec. 1 and landed upon it. The scientific interest of this feat lies in the fact that from its discovery by Bouvet in 1739, doubt and mystery have surrounded the island. Cook and Furneaux searched for it in vain in 1772; Cook again failed to find it in 1775, and although Enderby's sealers reported the island, on which they landed, in 1808 and 1825, Sir James Clark Ross sought for it without result in 1843, and Lieut. Moore, R.N., was equally unsuccessful in 1845. Not until 1898 was the existence of the island settled by the German scientific expedition under Prof. Chun in the *Valdivia*, and although the island was photographed, a landing was impossible. Better photographs were taken by the German expedition in the *Meteor* in February 1926, but rough weather made it impossible to land. None of the later expeditions has found more than one island in the neighbourhood, though the Admiralty charts continue to show Thompson Island as reported in 1825. After refitting at South Georgia, the *Norvegia* is proceeding towards Enderby Land, the objective of Sir Ernest Shackleton in the *Quest*, which has never been seen by any expedition since Biscoe discovered it in 1831.

MESSRS. CARL ZEISS, Winsley House, Wells Street, London, W.1, inform us that on Jan. 16, in the presence of the Ministers of Finance and Education, Signore Mussolini signed a contract for the erection of a Zeiss planetarium in Rome. The inauguration will take place on Oct. 29 next, and will be made the occasion of special ceremony. It is intended to erect the planetarium building in a prominent position, and the open space in front of the main station is said to be under consideration for the purpose. The city of Moscow has also recently contracted for a Zeiss planetarium. It is intended to erect the instrument in the building of the former Moscow Circus, situated in the centre of the city. A hemispherical projection surface measuring 26·6 metres in diameter is now being installed, and there will be seating accommodation for about seven hundred spectators. It is expected that the planetarium will be on view in May next.

SIR ERNEST RUTHERFORD, O.M., Pres. R.S., represented the Royal Society at the funeral of Prof. H. A. Lorentz at Haarlem on Thursday, Feb. 9.

IT is announced in *Science* that Prof. T. C. Chamberlin, of the University of Chicago, has been awarded the Penrose Gold Medal of the Geological Society of America.

DR. A. W. HILL, Director of the Royal Botanic Gardens, Kew, who is on a visit, made possible by a grant to Kew from the Empire Marketing Board, to the botanical, agricultural, and forestry institutions of Australia, New Zealand, and Java, has been given the degree of D.Sc. by the University of Adelaide.

AN exchange of greetings by radio telephony between the presidents of the Institution of Electrical Engineers and the American Institute of Electrical Engineers will take place on Thursday, Feb. 16, at 3.30 P.M. The message from America will be received in the Council Room of the Institution, but arrangements are being made for a repetition of the message

in the lecture theatre by means of a loud-speaker. Immediately after the exchange of greetings, a kinematograph film, lasting about fifteen minutes, and illustrating the new Anglo-American telephone service, entitled "Voices across the Sea," will be exhibited in the lecture theatre. This will be repeated at 6 P.M.

A NEW book on the "New Quantum Mechanics" is to be published shortly by the Cambridge University Press. It is the work of Mr. G. Birtwistle and deals with the development of the subject during the past two years. New and hitherto unpublished speculations of Prof. Niels Bohr are promised.

MESSRS. Watkins and Doncaster, 36 Strand, W.C.2, announce for early publication "A Revised Handbook of British Lepidoptera," by E. Meyrick. The work is a new form of the author's handbook of 1895, completely revised and remodelled, and largely rewritten, with about 100 additional species, and the classification and nomenclature corrected and brought up-to-date.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A rural industries assistant, from persons with a knowledge of fur-producing rabbits, under the Somerset Rural Community Council—The General Secretary, 14 Hammet Street, Taunton (Feb. 18). A lecturer in pure and applied chemistry at the Leicester College of Technology—The Registrar, Colleges of Art and Technology, Leicester (Feb. 20). A professor of physics at the University College of Hull—The Secretary, University College, Hull (Feb. 24). A post under the Meteorological Branch, Department of Scientific and Industrial Research, Wellington, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Mar. 6). A senior lecturer in physics at the Huguenot University College, Wellington, South Africa—The Registrar, University College, Wellington, Cape Province, South Africa (Mar. 30). A radiologist electrologist under the Government of Hong Kong—The Private Secretary (Appointments), Colonial Office, Richmond Terrace, Whitehall, S.W.1.

Our Astronomical Column.

ANOTHER TEST OF THE EINSTEIN BENDING OF LIGHT.—It was suggested by Prof. Chas. Lane Poor and others that the observed light bending at the eclipses of 1919, 1922 might be due not to the Einstein effect but to abnormal refraction in the terrestrial atmosphere, produced by the fall of temperature about the time of totality. While it was unlikely that this would act radially from the centre of the sun throughout totality, it was thought advisable to test the suggestion at the Sumatra eclipse of 1926. This was done by Dr. Miller and Dr. Marriott, their method being to obtain the diameter of the moon by photography during totality. The effect if present would affect the moon as well as the stars, while the Einstein effect would only act on the stars.

A recent *Science News Bulletin* issued by Science Service of Washington reports that the measures have now been completed and the moon's diameter has its normal value, thus making the suggestion of the effect being due to terrestrial refraction improbable. A slip in the account in the *Bulletin* should be corrected. It speaks of the Einstein shift as drawing the star-images closer to the sun; actually it pushes them out from it.

RECENT SOLAR ACTIVITY.—Although solar activity was considerable during 1927, the rapid rise which characterised the years 1924–26 has received so sudden a check that the average spotted area for 1927 is somewhat less than that of 1926. The appearance of a naked-eye spot has not been reported in NATURE since mid-November, but recently there have been several spots, which, although barely large enough for inclusion in this category, have been of interest to observers who regularly watch the sun's disc. In this respect mention should be made of the following spots (the date is given of their passing the sun's central meridian, together with their latitude): (1) Dec. 27, 1927, 12° N.; (2) Jan. 3, 1928, 8° S.; (3) Jan. 22, 15° N.; (4) Jan. 25, 8° N.; (5) Jan. 30, 21° S. On occasions, some of these spots were visible as naked-eye objects to the keenest vision.

In connexion with spot No. 4, Mr. Newbegin, observing at Worthing with his prominence spectroscope, reports that on Jan. 30 he saw a large metallic prominence of the 'rocket' type in the vicinity of this spot near the sun's west limb. The prominence extended to a height of 130″ above the limb, and the displacement of spectral lines indicated considerable motion outwards. The spot itself was not very active, but the *C*-line of hydrogen was reversed faintly, and there were signs of small displacements of the line. It may be added that the 'rocket' type of prominence is one in which streamers shoot out from a common centre which is almost invariably over a sunspot, and that the presence of metallic lines (*e.g.* sodium, iron, magnesium) in the spectrum of the prominence is indication of considerable disturbance. The prominence under observation by Mr. Newbegin showed increasing metallic activity from Jan. 30 until Feb. 1, when it had nearly disappeared around the sun's limb. No unusual terrestrial magnetic disturbance appears to have been recorded when the spot and its attendant prominence was on the disc. Mr. Newbegin adds that on Feb. 2, as many as twenty prominences were seen around the limb.

BRIGHT METEOR ON FEB. 3.—Mr. W. F. Denning writes that a fireball was seen from his garden by two observers on Feb. 3 at $7^h\ 56^m$ P.M. It was about twice as brilliant as Venus and pursued a rather long flight in 4 seconds from $99° + 40\frac{1}{2}°$ to $27° + 53\frac{1}{2}°$. The radiant point was in the constellation Hydra (which was rising at the time in the east by south) at 148° – 14°, and this position was only just above the horizon at the moment of appearance of the meteor. This radiant in Hydra is in well-defined activity during the months October to February and has been frequently observed. A mean of 15 determinations of the radiant point gives the position at 148° – 11°. It is important to hear of another observation of the bright meteor. Several small meteors were recorded from this shower on Jan. 22 last, and the radiant seems to be one of those long-enduring and fixed positions which appear abundantly distributed over the heavens according to observations during the past half a century.

Research Items.

BRONZE AGE URNS FROM SOUTH DEVON.—What further excavation may prove to be an important discovery relating to the Bronze age is described by Mr. H. G. Dowie in the *Proceedings of the Torquay Natural History Society* for 1926–27. In the course of excavations for a cess-pit at Slapton, South Devon, in July last, two urns were unearthed, and afterwards two stone cists were found. One urn was broken and a majority of the sherds dispersed, but enough have been recovered to show that, apparently, it was undecorated. It was of reddish-brown paste imperfectly fired, with a black core. A fragment of rim suggests a diameter of 9 in. The second urn contained a material of gray colour but no bones. It measures five inches high and is of the same paste as the first. Of the cists, one was in a dilapidated condition. Beneath and around a stone once forming part of the cist were burnt bones, pieces of charcoal, and several human teeth. The second cist was in perfect condition. It lay 25 inches below grass, and consisted of a flat stone for base, five flat stones for uprights, and a cover stone measuring 12 inches by 10 inches. It was almost cylindrical. Burnt bones were found within. The distance between the cists was 4 ft., and the general dispositions of the finds was as if there had been two parallel rows of interments running north-east and south-west. There is no trace of a barrow. The form of the second urn is interesting. Although it approaches the class of early Bronze Age pottery known as 'Food vessel,' in profile its form belongs to the succeeding class of cinerary urn. The decoration of the collar is the alternately shaded triangle. Along the lower curve runs a series of diagonal punctuations. The decorative motive on the collar, though uncommon, is wide spread. The occurrence of an example at Carnac suggests that Slapton may be the terminus of a sea route.

DISTRIBUTIONS IN NORTH-WEST AMERICA.—Mr. Ronald L. Olson has made a study of the types of adzes, canoes, and houses of the Indian tribes of the north-west coast of America, which is published by the University of Washington as No. 1 of vol. 2 of its Anthropological Series. Mr. Olson's thesis is that, historically, variation is as important as the invention of an entirely new trait. He has therefore taken the three cultural traits mentioned, analysed them in detail, and traced their distribution. Of the adze, the most important tool in wood-working, there are three types in the area, the elbow, the straight, and the D-shaped; their relation is difficult to see. The elbow-shaped type may be an intrusion. The adze, however, is a distinctive north-west trait as opposed to the axe, which is in use over the greater part of America. It may be an Asiatic element, and the occurrence of an elbow form, identical with the American, in Polynesia, suggests an extra American origin. The dug-out canoe is found outside the area over much of California, on the Columbia in Washington, and on all but the upper reaches of the Frazer. On the north it is found only along the coast, excepting for the one instance of the Athabascans of the extreme north-west of British Columbia. It is unknown in Alaska outside Tlingit territory. In north-east Asia it has a wide and sporadic distribution. Both the birch bark and the dug-out canoes of Asia may have spread from America. Their wide distribution in America points to a great antiquity. The rectangular plank house is confined to the north-west coast in the south, but occurs on the upper Frazer and in eastern Washington. It is found in Alaska, while there are comparable types in north-east Asia and in the Amur region, where the resemblance is very close. The general conclusion is that the basic features of the three traits are probably not developments of the north-west coast area, but the restriction of certain qualities to the area is a strong presumption in favour of these being the contribution of tribes in the area.

THE MOTHS OF TRINIDAD.—A catalogue of the Trinidad Lepidoptera Heterocera (Moths) forms No. 3 of the *Memoir of the Department of Agriculture of Trinidad and Tobago* (1927). The authors, Mr. W. J. Kaye and Sir Norman Lamont, Bart., mention that since 550 species of butterflies form the rich fauna of those insects recorded from the island, the number of moths here listed (1016) cannot be considered large. It can be safely assumed that we do not know half of the smaller species of the Pyralidæ, Geometridæ, or Noctuidæ. On the other hand, the Sphingidæ with 54 species, Syntomidæ with 83 species, and Castriidæ with 6 species, are tolerably well represented, and additions thereto are not likely to be numerous. From an economic point of view the number of injurious species is not large, and 28 species of moths pertaining to eight families are listed as habitually or occasionally pests to agriculture or horticulture. The catalogue is evidently very carefully compiled, and should prove useful, not only to entomologists resident in the West Indies, but also to students of geographical distribution elsewhere.

BEETLES INJURIOUS TO TIMBER.—A useful pamphlet devoted to this subject has recently been issued as *Bulletin No. 9* of the Forestry Commission (London: H.M. Stationery Office) by Dr. J. W. Munro. Certain Longicorn beetles and pin-hole borers are essentially forest insects, since they attack timber just after it has been felled, abandoning it after it has become dried and seasoned. The powder-post and furniture beetles, on the other hand, attack seasoned timber, the former occurring in timber yards and the latter infesting old furniture, rafters of ancient buildings, etc. A good and well-illustrated account of these several kinds of beetles is given and the types of damage sustained clearly explained, while suggestions are made regarding preventive and remedial measures. The losses occasioned by beetle-attacks to the roofing timbers of Westminster Hall and certain other public buildings are a matter of serious concern to those in charge of the preservation of ancient buildings. There is evidently a good deal of research still to be carried out before a speedy and trustworthy method of treatment can be devised. At present methods require to be periodically applied, even over several years, and no chemical preparation is known which will eradicate beetles from infested timber in a single application.

INDIGENOUS FOREST TREES OF SOUTH AFRICA.—In a recent paper (*Trans. Roy. Soc., South Africa*, **14**, Part 4) Dr. J. Phillips deals with the ecology and distribution of the large Proteaceous tree *Faurea M'Naughtonii* Phill ('Terblanz'). This tree has the curious distribution of other of the species of the comparatively small area of indigenous forests of South Africa. The species occurs in a single area of about 1000 acres in the Lilyvlei Forest of the Gouna Forest Reserve, Kynsna. It is also recorded from several isolated centres in the Elliotdale, Lusikisiki, and St. John's districts, from Ngorni Forest in Northern Natal, and from Mariep's Kop in the Transvaal. At Gouna there are about 12,000 trees above

1-inch diameter at breast height, and on the 1000 acre portion the absolute frequency of plants under 15 ft. in height and 1-inch diameter is 1·1 per square yard. The percentage frequency of Faurea above 1-inch diameter on the 1000-acre portion is 2·61 per cent. The tree occurs as a dominant in small associations termed the '*Faurea M'Naughtonii*—other spp. associations,' the co-dominants being *Podocarpus Thunbergii* Hook and *Olea laurifolia* Lamk. It is, however, more generally found as a sub-dominant in the extensively developed '*Podocarpus-Olea laurifolia*—other spp. association.' In the Transkei and in Natal the tree is less locally abundant, and is not a dominant in any community. From the forestry point of view it has been established that the tree is moderately light demanding, and is tender in isolation in youth. The dispersal of the fruits (a single-seeded, long villous nut), the author says, is over very short distances, the long hairs being very inefficient aids to flight, whilst water and animals have little influence; the result being the aggregation of regeneration on the crown-influence-zones of the parents. Flowers are produced in considerable abundance, pollination being effected either by a species of Apis or the flowers are self-pollinated. The seeds take from one and a half to three months to germinate, the germinative capacity being ½ to 1 per cent only. It is held that the species is gradually extending its limits at Gouna, where the Forest Department has set aside 200 acres as a scientific reserve.

IRON ORE IN SOUTH AUSTRALIA.—The "Mining Review" issued by the Department of Mines of South Australia for the half-year ended June 30, 1927, contains an interesting account of iron mining at Iron Knob, Iron Monarch, Iron Prince, and Iron Baron, which are operated by the Broken Hill Proprietary Company. This Company has constructed a railway line of 3 ft. 6 in. gauge, some 33 miles long, connecting the iron ore deposits with the Port of Whyalla, whence the ore is shipped to the steel works of the Broken Hill Proprietary Company at Waratah near Newcastle, New South Wales. The ore bodies consist mainly of hæmatite with some magnetite, and the quantity of ore proved available for open working is approximately 150 million tons. The ore as shipped contains 65·67 per cent. of iron and 1·69 per cent of silica. A full description is given of the methods of blasting, breaking, and handling the ore, its transportation to the Port and handling at the Port, whilst there is also a brief description of the steel works in New South Wales. It is stated that from the commencement of operations up to Nov. 30, 1926, more than 2¼ million tons of steel ingots have been produced at these works.

GENESIS OF KAOLINITE-BEARING NODULES.—In the *Proc. Geol. Assoc.*, pp. 518-547, 1927, Mr. Serge Tomkeieff describes with an admirable wealth of petrographical detail the kaolinite-bearing ironstone-nodules which occur in the Coal Measures near Newcastle-upon-Tyne. The second half of the paper discusses the various problems that arise in connexion with the genesis of the deposit, and as this part of the investigation is based on sound geology and a clear appreciation of physical and colloidal chemistry, the result is a contribution to petrogenesis of wide and unusual interest. An outline of the processes involved is as follows: (*a*) Deposition of fine laminated mud with an original pore space of nearly 90 per cent.; (*b*) segregation of colloidal hydrated iron carbonate and hydrated alumino-silicates in the form of nodules under the protective action of humic acids, the nodules being thus of the penecontemporaneous class; (*c*) gradual crystallisation of the colloform nodules from the outside inwards, with subsequent cracking of the interior due to syneresis; (*d*) gradual compression of the shale; (*e*) infiltration of solutions into the crack-spaces and deposition of kaolinite and calcite. It is suggested that the kaolinite represents materials that were in colloidal solution, and that, as they lost water, they formed a colloidal precipitate,

$$2H_4SiO_4 + 2H_3AlO_3 - 5H_2O = H_4Al_2Si_2O_9,$$

which gradually passed into a finely crystalline aggregate. The interesting observation is recorded that a bleached Cheviot granite from under a thick covering of peat contained no trace of kaolinite.

DIVISIONS OF THE ALPS.—At the congress of Italian geographers, held at Genoa in 1924, a commission was nominated with the task of forming a scheme for the nomenclature of the region and districts of the Alps. This work was much needed in order to give precision in writings on the Alps, for there has been hitherto considerable divergence in the application of various names. A map in the *Geographical Journal* for January gives the findings of the Italian commission and is accompanied by a short critical article by Mr. D. W. Freshfield. The principle adopted by the commission was that geological, climatic, linguistic and political boundaries must be ignored if the nomenclature is to have real practical value. Only orographical considerations have been kept in mind and, where possible, rivers and passes rather than mountain crests have been utilised as boundaries. For details, reference must be made to the map, but it may be noted that with a few exceptions the districts as now defined correspond more or less closely with those adopted by W. A. C. Coolidge in the "Encyclopædia Britannica."

THE STANDARD OF LENGTH.—When Arago took part sixty years ago in the conferences which led to the construction of the standard metre of the newly founded Bureau international des Poids et Mesures, he expressed himself most enthusiastically on the advantages of a unit of length defined in terms of the wave-length of a line of the spectrum of a particular element, for example, the red line of cadmium, and since his day others have expressed the same opinion with equal enthusiasm. But the work of spectroscopists during the last twenty or thirty years has shown that there are many circumstances and conditions which affect the wave-length of a line of an element, by small amounts it is true, but each year almost has added to the known conditions which must be satisfied if the standard line is to be obtained. It is mainly on this account that M. A. Pérard, of the Bureau, after an examination of the facts, comes to the conclusion in a paper in the *Travaux et Mémoires* of the Bureau, that for the present the old platinum standard must serve as the definition of the unit of length, nor can quartz serve as a substitute for platinum.

PASSIVE METALS.—An X-ray examination of finely divided iron, nickel, and chromium, conducted by F. Krüger and E. Nähring at Greifswald, has shown conclusively that films of oxide thicker than 10^{-7} cm. are not present on the surface of a passive metal. The diffraction pattern of an inert sample is identical with that of a chemically reactive specimen, and exhibits not only no extra lines where those of the oxides would be expected, but also shows those of the ordinary metal in their usual positions, proving that the pre-existing lattice has not undergone appreciable distortion. The plate which accompanies their paper in the *Annalen der Physik* (No. 23) shows distinctly the pattern of nickel oxide (NiO) superposed on that of

nickel, when in order to test the sensitivity of the method, a mixture of the two substances was taken which contained only 2 per cent. of the former.

USE OF THE GEIGER ELECTRICAL COUNTER.—The conditions under which this instrument can be used to enumerate β-rays accurately have been studied by Dr. N. Riehl in Fräulein Meitner's laboratory in Berlin, and are described, together with some allied work on radium *D* and radium *E*, in the *Zeitschrift für Physik* of Jan. 13. An important point overlooked by previous investigators is that in order to record with certainty a fast β-particle, producing less than about ten pairs of ions per cm. at atmospheric pressure, the density of gas in the ordinary type of counter must be increased. Dr. Riehl considers that neglect of this factor, and the application of an unduly large correction for reflection at the source, make previous estimates of the number of β-particles from radium *E* too small, and gives 1·2 as a new minimum value; in other words, about one in six of the particles constituting the continuous spectrum with speeds up to about 0·94 that of light are of secondary origin. The radiation from radium *D*, on the contrary, could only be partially recorded when the stopping power of the celluloid window of the counter was reduced to 0·45 mm. air-equivalent, and apparently the bulk of the primary β-rays from this element have velocities less than one-fifth that of light.

MINERS' LAMPS.—The flame of a modern safety lamp is quite visible through the glass cylinder which now forms the lower part of the lamp, and the candle power of the lamp varies from 0·8 to 1·2. The problem of increasing this candle power has been under consideration by the Safety in Mines Research Board for some time, and Paper No. 40 just issued by the Board (London: H.M. Stationery Office) gives an account of the work of Prof. R. V. Wheeler and Mr. D. W. Woodhead in this direction. They find that by using a blend of petroleum spirit with paraffin and mineral colza, an increase of 35 to 40 per cent. in the candle power is obtained. By increasing the height of the wire gauze chimney, using a wider mesh, a thinner wick with its top concave upwards and by surrounding the upper part of the flame by a short length of glass tubing open at top and bottom, the candle power can be raised to 2·75. It is to be hoped that these possibilities will become widely known and that lamp manufacturers will quickly place these improved lamps on the market.

THE PHOTOGRAPHIC DETECTION OF FALSIFIED DOCUMENTS.—Prof. Carlo Bonacini contributes an article on this subject to the *Rivista Fotografica Italiana*, a translation of which appears in the *British Journal of Photography* for Jan. 20. He finds that a photograph made by means of the infra-red shows chiefly superficial details, while the ultra-violet brings out detail more in the body of the document. This method demonstrated in one case that underneath the visible number was another number, invisible: that it had been effaced by chemical means, but had evidently left a clear trace in the fibres of the paper. He also confirms the work of Colson, that a document written in an easily oxidisable ink (as iron gallate), if left for a sufficient time in contact with a gelatino-bromide plate, will cause desensitisation where the ink is, so that if the plate is developed after a brief exposure to light, the writing will be shown transparent on a grey background. Prof. Bonacini finds that by this means one can reproduce an inscription that has been bleached by chemical means. In an example, the visible inscription being written with an ink made with a dye, this method revealed only the original writing that has been bleached and was quite invisible. He enumerates certain details in connexion with these methods that need further investigation.

HIGH TEMPERATURE EQUILIBRIA.—An ingenious method for the investigation of high temperature equilibria has been developed by C. H. Prescott, Jr., and W. B. Hincke, and some new results are recorded in the November issue of the *Journal of the American Chemical Society*. The furnace employed consisted of a thin graphite tube about one-third of a centimetre in diameter, supported on tungsten rods and mounted in a bulb in a thermostat. The materials were placed in the tube and the temperature raised by passing a heavy current through the graphite. An optical pyrometer was used to determine the temperature. The equilibrium between thorium oxide, thorium carbide, and carbon monoxide was investigated between 2000° and 2500° K. at pressures varying from 2 cm. to 2 atms. The thorium carbide, ThC_2, produced was a yellow crystalline substance which hydrolysed in a short time to a buff-coloured powder even over phosphorus pentoxide. Its melting-point is in the neighbourhood of 2773° K. The aluminium oxide and carbon system was similarly examined. The data obtained were utilised to calculate the free-energy and heat-content changes attending the reactions:

$$ThO_2 + 4C = ThC_2 + 2CO;$$
$$2Al_2O_3 + 9C = Al_4C_3 + 6CO.$$

CIRCUIT BREAKING AT HIGH PRESSURES.—The new problems which electrical engineers have to consider are mainly connected with high pressures and methods of breaking circuits supplying large amounts of electric power. The use of high pressure is made necessary by the greater distances the power has to be transmitted. Problems connected with underground cables up to pressures of 100 kilovolts and overhead wires up to 380 kilovolts have been practically solved, but engineers are still chary about adopting them. The solutions for high pressures cannot be obtained by a simple proportional increase of the dimensions of apparatus and cables. Entirely new electro-technical problems are involved which need exhaustive and prolonged study in the laboratory before the engineer can safely proceed to carry out high-pressure schemes involving the control of huge amounts of power. The question of the rupturing capacity of large oil-break circuit breakers can only be solved experimentally. Not even a roughly approximate theory has yet been given to indicate the effects that would be produced by increasing the number of breaks in a circuit or increasing the speed at which the contact pieces separate. This is a rich field for research and offers excellent prospects of technical developments. In *A.E.G. Progress* for October, Dr. Rengier discusses the relative advantages of multi-break interruption and explosion chambers in circuit breakers for use in polyphase systems. The arc which occurs on the separation of the contacts converts the oil in its neighbourhood into gas and vapour. As the oil gas mixes with the metallic vapour, the metallic vapour arc alters into a gas arc. The gas, which is under considerable pressure, offers increased resistance to the maintenance of the arc. On the other hand, the high gas temperature diminishes the resistance. The author shows that by fitting the oil circuit breaker with 'explosion chambers,' increased security can be obtained as the energy liberated in the apparatus is diminished.

Geology in Great Britain.

THE *Summary of Progress of the Geological Survey*[1] for the year 1926 is more than usually interesting, because it contains not only the annual report of the Geological Survey Board and that of the Director, but also a series of appendices in which are presented the results of some of the more important investigations made during the year under review.

Revision of the six-inch maps is being actively carried on in most of the British coalfields. Sixty-four maps were published last year, together with a number of memoirs, some of which are noticed briefly below. The appendices include accounts of the Silurian rocks of Wenlock; the Carboniferous Limestones of Cumberland and the Isle of Man; the Barnsley Seam; the Pliocene of the Surrey Downs; the Ochil Fault; and, perhaps most noteworthy of all, a long technical paper on "The Use of the Torsion Balance in the Investigation of Geological Structure in South-West Persia." This very able report, by W. E. P. McLintock and J. Phemister, provides a welcome account of the method of investigating deep-seated structures by means of the Eötvös balance, and also of some of the actual results achieved by the Anglo-Persian Oil Company. The latter is to be congratulated for its generosity in consenting to the publication of a report which the Board rightly felt would be of outstanding interest to geologists generally.

A memoir on the Wrexham District[2] describes the area represented on Sheet 121, an area that lies mainly within the county of Denbigh and includes the densely populated belt of the Denbighshire coalfield. The geological sequence described ranges from the Bala formation to the top of the Millstone Grit, which, in this neighbourhood, is roughly equivalent to the upper part of the Carboniferous Limestone. Special attention is devoted to the tectonic features of the district, and to the chief fossil localities.

The Stafford memoir[3] describes the area of Sheet 139, an agricultural district of red Keuper Marl and lighter Bunter and Glacial soils that lies between the Potteries and the South Staffordshire coalfield. The formations present include small patches of Carboniferous Limestone and Middle Coal Measures, but the Triassic rocks are dominant. Petrologists will be specially interested in the account of the Dyke of Butterton and Swynnerton, a dyke which is remarkable in that it cuts Triassic rocks. Various mineral products are described, including salt and brine; and the chief sources of water supply are discussed.

The area of the Rossendale Anticline[4] stretches west from the Pennines into Lancashire and embraces the high ground between the towns of Blackburn, Burnley, Todmorton, Rochdale, Bury, and Bolton. The structure and stratigraphy of the local Carboniferous rocks are described in more detail and greater precision than have hitherto been possible, palæontological methods of classification and correlation having been successfully adopted. The zonal forms of the difficult Millstone Grit series recently worked out by Mr. W. S. Bisat have been critically checked in this area. Other chapters are devoted to the glacial deposits and to various mineral products, of which coal is, of course, the chief.

The country around Ipswich[5] is of extraordinary geological interest, a fact which is partly due to and partly proved by the active research which it has stimulated in recent years. It typifies the late Cretaceous, Tertiary, and Pleistocene geology of East Anglia, and, thanks to the labours of Mr. J. Reid Moir, it has yielded a more complete series of worked flints than any other district in Britain. Dr. G. Slater has found in the glacial formations structures of which the investigation has led to most valuable and far-reaching results. Prof. P. G. H. Boswell has made many authoritative contributions to the geology of the district. His life-long interest in the area and the inevitable linking of his name with the history of its investigation, make it particularly appropriate that his services should have been enlisted by the Survey to prepare the official memoir. The hand-coloured map is now replaced by a new colour-printed edition of Sheet 207, the price of which is two shillings.

[1] "Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1926." Pp. xi+202+6 plates. 4*s*. 6*d*.

[2] Explanation of Sheet 121: "The Geology of the Country around Wrexham. Part 1: Lower Palæozoic and Lower Carboniferous Rocks." By C. B. Wedd, Dr. B. Smith, and Dr. L. J. Wills; with a Contribution by G. W. Lamplugh. Pp. ix+179+4 plates. 4*s*. 6*d*. net.

[3] Explanation of Sheet 139: "The Country between Stafford and Market Drayton." By T. H. Whitehead, E. E. L. Dixon, R. W. Pocock, Dr. T. Robertson, and T. C. Cantrill. Pp. vii+128+5 plates. 3*s*. 6*d*. net.

[4] Explanation of Sheet 76 (Rochdale): "The Geology of the Rossendale Anticline." By W. B. Wright, Dr. R. L. Sherlock, D. A. Wray, W. Lloyd, and L. H. Tonks. Pp. viii+182+7 plates. 4*s*. 6*d*. net.

[5] Explanation of Sheet 207: "The Geology of the Country around Ipswich." By Prof. P. G. H. Boswell. Pp. vi+121+4 plates. 3*s*. 6*d*. net.

All the above publications are published by H.M. Stationery Office, London, and the Ordnance Survey Office, Southampton.

A New Reflex Micrograph.

THE increasing use of the microscope for routine tests, and as an instrument of control in the factory, has resulted in directing the attention of makers and users to the production of microscopes of the projection type. The use of such instruments obviates the eyestrain that arises from prolonged and continuous observation at the eyepiece of an ordinary microscope. A new type of instrument—the Ramsden reflex micrograph—which has been designed by Lieut.-Col. J. V. Ramsden, and is marketed by Messrs. Micrographs, Whiston, Ford, Shrewsbury, and by Messrs. James Swift and Son, 81 Tottenham Court Road, London, W.1, constitutes a combined projection microscope and photomicrographic outfit embodying several novel features. In its mechanical design and construction, the instrument entirely departs from the traditional form of microscope stand.

The microscope tube carrying the objective and the ocular, with the objective pointing upwards, is fitted into a long bush in the box-like metal body of the instrument. Vertical guide bars mounted at one side of the body carry a lamp-house which contains a source of light for use when transparent objects are being examined. By means of a mirror mounted on the vertical guides, the rays of light from the lamp are reflected through the microscope on to a metallic mirror, from which they are reflected on to a screen so placed as to be convenient to the eye and close to all the controls for the operation of the instrument. The screen is shaded by a hood into which a mounted magnifying lens may be inserted when it is desired to examine the aerial image or to obtain more critical focussing.

When a photographic record of the image is required, the screen is withdrawn and a photographic plate inserted in its place. A recess in the metal of the body permits of the insertion of a ruled glass plate just below the screen or the photographic plate, by means of which objects may be measured at a glance or records of the measurement may be obtained on each

photograph. The title, or a description of the object under examination, may also be obtained on the plate at the same time as the object is photographed. A card on which the title has been written is placed on a slide which is inserted through an opening in the side of the body. The card is illuminated by a lamp within the body and its image projected by a lens on to the photographic plate.

The rack and pinion movement of the usual type of microscope has been replaced by a spiral screw of 1 mm. pitch cut on a cylindrical steel rod. This rod passes through an adjustable hollow pillar which is mounted vertically at one side of the body. The stage and the sub-stage are clamped to this pillar and can be moved up or down by turning the divided head at the top of the rod. Fine adjustment is effected by the rotation of an eccentrically mounted steel disc operating a lever, the short arm of which raises or lowers the pillar carrying the stage.

For the observation of opaque objects the instrument is provided with two horizontal guide bars mounted on the top of the body. These carry a second lamp house and also a condensing system. Vertical illumination is obtained by means of reflectors of the Beck universal type which can be slipped into a mirror holder mounted on the microscope tube in such a manner as to be capable of being moved backwards and forwards, and of being tilted in any direction. Entire control of the illumination is thus obtained.

The instrument described can be used for metallurgical, biological, or petrological work. Simpler types have been designed for use in routine work, where a universal instrument is not required. Geometric bearings have been adopted for all sliding parts so as to secure ease of movement and accuracy of adjustment. The instrument is built throughout on the lines of a precision machine tool. The design obviates the introduction of any delicate part, and the construction is such that the instrument may, if necessary, be put into the hands of an unskilled operator without fear of damage.

A New Bottom-Sampler for Oceanographical Research.

PROF. MARTIN KNUDSEN has published (*Meddelelser fra Kommissionen for Havundersøgelser*, Serie: Fiskeri, Bind 8, Nr. 3, 1927) an account of a new instrument which he has designed for obtaining samples of the sea bottom, together with the animals living therein. It is specially designed for use on hard bottoms, such as compact sand, where it has been realised that the instrument in most general use, the Petersen grab, is seriously lacking in penetrative power. The new sampler is filled by means of a pump which surmounts it, and the catch is retained by an ingenious 'tipping' device. The pump is operated from on board, being driven by a drum which is made to revolve by the same cable that serves for lowering and hauling the machine. An excellent feature of the sampler is that, when operating properly, it provides a sample which is stratified as *in situ*.

An accompanying paper (Nr. 4 of the same publication) by Dr. A. C. Johansen gives an account of the preliminary trials of Prof. Knudsen's sampler and furnishes a quantitative comparison of the samples obtained by this method with samples collected at the same time and under the same conditions by means of the Petersen grab. The trials show that the new instrument samples the sea-floor to a depth of 12·0-25·0 cm., as compared with a penetration of but 0·5-3·0 cm. by the Petersen grab. The area sampled is 0·1 square metre, and tables are given comparing the catches with those by two Petersen grabs sampling 0·1 square metre and 0·2 square metre respectively.

The quantitative results of these comparison tests are very striking. The average amount of bottom material per unit area taken by the Knudsen sampler on sandy bottom was found to be more than twenty times that taken by the smaller Petersen grab and more than ten times that taken by the larger. The average weight of animals captured per unit area was about five times that taken by the smaller grab and about four times that by the larger. The alcohol weight of the animals taken in one comparison off Fanø was for the Knudsen sampler about thirty times that obtained with the smaller grab and more than twenty times that with the larger, whilst the bulk of the species taken were totally unrepresented in the grab hauls, showing conclusively the vital importance of penetrating far enough into the bottom to obtain the burrowing species.

There is, therefore, ample evidence of the success of Prof. Knudsen's bottom sampler and of its importance and value for quantitative investigation of the sea bottom. The sampler is necessarily somewhat complicated and as described would probably be difficult to operate in other than calm and shallow waters. The principles embodied in it, however—utilisation of pressure to fill the sampler and the 'tipping' device for retaining the catch—will be of great service to all concerned in the elaboration of methods for investigating marine bottom populations.

Science and Primary Production.

IN his presidential address to the Australasian Association for the Advancement of Science, at Hobart, on Jan. 16, Mr. R. H. Cambage referred to the great need for the further application of science to primary production. This embraces such fundamental utilities as the production of grain, fruit, butter, wool, and meat, and it is a matter for satisfaction that the Commonwealth and State Governments, as well as private bodies, are showing increased appreciation of the value of science to these problems. A few years ago a thorough knowledge of dairy bacteriology and its application to the production of butter, resulted in increasing the output of first grade butter in New South Wales from 48 to 96 per cent.

When referring to wheat Mr. Cambage said: "It is difficult to find anything among the primary products of Australia which owes more to science than wheat production. This is a matter of national concern, and it is most comforting to know that the great pioneering work carried out by William James Farrer is not only being continued at Departmental experiment farms and Universities, but with most progressive results. New and better drought and rust-resisting varieties of wheat and other grain are being produced, and experiments are being made for the purpose of breeding rust and flag-smut-resisting plants which will also have other good characters."

Reference was made to the action of the pastoralists in arranging for the Australian Pastoral Research Trust to receive a contribution at the rate of two shillings

a bale of the 1927 wool-clip, with the hope of raising £200,000 for scientific research in connexion with the industry. This action Mr. Cambage regards as a most definite advance in Australia in the recognition of the benefits of science.

The Federal Government recently invited five leading pastoralists to act as a committee to inquire into the conditions of the pastoral industry in Australia, and advise on the best methods of conserving the national wealth represented by the industry. This provides further evidence that the authorities concerned are quite alive to the necessity of abandoning the old happy-go-lucky methods of trusting to chance in regard to seasons, but rather look for the introduction of some reasonable scheme of insurance that may have for its object the avoidance of excessive losses rather than the making of enormous profits.

Mr. Cambage concluded the first portion of his address by saying that it is the desire of the Australasian Association for the Advancement of Science, which includes New Zealand, to inspire and stimulate a science sense in the public mind, and this, he believes, can best be done by demonstrating how the principles of pure science may be applied successfully to familiar economic problems.

University and Educational Intelligence.

BIRMINGHAM.—The annual meeting of the Court of Governors is to be held on Feb. 23. The Vice-Chancellor, in his report to be presented to the Court, gives the usual statistics, which show that the number of students for the year 1926–27 was the lowest since the post-War boom. The number for the current session, however, shows an increase.

The sixth annual report of the Joint Standing Committee for Research is a record of the work accomplished and in progress during the session, and indicates a healthy activity in all faculties. Among the donations recorded is one from "a Firm in Birmingham" for research in the recent history of industry in Birmingham and the Midlands. This research is being carried out by the Faculty of Commerce. The anonymous charitable trust which has hitherto subscribed £600 per annum to meet the stipend of the reader in geography, has now decided to hand over to the University sufficient capital to produce the necessary income annually, thus putting the readership on a permanent basis.

CAMBRIDGE.—Dr. D. R. Hartree, St. John's College, and Mr. T. M. Harris, Christ's College, have been elected to fellowships at Christ's College. Mr. L. R. Jones, Emmanuel College, has been elected to the Nita King Scholarship for research in the etiology, pathology, and prevention of fevers.

The Council of the Senate has presented to the University a report proposing to open to women candidates from Girton and Newnham College, on the same terms as to men, practically all the scholarships, studentships, and prizes at present confined to members of the University.

LONDON.—Mr. M. E. Delafield has been appointed, as from a date to be determined later, to the University chair of chemistry as applied to hygiene tenable at the London School of Hygiene and Tropical Medicine. He was educated at Merchant Taylors' School and at Jesus College, Cambridge (Scholar and Exhibitioner). From 1910 until 1916 he was engaged in medical practice, and from 1920 until 1925 he was Deputy Medical Officer of Health for the Metropolitan Borough of Stoke Newington. Since 1925 he had been head of the Department of Public Health and Hygiene at University College. He has acted for some time as one of the sectional editors of the *Bulletin of Hygiene*.

The following doctorates have been conferred: *D.Sc. in Biochemistry* on Mr. H. G. Reeves (King's College) for a thesis entitled "Researches on Intermediate Carbohydrate Metabolism—the Preparation, Properties, and Physiological Significance of dl-Glyceric Aldehyde"; *D.Sc. in Zoology* on Mr. B. K. Das (Imperial College (Royal College of Science)), for a thesis entitled "The Biology and Post-larval Development of some Air-breathing Fishes of India"; *D.Sc. in Engineering* on Mr. H. W. Swift, for a thesis entitled "Orifice Flow," together with seven subsidiary contributions.

Dr. E. L. Kennaway has been awarded the William Julius Mickle Fellowship for 1928 in respect of the work he has carried out on cancer research during the past five years. The Fellowship this year is of the value of about £275.

OXFORD.—In a Convocation held on Jan. 31, the annual reports of the Committees for Anthropology and Forestry were presented to the House, and leave of absence was granted to the Savilian professor of geometry, Prof. G. H. Hardy, in order to enable him to exchange work for the next two winter terms with Prof. O. Veblen, of Princeton University. On the same day a vote of thanks was accorded to Sir John Findlay, Bart., for a gift to the Lewis Evans Collection of Scientific Instruments of a valuable silver microscope made by George Adams for King George III.

Alternative decrees for dealing with the Bodleian Library will be proposed in Congregation on Tuesday, May 8 next.

DR. GUSTAV HERTZ, professor of experimental physics in the University of Halle, has been appointed to succeed Prof. Kurlbaum as professor of physics at the Technische Hochschule, Berlin.

FIVE Fellowships, each of the annual value of £200 and tenable for two years, are being offered to graduates of the University of Wales. Applications should be sent to the Registrar, University Registry, Cathays Park, Cardiff, not later than June 1.

APPLICATIONS are invited by the London School of Hygiene and Tropical Medicine for the Wandsworth scholarship for research in tropical medicine, value £370 per annum, plus travelling and subsistence allowance for work overseas. The latest date for the receipt of applications by the Secretary, School of Hygiene and Tropical Medicine, Malet Street, W.C.1, is April 29.

LEPLAY House Educational Tours Association is organising three tours for the coming Easter vacation: to the Balearic Islands, under the leadership of Mr. G. Morris; to Normandy with Mr. W. Keesey; to Montpellier with Prof. P. Geddes. Particulars can be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE annual examinations will be held at Faraday House Electrical Engineering College on April 3–5 for a Faraday Scholarship of fifty guineas per annum, tenable for two years in College and one year in manufacturing works, and for a Maxwell Scholarship of fifty guineas per annum, tenable for one year in College and one year in works. Exhibitions may also be awarded. Particulars can be obtained from the Registrar, 62-70 Southampton Row, London, W.C.1.

Calendar of Customs and Festivals.

February 14.

ST. VALENTINE'S DAY.—St. Valentine, priest and martyr at Rome under Claudius II., the patron saint of lovers and more particularly of girls, for no reason which is very apparent from his legend. Traditionally he is characterised by the attribute of chastity. The most noteworthy event in his life is the restoration of her sight to the blind daughter of the Roman official Asterius, in whose house he was confined, which led to the conversion of the whole household. They were afterwards martyred with him. The obscure and indeed almost incongruous coupling of the saint with lovers has been explained as a substitution by the church of his festival for one observed at about this time by the Romans, more specifically said to be a feast of Juno Februata, in which boys and girls pledged themselves to one another. It is doubtful how far this explanation has the warrant of antiquity. St. Francis de Sales is said to have forbidden the custom of valentines, that is of giving boys in writing the names of girls to be waited on and admired by them, and substituted billets with the names of certain saints to be honoured and imitated. Another tradition bases the association on the fact that the saint's martyrdom took place at the time of the great Roman festival of purification, on Feb. 15—the Lupercalia. The legendary connexion with Roman observances associated with the spirit world is also indicated in the belief, noted in the old Romish calendar quoted by Brand, that ghosts walk on the night of Feb. 14.

In popular custom, the traditional observances of the day go back to at least medieval times. The custom of choosing valentines obtained in the fifteenth century, as is shown by one of the Paston letters, and there are references to it in the poems of Charles of Orleans, written while he was captive in England, and in Lydgate, Chaucer, and Gower, and frequently in poets of later days. In the poets, as in rustic tradition, the day is also associated with the pairing of birds. Similar customs were noted in France, and, though scarcely relevant, mention may be made of a belief embodied in a quatrain in a French almanack for 1672 on the virtues of blood-letting on St. Valentine's Day.

The pledging of lovers on St. Valentine's Day might be by chance, the first member of the opposite sex seen on the morning of Feb. 14 being the Valentine, or it might be a matter of deliberate choice. The most widely prevalent early form of the custom, however, was by lot, each member of a party—first the boys, then the girls—drawing a slip of paper on which the name of a member of the opposite sex was written. The difficulty of the double lot was overcome by preference or by the lot drawn by the boy prevailing. In its less sophisticated form the lot of the valentine was regarded as a good omen of the pair becoming man and wife. The choice of a valentine, whether deliberate or fortuitous, entailed some obligation on the man to confer gifts on his valentine—an obligation which in Scotland was reciprocal, and perhaps originally was so universally. The gifts were sometimes of considerable value, such as the jewel of the value of £800 given to Miss Stewart by James, Duke of York, at the Court of Charles II. Pepys, who mentions the drawing of valentines on several occasions, also dwells on the expense to which he was put by the presents involved. The custom of sending presents to the valentine survived well into the nineteenth century. Pepys also records the drawing of mottoes for the valentine in addition. This is one of the earliest references to the literary form of valentines, which later came to be sent anonymously, and from being poetical degenerated into the comic or even the obscene, before it practically died out, at any rate as a generally observed custom, in the latter part of the nineteenth century.

Young people greeting their parents and others with "Good morrow, valentine," the first thing in the morning, before themselves addressed, were said to 'catch' their valentine. A present followed. In Norfolk the 'catch' had to be effected before sunrise; otherwise the would-be catcher was 'sun-burned.'

Other customs associated with St. Valentine's Day are of some significance. Its connexion with the pairing of lovers made it a time especially suitable for divination in connexion with love affairs. Various methods were practised, such as a triple drawing of lots, or by the number of objects seen through a keyhole, or by casting various names on paper wrapped in clay pellets into water. A ritual not dissimilar from that enjoined on the eve of St. Agnes, including the eating of an egg which had been stuffed with salt, was observed in order to obtain a vision of the future consort. Girls were told to pray, with their legs crossed, to St. Valentine on this day for good luck. Another method of divination practised on the eve of St. Valentine was to scatter hempseed on the way home, after a vigil in the church porch, while reciting a charm. This evoked the image of the future mate raking up the hempseed into a winding-sheet. Here, as often, divination is close to the spell.

In some parts of the country the children roamed from house to house singing a valentine song for coppers. In Herefordshire they decorated themselves with wreaths and lovers' knots thrown to them from the house first visited; but one of their number, the youngest and a boy, was decked out more gaily than the rest. This brings the valentine into touch with the central figure of spring festival processions.

A Derbyshire custom was 'sweeping the girls.' If any girl were not kissed or visited by her sweetheart early in the morning, it was because she was 'dusty.' She was then swept with a broom and well kissed by the young men in the house or from the neighbourhood.

Finally, a curious custom from the west of England may be noted. Three single young men went out together at daylight with a clap net to catch an owl and two sparrows in a neighbouring barn. If they were successful, and could bring the birds to the house before the women had risen, they were entitled to three pots of purl in honour of St. Valentine.

The obvious difficulty in attempting to associate St. Valentine in any way with the popular customs and beliefs observed on his day and the character of the observances themselves, notwithstanding their sophistication in many respects, point not only to a pagan but also to a very remote origin. It is obviously a pairing custom; but scarcely to be related, as an anticipation, to the strict observance of the ecclesiastical fast of Lent, when marriage or a formal betrothal could not be solemnised; nor does it appear cognate to the carnival, though it may have a common forerunner with that period of license. The fortuitous mating, which was sometimes thought to portend, and often did lead to, a wedding, the divination, and especially the triple lot, the interchange of gifts, which probably at one stage represented a forfeit for non-compliance with custom, suggest a derivation from a ceremonial period of unrestricted and universally imposed sexual intercourse such as is found among primitive peoples at stated seasons as part of a religious ritual for the promotion of fertility in the animal and vegetable world.

Societies and Academies.

LONDON.

Royal Society, Feb. 2.—A. V. Hill: The air-resistance to a runner. The air-resistance to a model of a running man has been measured in a wind-channel, and found to be $0{\cdot}45\ \rho v^2 A$, where ρ is density of air, v relative velocity, and A projected area of model in direction of motion. This is $0{\cdot}00170\ v^2 A$ lb. weight (v feet per sec., A sq. ft.). The projected area of a runner is approximately = square of his height $\times 0{\cdot}15$. For a runner on a still day the air never provides more than 5 per cent. of total resistance, the remainder being in his own muscles and limbs. A following wind of 10 miles an hour will increase speed about 3 per cent.; a similar head-wind will diminish speed about 5 per cent. The correction for air-resistance is too small to affect materially the equations previously found for the acceleration of a runner at the beginning of a race.

S. M. Manton: On the embryology of a mysid crustacean, *Hemimysis Lamornæ*. Germ layers and the general rudiment are differentiated externally on the germinal disc. Gastrulation takes place by immigration from a blastoporal area. The mesoderm forms in three ways. A row of eight mesodermal teloblasts give rise to the trunk mesoderm; a pair of head bands of mesoderm supply the naupliar segments and in front of these a pair of pre-antennulary somites is formed. Cœlomic cavities appear in all except antennulary, mandibular, and maxillulary segments. The yolk cells or vitellophags represent true endoderm. They form secondary yolk pyramids and give rise directly to mid-gut epithelium. The liver is formed from posterior parts of head mesoderm bands. The endoskeletal system is ectodermal, as is also much of the musculature. The antennal gland is mesodermal, except for the short ectodermal exit tube.

G. M. Findlay: Immunological and serological studies on the viruses of fowl-pox and vaccinia. Three strains of fowl-pox virus have been studied: two are pathogenic for the fowl only; one is pathogenic for fowl and pigeon. All attempts to render these three strains pathogenic for rabbits, rats, calves, and ducks have failed. One attack of fowl-pox produces immunity. In the fowl any one of the three strains completely immunises against the others, but in the pigeon previous treatment with the strains pathogenic for fowl produces only partial immunity against the strain pathogenic for pigeon and fowl. Vaccinia virus passaged in the fowl does not become converted into fowl-pox virus, and remains pathogenic for rabbit and rat. Vaccinia virus and fowl-pox virus do not show any cross-immunity in the hen. Anti-vaccinia serum from hen has no viricidal action on virus of fowl-pox, nor has anti-fowl-pox serum viricidal action on the virus of vaccinia. While fowl-pox virus easily passes through a Berkefeld filter, vaccinia virus, even after repeated passage in the hen, is still largely held back. No evidence was obtained showing any close relation between virus of vaccinia and the three strains of fowl-pox virus investigated.

E. Sprawson and F. W. Bury: The chemical evidences of the organic content of human enamel. Previous analyses of enamel differ widely, from an unmeasurable trace of organic matter to 16·56 per cent., most of the work being on enamels of lower animals. An attempt has been made, after eliminating carbonates, to estimate quantitatively the residue of carbon and total nitrogen present. If present as some form of protein, these should show the same ratio to each other as in protein, and from the amount of either found, the percentage of protein in enamel can be calculated. Specimens of human enamel were obtained from deciduous young permanent and adult permanent teeth. New tests, qualitative and quantitative, of particular delicacy and accuracy, showed both carbon and nitrogen to be present—nitrogen to an extent indicating a maximum organic content of 0·15 per cent., carbon indicating up to 0·21 per cent.

R. J. Ludford: Studies in the microchemistry of the cell (1). When sections of suitably fixed material are submitted to mild hydrolysis, treated with fuchsin-sulphurous acid, and thoroughly washed in sulphurous acid, the nucleo-proteids of cells are stained an intense purple or violet colour. Chromatin alone is stained in the cells. In sections through a tar tumour and surrounding skin, no difference was apparent in the amount of chromatin of normal and malignant cells. It was not found possible to correlate any relationship between amount of chromatin in tumour-cell nucleus and rate of growth of tumour. Large nuclei often contain approximately the same amount of chromatin as do small, but the giant nuclei which occur in some tumours, and are apparently formed by fusion of smaller nuclei, contain large masses of chromatin.

R. J. Ludford: Cytological studies on the viruses of fowl-pox and vaccinia. Virus bodies produced by vaccinia on the skin of the chick are exactly the same as those of fowl-pox, in structure, in origin, and in the development. Vaccinia virus produces in the epidermal cells of the rat's cornea inclusions closely resembling those of the chick, but differing fundamentally in the absence of covering osmophil substance, characteristic of virus bodies of the chick. Vaccinia virus can be transmitted from rat's cornea to the skin of the chick, where it results in the formation of characteristic virus bodies. Chick virus does *not* bring about the same result in epidermal cells of rat's cornea. One strain of fowl-pox was found to produce in epidermal cells of the pigeon the same type of virus bodies as in the chick, but was without action on epidermal cells of the rat's cornea.

Mineralogical Society, Jan. 10.—L. J. Spencer: Potarite, a new mineral discovered by the late Sir John Harrison in British Guiana. Small nuggets and grains of a brittle white metal have been found very sparingly by diamond-washers in the neighbourhoop of the Kaieteur Falls on the Potaro River. This mineral, previously erroneously described as 'allo-palladium,' was proved by Harrison to be a compound of palladium and mercury, PdHg, with a density (15·0-16·1) considerably higher than that of either of the component metals. There is a crystalline structure which on the surface of one nugget is shown as indistinct cubic octahedra. The original 'allo-palladium' from the Harz Mts., supposed to be a hexagonal modification of palladium, could not be procured for a re-examination; it is probably the ordinary cubic palladium.—H. V. Ellsworth: A simple and accurate constant-volume pyknometer for specific gravity determination. The pyknometer of 10 c.c. capacity is made of silica-glass, thus possessing several advantages over one made of ordinary glass. The stopper is perforated by a capillary and is continued into a graduated side-tube, which dips under water while the apparatus is cooling. The volume of the contained water to the graduations on the side-tube can be readily and accurately determined to 0·0002 c.c.—W. Campbell Smith: The optical orientation of labradorite from County Down (Ireland) determined by the Fedorov method. The labradorite from basaltic dikes at St. John's Point, Ardglass, Co. Down, of which the chemical composition and refractive indices were published in 1912, has been

studied by the Fedorov method and the optical orientation determined.

Geological Society, Jan. 11.—**G. M. Lees**: The geology of south-eastern Arabia. South-eastern Arabia consists of two separate tectonic and stratigraphic provinces: (1) A foreland where, as at Dhofar, ancient gneiss is overlain by a 'Nubian' type of desert-sandstone. (2) An orogenetic zone of typical Alpine character. The relation of Oman to the Zagros arc is discussed. The characteristic zone with red and green radiolarites and shales and basic igneous rocks occurs again in Persia, and forms great tracts of country south-west of Kerman. Here also Upper Cretaceous rocks are strongly unconformable. One great branch of the Cretaceous orogenetic zone of Central Persia must, therefore, have passed southwards into Oman. The Upper Cretaceous-Tertiary geosyncline broke down across the older strike, and pursued an independent direction parallel to the present Persian Gulf-Mekran coast. The late Pliocene movements also followed this trend, the influence of the older tectonics only being shown in the marked swing of the strike between Bandar Abbas and Jashk. Such a complete independence of these two phases of Alpine movement is unique. The Oman orogenetic zone may be followed through Masirah Island to Ras Madhraka, where it passes southwards into the Arabian Sea. The Kuria Muria Islands belong already to the foreland. A further movement, though of much less intensity, took place in Oman in post-Miocene time. South of Sur these folds strike north-west and south-east, and appear to pass out to sea at Ras al Hadd, independent of, and across, the older structures. Perhaps these folds form a continuous loop with the Kirthar Range of Sind, but no connexion can have existed between the latter and the Cretaceous orogen of Oman. The Triassic, Lower, and Upper Cretaceous fossils are described.

PARIS.

Academy of Sciences, Jan. 3.—**V. Smirnoff**: Orthogonal polynomials with one complex variable.—**Florin Vasilesco**: Some points in the theory of harmonic functions.—**Georges Valiron**: A general theorem on meromorph functions of positive order.—**L. Escande**: The technique of reduced models of barrages with overflow weir. Four models of the weir were made on a reduced scale, 1/19·5, 1/100, 1/150, and 1/300 of the actual weir, and the actual flow determined for each as a function of the head of water. The four curves shown do not coincide exactly. The yield shown by a model is less than the actual flow on full scale, the extrapolation error being on the side of safety. The divergence increases as the model is made smaller.—**L. Hirschauer** and **A. Talon**: The formula for the ultra-rapid propulsion of extra-light vehicles on rails.—**René Darbord**: The reactive power.—**M. Geloso** and **Mlle. L. S. Lévy**: Researches on selective adsorption.—**A. Wahl** and **J. Rolland**: The chlorobenzoylacetic esters.—**Mme. Ramart-Lucas** and **F. Salmon-Legagneur**: Intramolecular transposition by photochemical action. Isobutyl bromide after exposure to the radiation of a mercury arc lamp for four hours is partially converted (4 per cent.) into tertiary butyl bromide: after forty-eight hours' exposure, 13·5 per cent. is converted. The reaction is considered from the point of view of the hypothesis of semivalence.—**M. Gignoux**: A layer of Triassic vegetation near Saint-Jean-de Maurienne (Savoie).—**Albert Morel** and **Léon Velluz**: Contribution to the study of the biochemical synthesis of the glycerides. The reversibility of the diastatic action of the cytoplasm of castor-oil seed.—**Constant Mathis**: The identity of the spirochæte of the shrew mouse and the human spirochæte of Dakar. All the experimental work described tends to prove the identity of these two diseases. It only remains to find the agent of transmission from the animal to man.

ROME.

Royal National Academy of the Lincei, Nov. 6.—**G. Giorgi**: Doppler phenomenon of acceleration.—**S. Minetti**: The necessary and sufficient conditions for an entire function to be of a certain genus and of a certain order.—**S. Cherubino**: The notion of parity and the real character of real Abelian varieties.—**G. Vitali**: A covariant derivation in generalised absolute calculus (2).—**M. Pastori**: Bernouilli's surfaces.—**G. Gherardelli**: An observation on the Jacobian series of a linear series.—**B. Caldonazzo**: Certain properties of permanent liquid motions, the vortices of which are normal to the velocity.—**Lodovico Straneo**: The conditions of validity of some developments of functional operators.—**C. Cannata**: Contribution to the ballistic theory of variable stars.—**G. Tiercy**: The problem of the colour index in astronomy.—**G. Piccardi**: Relationships between the ionisation potentials of homologous elements. In the case of helium and the alkaline-earth metals, the relationship between the atomic number and ΔV, the difference between the ionisation potential of an element and that of the corresponding fundamental element—that is, the element having a single electron in the external orbit on which the element concerned has its peripheral electrons—is expressed by a continuous curve (1). In the zinc-cadmium-mercury group, passage from an element with one electron to one with two electrons (of the same orbit *s*) is accompanied by an increase in the ionisation potential which is a well-defined function of the atomic number. For other groups of elements, the laws connecting ionisation potential with increase in the number of electrons in the same orbit are obtained by multiplying the ordinates of curve (1) by 1 for the quadrivalent elements (C group), 2 for quinquevalent and sexivalent elements (N and O groups), 3 for the halogens, and 5 for the rare gases.—**A. Ferrari** and **C. G. Fontana**: Structure of silver chlorate. The lattice of this salt consists of a tetragonal cell of dimensions $a = 8{\cdot}48$ A. and $c = 7{\cdot}91$ A., containing eight molecules.—**L. Settimj**: Chemical composition of certain food species. The results of analyses are given for the following common Italian foods: tinned meats of various ages, fresh lean beef, cheese, stockfish, lean bacon, and dried mushrooms (*Boletus edulis*).—**C. Antoniani**: The influence of superphosphate on the reaction of the soil. When applied to neutral or almost neutral bare soils free from lime, superphosphate effects a gradual but slight acidification; the opposite results recorded by other investigators are influenced by the presence of a growing crop or by other factors.—**U. Panichi**: Independent elements of symmetry of the first and second species.—**E. Benedetti**: Certain modifications in the course of alcoholic fermentation due to the action of the oscillating electromagnetic field on the yeast (2). The alteration produced in the course of alcoholic fermentation by subjection of the yeast to an oscillating electromagnetic field for 35-40 minutes varies with the frequency of the oscillation. With a low frequency (272·7 kilocycles), the fermentation is accelerated, the extent of the acceleration increasing for some hours and then remaining virtually constant. A similar, but less marked effect is observed with a frequency of 400 or 500, whilst for the value 1200 the fermentation is retarded.—**T. Terni**: Histological modifications in the thymus of

birds resulting from castration and from old age.—C. Gorini: Investigations on disgenesic milk.—V. Puntoni: Elimination of the virus of rabies by the digestive tract. The results of experiments on dogs indicate that the old theory of the salivary elimination of the virus of rabies should be replaced by a more comprehensive theory, according to which the whole of the mucus and almost all the glands of the digestive tube must be regarded as surfaces for the elimination of this virus.—A. Galamini: The action of ethyl alcohol on the renal secretion. When ingested in the proportion of 0·5-0·75 c.c. per kilo of body weight, alcohol of 95 per cent. concentration, diluted to double its volume with water, invariably exerts a diuretic action, varying in degree with different individuals. The quantity of alcohol eliminated with the urine in successive periods follows the quantities of alcohol present in the blood at an interval of about 30 minutes, and reaches a higher level.

VIENNA.

Academy of Sciences, Nov. 10.—L. Moser and J. Singer: Determination and separation of rare metals from other metals (10). Three new gravimetric determinations of beryllium and separations based on them. By gallo-tannic acid in the presence of ammonium acetate, beryllium can be separated from iron, aluminium, chromium, titanium, zirconium, thorium, tungsten, and vanadium. A dense beryllium hydroxide can be precipitated by the hydrolysis of the beryllium ion with ammonium nitrite in the presence of methyl alcohol. A third method involves the formation of $Be_2P_2O_7$, similar to the magnesium method. A crystalline precipitate of the ammonium salt is obtained in the presence of weak acids (acetic or citric).—R. Schwinner: The structure of the mountains east of the River Lieser in Carinthia.—L. Waldmann: Geological structure of the Moldau-Danubian primitive rocks on the map sheet Gmünd-Litschau; also report on the geological survey of the Moravian primitive rocks in Lower Austria.—A. Marchet: Report on researches on the eruptive rocks of Gleichenberg in East Styria. Chemical analyses of trachite and andesite have been made.

Nov. 17.—O. Halpern: Quantum statistics.—M. Holly: Fishes from Kamerun—a new species of silurid.—L. Kölbl: Alpine tectonics of the Altvater hills.—E. Chwalla: The stability problem of a circular arc in a plane.—W. J. Müller and K. Konopicky: The theory of passivity: a theory of polarisation as to anodic covering and passivity of metals. A mathematical equation is given, and the cases of copper, iron, nickel, and chromium considered. The potential of the metal does not alter, but the apparent alteration of potential is to be traced to a change of resistance due to extension of a surface layer.—A. Müller and A. Sauerwald: New synthesis and purification of hexamethylenimine.—E. Bersa: Actino-biological researches. The action of Röntgen rays on the nuclear division of the root tips of *Zea mais*. There is a transitory depression of the frequency of cell division, but vegetative growth is not markedly altered. Also the influence of Röntgen rays on the respiration of the root-tips of *Vicia faba*.—A. Zinke, K. Funk, and H. Ipavic: Researches on perylene and its derivatives (16).—A. Ginzberger and H. Zerny: Expedition to the Lower Amazon, Pernambuco, and Para.

Nov. 24.—A. Müller and E. Rölz: A new and simple preparation of 1, 7-dioxy-*n*-heptane (heptamethyleneglycol) and 1, 7-dibrom-*n*-heptane.—D. B. Anderson: The structure of collenchyma cell-wall deduced from micro-chemical investigations. The cell-wall collenchyma of *Solanum lycopersicum* is neither chemically nor physically homogeneous, but consists of lamellæ which are alternately pectin and cellulose. Normal collenchyma between crossed Nicols appears to be doubly refracting. After treatment with ammonio-cuprous oxide, cellulose is removed, and the cell-walls are isotropic. The lamellæ can be separated after treatment with potassium iodide and sulphuric acid.—A. Winkler: New results of inquiries into the inner Alpine tertiary.

WASHINGTON, D.C.

National Academy of Science (*Proc.*, Vol. 13, No. 11, November).—Arthur A. Noyes and Arnold O. Beckman: A periodic table of the structure of atoms and its relation to ion formation and valence. A chart has been prepared from spectroscopic data showing the number, the quantum states and the energies of removal of the electrons from the outer shells of the atoms and ions of the first twenty-six elements. Atomic numbers are the abscissæ, and the square roots of the energies absorbed in the removal of the electrons from the atoms, in terms of the energy absorbed in removing the electrons from the hydrogen atom, are the ordinates. The chart indicates the mode of ion formation and is suggestive as regards valencies.—Oliver R. Wulf: The magnetic behaviour of ozone. An armature of pyrex glass (20 cm. long × 8 mm. diameter) was suspended from a balance so that the lower end came between the poles of a large electro-magnet. The force exerted on the armature was measured when the armature was surrounded by air, oxygen, and an ozone-oxygen mixture. Experimental conditions produced effects comparable with the deviations to be measured, so the pyrex armature was replaced by a tube of soda glass containing oxygen at atmospheric pressure. The results showed that ozone is diamagnetic and its volume susceptibility is a small fraction of that of oxygen.—Morgan Ward: General arithmetic.—W. L. Ayres: On the structure of a plane continuous curve.—E. T. Bell: On the arithmetic of Abelian functions.—G. A. Miller: Groups whose operators are of the form $s^p t^q$.—Joseph Kaplan: The continuous spectrum of hydrogen. Horton and Davies observed that hydrogen at pressures less than 1 mm. of mercury, when excited by electrons of less than 15 volts velocity, becomes suffused with a blue glow with no atomic or molecular lines. This continuous spectrum appears to arise when the molecule, in the first electronic state and possessing more than 0·5 volt of vibrational energy, splits into two atoms.—Arthur Edward Ruark and Harold C. Urey: The impulse moment of the light quantum. It is suggested that the light quantum has a property corresponding to the spin of the electron. Various consequences of such a property are worked out and experiments likely to afford evidence of its existence are suggested.—H. Bateman: The symmetry of the stress-vector obtained by Schroedinger's rule.—H. B. Vincent: Some extensions of theory and measurement of shot-effect in periodic circuits.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Edinburgh, Session 1926-1927. Vol. 47, Part 4, No. 25: The Structure and Movement of the Atmosphere as affected by Diurnal Variations. By A. H. R. Goldie. Pp. 326-358. 2*s.* 9*d.* Vol. 47, Part 4, No. 26: Some further Notes on the Salmon (*Salmo salar*) of the Moisie River (Eastern Canada). By W. J. M. Menzies and P. R. C. Macfarlane. Pp. 359-365+1 plate. 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 373, January. Pp. 89-164+xxx. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

The Collection and Preparation of Herbarium and Timber Specimens. By J. Burtt Davy and L. Chalk. Pp. 28. (Oxford: The Imperial Forestry Institute.)

Commonwealth of Australia. First Annual Report of the Council for Scientific and Industrial Research for the Period from the 13th April 1926 to the 30th June 1927. Pp. 64. (Melbourne: H. J. Green.)

The Institute of Journalists. Grey Book, 1928 (revised to December 1927). Pp. 134+xviii. (London.)

Report of the Botanical Survey of India for 1926–27. Pp. 10. (Calcutta.)

The Physical Society and the Optical Society. Catalogue of the Eighteenth Annual Exhibition of Electrical, Optical and other Physical Apparatus, January 10, 11 and 12, 1928. Pp. 134+xxii. (London.)

The Observer's Handbook for 1928. Edited by C. A. Chant. Twentieth Year of Publication. Pp. 72. (Toronto: Royal Astronomical Society of Canada.)

The South African Journal of Science. Vol. 24: Being the Report of the South African Association for the Advancement of Science, Salisbury, 1927, 29 June to 4 July. Pp. xliv+626. (Johannesburg.) 30s. net.

Report of the Fan Standardisation Committee appointed by the Institution of Heating and Ventilating Engineers, June 1927. Pp. 28. (London.) 2s. 6d. net.

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1926–27. Vol. 71. Pp. 122+xliv+7 plates. (Manchester.) 12s.

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 3, No. 1, January. Pp. 91. (Cambridge.) 12s. 6d. net.

Blaise Pascal: an Address delivered by Sir Philip Hartog at the Convocation held on the 23rd December 1927. Pp. 26+ii. (Lahore: University of the Punjab.)

Agricultural Research Institute, Pusa. Bulletin No. 170: Seasonal Variations in the Germ Content of Milk at Pusa. By J. H. Walton. Pp. 12+2 plates. (Calcutta: Government of India Central Publication Branch.) 6 annas; 8d.

FOREIGN.

Proceedings of the United States National Museum. Vol. 72, Art. 12: Crystalline Carnotite from Utah. By Frank L. Hess and William F. Foshag. (No. 2708.) Pp. 6. (Washington, D.C.: Government Printing Office.)

Pisma Marjana Smoluchowskiego, z Polecenia Polskiej Akademji Umiejętności zgromadzone i wydane przez Władysława Natansona i Jan Stocka. Tom Pierwszy. (Œuvres de Marie Smoluchowski, publiées sous les auspices de l'Académie Polonaise des Sciences et des Lettres par les soins de MM. Ladislas Natanson et Jean Stock. Tome Premier.) Pp. xv+612. Pisma Marjana Smoluchowskiego, z Polecenia Polskiej Akademji Umiejętności zgromadzone i wydane przez Władysława Natansona. Tom Drugi. (Œuvres de Marie Smoluchowski, publiées sous les auspices de l'Académie Polonaise des Sciences et des Lettres par les soins de M. Ladislas Natanson. Tome Deuxième.) Pp. iv+656. (Krakowie: Drukarnia Uniwersytetu Jagiellońskiego; Paris: Ch. Béranger.)

Department of Commerce: Bureau of Mines. Technical Paper 420: Geophysical Methods of Prospecting; a Brief and Elementary Account of the Principles Involved. By A. S. Eve and D. A. Keys. Pp. iv+26. (Washington, D.C.: Government Printing Office.) 10 cents.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 108 Jahresversammlung vom 1 bis 4 September 1927 in Basel. Pp. 138+282+57. (Aarau: H. R. Sauerlander et Cie.)

Videnskapsselskapet i Kristiania. Resultater av de Norske Statsunderstøttede Spitsbergenekspeditioner. Bind 1, Nr. 2: On the Mollusca of the Tertiary of Spitsbergen. By J. P. J. Ravn. Pp. 28+2 plates. 1.60 kr. Bind 1, Nr. 3: A Burning Coal Seam at Mt. Pyramide, Spitsbergen. By W. Werenskiold and Ivar Oftedal. Pp. 14+1 plate. 1.20 kr. Bind 1, Nr. 4: The Spitsbergen Reindeer. By Alf Wollebæk. Pp. 71+6 plates. 10.00 kr. Bind 1, Nr. 5: Lichens from Spitsbergen, I. By Bernt Lynge. Pp. 21+2 plates. 2.50 kr. Bind 1, Nr. 6: The Coal Deposits and Coal Mining of Svalbard (Spitsbergen and Bear Island). By Adolf Hoel. Pp. 92+8 plates. 10.00 kr. Bind 1, Nr. 7: Contributions to the Biology of the Spitsbergen Char. By Knut Dahl. Pp. 12. 1.00 kr. Bind 1, Nr. 8: Notes on the Geology of Northwestern Spitsbergen. By Olaf Holtedahl. Pp. 28+7 plates. 5 50 kr. Bind 1, Nr. 9: Lichens from Bear Island (Bjørnøya) collected by Norwegian and Swedish Expeditions, chiefly by Th. M. Fries during the Swedish Polar Expedition of 1868. By Bernt Lynge. Pp. 78+2 plates. 5.80 kr. Bind 1, Nr. 10: Hopen (Hope Island), Svalbard. By Thor Iversen. Pp. 44+10 plates. 7.50 kr. Bind 1, Nr. 11: Mollusken aus den Redbay- und Greyhookschichten Spitsbergens. Von Werner Quenstedt. Pp. 107+4 Tafeln. 8.50 kr. Nr. 12: The Downtonian and Devonian Vertebrates of Spitsbergen. By Erik Aʻson Stensiö. Part 1: Family Cephalaspidae. A, Text. Pp. xii+391. B, Plates. Pp. iii+112 plates. 60.00 kr. (Oslo: Jacob Dybwad.)

Proceedings of the Imperial Academy. Vol. 3, No. 9, November. Pp. xxi-xxiii+579-636. (Tokyo.)

The School of Surveying of the American Geographical Society of New York. Pp. 16+2 plates. (New York City.)

Diary of Societies.

SATURDAY, FEBRUARY 11.

MINING INSTITUTE OF SCOTLAND (at Heriot Watt College, Edinburgh), at 3.—D. C. Gemmell: Supporting Underground Roadways with Steel Arches.—Papers open for discussion:—An Improved Face Conveyer, A. V. Reis.—The Transport of Injured Persons Underground, D. Davidson.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660–1759) (2).

FEDERATION BRITANNIQUE DES COMITÉS DE L'ALLIANCE FRANÇAISE (at London Day Training College), at 3.15.—M. Moureu: Marcelin Berthelot (Lecture).

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—W. A. E. Woodman: The Lubrication of Prime Movers.

MONDAY, FEBRUARY 13.

CHARITY ORGANIZATION SOCIETY (at Denison House, 296 Vauxhall Bridge Road), at 3.30.—Sir William H. Hamer, Dr. E. Graham Little, and Dr. H. Nockolds: Discussion on the Voluntary Hospitals and the Public Authorities. Chairman: Lord Dawson of Penn.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Dr. C. Crossland: The Island of Tahiti.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. A. Abrahams: The Physiology of Violent Exercise in Relation to the Possibility of Strain.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss Mary Chadwick: The Child's Early Discrimination between Sound and Speech.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—C. R. F. Engelbach: Works Re-organisation to Increase Production.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—H. B. Poynder: Some Practical Considerations in the Design of Automatic Equipments for Heavy Traction Sub-stations.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—F. West: Practical Experience of Firing Refractory Materials with Oil.—C. E. Jackson and A. Heath: Florida Clay in China Bodies.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30—D. R. Tullis: Further Notes on Aluminium Alloys.

ROYAL SOCIETY OF ARTS, at 8.—H. Gough: Fatigue Phenomena, with Special Reference to Single Crystals (Cantor Lecture) (I.).

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry (Edinburgh and East of Scotland Section)) (at North British Station Hotel, Edinburgh), at 8.—Dr. Kermack and Dr. C. P. Stewart: Report upon the Preliminary Investigation into Personal Errors in Chemical Determinations.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol).—A. H. Law and J. P. Chittenden: Higher Steam Pressures and their Application to the Steam Turbine.

TUESDAY, FEBRUARY 14.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (at Maudsley Hospital, Denmark Hill), at 4.—Clinical Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. P. Newton: The Dependent Empire and the British Commonwealth of Nations, 1870–1926.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—C. Dalley: Causes of Fires in the Petroleum Industry and Methods of Prevention.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—T. Thorne Baker: Television and Electric Image Transmission.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Municipal College, Burnley), at 7.15.—Mr. Goodyer: Semi-Steel.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—C. R. F. Engelbach: Works Reorganisation to Increase Production.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—D. S. Munro: Modern Electric Wiring, particularly as applied to Small Houses.

QUEKETT MICROSCOPICAL CLUB (Annual General Meeting), at 7.30.—Presidential Address.

HULL CHEMICAL AND ENGINEERING SOCIETY (at Photographic Society, Grey Street, Hull), at 7.45.—J. B. Upton: Westinghouse Brakes.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—C. E. Corfield and P. A. W. Self: The Correlation of Analytical Data and Accuracy in Dispensing.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. F. G. Parsons: The Increasing Size of the Skull.

WEDNESDAY, FEBRUARY 15.

SOCIETY OF GLASS TECHNOLOGY (in Applied Science Department, Sheffield University), at 2.30.—W. Singleton: The Analysis of Opal Glasses.—J. T. Howarth and Prof. W. E. S. Turner: The Study of a Fundamental Reaction in Glass Making.—David Starkie and Prof. W. E. S. Turner: Note on the Ultra-Violet Ray Transmission of Colourless Bottle Glass.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Holborn Restaurant), at 2.30.—S. B. Horrocks: Presidential Address—Discussion on Report of the Fan Standardisation Committee.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—A. Fleming: Lysozyne, a Bacteriolytic Ferment normally present in Tissues and Secretions.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—W. T. Shaddock: New Training Bank at South Haven, Poole Harbour.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—E. C. McKinnon: Storage Batteries in Relation to Modern Supply to Electric Lighting and Power.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Newcastle-upon-Tyne), at 7.15.—L. C. Burrill: Floating Docks.

MERSEYSIDE AQUARIUM SOCIETY (at 1 Falkland Road, Egremont), at 7.30.—G. A. Dunlop: The Science of the Sea.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. J. Glasspoole: The Distribution over the British Isles of the Average Number of Days with Rain during Each Month of the Year.—Memoirs to be discussed:—The Single-layer Problem in the Atmosphere and the Height-integral of Pressure, by L. F. Richardson and R. E. Munday.—The Variance of Upper Wind and the Accumulation of Mass, by L. F. Richardson, D. Proctor, and R. C. Smith.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—D. J. Scourfield: A New Type of Aquarium Microscope.—Prof. J. T. Wilson: Description of a Convenient Table for Microscopy.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Sir E. Owen Williams: Bridges.
ROYAL SOCIETY OF ARTS, at 8.—Capt. Sir Beachcroft Towse: The Education of the Blind.
ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.15.—Col. W. P. MacArthur: Some Medical References in Pepys.
INSTITUTION OF MECHANICAL ENGINEERS (Liverpool Branch) (jointly with Liverpool Engineering Society).—Prof. C. J. Hawkes: The Marine Oil-Engine (Thomas Lowe Gray Lecture).
INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Branch).—E. G. Herbert: Cutting Temperatures: Their Effect on Tools and on Materials subjected to Work.
INSTITUTE OF CHEMISTRY (Manchester and District Section).—Prof. J. R. Partington: Some Manchester Scientists.

THURSDAY, FEBRUARY 16.

EUGENICS SOCIETY (at Rembrandt Hotel, Brompton Road).—2.30 to 6.—Exhibitions. Demonstrations: Miss O. C. Lodge, Health and Education; Eldon Moore, Agricultural Shows.—At 7.15.—C. J. Bond: The Distribution of Natural Capacity in the Population and the Need for National Stocktaking (Galton Lecture).
ROYAL SOCIETY, at 4.30.—Prof. A. Fowler and E. W. H. Selwyn: The Arc Spectrum of Carbon.—R. H. Fowler: The Chemical Constant of Hydrogen Vapour and the Failure of Nernst's Heat Theorem.—A. H. Wilson: (*a*) The Ionised Hydrogen Molecule; (*b*) A Generalised Spheroidal Wave Equation.—O. H. Walters and S. Barratt: The Alkaline Earth Halide Spectra and their Origin.—*To be read in title only*:—Prof. T. R. Merton: On a New Effect in the Electric Discharge.—S. W. Watson and M. C. Henderson: The Heating Effect of Thorium and Radium Products.—C. C. Farr and D. B. Macleod: Some Physical Properties of Gas-fired Sulphur.—Prof. H. F. Baker: Note on the Paper 'Commutative Ordinary Differential Operators' by J. L. Burchnell and T. W. Chaundy.—L. S. Ornstein, W. Kapuscinski, and J. G. Eyners: Intensity Measurements in the Secondary Spectrum of Hydrogen.—P. A. M. Dirac: The Quantum Theory of the Electron (II.).
LINNEAN SOCIETY OF LONDON, at 5.—E. Heron-Allen: On the Further Researches of J. J. Lister upon the Reproductive Processes of *Polystomella crispa* L.—M. A. C. Hinton: False Killer-Whales in the Dornoch Firth.—Mrs. L. Hunter: Alcyonaria of the Abrolhos Islands.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: Transformations of Generalised Hypergeometric Series.—P. Hall: Note on Soluble Groups.—Prof. L. J. Mordell: (*a*) The Magnitude of the Derivate of a Function; (*b*) A Summability Convergence Theorem.—G. Temple: The Computation of Characteristic Numbers and Characteristic Functions.—E. C. Titchmarsh: On Conjugate Functions.—F. J. W. Whipple: On Series allied to the Hypergeometric Series with Argument −1.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: From Faraday's Note Books (III.). The Colours of Gold.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Sir Humphry Rolleston, Bart.: Child Guidance.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A Cinematograph Film entitled Voices Across the Sea, illustrating the New Anglo-American Telephone Service.—D. S. Munro: Modern Electric Wiring, particularly as applied to Small Houses.—A. J. Milne and R. H. Rawll: The Domestic Applications of Electricity.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. G. P. Douglas: Experiments on Model Air-Screws at High Tip Speeds.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.—Papers by Dr. W. J. Hickinbottom and Dr. E. L. Hirst.
CHEMICAL SOCIETY, at 8.—R. S. Morrell and S. Marks: Studies in China Wood Oil. Part II. The Oxidation of b. Elaeostearic Glyceride.—W. M. Madgin, J. B. Peel, and Prof. H. V. A. Briscoe: Cryoscopic Evidence of Compound-formation in Mixtures of Organic Liquids.—Prof. H. V. A. Briscoe and J. B. Peel: The Preparation and Properties of Selenophene, Tetrabromoselenophene and Tetrachloroselenophene.
LANCASTER ASTRONOMICAL AND SCIENTIFIC ASSOCIATION (at Storey Institute, Lancaster), at 8.—Dr. T. Green: Colour in Nature.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. A. R. Paterson: The Provision of Medical and Sanitary Services among Rural Populations in Tropical Africa.
INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).
INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Major W. Gregson: Waste Heat Recovery.

FRIDAY, FEBRUARY 17.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (jointly with Andersonian Chemical Society) (at Glasgow University), at 3.30.—Debate.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. I. C. Mann: The Regional Differentiation of the Vertebrate Retina.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (jointly with Manchester and Fuel Sections) (at Liverpool University), at 6.—H. H. Thomas: An Examination of the Influence of Various Factors on the Products of Carbonisation of Coal.
INSTITUTION OF MECHANICAL ENGINEERS (Annual General Meeting), at 6.—Major W. Gregson: Waste Heat Recovery.
INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual Meeting.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.—J. D. Johnston: Changing Ideals in Pictorial Photography.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—St. John Plevins: Oil Production.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Rev. Dr. E. M. Walker: The University: Its Ideals and its Problems.
SOCIETY OF DYERS AND COLOURISTS (London Section).—M. C. Lamb: The Dyeing of Gloving and Clothing Leathers.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section, jointly with Junior Section).—F. Scholefield: The Standardisation of Fastness of Coloured Textiles.
ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Sheffield).—Conference on The Electrodeposition of Silver:—Dr. E. B. Sanigar: Recent Work on Electrodeposition of Silver.—A. E. Nicol: Silver Plating.

SATURDAY, FEBRUARY 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660–1759) (III.).
PHYSIOLOGICAL SOCIETY (in Department of Physiology, University, Manchester).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: In the Haunts of the Sea-birds.

MONDAY, FEBRUARY 13.

GRESHAM COLLEGE, at 6.—G. P. Bailey: Modern Science and Daily Life: The Inter-relationship of the Elements.
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—E. P. Weller: Factors affecting Farm Profits.
UNIVERSITY OF LEEDS, at 8.—Dr. Ll. Wynn Jones: Recent Advances in Experimental Psychology: Doctrines and Methods established during the last twenty-five years.

TUESDAY, FEBRUARY 14.

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Feb. 15, 16, and 17.)
BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Prof. J. Laird: The Possibility of Rationalism in Ethics.

WEDNESDAY, FEBRUARY 15.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30.—Dr. W. M. Feldman: Medico-Legal Aspects of Jewish Life.

THURSDAY, FEBRUARY 16.

UNIVERSITY OF LEEDS, at 8.—A. N. Shimmin: Economics in Everyday Life: The Process of Earning a Living.

FRIDAY, FEBRUARY 17.

KING'S COLLEGE, at 5.30.—K. Kyriakides: Social Life in Cyprus in the Middle Ages.

SATURDAY, FEBRUARY 18.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Amulets and Magical Figures of the Ancient Egyptians.

CELEBRATION.

FEBRUARY 14 AND 16.

BICENTENARY OF JOHN HUNTER (at Royal College of Surgeons of England).
February 14, at 4.—Sir Holburt Waring: Hunterian Oration.
February 6, at 5.—G. C. Peachey: London Homes of the Hunters (Thomas Vicary Lecture).

CONFERENCE.

FEBRUARY 21 TO 24.

CARBONISATION CONFERENCE (in Birmingham and Midland Institute and Queen's College, Birmingham).

Tuesday, February 21 (in Birmingham and Midland Institute).
At 10.30 A.M.—
W. J. A. Butterfield: The General Scope of the Gas Industry.
T. Hardie; Some Phases of Modern Practice in Gas Manufacture.
T. Hardie: Presidential Address to the Southern Association of Gas Engineers and Managers.
M. Barash and T. C. Finlayson: Continuous Vertical Retorts.
N. J. Bowater: Vertical Intermittent Chamber Ovens for Gas Manufacture.
R. H. Ruthven: Intermittent Vertical Chambers.

Wednesday, February 22 (in Birmingham and Midland Institute).
At 10 A.M.—
C. P. Finn and R. Ray: The General Scope of the Coke Oven Industry.
G. J. Greenfield and G. H. Harrison: Modern Coke Oven Practice.
E. C. Evans: Coke Research and the Steel Industry.

Thursday, February 23 (in Birmingham and Midland Institute).
At 2.30—
T. F. E. Rhead: Steaming in Vertical Retorts.
A. T. Green: Gas Works Refractories.
Dr. A. Parker: Gas Works Effluents.

Friday, February 24 (in Queen's College).
At 10 A.M.—
Sir Arthur Duckham: The Handling, Preparation, and Utilisation of Gas Works Coke.
J. Roberts: Blending in the Gas and Coke Oven Industries.
At 2.15—
F. S. Sinnatt: A General Review of Low Temperature Carbonisation.