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Pensionable Teaching Service.

IN our issue of November 18, 1922, we published a leading article dealing with the principles of Circular 1286 issued by the Board of Education. That circular attempted to define what was a "Full-Time" Teacher within the meaning of the Superannuation (Teachers) Act of 1918, and the attempt was by no means successful in so far as it applied to teachers of experimental science and teachers of technology generally, and particularly to teachers of advanced subjects in Technical Institutions. In the article referred to we pointed out the salient defects of the proposals, and we are pleased to record that in Circular 1311 of the Board of Education now before us there are not only some modifications but also some "explanations" which in themselves modify the original proposals considerably and suggest that Full-Time Teaching Service will be determined on broader and more knowledgeable principles than were indicated in Circular 1286.

In the new circular—we wonder, by the way, why it was not issued as a "supplement to Circular 1286"—the Board of Education states that it will apply the principles set out in the original circular, subject to the modifications and explanations indicated. These modifications go far to meet the objections raised in our article referring to Circular 1286.

The Board makes it clear that the 30 hours suggested as a weekly minimum (for 36 weeks, or the equivalent) were intended to include not only the hours of actual teaching but also hours devoted to subsidiary duties entailed by actual teaching; that actual teaching covers not only class teaching in accordance with a regular time-table, but also the supervision of preparation and tutorial work with individual pupils or small groups of pupils; and that the subsidiary duties to be taken into account are not limited to those which are performed on the school premises, since in many cases some of them can be performed more conveniently—and, we may add, more efficiently—elsewhere. Those explanations should help to round off many sharp edges of the parent circular.

There is also a more definite statement in respect of relief from actual teaching hours for heads of departments in Technical Schools and for assistant teachers in secondary and other schools who are charged with substantial duties in organising particular subjects or in organising features in the corporate life of the school. This is only right, and we are glad to see it definitely pronounced.

In clause 7 of the original circular there was a reference to research work which we considered to be very unsatisfactory. The Board now states that time spent

in instructing students in the methods of research will be regarded as forming a part of the teaching. Further, it is stated that research work which enters into the actual preparation of lessons to advanced students will be properly regarded as a duty subsidiary to actual teaching.

On the whole, then, it may be said that the new circular is more reasonable and more justly favourable than the old. We still feel that teachers in Technical Institutions may be penalised if their full-time service is to be judged by the same standard of actual teaching hours as that which normally obtains in Primary and Secondary Schools. We admit that the circulars do not say they will be so judged, but, on the other hand, there is no statement, direct or implied, that the same standards exactly will not be applied. That would be extremely unfair, and extremely bad educationally, to those teaching subjects which involve experimental demonstration and laboratory preparation, and to those teaching advanced subjects. A definite statement on this point would have allayed anxiety on the part of many who are approaching the pensionable age.

Further, most of the work done by full-time teachers in Technical Institutions is evening work, and this work is necessarily more intensive, and involves not only a heavier strain in the actual teaching process but also much more complete preparation work than is required for corresponding day work. We regret that this has not been recognised in the new circular, for even though the officers of the Board may recognise it and act upon it, it does not seem fair either to the teachers concerned, or yet to the Principals and Education Authorities, that no definite pronouncement is made on the subject.

Finally, we cannot help feeling that Circular 1286 should not have been issued officially before it had been submitted to representatives of the authorities, governing bodies, and teachers concerned. The Board stated in the first paragraph of that circular that though it contemplated the application of the principles set out, it would be glad to consider any observations by a certain date before arriving at a final decision. The result of the observations is shown by Circular 1311; but surely it would have been very much better had the revision been made before the official issue of the first circular. As it is, there has been much difficulty and misunderstanding, and in some cases these provisional principles have already been acted upon and, in the light of the supplementary and explanatory circular before us, acted upon wrongly. We also feel that it would have been better to have cancelled Circular 1286 entirely and to have issued a new one amended on the lines of Circular 1311.

Map-making from Air Photographs.

Generalised Linear Perspective: Treated with Special Reference to Photographic Land Surveying and Military Reconnaissance. By J. W. Gordon. Pp. xvi+184. (London, Bombay and Sydney: Constable and Co., Ltd., 1922.) 21s. net.

DURING recent years much attention has been paid to air-photography as a means of surveying; the present developments of the subject being chiefly due to the varied experience which was gained in the War. The method is still on its trial. There are certain conditions under which it promises to be successful, but no peace-time surveys of any importance have yet been carried out on this system. It is likely to be found of value in flat countries, and for maps on medium scales. Air-photo surveys have been suggested for the mapping of deltas, such as those of the Ganges, the Niger, and the Irrawaddy, and for the surveys of large native towns. The suggestion, made a few years ago, to map a hilly West Indian island in this way, was, probably wisely, "turned down."

The subject is thus, so far as concerns peace-time surveys, in a tentative stage, and any original contribution to the theory is most welcome. Mr. J. W. Gordon has made such a contribution in his book entitled "Generalised Linear Perspective." He gave a demonstration of his methods at the British Museum on March 25 last, and they have been described in popular terms in the *Times*. His ideas are thus being made well-known.

The main object of his investigation is to find a direct and simple system of converting an "inclined" air-photograph into a map or plan. In the most general case a photograph is taken in the air, at an unknown height above the ground, of country with unknown undulations and hills; the camera is tilted at an unknown angle and the direction of the tilt is also unknown. Nowadays, however, thanks to the insistence of the Air Survey Committee, it may be expected that the focal length of the lens will be known in every case, and also the position of the optical centre of the photographic plate.

The first step in Mr. Gordon's investigation is to choose a horizontal reference plane on which the plan of the ground is to be projected, at a distance from the nodal point of the lens equal to its focal length—a useful simplification, which, however, determines automatically the scale of the plan, so that photographs taken at different heights will be plotted on different scales.

Mr. Gordon introduces us to a new terminology, puzzling at first, and not always very clearly explained, but legitimate. It is necessary to learn the

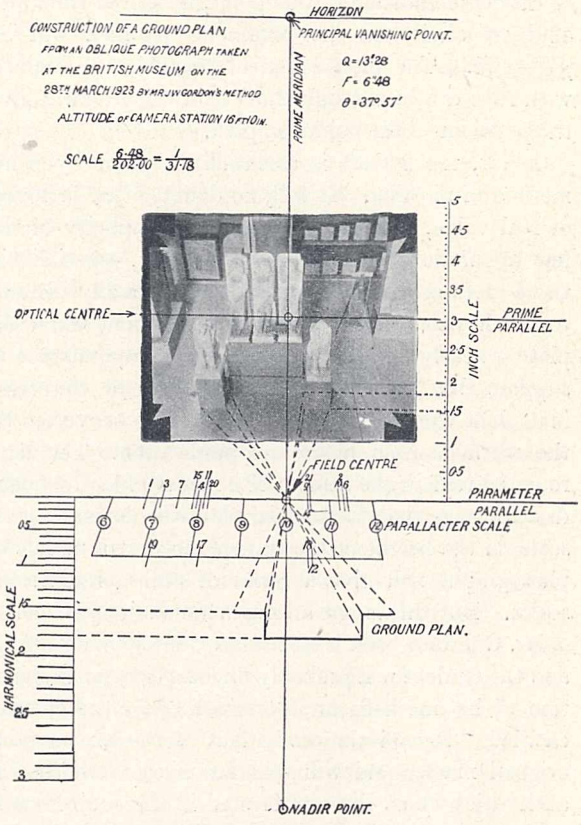
meaning of such terms as air-foot, margin, margin parallel line, carto-photo-field, parameter parallel, and so on. By taking measurements from the horizon on the photograph and from the "margin" on the reference plane (the margin being the intersection of the reference plane with a plane through the nodal point parallel to the plate), the invariable relation is obtained $H/p=p/h$, where $p=F \sec \theta$, F being the focal length, θ the tilt of the optical axis measured downward from the horizontal, h the distance measured to any point in the photograph from the horizon, and H the distance from the "margin" to the projection of that point in the reference plane, these distances being measured in the principal plane. Such distances have thus the reciprocal relation that if one set, say in the photo plane, is expressed as an arithmetical series, the other set in the reference plane will be expressed as a harmonical series.

Along the line of the intersection of the photo plane with the reference plane all magnitudes have, of course, the same value; and it also results from the perfect similarity of position of the two planes that, at the point on their intersection where it is cut by the principal plane (the vertical plane containing the optical axis), angles on the reference plane are correctly represented on the photograph. This point, which is sometimes known as the "isocentre," is called by Mr. Gordon the "field centre," and, as he remarks, this property of the identity in the two fields of any angle located in the field centre is the fundamental law of the perspective of angular magnitudes. The field centre is thus an appropriate origin for polar co-ordinates.

Let us now imagine the photograph to be hinged along the line of its intersection with the reference (or map) plane, and let it be turned round on this axis until it is in the map plane. The hinge (parameter parallel) is a line on which all lengths are truly represented in the photograph, and the field centre is a point in this line at which angles are truly represented. Distances measured at right angles to the hinge are connected by the expression $H/p=p/h$. For distances measured parallel to the hinge, we have $Y/y=p/h$ where Y is the ordinate of a point on the map, y that of a point on the photograph; or $Y/y=(X+p)/p$, where X is the abscissa on the map plane, measured at right angles to the hinge.

To make use of these expressions we must fix on the photograph the position of this hinge line, which is parallel to the line of the horizon; and to do this we must draw the horizon. The distance between the hinge line and horizon is p. To fix the horizon, Mr. Gordon rediscovered, in the course of his investigation, a solution which he afterwards found had been given by Brook Taylor, of Taylor's Theorem, two hundred years ago. Thus, let there be three points in a line in the reference plane (or cartographic field), and let the known length of one segment be a and of the other b, the line lying in any direction. Let A and B be the lengths of the representations of these segments in the photograph. Then the distance, V, from the intermediate point of the three, on the photograph, measured along the given line, to the horizon, is $(a+b)AB/(aB-bA)$. This gives one point on the horizon and a second divided line will give a second point, so that the horizon can be drawn on the photograph.

Mr. Gordon also points out that it is possible, in a



similar way, to identify the nadir point on a photograph, by making use of a vertical line on which three points have been marked at known distances from each other. From the nadir point, a line drawn through the optical centre, at a distance $2F/\sin 2\theta$ from the nadir point, gives the position of the principal vanishing point.

The accompanying illustration will serve to give an idea of the lines made use of by Mr. Gordon in constructing a plan from an oblique photograph. The method used was not precisely that which would be employed in survey work, but the diagram indicates the general principle. The height of the nodal point of the lens was 16 ft. 10 in. above the floor; the focal

length was 6·48 in. The optical centre of the photograph was known. In place of measuring the tilt, this was determined from the photograph; the joints in the floor gave the principal vanishing point, and the vertical lines the nadir point. If the distance between these two points is Q, then the angle of tilt $= \frac{1}{2}\sin^{-1}2F/Q$; in this case the tilt worked out at 37° 57′. The distance of the parameter parallel and field centre from the principal vanishing point is p. If an upright arithmetical scale, measuring from the parameter parallel, is drawn alongside the photograph, this will be represented on the plan by a harmonical scale. Or, by computation, if h is the perpendicular distance, from the horizon, of any point in the photograph, the distance of the representation of this point, measured from and at right angles to the parameter parallel, will be $p(p-h)/h$. The intersection of parallels so obtained with rays drawn through the "field centre" will give the positions of the points on plan.

So far, the system is essentially a point by point method of plotting. It will, no doubt, often be found of real value, and the neatness and simplicity of the few calculations required recommend it, especially in those cases in which the plate is considerably inclined to the horizontal. It is not so convenient when the plate is nearly horizontal, and it would be a mistake to suppose that it enables photographs to be converted into plans which could not have been so converted by the methods used before its publication. The data required remain the same. The method has the minor disadvantage that the plotted plan will depend for its scale on the height of the camera, so that a mosaic of photographs will give a series of plans on different scales. But this is not an important objection.

Mr. Gordon's book is somewhat troublesome reading, and the student will probably find the clearest explanation of his methods and terminology in the chapter entitled "Recapitulation." But the book contains original matter and will take its place in the list of authorities which those interested in the subject must study.

Mr. Gordon states in his preface that recent developments of methods of military reconnaissance have given "an urgent call" for a generalised system; he writes of "the authentic rule which the soldiers of 1915 so urgently desiderated"; he states that he provides the solution of the mathematical problem "that grievously vexed the soldiers during the years of the Great War"; and he indicates generally that, in his opinion, the want of a knowledge of Taylor's rule, rediscovered by him, prevented the survey staffs of the armies from making effective use of air-photographs in the construction of military maps. This does not do justice to the work of the survey staffs. The writer of this notice is satisfied that if Mr. Gordon's book had been available during the War, it would have made no material difference. Mr. Gordon provides a new method of plotting; but several other thoroughly sound methods were in use.

No difficulty was, as a fact, experienced in converting air-photographs into plans by the methods actually used. It is not the case that oblique photographs were avoided on account of any supposed difficulty in making use of them. This is a mistaken idea. Photographs departing considerably from the horizontal were, in general, avoided, because it was necessary to get vertically, or nearly vertically, over the enemy, to find out what he was doing and to avoid the interference of cover. The photographs so obtained, although taken on plates that were only inclined to the horizontal some 3° or 4° on the average, were not treated as plans, but were converted into plans by perfectly orthodox methods. There is an admirable exposition of the matter by Lt.-Colonel M. N. MacLeod entitled "Mapping from Air Photographs," published by H.M. Stationery Office. All who are interested in the subject may be advised to read this. They should also read Mr. Gordon's instructive book, and they will then see that there are several ways of killing this particular cat.

Two other matters call for special comment, namely, contouring from air-photographs and the use of a vertical base. As to the first, the theoretical difficulties are not formidable, but the practical difficulties are, and neither Mr. Gordon nor any one else has yet properly solved them. At present Mr. Gordon's suggestion is as good as any, and that is to plot two maps of the same piece of ground from two different positions of the aeroplane, and determine the heights, point by point, by means of the varying parallaxes. This agrees with the advice of Lt.-Col. MacLeod, which is to prepare prints of two photographs, separately taken, "rectified" to a chosen horizontal plane, and from one of them to make a tracing which can be superimposed on the other, for comparison of parallaxes. But even this method will fail when the points are not visibly marked, and would be inapplicable to the contouring of an ordinary hill-side. Perhaps something might be done by stereoscopic plotting from two parallel plates simultaneously exposed from the extremities of the wings of an aeroplane.

With regard to the use of a vertical base, Mr. Gordon points out that it is theoretically possible, given, in the oblique photograph, a vertical line which has three points marked on it, at known distances from each other, to determine the nadir point on the photograph, and, the optical centre being known, the tilt and parameter parallel can be found. But the practical

difficulty of arranging for such a vertical line to appear in the photograph would appear to be considerable. Ropes suspended from small balloons are liable to be deflected from the vertical by local air movements, and the system would involve additional apparatus. The suggestion is an ingenious one, however, and deserves to be tried.

It should be noted, in conclusion, that recent [1] experiments by Prof. Melvill Jones and Maj. J. C. Griffiths have shown that it is possible to fly on such an even keel that the photographic plate shall seldom be inclined to the horizontal as much as 2°. This would result in linear errors, on the uncorrected photograph, of less than 1½ per cent. In many cases this class of plotting error can be permitted for detail, and in such cases no knowledge of, or correction for, tilt would be required, and all that would be necessary would be to know the length of one line on the ground to give the scale. There would be a great saving of time and expense in plotting the map and in fixing ground points, and, for the more rapid kinds of reconnaissance, in flat or undulating country, progress may be hoped for in this direction.

Light and Health.

Heliotherapy. By Dr. A. Rollier. With the Collaboration of Dr. A. Rosselet, Dr. H. J. Schmid, Dr. E. Amstad. (Oxford Medical Publications.) Pp. xxii + 288. (London: Henry Frowde and Hodder and Stoughton, 1923.) 25*s*. net.

ALTHOUGH it has long been known that certain radiations have a powerful action on physiological processes, it is only in recent years that much attention has been given to the subject as it affects the higher animals. Apart from the mechanism of carbon assimilation in the green plant, our eyes have been mainly directed to the lethal effects of ultra-violet rays, and, more recently still, to those of X-rays and of radium. The author of the book before us was one of the first to appreciate and to make practical use of the *beneficial* action of sunlight. Dr. Rollier's work at Leysin has been made familiar to readers of NATURE by the recent lecture given at the Royal Institution by Dr. Saleeby, and the reviewer cannot do better than refer those who wish for further information, with abundant and deeply interesting illustrations, to this translation of Dr. Rollier's book. Forewords are contributed by Sir Henry Gauvain and Dr. Saleeby, while special chapters are included on the scientific basis by Dr. Rosselet, on the use of X-rays in the control of the progress of the treatment by Dr. Schmid, and on the adjuvants of heliotherapy by Dr. Amstad, who also adds a chapter on non-tuberculous diseases.

[1] See NATURE, May 26 and June 2, 1923.

The book itself is a most fascinating one and will be found full of interesting details, not merely of clinical nature, but of value to the student of science, art or morals. It should have a wide circulation, and the only criticism that I am inclined to make is that the price seems rather high. I refer to this now in order not to end on a discordant note. It is difficult to see what might be the cause of this high cost, and it is to be feared that it may tend to restrict the sale of a book which should be in the hands of everyone who has at heart the happiness of his fellow-men, and especially of those who love children. I wish particularly to direct attention to the wide general interest of the contents, because the title might give the mistaken impression that it is a purely medical work.

The scientific reader will notice that we have much to learn as to the physiological action of light, and it will probably serve the best purpose if I devote the space available to a brief reference to the facts brought out by Dr. Rollier's work and to the gaps which await the results of further investigation, much of which can be done in the laboratory.

In the first place, we must distinguish between the effects of rays of different wave-lengths. In rickets, it is a limited region of the ultra-violet that is effective; in tuberculosis, we have no precise knowledge of the important region, except that the heat rays of long wave-length have to be guarded against. The necessary exposure cannot be tolerated except under the cooling influence of alpine air or of sea-bathing. Recent work tends to show that the rays of the red end of the spectrum may neutralise the benefit of the shorter wave-lengths. There is scope for investigation of the action of optical sensitisers, when atmospheric conditions cut off the active rays. The red algæ give us an example to follow. It is also clear that exact measurements and records are needed of the rays of various wave-lengths present in the sun's light in different places and at different times of the year and day.

Next, we may note that Dr. Rollier has from the first been aware of the fact that the direct action of the rays on a diseased organ is not what is required. Exposure of the skin in any situation suffices. It is natural to draw the conclusion that some photo-chemical product is sent from the skin into the circulating blood. But we have as yet no actual proof of this, and there are other possibilities which cannot be entered into here. In any case, we are shown that the skin has some important functions hitherto unappreciated.

Then there is the remarkable fact that it is only those individuals whose skin takes on the well-known brown pigmentation after exposure to the sun who

react rapidly. We do not know the meaning of this—whether it is merely an unessential reaction which is associated with other characteristics of the individual, whether the brown pigment is an optical sensitiser, or again whether it is a screen to cut out injurious rays.

A further question requiring more investigation is the increase in oxidative metabolism. There may be reflex effects to muscle, or a direct result of warming of the blood (Sonne), or it may be simply a reaction to the cold air. It appears that the muscles of tuberculous patients may grow in size and firmness, although they may be but little used.

The general effect of the treatment is not to be overlooked, especially in the case of children brought into bright and interesting surroundings.

Although it is in the direct cure of disease that the most striking effects of sunlight are seen, it is impossible to believe that the physiological processes at the basis of these effects play no part in the prevention of disease. Dr. Rollier has an interesting chapter on his "École au Soleil," established for children predisposed to tubercular disease. Exposure to sunlight must, moreover, be of the greatest importance in maintaining normal health—a fact far too little taken to heart.

There are many points of practical importance brought to our notice by this book. I may conclude with mentioning two of these. Dr. Rollier shows that pulmonary cases do quite well, contrary to the view often expressed. Care must be taken to avoid overheating and exposure to the sun must be very gradual, with adequate ventilation. The other point is the necessity for keeping the atmosphere over our large towns and manufacturing areas free from the pollution of smoke.

W. M. BAYLISS.

Primitive Culture Analysed.

Early Civilisation: an Introduction to Anthropology. By Alexander A. Goldenweiser. Pp. xiv+428. (London, Calcutta, and Sydney: G. G. Harrap and Co., Ltd., n.d.) 15*s.* net.

DR. GOLDENWEISER has long been known for his acute criticism, in various journals, of the theories and constructive efforts of the most noted ethnologists; we therefore welcome in this introduction to anthropology an exposition of his matured views, though his book will but partly supply the need there is for a systematic treatise on ethnology.

The book consists of three parts: the first deals with a general sketch of the Eskimo, Tlingit and Haida, Iroquois, Baganda, and Central Australians, as illustrative of distinct civilisations, though in each case one of their respective cultures has been given more careful treatment than the others. Goldenweiser correctly states that "the only way to know early civilisation is to study it in the wholeness of its local manifestation." The various activities and beliefs of a people are so intimately interwoven that quite wrong inferences may be drawn if a custom is separated from its context and compared with an analogous custom isolated from another group. These five accounts afford material for future discussion; as the author states, other groups would have served as well, but these suffice for practical purposes without rendering the book unwieldy.

The second part deals with industry, art, religion and magic, and society, which are considered partly from the point of view of special cases and partly constitute a limited comparative survey. There is a great deal of valuable matter in this section, but there are also many aspects of culture that are not alluded to, possibly from lack of space. For example, the researches of A. R. Brown on various Australian tribes throw new light on Australian sociology, and what is often termed "soul substance" is not mentioned. In discussing diffusion *versus* independent development in early civilisation some valuable reflections are made. Graebner's views are slightly criticised, Elliot Smith is dismissed with scorn, but Rivers is dealt with at greater length, though some of his arguments are described as "highly artificial." The author concludes by saying "we must reiterate our former position that the diffusion of civilisation from tribe to tribe is but one of the basic factors in cultural advance, the other factors being human creativeness, resulting in the independent origination of new things and ideas," though elsewhere he says, "the civilisational rôle of borrowing is fundamental."

In the third part Dr. Goldenweiser discusses various theories of early mentality: those of Herbert Spencer, that the ghost is the corner-stone of early theology, that spirits are derived from ghosts, the nickname theory of animal and other cults; the views of Frazer on magic and its relation to science and religion, the origin of exogamy. He says that "Wundt approached the problem of primitive mentality with a far broader and deeper equipment in scientific method than did Spencer, Tylor, or Frazer. As a student of psychology he was proof against the allurements of a facile mode of interpretation of primitive thought, of which these authors are so often guilty. He discarded the crude rationalism of Spencer and Tylor. . . . The associationism of Frazer also collapsed before Wundt's critical onslaught," but even Wundt often failed "to escape the allurements of monogenetic derivations." Durkheim also receives very favourable consideration, though his "tremendous exaggeration of the import-

ance of social factors as contrasted with all others" is duly noted, and he "fails to do justice to the contribution of the individual to religious experience." He also disagrees with certain aspects of Lévy-Bruhl's views, and with Rivers in his criticisms thereon; he, like others, cannot accept Freud's Cyclopean family or his conception of totemism.

The last chapter on early life and thought is an admirable constructive effort on the part of the author, in which he ranges himself on the side of the French and German psychologists as opposed to British anthropologists.

As Dr. Goldenweiser freely criticises others, he cannot object to having a few of his own shortcomings pointed out. Buganda lies north and north-west of the Victoria Nyanza; we are told that "maize is perhaps the principal staple food" of the Baganda (p. 83), but Roscoe says no grain is grown and that plantains furnish their staple food. There are more varieties of Australian canoes than the two bark ones he refers to, and the dingo is not a wolf, but allied to the Indian dog. The decorative art of Australia is more varied than he imagines, and ceremonies for the multiplication of totemic animals are not confined to the Aranda, as he seems to imply (pp. 109, 281). Pile dwellings and tree houses have a more extended range than is indicated (p. 135). The great stone images of Easter Island are not "wooden idols" (p. 306). It is incorrect to describe Elliot Smith as a "follower" of Rivers; if anything, the reverse is nearer the mark. The statements are erroneous that "Man has never used man as a regular article of diet . . . we do not hear of the eating of relatives" (p. 396). Throughout the book the term "etching" is used for engraving or incising: etching is a definite technical process.

A. C. HADDON.

Sir Alfred Yarrow.

Alfred Yarrow: his Life and Work. Compiled by Eleanor C. Barnes (Lady Yarrow). Pp. xv + 328 + 78 plates. (London: E. Arnold and Co., 1923.) 10*s.* 6*d.* net.

LADY YARROW has given us a most interesting and genial account of the life and work of Sir Alfred Yarrow and has successfully portrayed, in happy and engaging style, a character which Smiles would assuredly have been glad to utilise in his examples of "Self Help," and to have included in his "Lives of the Engineers." She has succeeded in showing not only the shrewd business capacity of Sir Alfred, but also his remarkable ability to apply science to the needs of the great industry with which he was chiefly associated, especially in those branches in which he was in the front rank of pioneers for a very long period. His admiration for the attainments and discoveries of the man of science stands high, but it is equalled by his appreciation of the sound sense and fertility of resource of the skilful manual worker; and a perusal of the book will indicate the reasons for his being in the forefront of those who have derived advantage from the happy combination of the two.

Lady Yarrow shows that Sir Alfred, equipped with an abundance of scientific and general knowledge, was quick to perceive when the teachings of science or of handicraft, or both, could be brought to the aid of his problems, and, soon satisfying himself of the accuracy of his premises (generally by the help of homely but convincing experiment), he rapidly proceeded to successful solution, mostly with satisfactory and frequently with far-reaching results.

It has fallen to the good lot of many to have been associated with Sir Alfred in some portions of his comprehensive work; few, if any, can have been connected with the whole of the developments in shipbuilding and marine engineering in which he has taken such a prominent part, and this story of his life consequently contains much of interest that must be new to every individual reader, however intimate his acquaintance for a period may have been. To all such the book will be highly reminiscent, and naval engineers in particular will recall many exciting incidents of the trying times which marked the endeavour to get better than their best from the coal-fired boiler and the high-speed reciprocating engine, each in its special pandemonic environment. As described in the book, these experiences constituted a phase provoked by the demand for high speeds which necessitated the use of extremely light machinery, and they had to be endured to prepare the way for the engine-room conditions that we now enjoy—perfect peace with oil-fired boilers and turbines.

Sir Alfred Yarrow's part in the development of high-speed craft is generally well known, but the full extent of the part he took during the War is perhaps not so widely known. The chapters devoted to this portion of his work do not disclose the whole of his efforts, so remarkable in one of his advanced years, but they are sufficient to reveal his high sense of patriotic duty, and the versatility and value of his vigorous endeavours. He enjoyed the confidence of Lord Fisher in his work for the Navy, and amply proved that the confidence was justified.

But, in addition to his high professional reputation, Sir Alfred is esteemed for his kindly disposition coupled with more than an ordinary desire to help his fellow-men. The author's note at the end of the volume delineates this side of Sir Alfred's character in touching words,

and her interesting descriptions in the text of his principal philanthropic schemes supply further details. His own ideas of how to dispose of "a balance at the bank in excess of what is necessary" are given in Chapter XX., "The Convalescent Home," and are commended to readers, who will afterwards understand more readily the unique reasons for Sir Alfred's many generous benefactions during his lifetime.

Lady Yarrow has evidently compiled her work under some restraint, as more could be told both of Sir Alfred's professional success, and of his bounty, and his methods of encouraging others (for example, his recent munificent gift to the Royal Society is not mentioned in this book), but she has told enough to warrant Sir Alfred's claim that "his business life has been filled with sentiment and friendship." She is to be congratulated on the scheme, sequence, and style of the compilation, and she can be assured that her work will be highly appreciated by the very large circle of Sir Alfred's friends. G. G. GOODWIN.

Our Bookshelf.

Grundriss der allgemeinen Zoologie für Studierende. Von Dr. Alfred Kühn. Pp. viii + 212. (Leipzig: Georg Thieme, 1922.)

THIS is a wholly admirable text-book. We know of no book in the English language exactly like it, none that attempts so much within so limited a space, and, moreover, attempts it so successfully, with a due regard to the requirements of those for whom it is written and to the maintenance of a proper balance between the various parts of the subject. The book is divided into three approximately equal parts, the first giving a rapid survey of the morphology of each phylum of the animal kingdom, the second an account of the physiology of animals, and the third a review of the main principles of embryology and the problems of variation, heredity, sex, and evolution. The book concludes with a short bibliography of more advanced text-books and original memoirs to which the student can turn for more detailed information on any point.

In attempting to treat of the whole of the animal kingdom in 70 pages, the author may be thought to have essayed an impossible task. By confining himself to the broad and general characters of each phylum, without entering into details of any one type, however, and aided by an excellent series of diagrammatic figures, he has succeeded in giving an admirably clear account of each phylum. The book is intended for medical students, and, consequently, special emphasis is laid on parasitic forms throughout, without, however, overburdening the book in this way or losing the general perspective of the whole. The illustrations have been mainly drawn specially for this book. They are, in the majority of cases, schematic drawings, very clearly reproduced and excellently chosen for the purpose, and would make good wall diagrams for lecture purposes.

The point which most impresses us in this book is the excellent balance which the author has kept between the three broad divisions of zoology—morphology, physiology, and embryology—with its kindred problems. The general course given to first-year medical students is apt to be weighted too much on the morphological side; physiology is generally neglected, and very little consideration is given to the fundamental and general problems of zoology. We feel sure that a course on the lines so admirably sketched by Prof. Kühn would give the medical student a broader outlook on zoological subjects, would interest him more for its own sake, and would make abundantly clear to him the fundamental bearing of his zoology course on his future life's work. He would no longer regard zoology as a subject put into his curriculum for his ultimate confusion, to be got through with the minimum amount of work in the minimum time. With a little amplification, Dr. Kühn's book would serve as a basis for subsidiary one-year courses in zoology for science students.

Our Solar System and the Stellar Universe: Ten Popular Lectures. By the Rev. Charles Whyte. Pp. xi + 234 + 18 plates. (London: C. Griffin and Co., Ltd., 1923.) 10*s.* 6*d.* net.

THE ten lectures which form the basis of this volume were delivered as the Thomson Lectures for the session 1919–1920 in connexion with the United Free Church College, Aberdeen. They provide a survey—fairly up-to-date and in general accurate—of the present state of astronomical knowledge, in a form suitable for the non-scientific reader, so far as it is possible to do so without the introduction of mathematics or of mathematical reasoning.

There are a few errors to which attention may be directed. The statement on p. 27 that "the theory now generally accepted as being the chief cause in the maintenance of the sun's heat, is that advanced by Helmholtz in 1853," is not correct. It is well known that this theory is not in accord with geological facts. Again, on p. 60, it is stated that a temperature of 750° F. at the surface of a planet corresponds to an intensity of the rays of the midsummer sun multiplied by 9. This is, of course, a fallacy. The rotation period of Mercury is not known with certainty, though from p. 61 the contrary would be inferred. It is certainly exceeding the limits of scientific truth to say, as on p. 151, that "we have every reason to believe that a number of planetary bodies, many of them exceeding in size our own solar satellites, travel round these suns in swift motion over enormous circumferences," while on p. 164 the sentence, "They (the Cepheids) are situated from us at enormously greater distances than those which up to now have been measured," requires modification. In dealing with the Martian canals, their possible subjective nature might have been mentioned. The detailed elementary calculations on pp. 61-2, 87-8 might have been omitted with advantage.

The book is well produced, with good paper and clear type. The plates have been carefully selected, and it is a pleasure to see them reproduced on well-glazed paper. Too frequently astronomical photographs lose much of their value when reproduced in popular works, through the use of inferior paper. The book can be recommended as one which will provide much interesting reading to those who, though without scientific training, are interested in astronomy. H. S. J.

Some Questions of Phonetic Theory. By Wilfrid Perrett. Chapter 6: The Mechanism of the Cochlea. Pp. 39-80. (Cambridge: W. Heffer and Sons, Ltd., 1923.) 2*s.* net.

THIS section of Mr. Perrett's book is an attack on the resonance theory of hearing, and on all those who have written in support of it. It is his avowed object "to lay the yammering ghost of 'sympathetic resonance' in the cochlea" (p. 44). His criticisms of the resonance theory are under three headings: (1) An attack upon Helmholtz's theory of beats as he conceives it. The construction he puts upon Chapter VIII. of the "Tonempfindungen" is, in the reviewer's opinion, forced and unfair. (2) An uncorroborated personal experience of his own which leads him to the conclusion that the ear can distinguish two notes "in perfect physical unison" sounded simultaneously. (3) That speech sounds can terminate suddenly in a "voiceless-occlusion" consonant, consequently no "after vibrations" of the basilar fibres occur. Mr. Perrett quotes graphic speech records, but admits that the evidence drawn from them is inconclusive.

We gather that Mr. Perrett has abandoned the Wrightson theory in favour of a "travelling-bulge" theory on the lines of those of Meyer and ter Kuile, but he does not appear to have brought forward any additional evidence in support of this view. He tells us that the preceding four chapters of his book have been received "with gratuitous contumely in certain quarters" (p. 59). We cannot help thinking that his manner of conducting a controversy may have been responsible to a certain extent for the treatment his work has received. G. W.

The Americas. By J. Bruce. (The "Explorer" Geographies). Pp. viii+216. (London: G. Bell and Sons, Ltd., 1922.) 3*s.*

A NEW note is introduced into elementary geographical teaching by this volume, which appears to be the first of a series. After an introductory chapter on map-reading, there are several chapters describing the way in which the American continent was discovered and opened up by Europeans. The sections are vividly written and cannot fail to interest, although the paragraphs and map dealing with Arctic Canada and the North-west passage would bear some revision. Then follows a general geographical survey of the Americas. Eight double-page plates with full descriptions are a notable feature, and there are in addition several sketch maps and two coloured orographical maps. The list of books for students' reading is useful, but might well be extended. The book as a whole gives a far more vivid picture of North and South America than the more formal analytical text-books succeed in doing.

R. N. R. B.

Elements of Glass-blowing. By Dr. H. P. Waran. Pp. ix+116. (London: G. Bell and Sons, Ltd., 1923.) 2*s.* 4*d.* net.

DR. WARAN'S book deals in a clear and practical way with many things which a research student will find that he requires to know. The ability to put together and to repair simple glass apparatus is one of the things which he should gradually acquire, and this book will be found a useful guide in this direction. It is very doubtful whether the laboratory worker will find it desirable to make his own stopcocks or Dewar vessels; the time spent on such work would usually be more profitably applied in research, but in places where apparatus is not easily obtained it may be quicker to make it. As a general rule, unless one has become very proficient in glass-working, it is usually cheaper and quicker to leave complicated things to the professional man.

The Wonders of the Stars. By Joseph McCabe. Pp. ix+114+4 plates. (London: Watts and Co., 1923.) 3*s.* net.

THE author has written a series of volumes on various phases of evolution; the present book belongs to the series, and discusses the light that has been thrown on stellar and planetary evolution by the discoveries of the last half-century. As an illustration of the difficulty of keeping up-to-date in discussing the status of the spiral nebulæ, some of the views of leading astronomers in favour of the "island-universe" theory that are quoted in the book have already been modified by the discovery of their rapid rotation.

While a few sentences here and there might be picked out for criticism, chiefly the statement of matters of conjecture as facts, on the whole the picture given of our present knowledge of the universe appears to be correct, and as complete as can be expected in the space of 112 pages. We sympathise with the author's appeal for a general agreement among astronomers as to the meaning of a "billion."

A. C. D. C.

Astronomie: Grösse, Bewegung und Entfernung der Himmelskörper. Von A. F. Mobius. 13 Auflage, bearbeitet von Prof. Dr. Hermann Kobold. Teil 2: Kometen, Meteore und das Sternsystem. (Sammlung Göschen Nr. 529.) Pp. 128. (Berlin und Leipzig: W. de Gruyter und Co., 1923.) 1*s.*

THIS little book has three chapters dealing with comets and meteors, the fixed stars, and cosmogony respectively. This restriction of subjects enables each to be treated pretty fully, in spite of the small size of the volume. The information is brought up-to-date, and includes recent comets, the Giant and Dwarf theory, and a discussion of the planetesimal theory. The star-maps give the positions of all stars of magnitude 5 or brighter down to south Decl. 45°.

A. C. D. C.

Tracks of British Animals. Edited by H. Mortimer Batten. (Edinburgh: W. and A. K. Johnston, 1923.) 4*s.* net.

THIS publication takes the form of a chart, 20 in. × 30 in., depicting in life-size the spoors of the commoner British wild animals and of domestic animals for comparison, with brief explanatory notes by the editor. The diagrams are boldly and clearly printed and the chart should be of the greatest use for the teaching of nature study in schools and for the instruction of Boy Scouts and Girl Guides in the craft of the country-side. The omission of a figure of the track of a dog is one that should be made good in a future edition.

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.*]

Photographic Plates for the Extreme Ultra-Violet.

IN recent years there have been a number of attempts to improve the photographic methods, perfected by Schumann, used in the investigation of the ultra-violet, so far without any very striking results.

Recently Mr. David Mann and I have been making some experiments with the daguerreotype process. The results, though interesting, are so far of no great practical value. It is not difficult to prepare a surface which will be very sensitive in the region about wave-length 1850 Å.U., and on two or three occasions we have obtained records extending to wave-length 584 Å.U., but in general the behaviour of the plates in the extreme ultra-violet is capricious and unsatisfactory.

Duclaux and Jeantet (*Journal de Physique*, ii., 1921, p. 154) have described a way of "Schumannising" an ordinary dry plate by treating it with sulphuric acid, and recently Aston has referred to the same process. M. Duclaux has been so kind as to send me some specimens of the results he has obtained. He informs me, however, that he prefers another method which he and his colleague have discovered, described in their article just cited. His experiments were confined to the region of the spectrum which may be investigated with a quartz prism spectrograph; I have continued them into the extreme ultra-violet.

The procedure is extremely simple. A fast commercial photographic plate (I have employed a "Seed 30") is coated with a thin film of a colourless paraffin oil. It is then exposed in the usual way in a vacuum spectroscope, the oil is removed with acetone and the plate is developed. The results are nearly, though not quite, as good as those which I have obtained with the most sensitive Schumann plates prepared according to the old method; it is quite easy to get a record of the strong helium line at λ584 Å.U.

The success of the process evidently depends on fluorescent action; I have tried a number of different kinds of oil, and I find that "Nujol," a very pure oil sold in this country for medical purposes, yields good results.

I feel sure that this discovery of Duclaux and Jeantet will prove a real blessing to all spectroscopists who work in the extreme ultra-violet.

THEODORE LYMAN.
Jefferson Laboratory, Harvard University,
June 28.

The Presence of Urease in the Nodules on the Roots of Leguminous Plants.

AFTER the discovery of urease in the Soya bean by Takeuchi in 1909, the presence of this remarkable urea-splitting enzyme was soon recognised in the seeds of many leguminous plants. On the other hand, while the occurrence of the enzyme in seeds from widely different varieties of plants has been recorded in recent years, its absence from the seeds of several Leguminosæ has also been noted.

So far as we have been able to ascertain, the peculiar root nodules of leguminous plants have not hitherto been tested for urease. Experiments carried out in this laboratory in conjunction with Mr. J. V. Collins have revealed the presence of the particular enzyme in all the cases examined. Crushed nodules taken from the well-washed rootlets of *Trifolium procumbens*, *T. pratense*, *T. repens*, *Vicia sativa*, *Medicago sativa*, *Galega officinalis*, various lupins, and the garden pea, were placed separately in a two per cent. solution of urea (sterilised by saturation with toluene) to which a few drops of neutral phenol-red solution had been added as indicator. A purple-red colour, due to ammonia generated from the decomposition of urea, was gradually developed in the solutions, after they had been maintained at 55° for about an hour. Several control experiments showed that ammonia was not generated in the absence of urea, and that the solution of the latter alone did not change the colour of the indicator under the above conditions. Also, rootlets not bearing nodules, and roots taken from plants belonging to several different natural orders, failed to give any evidence of the presence of urease. Judging from qualitative experiments, nodules from the white and the yellow tree lupin appeared to be the most active of those examined.

From these observations it must be concluded that the nodules on the roots of leguminous plants possess an additional function to the one which they have been known to perform since Hellriegel's discovery. While we have not found urease in any roots devoid of nodules, clear evidence was obtained of its presence in the cylindrical tuberous growths developed from the rootstock of the lesser celandine (*Ranunculus Ficaria*). This is the only case so far in which the enzyme has been detected in the adjunct of a root outside the leguminous family of plants.

An interesting demonstration of the presence of the enzyme can be made without crushing the nodules. The entire root cut from a young pea plant, or preferably from a young lupin, as it usually carries larger nodules, is immersed in a solution of urea containing a liberal supply of the indicator (neutral phenol-red). The action of the enzyme is allowed to continue until the solution has attained a rich purple-red colour, which of course requires a much longer time than if the nodules had been crushed. The root is now removed from the solution, rinsed for a few moments under the tap and then placed in water to which a few drops of the indicator have been added. The diffusion of alkaline solution from nodules into the outer liquid can be readily observed by the zone of colour which forms in the solution directly round the nodules.

While the first part of this experiment illustrates the relatively feeble activity of the nodules *in situ*, if the root be now washed in running water until the colour of the indicator is no longer affected, it will be found that when immersed again in a solution of urea the rate at which the latter is decomposed will be much greater than when the nodules were tested originally. This obviously suggests that urease is produced within the nodules during contact with the urea solution. Under natural conditions the micro-organisms present in the nodules are probably concerned in the generation of the enzyme as required. In our experiments the antiseptic power of toluene was apparently insufficient seriously to affect their activity. Pending a more extended investigation of the subject, our preliminary observations seem worth recording.

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Solar Activity and Atmospheric Electricity.

DR. CHREE in a recent paper,[1] giving the results of his investigation based on the Kew atmospheric-electric data, reaches the following interesting conclusion, as stated in his abstract: "The results obtained are on the whole not incompatible with Dr. Bauer's conclusion, but they indicate that if a relationship of the kind supposed exists, the sun-spot influence must be very much less in the case of atmospheric electricity than in that of terrestrial magnetism." The conclusion[2] referred to by Dr. Chree is that the potential gradient of atmospheric electricity apparently varies during the sun-spot cycle, increasing with increased sun-spot activity, and that the diurnal range of the potential gradient of atmospheric electricity, like the diurnal range of terrestrial magnetism, increases with increased sun-spot activity.

I fully agree with Dr. Chree that if there is a relationship between solar activity and atmospheric electricity, it ought to turn out to be a world-wide phenomenon, just as in the case of the recognised relationship between solar activity and terrestrial magnetism. However, this fact is to be kept in mind, that disturbances, because of local conditions, play a far more predominant rôle in atmospheric electricity than in terrestrial magnetism, and may in fact be of such a character as to mask completely any world-wide effect. Accordingly, in atmospheric electricity a very careful selection of stations is necessary for the study of world phenomena. It thus may turn out that one very favourably located station, such as the Ebro Observatory at Tortosa, Spain, upon the excellent and consistent observations of which my first conclusions were chiefly based, may lead to a more certain result than a dozen unfavourably located stations.

One of the best criteria for judging the unfavourableness of a station is the ratio c_2/c_1 of the amplitude of the 12-hour and 24-hour waves, respectively, of the potential gradient; the smaller the ratio the more readily does the station show "universal" or "terrestrial" results. This ratio at Kew is one of the largest of any of the stations known to me; it varies between winter and summer from about 1 to 5, and on the average for the year is 2 against 0·8 for Ebro, 0·7 for Eskdalemuir, and 0·25 for the oceans. Furthermore, the absolute value of the potential gradient at Kew is more than twice the average normal value for the region of the earth from 60° N. lat. to 60° S. lat. However, in spite of the disturbed character of the Kew station, Dr. Chree has succeeded in getting results which he says are not incompatible with mine, and I shall show how, by the recognition of another variation to which atmospheric electricity appears to be subject, the validity of his results respecting the sun-spot effect may be enhanced.

Every series of carefully made and undisturbed observations, extending over a period approximating a sun-cycle or more, has received investigation and definite results have, in general, been obtained. A notable exception is Potsdam, where, because of severe climatic disturbances, instrumental changes, and changes in reduction factor, the extensive series of observations at this station unfortunately is subject to discontinuities and therefore cannot safely be utilised for the detection of a sun-spot effect. For the present sun-spot activity, as indicated by the Wolf or Wolfer sun-spot number, is taken as a measure of solar activity, the possible influence of which upon atmospheric electricity is to be investigated. Other measures of solar activity—for example, prominences—are likewise included in the complete investigation.

Suppose we have for a series of years the mean annual values of the potential gradient P in volts per metre, as resulting from continuous registrations throughout the year and based only on electrically undisturbed days, without negative potential. Let P_m be the mean value of P for the entire series corresponding to the mean date T_m, and let S_m be the mean annual sun-spot number; then with fair approximation a formula of the following type is found to hold:

$$P = P_m + s(S - S_m) + t(T - T_m). \quad . \quad . \quad (1)$$

The coefficient s represents the change in P corresponding to one sun-spot number, and t represents the time-effect or annual change in P dependent, apparently, upon the average character of the particular sun-spot cycle in which the series of P-observations happens to occur.

For nearly every series discussed thus far, when the station is fairly free from pronounced local or climatic disturbances and the annual values of P have been derived from electrically-undisturbed days, the coefficient s is found to be positive and averages about 0·30 per cent. of P_m for the mean of the year; hence, if the sun-spot development from minimum to maximum is 100 numbers, *the potential gradient P suffers an increase from the year of minimum sun-spot activity to the year of maximum sun-spot activity of about 30 per cent. of* P_m. (See Table 1.)

The value and sign of the coefficient t may depend upon whether the sun-spot cycle in which the P-series occurs is below or above average development. Thus the present cycle, beginning with the year 1913 of minimum sun-spot activity, is above average development; hence t turns out to be negative, as shown in Table 1. No such high mean annual sun-spot number as 103·9 for 1917 has occurred since 1870, when S was 139·1. How t may vary with cycle, and s with season of year, will be discussed in the complete paper which is to appear in the September 1923 issue of *Terrestrial Magnetism and Atmospheric Electricity*.

The values of s and t, expressed both in percentages of P_m and in volts per metre, as determined by the method of least squares, will be found given in Table 1 for three observatories, from Spain to Scotland, and the mean epoch 1916. The third and second columns from the end of Table 1 contain the mean square errors, μ_o and μ_c, obtained respectively, first on the assumption that the departures of P from the mean value P_m represent errors of observation, and secondly that formula (1) applies. It will be seen, from a comparison of the figures in the two columns, that by the application of the corrections (sun-spot effect and cycle or time effect) a very much better representation of the observed values of P is obtained than by the arithmetical mean P_m.

The last column, r_s, contains the correlation coefficient between potential gradient and sun-spot activity after the application of the corrective term $-t(T - T_m)$ to the observed values of P. It will be observed that, in general, the coefficient so nearly approaches unity, especially for Ebro and Eskdalemuir, as to leave scarcely any doubt of a definite relationship between the potential gradient of atmospheric electricity and sun-spottedness. By the recognition of the t-change, which is similar in its effect to the secular change in terrestrial magnetism,

[1] "A Supposed Relationship between Sun-spot Frequency and the Potential Gradient of Atmospheric Electricity," Proc. Phys. Soc., London, vol. 35, Part 3, April 15, 1923, pp. 129-136.

[2] *Terr. Mag. and Atm. Elec.*, vol. 27 (1922), p. 30; see conclusion *f*.

except that it is of shorter period and seems to vary from cycle to cycle, Dr. Chree's correlation coefficient for the Kew series 1911 to 1921 is increased from 0·55 to 0·77, and for the less regular series 1898 to 1909 from 0·24 to 0·62.

TABLE 1.—RELATION BETWEEN ANNUAL POTENTIAL GRADIENT OF ATMOSPHERIC ELECTRICITY AND ANNUAL SUN-SPOT ACTIVITY.

Observatory.	Period.	Weight.	T_m.	S_m.	P_m.	s.	t.	s.	t.	μ_o.	μ_c.	r_s.
					Volts per m.	Volts per m.	Volts per m.	Per cent. of P_m.	Per cent. of P_m.	Volts per m.	Volts per m.	
Ebro . .	1911–21	2	1916·5	39·6	113	+0·35	−3·08	+0·31	−2·73	±11·1	± 4·2	0·94
Kew. . .	1911–21	1	1916·5	39·6	330	+0·65	−4·29	+0·20	−1·30	±25·9	±18·5	0·77
Eskdalemuir	1912–19	1	1916·0	45·8	258	+0·65	−4·66	+0·25	−1·81	±17·4	± 8·7	0·90

It will be instructive to show (Table 2) for a favourable case, Ebro, the application of formula (1). We have for this station, if $\Delta P_o = (P_o - P_m)$ represents the observed quantity and ΔP_c similarly the computed quantity, expressed in percentages of $P_m = 112{\cdot}6$ volts per metre:

$$P_c - P_m = 0{\cdot}313(S - 39{\cdot}6) - 2{\cdot}73(T - 1916{\cdot}5),$$

or

$$\Delta P_c = 0{\cdot}313\Delta S - 2{\cdot}73\Delta T. \quad . \quad . \quad . \quad (2)$$

TABLE 2.—COMPARISON OF OBSERVED AND COMPUTED VALUES OF POTENTIAL GRADIENT AT EBRO OBSERVATORY, 1911–1921.

No.	T.	S.	P_o (Obs'd).	ΔP_o.	ΔP_c.	P_c (Comp'd).	$P_o - P_c$.	ΔP_o.	$s\Delta S$.	$t\Delta T$.	ΔP_c.	$\Delta P_o - \Delta P_c$.
			Volts per m.	Volts per m.	Volts per m.	Volts per m.	Volts per m.	Per cent. of P_m.	Per cent. of P_m.	Per cent. of P_m.	Per cent. of P_m.	Per cent. of P_m.
1	1911·5	5·7	116	+ 3	+ 3·0	116	0	+ 3·0	−10·5	+13·6	+ 2·7	+0·3
2	1912·5	3·6	113	0	− 0·7	112	+1	+ 0·4	−11·1	+10·9	− 0·6	+1·0
3	1913·5	1·4	110	− 3	− 4·8	108	+2	− 2·3	−12·1	+ 8·2	− 4·3	+2·0
4	1914·5	9·6	109	− 4	− 4·7	108	+1	− 3·2	− 9·3	+ 5·5	− 4·2	+1·0
5	1915·5	47·4	111	− 2	+ 5·2	118	−7	− 1·4	+ 2·3	+ 2·7	+ 4·6	−6·0
6	1916·5	57·1	121	+ 8	+ 5·7	118	+3	+ 7·5	+ 5·5	0·0	+ 5·1	+2·4
7	1917·5	103·9	130	+17	+19·3	132	−2	+15·5	+20·2	− 2·7	+17·1	−1·6
8	1918·5	80·6	126	+13	+ 8·0	121	+5	+11·9	+13·0	− 5·5	+ 7·1	+4·8
9	1919·5	63·1	110	− 3	− 1·5	111	−1	− 2·3	+ 7·3	− 8·2	− 1·3	−1·0
10	1920·5	38·7	107	− 6	−13·0	100	+7	− 5·0	− 0·2	−10·9	−11·5	+6·5
11	1921·1	24·7	86	−27	−21·0	92	−6	−23·6	− 4·6	−13·6	−18·6	−5·0

Let us take, for example, the change in the observed values of the potential gradient P_o between 1917 (year of maximum sun-spot activity) and 1921, as shown in Table 2. The observed change (decrease) at Ebro amounted to 39 per cent.; the computed decrease, according to formula (2), is 36 per cent.; 25 per cent. being contributed by the sun-spot term and 11 per cent. by the cycle or ΔT-term (see columns 9, 10, 11, and 12). That this remarkable decrease at Ebro between 1917 and 1921 was a world-wide phenomenon, besides being corroborated by Eskdalemuir and Kew, is further shown by the fact that the results of the *Carnegie* potential-gradient observations on the oceans, all instrumental and reduction constants having been most carefully controlled throughout the various cruises of the *Carnegie*, gave a mean value for 1921·5 which was about 30 per cent. less than the corresponding value for 1917·5.

There are no such correspondingly large changes in terrestrial magnetism during a sun-spot cycle as have just been shown to occur in atmospheric electricity. According to my 1918 investigations [3] an increase of 100 in the sun-spot number would correspond to a decrease in the intensity of magnetisation of the earth of about 0·1 per cent., whereas for an increase of 100 in the sun-spot number the normal potential gradient of atmospheric electricity was increased about 30 per cent.

The investigations thus far would indicate that the *electric conductivity* λ does not vary with sun-spot activity in the same marked degree as does the potential gradient P; hence, as the current density of the vertical current is $i = \lambda P$, we may say, with high degree of certainty, that the vertical conduction current increases with increased sun-spot activity at the rate of about 3 per cent. per 10 sun-spot numbers. The bearing of this most interesting fact upon theories of the origin and maintenance of the earth's negative electric charge needs no elaboration here.

But of equal importance with the sun-spot effect to theories is the cycle effect, which indicates that the earth's negative charge, even if all periodic variations and sun-spot effects are eliminated, is not maintained constant but may progressively, from year to year, show in one cycle a steady diminution, and in another a steady increase. During the present cycle, beginning with the year of minimum spottedness, 1913, the total decrease may be such that the potential gradient at Ebro in the approaching year of minimum, 1923 or 1924, may be about 30 per cent. less than in the minimum year of 1913, when the observed value was 110 volts per metre. But, as already intimated, the cycle effect may not always be a diminishing one. I hope to study the variations in t more exhaustively by utilising all past data obtained with the requisite care.

Lack of space will not permit describing here in detail the various examinations already made concerning the *effect of sun-spot activity on the periodic variations of the potential gradient of atmospheric electricity*. Dr. Chree in his paper cites the results drawn by me from a Fourier analysis of the diurnal variation of P at Ebro for the period 1910 to 1920, and he finds a correlation coefficient of 0·72; if account be taken of the cycle effect, which is also evident here, as the diurnal variation is a function of the absolute value of P, then the correlation coefficient is 0·96. The analysis has been extended so as to include the data for 1921, which have become available since the 1922 paper.

In my 1921 investigations, which Dr. Chree apparently overlooked, I investigated the relationship between the *range* of the diurnal variation of the potential gradient at Ebro and sun-spot activity, and found that the sun-spot variation in the diurnal range between minimum and maximum was about 25 per cent., and that it increased with increased sun-spot activity.[4] With the aid of a similar formula to (1), and taking the Ebro series 1911–1921, the value of s turns out to be +0·31 for the mean of the year; *i.e.* an increase in the sun-spot number of 100 between minimum and maximum, which was about the case for the present cycle, was accompanied by an increase of 31 per cent. in the diurnal range at Ebro. A similar result is found for the Kremsmünster series, 1903–1910. The average corre-

[3] *Terr. Mag. and Atm. Elect.*, vol. 23 (1918), p. 63.

[4] *Terr. Mag. and Atm. Elec.*, vol. 26 (1921), p. 68, conclusion *b*, and Fig. VII., fifth curve.

lation coefficient for the sun-spot effect on the diurnal-variation (range, average departure, Fourier combined amplitude) of the potential gradient for various stations is about 0·8; for Ebro and Eskdalemuir it exceeds 0·9. The reason that Dr. Chree gets somewhat unsatisfactory results from certain diurnal data at Kew is partly because of the fact, already mentioned, that Kew is not a favourable station for the most successful study of world effects. However, applying a formula similar to (1) to the Kew series 1898–1909, Dr. Chree's correlation coefficient for the sun-spot relation of his quantity c_r (combined amplitude of the 24-hour and 12-hour waves of the Fourier series) is increased from 0·46 to 0·77; $s = +0·50$ per cent., and $t = -2·11$ per cent. of c_r.

The *sun-spot influence is also shown in the annual variation of the potential gradient at Ebro*, for the period 1910–1921; the correlation coefficient is 0·71.

General Conclusion.—The relationship between sun-spot activity and atmospheric electricity turns out to be, for locally undisturbed stations, as definite as in the case of terrestrial magnetism; the sun-spot influence on the periodic variations of the atmospheric potential-gradient is, in general, as great as on the periodic variations of terrestrial magnetism; and as concerns the effects on the absolute values, the sun-spot influence is about 300 times greater in atmospheric electricity than in terrestrial magnetism. The potential gradient of atmospheric electricity, and, presumably, the earth's total negative electric charge, is furthermore subject to an annual or secular change, which may vary in magnitude and sign from one sun-spot cycle to another.

LOUIS A. BAUER.
Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Washington, D.C., June 7.

Use of Yeast Extracts in Diabetes.

IN a previous letter to NATURE of March 10 (111, p. 327) we stated that we had obtained from yeast an insulin-like substance which had the effect of lowering the blood sugar of normal animals. Later we described the beneficial effect of this extract on some cases of diabetes mellitus (*Brit. Med. Journ.* i. p. 711, 1923). We soon found that the activity of the extract from different samples of yeast varied very widely. The results of these experiments will be published at a later date in conjunction with Dr. H. B. Hutchinson. In this connexion it is of interest to note that Collip (Proc. Soc. of Exp. Biol. and Med., 20, p. 321, 1923) reports numerous failures before he succeeded in obtaining an active extract from yeast, and later Funk and Corbitt (Proc. Soc. of Exp. Biol. and Med., 20, p. 422, 1923) have met with similar variability.

We have recently obtained from the action of micro-organisms other than yeast extracts which have a very considerable power of lowering the blood sugar of normal animals to a point where convulsions occur. That the convulsions were not due to a toxic effect is shown by the fact that they were relieved by injection of glucose. The extract like that from yeast caused the blood sugar to be lowered for a much longer time than when insulin was used. Whether these extracts will be of practical importance remains to be decided. Experiments are being directed to this end.

L. B. WINTER.
W. SMITH.
Biochemical Laboratory, Cambridge,
July 20.

Tenacity of Life of an Eel.

I HAVE lately had occasion to notice a further proof of the tenacity of life exhibited by the eel, which may perhaps be of interest.

A correspondent in America, Mr. L. L. Mowbray, of the Aquarium, Battery Park, New York City, has kindly sent me from time to time specimens of elvers [1] of the American eel, preserved in formol, for investigation purposes. Quite recently, a parcel from Mr. Mowbray was delivered at the laboratory here. Greatly to our surprise, however, instead of elvers preserved in formol as usual, it proved to contain a single specimen very much alive.

The little eel was enclosed in a small glass bottle (quarter-litre size), which had been corked and waxed so as to render it perfectly air-tight, and the bottle again enclosed in one of the tin cylinders commonly used in the United States for sending natural history specimens by post. The tiny creature had thus made its voyage across the Atlantic in complete darkness, and without any renewal of air in the 200 c.c. of water in which it was originally placed.

The postmarks showed that it had left New York on April 19, and arrived in Copenhagen on May 19, 1923. It has now been transferred to a small aquarium, where it is still alive and active, to all appearances in excellent form after its lengthy journey.

Evidently, then, the American fresh-water eel is by no means inferior to its European cousin in respect of endurance and tenacity of life.

I may add that we have, at the Laboratory here, two live adult specimens of the American eel. They have been in our aquaria since 1914, when we brought them home, as elvers, from Santa Cruz, in the West Indies. They, however, made the journey in an open beer bottle, with frequent changes of water, and were thus not subjected to so severe a test of endurance as the specimen above mentioned.

JOHS. SCHMIDT.
Carlsberg Laboratory, Copenhagen,
June 28.

Adsorption on Soil-Grains.

THE recently published work by Messrs. J. Hendrick and G. Newlands (*Journ. Agric. Sci.*, January 1923) on the mineral particles in the coarser grades of the "fine earth" separated from soils was noticed in NATURE of June 9, p. 736, and it was remarked that "the study of adsorptive reactions should not be entirely restricted to the colloidal field."

It is of interest to note that the United States Department of Agriculture took up this question last year, and its Bulletin No. 1122 (October 21, 1922) records the work of Messrs. M. S. Anderson, W. H. Fry, P. L. Gile, H. E. Middleton, and W. O. Robinson, on "Absorption by colloidal and non-colloidal soil constituents." The authors worked on material finer than 2 mm. in diameter, which, in common with so many experimenters, they call "the soil," by an unfortunate restriction of the term. This earth is separated, preferably by centrifugal methods, into three grades, 2·000-0·050 mm., 0·050-0·001 mm., and less than 0·001 mm., the last being styled colloidal. In testing the relative powers of adsorption on (or absorption by) these grades, it was justly felt that samples really free from colloidal matter could be best obtained by crushing unaltered minerals. In

[1] The youngest stages of eel-fry which make their way up into fresh water are called elvers.

each case, the grade 0·050-0·001 mm. was selected and examined under the microscope, the particles being counted and measured; the surface exposed by samples weighing one gram was thus determined for a number of common minerals.

The conditions of comminution seem, however, not quite comparable with those in natural soil-material, where it may be doubted if quartz and garnet, for example, present so large a surface in comparison with other minerals as appears from the table on p. 9. Limonite, again, is probably distributed in soils in a much finer form than is suggested by the artificially crushed material. Where a mineral grain, again, goes to pieces mainly under chemical action, as in the case of olivine set free from basalt, it may yield surviving cores that are of considerable coarseness. The table referred to, however, has obviously very great interest in connexion with the work of Hendrick and Newlands on the mineral constitution of various grades in a fine earth.

The American absorption-tests have been made with a dye (malachite green), water vapour, and ammonia, according to methods that are carefully stated. Four typical samples from the U.S. soil-series were then treated, and it was found that the absorption by the "non-colloidal minerals" (I should prefer to write "non-colloidal mineral particles") is less than 2 per cent. of the total absorption by the fine earths used. It is pointed out that this result is affected to some extent by the wide range of absorptive power shown by the tests on separate minerals. Reference is made to W. O. Robinson's work on "The inorganic composition of some important American soils" (U.S. Depart. Agric. Bulletin 122, 1914), in which the average constitution of the "silt" group in 26 soils was determined as quartz 51, potash felspars 7, muscovite 7, and other minerals 35 per cent. The dye-absorption is practically nothing for quartz and orthoclase; but the authors of Bulletin 1122 state that in a soil rich in muscovite the absorption by non-colloidal particles may be as high as 7 to 20 per cent. of the total absorption of the fine earth.

The conclusion is that the particles styled colloidal possess absorptive characters that are dependent on their composition and not merely on their fineness of comminution. The authors confirmed this opinion by grinding six selected minerals dry in a steel ball mill to a fineness of 1 micron and less, so as to reduce them to the "colloidal" grade. The coarser particles were then (p. 14) removed by sedimentation extending over several days. The average value for absorption of ammonia by these finely powdered minerals is only 22 per cent. of that given by the "ultra clays" from a number of different soils. The fine quartz and microcline showed practically no absorption for malachite green; but chlorite and muscovite gave results equal to the lowest of those obtained from the colloidal particles in the 33 soils tested. It is pointed out that some alteration may have taken place in the powdered minerals by hydrolysis during the process of separation. Their absorptive power may have been thus increased, and may be in part due to the formation of gels upon the particles. Experiments were then made with synthetic gels, and it now seems highly probable that by far the greater part of absorption in the fine earth of soils is due to gels in the material finer than 1 micron in diameter. The term "colloidal" thus comes to have a more definite significance when applied to the constituents of a soil.

GRENVILLE A. J. COLE.

Geological Survey of Ireland,
Dublin, July 12.

Discovery of Ascodipteron in Ceylon.

HITHERTO the species of this peculiar genus of Streblidae have been known only from the Malayan sub-region. Thanks to the interest taken on my behalf by Mr. W. W. A. Phillips of St. George Estate, Matugama, well known locally as an authority on the Chiroptera, I have to announce the discovery of an encysted female of the genus in the small leaf-nosed bat of Ceylon, *Hipposideros atratus*. The specimen was attached to the skin in the vicinity of the tail, whereas previously discovered specimens have been found either in the wing membrane (Adensamer) or at the base of the ear (Muir). The host, also, is of a species in which these parasites have not been hitherto recorded, and Mr. Phillips informs me that it is usually very free from all such, a character which it shares with the rest of its family.

The identity of the specimen has been confirmed by Mrs. Q. Cattell Kessell, working with Dr. Scott at Cambridge.

RONALD SENIOR-WHITE.

The Kepitigalla Rubber Estates, Ltd.,
Suduganga Estate, Matale,
Ceylon, June 1.

ASCODIPTERON is one of the most remarkable examples of specialisation to a parasitic existence known among insects. It was described by Adensamer in 1896 from a single example found imbedded in the dorsal wing-membrane of a bat (*Phyllorhina* sp.) from the Dutch East Indies. Subsequently Mr. Frederick Muir found a number of examples of another species, imbedded in the skin at the base of the ear, on seventeen specimens of *Miniopterus schreibersi* taken at Amboina; from these he obtained puparia and bred both sexes of the fly, publishing an account of the life-history (1912) and referring the insect to the family Streblidæ.

The newly emerged males and females have fully developed wings and legs. At a later stage the female bores its way into the skin of the bat by the aid of a series of remarkable cutting blades on its proboscis, loses its wings and legs almost entirely (only the stumps being present in the fully imbedded individual), and becomes almost completely encysted under the skin of the host, only the posterior extremity of the abdomen remaining external. The front part of the abdomen becomes enlarged and completely engulfs the head and thorax, which come to lie, as though invaginated, at the bottom of a pit. The imbedded female gives birth to a full-fed larva, which falls to the ground and immediately pupates, as is normal in "pupiparous" Diptera.

The discovery of specimens, which may possibly represent a new species of the genus, in Ceylon is highly interesting.

HUGH SCOTT.

University Museum of Zoology,
Cambridge, July 11.

Antarctic Geophysics.

HAVING been responsible for the final values of g derived from the pendulum observations made in the Antarctic in 1902–3 by Commander Bernacchi and his associate Engineer-Commander Skelton, I wish to direct attention to a point which has apparently escaped your reviewer when making the following statements (NATURE, vol. 111, p. 898): "The mean value of g from the three pendulums used in

1912 [by Capt. C. S. Wright] at Cape Evans was 983·003 from the July series and 983·004 from the August series. . . . Commander Bernacchi . . . obtained the values 982·970, 982·979, and 983·025. . . . These values may be compared with the standard value 981·292 at Potsdam. . . ."

This suggests the existence of a substantial difference between the results of the two British expeditions. This does not, however, seem to be the case. The final value for *g* derived from Commander Bernacchi's observations (National Antarctic Expedition 1901–1904, "Physical Observations," Table V., p. 34) was 982·985. In obtaining this, for reasons stated in the discussion, half weight only was allowed to the third pendulum. Thus the *apparent* difference between the results from the two expeditions is $0{\cdot}018_5$ cm./sec.^{2}. But this is accounted for by the fact that while Capt. Wright accepted for *g* at Potsdam—on which all the Antarctic results really depend—the value 981·292 quoted by your reviewer, I accepted 981·274 on the authority of Sir Gerald Lenox-Conyngham (Roy. Soc. Proc. A, vol. 78, p. 245). The difference between these two assumed values is 0·018 cm./sec.^{2}. Thus the values obtained by the two Antarctic expeditions—not exactly at the same place—really agreed to six significant figures. Though not assigning the importance that Paley did to "undesigned coincidences," I think this coincidence is remarkable enough to be worth mentioning. It would be of interest in this connexion to know what value the German experts assign now to *g* at Potsdam.

C. CHREE.

June 30.

The Translocation of Carbohydrates in the Sugar Maple.

THE conclusion of Prof. H. H. Dixon (NATURE, February 23, 1922, p. 236, and October 21, 1922, p. 547) that the translocation of organic substances could take place through the vessels of the xylem appears to have created a mild sensation among plant physiologists. Attention, however, does not seem to have been directed to the behaviour of the sugar maple, which furnishes important evidence in this connexion.

The sugar maple or rock maple (*Acer saccharum*, Marsh) is well known in Eastern Canada and New England as the source of the maple syrup and maple sugar of commerce. To obtain the sap, a small hole about half an inch in diameter is bored into the sapwood to a depth of about 3 inches, at a height of about 4 feet above the ground-level at the time when the snow is melting at the beginning of spring. A metal tube is inserted into the hole, and a small bucket is attached into which the sap drops from the metal spout. The sap as it oozes from the tree is colourless, but becomes brown on concentration by boiling.

A bulletin entitled "The Maple Sap Flow," by Jones, Edson, and Morse, published by the Vermont Agricultural Experiment Station in 1903, gives a full account of observations and experiments on this subject. Some of the conclusions reached by these investigators are as follows: The sap contains about 3 per cent. of sucrose and also small amounts of proteids, mineral matter, and acids, mainly malic acid. The greatest sap flow does not occur at the time when the most water is contained in the tree. More sap flowed at the opening of the sugar season than at the close when more water was in the tissues. There is no evidence that the water is forced into the maple trunk by root pressure at any season.

Warm sunny days and freezing nights form ideal sugar weather. On good sap days the pressure from above downwards is greater than that from below upwards. The flow generally, but not always, parallels the pressure. Later in the season and upon poor sap days, upward pressure and flow exceed those from above. The fastest run of sap from a tap hole during the experiments was 17·7 c.c. per minute. Jones and Orton, using lithium chloride, had previously determined the rate of flow in either direction as 2 to 6 inches per minute.

Some observations on this subject were made during the spring on two trees, numbered respectively 185 and 3389, growing in the Botanical Garden at Ottawa. In order to determine whether the flow of sap came from the bark or the wood, several small branches on each tree were chosen which projected horizontally or inclined slightly upward. These were cut across at right angles to their length on March 1, 1923, the cut end was smoothed and the bark peeled off close to the wood for a distance of about an inch from the cut end. In tree No. 185 sap commenced to flow on April 11 and ceased on April 27, while in tree No. 3389 the respective dates were April 17 and May 14. In no instance was sap observed to exude from the cut surface of the bark. Several observations were made on the rate of flow of sap from a cut branch together with records of temperature, etc. In tree No. 185 a branch measuring 15 mm. in diameter (including the bark) was selected, while in tree No. 3389 the diameter of the branch was 18 mm. The number of drops falling per minute was counted; the diameter of each drop was about 5 mm. Some of the results were as follows:

April 19, 1923. Tree No. 185. Time, 3.40 P.M. Shade temperature = 50° F. Fifty-one drops fell in five minutes.

April 20, 1923. Tree No. 185. Time, 3.15 P.M. Shade temperature = 77° F. Sunny. Two counts gave 8 drops each per minute.

April 16, 1923. Tree No. 3389. Time, 3 P.M. Shade temperature = 38° F. Snow was still lying round the base of the tree. Sap was flowing at the rate of 18 drops in five minutes. Another count gave 17 drops in five minutes.

April 19, 1923. Tree No. 3389. Time, 3.55 P.M. Shade temperature = 50° F. Some snow still around the base of the tree. Drops were falling at the rate of 115 in five minutes. Another count gave 22 drops in one minute.

A microscopical examination of twigs cut from each tree on March 1 and on May 7, on which date the buds were swelling, showed abundant starch grains in the medullary rays but none in the pith on both occasions. The amount of water present in several small branches half an inch in diameter taken from each tree was also determined for the above dates, when it was found that each tree contained 1 per cent. less water on May 7 than it did on March 1.

The spring flow of sap was also observed in five other species of maple growing in the Botanical Garden here. In *Acer Myabei* on April 14 an icicle measuring 9 inches long and $1\frac{3}{4}$ inches wide at the base was observed hanging from a broken branch.

While some points in the metabolism of the maple sap may still be obscure, it is abundantly evident that the vessels of the wood are able to carry the sugar solution in both directions in the tree-trunk and that the rate of flow is comparatively rapid.

J. ADAMS.

Central Experimental Farm, Ottawa,
July 11.

The Origins of the Conception of Isotopes.[1]

By Prof. FREDERICK SODDY, F.R.S.

ONE of the most important consequences of the study of the chemistry of the products of radioactive change has been the discovery of isotopes and the interpretation, in consequence, of the Periodic Law in terms of modern views of atomic structure. It is one of the few fields in the vast borderland between physics and chemistry, overrun of recent years by an advancing swarm of mathematicians and physicists, armed with all sorts of new-fangled weapons, in which the invaders have found the chemist already in possession. The broad highways they have hewn thereto are already dusty with the feet of pilgrims and are being watered by the tears of candidates for "Honours." But the somewhat intricate bye-ways through which the chemist first found his way into this virgin territory, and the views on the road before it was in sight, may still preserve something of their pristine interest.

The word *isotope* signifies "the same place," in allusion to isotopes occupying the same place in the Periodic Table. Before this word of theoretical meaning was coined, isotopes were experimentally well known as elements non-separable by chemical methods and completely identical in their whole chemical character. The analysis of the constituents of matter, to which we were born and brought up to regard as the most searching and fundamental, is an analysis by means of its chemical properties. Although, later, a new and even more powerful method—spectroscopic analysis—was developed, it merely dotted the *i*'s and crossed the *t*'s of chemical analysis, filled in a few vacant places in the Periodic Law, and handed over the newcomers to the chemist to classify along with the rest of the eighty or so "foundation stones" of which he supposed the material universe to be built up.

With the close of last century another new method—radioactive analysis—was developed, which is applicable, of course, only to the radio-elements; that is, to the elements uranium and thorium and the 34, as we now know, successive unstable products of their spontaneous disintegration. Each of these possesses a definite radioactive character; it is produced from one and changes into another element, and, in both changes, rays characteristic of the two substances are expelled, which are as fine a hall-mark of their identity as any of the "tests" of chemical analysis. But radioactive character, unlike spectroscopic character, is completely independent of chemical character. The latter might be called "existence properties," whereas the radioactive character is that attending the explosion of the atom which terminates the existence of the element as such. It provided the necessary independent method of analysis capable, for the first time, of distinguishing between elements identical chemically and occupying the same place in the Periodic Table, *i.e.* between isotopes.

The Earlier Chapter of Radio-chemistry.

Not a hint of this, however, was afforded by the earlier chapter of radio-chemistry. On the contrary, no development could appear more normal. Just as rubidium, thallium, etc., were detected by the spectroscope before anything of their chemistry was known, so radium was detected in pitchblende by its radioactivity in concentration thousands of times less than is necessary to show a single line of its spectrum. But with more concentrated preparations a new spectrum *was* discovered, and then a new element, which was found to possess a chemical character entirely new and sufficing for its separation in the pure state from all other elements. As in the case of the elements discovered by the spectroscope, radium was found to occupy a place, hitherto vacant, in the Periodic Table. But, as it happened, radium is exceptional in this. Its chemical character was quite normal, and indeed could have been largely predicted beforehand for the missing element occupying this place. The development of the subject showed it to be but one of some 34 radio-elements formed from uranium and thorium. But there are not 34 vacant places in the Periodic Table to accommodate them.

Meta-elements.

So far as I am aware, there is no anticipation, prior to the systematic study of the chemistry of the radio-elements, of the idea that there may exist different elements with absolutely identical chemical character. Sir William Crookes, it is true, once thought, though the idea has not survived more extended examination, that the properties of the elements, as we know them, might be a mean value, and that the individual atoms composing the element might differ in weight and chemical character continuously on either side of this mean. If so, more refined methods might serve to resolve the element into a collection of what he termed "Meta-elements," possessing the main character of the original, but differing from one another to a slight extent. Misled by the phosphorescence spectra, which are now known to be characteristic of mixtures rather than chemically homogeneous substances, he thought at one time that he had been successful in so resolving yttrium. But the present idea, that elements may exist absolutely the same in chemical nature and yet absolutely different in other properties, such as radioactivity and atomic weight, is totally distinct from this.

The Experimental Method that first revealed Isotopes.

I venture to think that no more elegant extension of our methods of gaining new knowledge has ever been obtained than that which, in due course, was to reveal the existence of isotopes. The original observations, upon which the theory of atomic disintegration was first founded, were that thorium is continuously producing a new radioactive substance, thorium X, separable from it by precipitation with ammonia but not with other precipitants, and, after separation, continuously re-forming again. The thorium X was short-lived and changed again into a gas, the thorium emanation, for which the name *thoron* has recently been proposed, which was even shorter-lived and changed again to a solid—the "excited activity" now known

[1] Discourse delivered at the Royal Institution on Friday, May 4.

as the active deposit—which again went through further changes. The rays resulted from these successive changes, α-rays in the first and α-, β-, and γ-rays in the last changes. Below is the first part of the thorium disintegration series as it appeared to Sir Ernest Rutherford and myself in 1903:

$$\text{THORIUM} \xrightarrow{\alpha} \text{THORIUM X} \xrightarrow{\alpha} \text{THORON} \xrightarrow{\alpha} \text{, etc.}$$

In 1905 Sir William Ramsay and O. Hahn were engaged in extracting radium from thorianite, a new Ceylon mineral containing both uranium and thorium in important quantity. The radium was separated with the barium, and the chlorides fractionated in the usual way. They found a new radio-element to be present and to be separated from the radium with the barium. It proved to be the direct parent of thorium X, and intermediate in the series between the latter and thorium, and they called it radiothorium. In spite of this easy and apparently straightforward separation, the experience of a number of chemists showed that something remained to be explained, for it was found to be difficult to the verge of impossibility to separate radiothorium from thorium. Ramsay and Hahn had in fact "separated" isotopes in 1905, for radiothorium and thorium are isotopes. Yet further work has shown the two to be so alike that no separation by chemical means is possible!

Then in 1907, along with the radium which had been separated from thorianite, Hahn discovered another new radio-element, mesothorium, the direct parent of radiothorium and intermediate between it and thorium. In the next year he showed that mesothorium consists of two successive products—the first, the direct product of thorium, mesothorium 1, being practically rayless and generating a short-lived product, mesothorium 2, giving powerful β- and γ-rays.

This resolved the mystery, and one cannot do better than to quote the words of McCoy and Ross (J. Amer. Chem. Soc., 1907, 29, 1709).

> "Our experiments strongly indicate that radiothorium is entirely inseparable from thorium by chemical processes. . . . The isolation of radiothorium from thorianite and from pure thorium nitrate . . . may have been accomplished by the separation of mesothorium which in time changed spontaneously into radiothorium."

Thus the radiothorium separated from the mineral thorianite by Ramsay and Hahn was not the radiothorium *in the mineral*, but that subsequently produced from the easily separated mesothorium, after it had been removed from the thorium. If they had fractionated the radium-mesothorium-barium mixture at once they would not have discovered radiothorium. The lapse of time after the separation of the mesothorium is essential. Nowadays many non-separable radio-elements are, like radiothorium, "grown" from their separable parents. Thus radium D, an isotope of lead, is grown from the radium emanation (radon), although it cannot be separated from the mineral, which always contains lead in quantity.

The first part of the thorium series now runs [2]

$$\underset{2\cdot10^{10}\text{ years}}{\text{THORIUM}} \xrightarrow{\alpha} \underset{9\cdot67\text{ years}}{\text{MESOTHORIUM 1}} \longrightarrow \underset{8\cdot9\text{ hours}}{\text{MESOTHORIUM 2}}$$

$$\xrightarrow{\beta} \underset{2\cdot91\text{ years}}{\text{RADIOTHORIUM}} \xrightarrow{\alpha} \underset{5\cdot25\text{ days}}{\text{THORIUM X}} \xrightarrow{\alpha} \underset{78\text{ seconds}}{\text{THORON}} \xrightarrow{\alpha} \text{, etc.}$$

In this series thorium and radiothorium and mesothorium and thorium X are two pairs of isotopes. If we represent the successive products by balls of different colours to indicate their chemical character, isotopes being of the same colour, chemical analysis will sort the balls into their different colours, and the lapse of time will cause some of the colours to change. The ball representing mesothorium will in time turn into that representing radiothorium, so that the latter, before indistinguishable from thorium, becomes known as a separate individual.

The Isotopes of Uranium.

It will be noted that the method of separating isotopes depends upon their being alternate rather than successive in the series. If radiothorium had been the direct product of thorium, the two would to this day never have been separated. The changes of chemical character are, as we shall later see, intimately connected with the electric charges on the α- and β-particles expelled. For successive products to have the same character, no rays, or at least no charged particles, must be expelled. It is always as well, and no subject illustrates the point better than that of isotopes, to reflect not only upon what our methods are able to reveal but also upon what they could not reveal.

At first it seemed that uranium itself was a case of successive isotopes. Boltwood in 1908 proved from his study of the relative activities of the successive products giving α-rays in minerals, that whereas all of them, except uranium, gave off only one α-particle per atom disintegrating, uranium gave off two. By direct observation with the scintillation method it was proved that the two α-particles from uranium are *not* simultaneously expelled, and later it was shown that they possess different velocities. If the slower comes from uranium itself (uranium I), the period of which is known to be $6\cdot10^9$ years, the swifter must come from the isotope (uranium II), and its period must be some three million years. This is an example of isotopes being revealed by difference of radioactive nature simply, though no other evidence of their separate existences is available. Owing to the long periods of the α-ray-giving members of the early part of the uranium series, it has been much more difficult to unravel than the thorium series. As a result of researches too numerous to detail, it has been concluded that the main series is almost entirely analogous to the thorium series and runs

$$\underset{6\cdot10^9\text{ years}}{\text{URANIUM I}} \xrightarrow{\alpha} \underset{35\cdot5\text{ days}}{\text{URANIUM X}_1} \xrightarrow{\beta} \underset{1\cdot65\text{ minutes}}{\text{URANIUM X}_2} \xrightarrow{\beta} \underset{3\cdot10^6\text{ years}}{\text{URANIUM II}}$$

$$\xrightarrow{\alpha} \underset{10^5\text{ years}}{\text{IONIUM}} \xrightarrow{\alpha} \underset{2\cdot440\text{ years}}{\text{RADIUM}} \xrightarrow{\alpha} \underset{5\cdot55\text{ days}}{\text{RADON}} \xrightarrow{\alpha} \text{, etc.}$$

Though two short-lived products probably intervene between the two uraniums, analogous to the two mesothoriums between thorium and radiothorium, the relation of their period to that of their product, uranium II, is so hopelessly unfavourable that there is no hope of ever being able to put the separate existence of uranium II into evidence in the same way as was done

[2] The periods shown in the second line are the periods of average life of the successive products. These are 1·443 times the period required for one-half of the element to change.

for radiothorium. For all *practical* purposes the two uranium are as non-separable by this method as if they were actually successive products. I spent many years, before this part of the series was at all well known, looking for the product of uranium X, and separated this constituent from 50 kilograms of uranium nitrate repeatedly in the attempt. I was looking for a growth of α-rays concomitantly with the decay of the β-rays of the uranium X. If the product had been ionium,

$$\text{UI} \xrightarrow{\alpha} \text{UII} \xrightarrow{\alpha} \text{UX} \xrightarrow{\beta} \text{Io} \xrightarrow{\alpha}$$

as at first thought, it should have been just possible to detect it; but since it is the 30 times longer-lived uranium II, the attempt is hopeless, especially as uranium X and ionium are isotopes, and therefore the uranium X separated must always possess a certain initial α-activity due to ionium.

The Absolute Chemical Identity of Isotopes and its Implications.

The years 1908–10 were productive of many prolonged and serious efforts to separate isotopes by chemical means. In 1908 Boltwood discovered ionium and showed that it resembled thorium. Keetman, who with Marckwald discovered ionium independently, tried twelve good methods all known to be effective in the purification of thorium in the attempt to separate the ionium from thorium, completely without success. Auer von Welsbach, on a technical scale, separated the ionium and thorium from 30 tons of pitchblende and tried fresh methods in the hope of separating them, but failed. It was with this preparation that Exner and Haschek tried without success to find the ionium spectrum; and Russell and Rossi confirmed their result, that the spectrum of ionium was that of pure thorium. When later I had determined beyond doubt, from measurements of the rate of growth of radium from uranium, that the period of ionium was 100,000 years, and that Welsbach's preparation must have been approximately 30 per cent. ionium and 70 per cent. thorium by weight, it followed that the spectra of isotopes must, like their chemical character, also be identical. The difference, if any exists, is almost beyond the limit of detection by the most powerful methods.

Similarly, the chemical identity of radium D and lead was established as a consequence of very prolonged and refined chemical examination. Paneth and Hevesy established upon this their well-known method of using radioactive isotopes as indicators for elements in too small quantity to be dealt with except by such methods. On the principle that wherever the radioactive element is there will its inactive isotope be also, provided that they have once been properly mixed, many difficult or uncertain chemical analyses may be converted into simple radioactive ones.

In 1909 Strömholm and Svedberg made what was probably the first attempt to fit a part of the disintegration series into the Periodic Table, and although the effort in itself was in an important respect erroneous, in their paper is to be found the first anticipation that the chemical non-separability found for certain pairs and groups of radio-elements may also apply to the non-radioactive elements. Remarking on the fact that there are three parallel and independent radioactive series, they suppose this to proceed down through the Periodic Table, "but that always the three elements of the different genetic series, which thus together occupy one place in the Periodic System, are so alike that they always occur together and also have not been able to be appreciably separated in the laboratory." They point out also, this idea would explain the exceptions to the Periodic System "if the elements of the scheme were mixtures of several homogeneous elements of similar but not completely identical atomic weight."

In the next year I arrived independently, and without in the least postulating any continuance of the genetic series beyond the radio-elements, at a similar view. Marckwald and I found independently that mesothorium 1 was chemically similar to radium, a fact undoubtedly known to Hahn and those engaged in the technical extraction of mesothorium, but kept secret. It was known from some work of Boltwood that precipitating barium sulphate in a solution containing mesothorium removes it, but it was thought that the action of the barium sulphate was similar to that in removing uranium X, for which it had long been used, namely, a simple adsorption. I was surprised to find it absolutely different. The removal of the barium from the mesothorium, as from radium, could only be accomplished by the fractional crystallisation of the chlorides. In this fractionation the radium and mesothorium remained together and behaved as a single element. Within the limit of error of the most careful radioactive measurements, there was no change in the relative proportion of the two elements at the end of the process from that in which they exist in the original mineral.

Chemistry has many cases of elements similar in chemical character, but nothing approaching this. For we know, beforehand, that we are dealing with a mixture of two substances and can estimate accurately the proportion of each individual. Yet to all chemical operations they behave as a single substance. The differences of atomic weight are considerable, two units in the cases of mesothorium and radium, and of ionium and thorium, and four units in that of radiothorium and thorium. It was certain that if isotopes existed in the case of the ordinary chemical elements the absence of a second radioactive nature independent of the chemical nature would make it impossible for them to have been recognised. Hence the implication followed that any supposed element may be a mixture of several chemical identities of different atomic weight, and any atomic weight might be merely a mean number (Ann. Reports, Chem. Soc., 1910, 286). There is an element of tragedy in this. The lifetime labours of the chemists who, since the time of Stas, have devoted themselves to the exact determination of atomic weights appear to have as little theoretical interest now as if you sought to determine the average weight of a collection of beer bottles, all exactly alike but not all quite full.

The Radio-elements and the Periodic Law.

The years from 1911–13 were crowded with important advances, and to do the exact history justice would take an undue share of the available time. In 1911 the chemistry of most of the α-ray-giving members was sufficiently known for it to be seen

that the expulsion of the α-particle caused the element expelling it to move from the place it occupied in the Periodic Table to the next place but one to it in the direction of diminishing mass.

At this time the chemistry of the post-emanation members had scarcely been studied, though von Lerch, from electrochemical researches, had put forward the rule that the successive products are each electrochemically "nobler" than the last, a rule which describes well enough the electrochemical behaviour of the first three—the A to C members, as they are called. Then, as a result of the experiments of Schrader and Russell, it was found that their volatility was much affected by chemical treatment and by the atmosphere in which they were volatilised. Thus, in hydrogen, radium C volatilises at as low a temperature as 360° C., though, in air, a temperature of 1200° is necessary. This clearly indicated the possibility that even these excessively ephemeral elements have a definite chemical character. Hevesy showed, by electrochemical methods, that the three B-members are identical in properties among themselves, and also the three C-members.

But the work which, more than anything else, served to reveal, as in a flash, the simple and sweeping generalisation which covers the evolution of the radioactive elements was that of A. Fleck in my laboratory in Glasgow. He studied the chemistry of the various members, still uncharacterised, from the definite point of view of ascertaining to which element each most closely approximated in chemical character, and then whether it was separable from that element or not. In addition to confirming more rigorously many conclusions already reached, he proved that mesothorium 2 was non-separable from actinium, the three B-members from lead, like radium D, and the three C-members and radium E from bismuth.

Hevesy and Russell—the first with regard to the valency of the radio-elements and the second with regard to the positions they occupy in the Periodic Table—published early in 1913 statements of the full law underlying radioactive evolution, but only in part correct. Within a month K. Fajans, in Carlsruhe, published the scheme correct and complete, including the complicated branchings that occur at the C-members. In a paper, amplifying and amending Russell's scheme, I arrived independently at the same scheme as Fajans. Each α-ray expelled causes a shift of two places in the Periodic Table in the direction of diminishing mass, and each β-ray a shift of one place in the opposite direction. In its present form the scheme is shown in Fig. 1. The chief uncertainty remaining is whether the actinium branch starts from uranium II, as shown in the figure for convenience, or from uranium I, or even from a third independent isotope of uranium. So that the atomic weights shown for the actinium series are purely provisional.

By the consistent application of the two rules mentioned, the members found to be non-separable from one another fall in the same place in the Periodic Table. The chemical character has nothing to do with the radioactivity, nor with the series to which the element belongs, nor with its atomic weight. It depends upon a number, now called the atomic number, shown at the top of the place in the figure.

Before passing on to this, the chief practical consequences of the generalisation may be briefly enumerated.

(1) Of the members still uncharacterised, the A and C′ members must be the isotopes of polonium (radium F) and radium C_2 (now called radium C″), actinium D and thorium D must be isotopes of thallium. Fleck at once verified these predictions as regards radium A, actinium D, and thorium D.

(2) Uranium X, like mesothorium, must consist of two successive β-ray-giving products, intermediate between the two uraniums. Fajans and Gohring at once succeeded in separating from uranium X a very short-lived product, uranium X_2, giving the more penetrating of the two types of β-ray expelled, the uranium X_1 giving the less penetrating β-rays.

(3) The parent of actinium in the IIIrd family must be an isotope of radium, if actinium is formed in a β-ray change—a conclusion I at once experimentally disproved—*or* it must be an isotope of uranium X_2, in the Vth family, if actinium is formed in an α-ray change. This was proved by Cranston and myself, and the name "eka-tantalum" given to the new element, and by Hahn and Meitner, who named it protoactinium. It is linked to uranium through uranium Y, a branch member discovered by Antonoff in 1911, and suspected to be in the actinium series.

Protoactinium, to give it Hahn and Meitner's name, has been shown by them to give α-rays and to be chemically so like tantalum that hitherto it has not been separated from it. Its period is about 17,000 years, and from this it may be calculated that there is about one-fifth as much of it by weight in minerals as there is of radium. This may be sufficient to enable it to be isolated, and for its spectrum, atomic weight, and chemical character to be ascertained. The branch series runs

$$\underset{\text{VI}}{\text{U}} \xrightarrow{\alpha} \underset{\text{IV}}{\text{UY}} \xrightarrow{\beta} \underset{\text{V}}{\text{Pa}} \xrightarrow{\alpha} \underset{\text{III}}{\text{Ac}} \longrightarrow \underset{\text{IV}}{\text{RaAc}} \xrightarrow{\alpha} \underset{\text{II}}{\text{AcX}} \xrightarrow{\alpha} \underset{\text{o}}{\text{An}} \xrightarrow{\alpha}, \text{ etc.}$$

in which the figures in the second line refer to the family in the Periodic Table to which the element belongs.

(4) All the ultimate products in all branches are isotopes of lead. The atomic weight of the two products of thorium are both 208, and of the major branch of uranium 206. As is well known, this had only to be tested to be proved correct. The atomic weight of the lead from the purest thorium minerals is as high as 207·9, and of that from the purest uranium minerals 206·0. The spectra of these isotopes, but for the infinitesimal difference already alluded to, are identical. But the densities are proportional to their atomic weights. This was a very simple prediction I made, before testing it, from the theoretical views about to be dealt with.

THE THEORETICAL INTERPRETATION OF ISOTOPES.

The results on the theoretical side were no less definite and important, and isotopes found a ready explanation on the nuclear theory of atomic structure put forward in a tentative form by Rutherford in 1911. This theory accounted for the large angles through which occasional α-particles were deflected in their

passage through atoms, by the existence of a very minute highly charged nucleus at the centre of the atom, the rest of the atom being occupied by separate charges of opposite sign equal in number to the nuclear charge. For such an atom scattering should be proportional to the square of the nuclear charge. Experiment showed that scattering was approximately proportional to the square of the atomic weight. So that it looked as if, as in the α-particle itself, there existed one unit of nuclear charge to each two units of atomic weight. This would make the nuclear charge of uranium of atomic weight about 240, 120+.

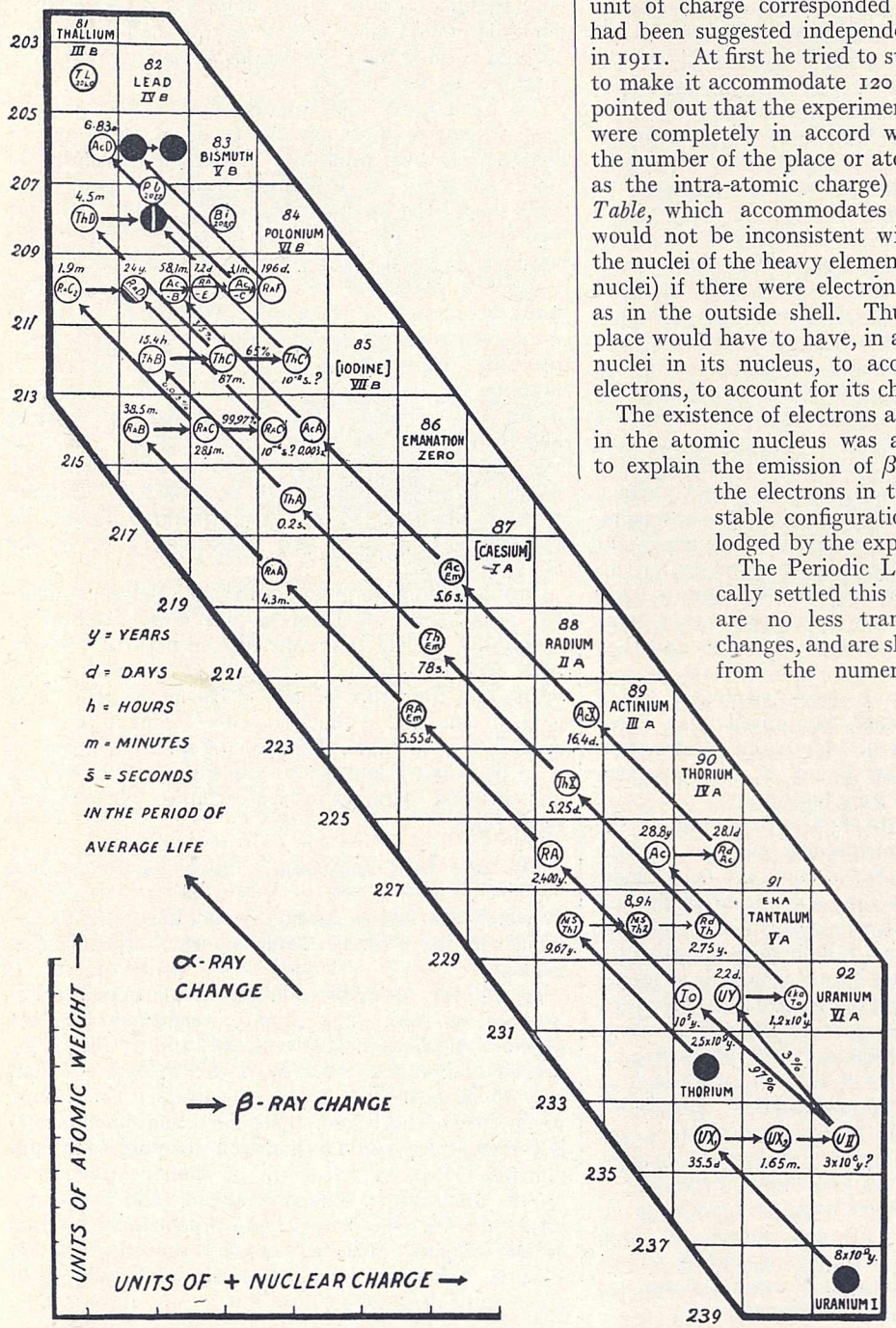

FIG. 1.—Radio-elements and the periodic law. All elements in the same vertical column are isotopes.

Since the α-particle carries two positive charges and the β-particle one negative, the obvious inference from the figure is that the successive places in the Periodic Table correspond with unit difference in the intra-atomic charge. This view, and also that each unit of charge corresponded to two units of mass, had been suggested independently by van der Broek in 1911. At first he tried to stretch the Periodic Table to make it accommodate 120 places. But in 1913 he pointed out that the experimental results for scattering were completely in accord with his own view (that the number of the place or atomic number is the same as the intra-atomic charge) *on the existing Periodic Table*, which accommodates some 90 elements. It would not be inconsistent with his other view (that the nuclei of the heavy elements are made up of helium nuclei) if there were electrons in the nucleus as well as in the outside shell. Thus uranium in the 90th place would have to have, in addition to the 60 helium nuclei in its nucleus, to account for its weight, 30 electrons, to account for its charge of 90+.

The existence of electrons as well as positive charges in the atomic nucleus was also postulated by Bohr to explain the emission of β-rays, for on his theory the electrons in the external shell form a stable configuration and could only be dislodged by the expenditure of work.

The Periodic Law generalisation practically settled this question. β-ray changes are no less transmutational than α-ray changes, and are sharply to be distinguished from the numerous processes, such as friction, chemical change, action of ultra-violet light, and incandescence, during which electrons are detached from atoms. The effect on the chemical character produced by the expulsion of one α-particle is exactly undone by the expulsion of two β-particles, and the product becomes isotopic with the original parent. This means that both α- and β-particles must be expelled from the nucleus and that isotopes are elements the atoms of which have the same *nett* nuclear charge; *i.e.* the same excess number of positive over negative charges in the nucleus, but different numbers of positives and negatives reckoned separately. For such systems the electronic shell would be identical, and so the identity of the chemical and spectroscopic character is explained. Also the atomic volume is the same; that is, the density must be proportional to the atomic weight.

We were able to get an interesting confirmation of this view. In the change of uranium X_1 to uranium II

two electrons are lost as β-rays. In the oxidation of a uranous salt to a uranic or uranyl salt two electrons are also lost,

$$U^{++++} = U^{++++++} + 2E.$$

If these come from the same region of the atom as the β-particles, then uranous salts, so long as their valency does not change, should be like uranium X_1, chemically non-separable from thorium. Fleck, trying this, found great similarity in chemical properties between uranous salts and thorium, but not identity. He was able to separate them by chemical methods without changing the valency of the uranous salt.

The great merit of the nuclear atom from the chemist's point of view was that it afforded for the first time a clear picture of the difference between a chemical and a transmutational (or radioactive) change. The latter occur in the nucleus and are irreversible. The external shell accommodates itself instantly to the change of the nucleus. But any change suffered by the external shell (chemical change) has no effect on the nucleus, which always acts so as to make the external shell conform to one most stable configuration.

The atom is an *imperium in imperio*, and like most such systems is very conservative and resistant to change. The electrons in the shell, that govern almost all the atomic properties, except mass and radioactivity, are in turn but the bureaucratic instruments of the real government, which is the intensely charged central nucleus. The transmutation of atoms, as of social systems, is alike impossible because the apparent government is not the real government. Rutherford's experiments on the bombardment of atoms by α-particles show that only about one out of a hundred thousand of the latter, in passing through hydrogen, ever hits a hydrogen nucleus, and the proportion of hits to misses is something like one in a thousand millions. In politics, contrasting the number of missiles hurled with the results achieved, the shooting seems even worse. It is only when the atomic or social systems break up or break down that we learn even of the existence of their real internal constitution.

Current Topics and Events.

ON July 30 there was read a third time in the House of Lords the Wild Birds Protection Bill introduced by Viscount Grey of Fallodon. The Bill aims at the repeal of existing enactments on the subject, and at substituting new provisions on lines recommended in 1919 by a Departmental Committee. The measure appears to us to be a wise one which should be welcomed by ornithologists and other bird lovers and also on grounds of economic importance. More than this, it is a much stronger measure than any of its predecessors, and if it become law and be properly enforced it should give a much more effective protection than is at present possible. The important new powers are those which are to make it an offence to be in possession of any bird, part of a bird, nest, or egg which may be presumed to have been illegally taken, and those which are to place the onus of proof on the possessor. At present, on the other hand, the onus is on the prosecution, and the act of killing or taking is the material fact to be proved: as a result, the skins and eggs of protected birds can be offered for sale with impunity by taxidermists and dealers, and "plovers' eggs" are freely sold in shops and restaurants in the close season. The Bill has still to be passed by the House of Commons, but we hope that this may be successfully accomplished next session.

AUGUSTIN LE PRINCE has rarely been recognised as one of the pioneers in kinematography. Mr. E. Kilburn Scott, who knew him personally, recently lectured before the Royal Photographic Society on his work in this direction, and a report of the lecture is given in the current number of the Society's Journal. Mr. Scott considers it established that Le Prince was the first to make a successful camera to take photographs at more than 16 in a second, was the first to show moving pictures on a screen (at Leeds in 1889), was the first to appreciate the importance of using flexible film (he is stated to have used celluloid films before September 1890), and was the first to use perforations and sprocket wheels (patents dated 1888). Le Prince's career came to an extraordinary end. He was last seen on September 16, 1890, at Dijon, entering a train for Paris, but since then nothing whatever seems to be known of him. One suggestion was that he might have been kidnapped by agents of American inventors whom he had forestalled.

THE Royal Geographical Society of Australasia (Queensland) is contemplating the investigation of the problems of the Great Barrier Reef, and is inviting other scientific societies and the universities of Australia to co-operate. In the *Queensland Geographical Journal* for 1920–22 Prof. H. C. Richards indicates some of the problems that await solution, and shows by a sketch of previous work on the subject how divergent are the views expressed on some important points. For example, it is apparently not known if the Great Barrier Reef is rising or falling or is in a static condition. The suggested investigations would include complete charting, including making vertical sections, of at least three island points on the reef, one each in the northern, middle, and southern regions, and recharting at intervals of a decade; charting of several of the more important troughs or valleys in the reef and the lagoon area, and recharting, also, at intervals of a decade; complete survey of the fauna, flora, and economic resources; and experiments on the growth of corals under varying conditions.

A COPY of a pamphlet has reached us on "Suggestions for the Prevention of the Decay of Building Stone," by Mr. J. E. Marsh (Basil Blackwell, Oxford, 1*s.* 6*d.* net). The author remarks in the preface: "In 1861 the Commission, appointed to stop the decay in the stone of Westminster Palace, decided to wait till a remedy had been discovered, and did not expect to have to wait long. We have waited sixty

years and seem to be no nearer a solution of the problem. . . . The preservation of our old historic buildings is a matter of as much concern now as it has ever been. Suggestions however slight may help. That is why this pamphlet has been written." Sections are given on Parliamentary commissions on the subject, theories of stone decay, and the treatment of stone, and the author describes experiments which he has carried out. The final sentences of the booklet are worth quoting: "The simple remedy is to keep the stone sterile. . . . This means, in simple language, keeping the stone clean. Alkalies have been used as cleansers from time immemorial. The walls of Oxford are sick; they have been drugged, but they have not been cleaned. What they need more than drugs is a good wash; for dirt rather than time is the destroyer of things."

Bergens Museums Aarsberetning for 1921–22 records the gift by the heirs of Herman Friele of that distinguished naturalist's cabinet of mollusca, mainly collected by him in the neighbourhood of Bergen, but also, in company with G. O. Sars, from northern Norway. It comprises in addition authentic specimens from the Atlantic and adjacent seas received in exchange from the leading specialists of his day. The number of specimens is 1650. This report also announces the commencement of work at the new biological station erected on the island of Herdla, 27 kilometres north-west of Bergen, where Herlö-fjord branches off from Hjelte-fjord, in a region already classic through the researches of Michael Sars. The station is provided with a small research sailing vessel, the *Herman Friele*, of 23 tons gross tonnage, with auxiliary oil-motor power.

THE University of Frankfort-on-Main has established an Institute with a professorship which is to deal with the applications of physics in medicine, *e.g.* radioactivity, X-rays, light rays, and the like. It is stated to be the first institute of the kind to be established in Germany.

THE Research Department of the Calico Printers' Association, Ltd., St. James's Buildings, Manchester, invites application for the post of a physicist whose duties will be to conduct research on physical problems arising in the calico-printing industry. The person appointed will work in association with the chemical research staff.

THE following are among the Civil List pensions granted during the year ended March 31: Miss A. H. Bacot, in recognition of the services rendered by her brother, the late Mr. A. W. Bacot, to science and to the nation, 75*l.*; Mrs. M. Barnwell, in recognition of the services rendered by her father, the late Dr. H. Woodward, to the cause of geological science, 25*l.*; Lieut.-Col. H. H. Godwin-Austen, in recognition of his services to science and to the nation, 100*l.*; Mrs. M. Lyster Jameson, in recognition of the services rendered by her husband, the late Dr. H. Lyster Jameson, to science, 50*l.*

BY the will of the late Mrs. Bacon, of New York, the Smithsonian Institution of Washington has received a sum of 10,000*l.* for the establishment of a travelling scholarship for the study of the fauna of countries other than the United States, in memory of her husband, Walter Rathbone Bacon. The scholarship will be tenable for at least two years, and the annual value about 500*l.* Applications for the award must include details of the proposed research, the benefits to be expected from it, the estimated cost, and full particulars of the scientific and physical qualifications of the candidate; they should reach the secretary of the Smithsonian Institution not later than October 1.

MR. J. S. HUXLEY informs us that, by an oversight, his name was omitted from the list of signatories to the letter on the forthcoming *British Journal of Experimental Biology* which appeared in NATURE of July 28, p. 133.

THE July issue of *The Fight against Disease*, the organ of the Research Defence Society, contains the report of the Committee for the year, and an abstract of Dr. Saleeby's lecture on sunlight and disease, with photographs of patients at Rollier's "sunlight school" at Leysin. Notes on smallpox and vaccination also occupy considerable space.

WE have received the twelfth report of the Microbiological Laboratory, N.S. Wales, for the year 1921. It contains a useful list of the species of fleas that occur on native rats. In some instances species of fleas appear to occur on marsupials and rodents indiscriminately. Some observations are also recorded on the Sydney milk supply, which on the bacteriological results seems to be of very poor quality. It is to be hoped that the publication of this annual report may be expedited in the future.

BULLETIN No. 25 of the Institute of Science and Industry, Australia, deals with "The Manufacture of Pulp and Paper from Australian Woods." The book itself is printed on paper made by the Institute in the course of the experiments described; a few sample sheets of paper of varying composition are also bound in at the end. The Bulletin is divided into five parts: General information; investigations (prior to 1920); laboratory investigations; semi-commercial experiments; economics.

WE have received a copy of the Nobel Lecture, "The Origins of the Conception of Isotopes," delivered by Prof. F. Soddy at Stockholm last December. This is a clear account of the development of radioactivity from its discovery by Becquerel in 1896 down to modern times. The conception of isotopes dates from 1905, though their complete chemical identity was not recognised until two years later. This identity was afterwards extended to include their electrochemistry and their spectra, but more recently infinitesimal differences have been found in the latter.

BULLETIN 53 S, issued by Messrs. Watson and Sons, Sunic House, Parker Street, Kingsway, London, illustrates the various medical uses to which high-frequency currents may be put. Use is made of the term violet-ray treatment; no doubt violet rays issue from the glass electrodes holding the gas under discharge, but it is open to question whether it would

not be better to retain the use of the term high-frequency treatment until it is definitely proved that the beneficial effects are due to the radiation. A large variety of electrodes suitable for the cavities and other parts of the body is illustrated, and instructions are detailed for their use.

THE British Medical Association (429 Strand, W.C.2) has published and issued a useful "Handbook for Recently Qualified Medical Practitioners" (price 2*s.* 6*d.* net). It gives concise but clear details of the duties of medical practitioners and of the legal obligations (by Dr. W. A. Brend) placed upon registered practitioners. The main careers open to members of the medical profession are summarised, and a section is devoted to post-graduation study and special diplomas. A section deals with the British Medical Association and its work, and the Dangerous Drugs Regulations are printed in an appendix.

PUBLICATION No. 110 of the Koninklijk Nederlandsch Meteorologisch Instituut is an important contribution to the oceanography of the Atlantic. It is a summary of about two and a quarter millions of observations made by steamers and sailing ships during March, April, and May throughout the period 1856–1920. There are 186 pages of tables and an atlas, with 24 plates. These represent currents, winds, the general circulation of the water and air, isobars, the general courses of water and air isotherms, and the limits of ice, fogs, etc. The tables were published in 1921 and the plates in 1922.

RECENT fishery publications include two papers from the Ministry of Agriculture and Fisheries ("Fishery Investigations"; Ser. II. vol. v., Nos. 5 and 6). No. 5, by Dr. W. Wallace, is a report on experimental hauls with small trawl nets made in the shallow waters of the North Sea in the years 1904-1912. No. 6 deals with the plankton collected during special cruises made in 1920-21 in order to estimate the annual production of plaice ova. The report is prepared by Mr. R. E. Savage. An important report (in continuation of earlier ones) on the life-history of the mackerel is contained in vol. xxx. of the reports (issued by the International Council for Fishery Investigations). This paper is the work of Dr. E. Ehrenbaum, of the Natural History Museum in Hamburg.

WE have received from the Eastman Kodak Company of Rochester, New York, the fifth volume of the "Abridged Scientific Publications from the Research Laboratory" of the Company. Owing to the increasing number of publications it has been decided to issue these volumes annually, and the present volume deals with the papers which were published during 1921. The abridgments are, of course, somewhat condensed as compared with the original papers, to which any one actually working at the subject dealt with would naturally refer, but for almost every purpose the abridgments will probably be found advantageous. Twenty-three communications are given in 172 pages, and there are added indexes of authors and subjects. This series of volumes forms a most valuable record of the activities of the Company's Research Laboratory, and incidentally a good indication of the general trend and progress of scientific photographical investigation throughout the world.

DR. G. ARNOLD'S report as curator of the Rhodesia Museum, Bulawayo, for 1922, announces the completion of the new wing and the transference to it of the zoological collections and part of the ethnological material, thus freeing space for economic exhibits in the old building. As a result of Dr. Arnold's monograph on the sandwasps of the Ethiopian Region, the types of 70 new species have been added to the collection, a number that probably will be doubled. There are also accessions of type-specimens among bees, beetles, and Neuroptera, as well as the syntype of *Tangasaurus mennelli*, a lizard-like reptile from beds of Karroo age in Tanganyika Territory. Examination of the previously reported Codrington collection of ethnological objects has brought to light nine ceremonial staves of chiefs, from Kasembe's stronghold, such as could no longer be obtained to-day. Five Bantu spears with copper blades are evidence that the Bantu were more than capable of producing the metal weapons found at Zimbabwe. A female Bantu skeleton, found in an ancient mine-working near Gwanda, Southern Rhodesia, has been studied by Sir Arthur Keith, who considers it to date back 800 years or more. It will be seen that this report, though brief, indicates a great deal of good work.

MESSRS. ROSS LTD., optical instrument makers, have been awarded the diploma of the Grand Prix at the International Exhibition of Photographic Optics and Kinematographs held recently at Turin.

THE lectures delivered by Sir J. J. Thomson in April last on "The Electron in Chemistry," before the Franklin Institute, are being published singly in the Journal of the Institute. The complete series will shortly be published in book form under the title "The Electron in Chemistry."

IT is announced by Messrs. Longmans and Co. that the new edition of Thorpe's "Dictionary of Applied Chemistry," which is now in course of publication, will extend to seven volumes, and that a large part of the concluding volume will be devoted to an index to the complete work.

THE latest catalogue (No. 449) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is devoted to books, engravings, and paintings relating to the Indian Empire, and gives particulars of some 646 items, including geography and travel, ethnology, natural history, antiquities, etc. Among the works listed is "Annals of the Royal Botanic Garden, Calcutta," vols. 1 to 8.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, have in the press a translation of "The Internal Secretion of the Sex Gland," Prof. A. Lipschütz, with a foreword by Dr. F. H. A. Marshall. The work will give an account of the recent experimental work

of Prof. Steinach and others on the reversibility of the sexes, the part played by the interstitial gland, and the results of the transplantation of this organ.

AMONG the books shortly to be published by the Cambridge University Press we notice "Stories of Scientific Discovery," by Mrs. D. B. Hammond, consisting of short biographical sketches of Priestley, Lavoisier, Count Rumford, Herschel, Fabre, Faraday, the Curies, Darwin, Wallace, and Pasteur; vol. 4 of the "Cambridge Medieval History," dealing with the Eastern Roman Empire (717–1453), and "Foundations of Agricultural Economics," by J. A. Venn; the aim of the latter is to give some account of the origin and incidence of the numerous economic problems which affect the agricultural community.

Our Astronomical Column.

AN OFT-RECURRING RELATIVITY BLUNDER.—Many people have been temporarily misled by a fallacy in considering the Einstein bending of rays of light. They imagine that it ought to produce a sensible shift in the position of the further component of a double star, owing to its light passing close to the nearer component, or similarly that the satellites of Jupiter ought to undergo the shift at the time of occultation. Another form of the fallacy is put forward by M. de Saussure in *Astr. Nachr.* No. 5235, in an article entitled "Influence de la déviation des rayons lumineux sur la valeur du diamètre du soleil." He notes that the light from each limb of the sun would be subject to the Einstein bending, but that since it has only traversed half the gravitational field as compared with a star behind the sun, the bending at each limb is 1·75″/2. So far he is correct. His error comes in when he asserts that the true diameter of the sun is 1·75″ less than that measured, equivalent to 1300 km. In fact we only see the full Einstein shift when the distance from the eye to the place of bending is small compared with the distance from the eye to the object viewed. This is obviously the case for a star near the sun, but not for the components of a double star, for Jupiter's satellites or for the sun's limb.

Since the Einstein bending is similar to refraction we can easily see the fallacy by the following example. Take a bowl 6 inches deep, and let a mark on the bottom be just brought into view to an eye placed horizontally behind the edge of the bowl, when the latter is filled with water. Then the mark is seen deflected through some 41·4° from its true place. But if the eye be placed a mile away, still in the same level, the deflection is no longer 41·4° but only 19·5″. Similarly in the case of the sun's limb, the principal bending takes place near the sun, and the enlargement of the sun's diameter is not 1·75″ but only about 0·01″; practically a negligible quantity.

SPECTROSCOPIC PARALLAXES.—The Memoirs of the R.A.S., vol. 62, contains a valuable paper by Mr. W. B. Rimmer on the spectroscopic parallaxes of 500 stars, the types of which range from Fo to Mb. The spectra were photographed at the Norman Lockyer Observatory, Sidmouth, with the 12-inch prismatic camera formerly belonging to Dr. F. McClean; a few of his spectrograms with the same instrument are also discussed. The differences of line-intensity were measured by the wedge extinction method devised and recently described by Dr. Lockyer. A special study was made of the means for obtaining uniform results, and cases of discordant readings were remeasured. A search has been made for additional pairs of lines suitable for the purpose, besides those used at Mt. Wilson; the enhanced titanium line at 4444 was successfully adopted in conjunction with the cadmium line at 4455; the pair 4216, strontium, and 4250, iron, is available for all types of spectra from F to M; other pairs have a limited range of applicability.

In drawing curves connecting line-intensity with absolute magnitude, use was made of all the trigonometrical parallaxes deduced by recent methods, equal weight being given to all; 0·005″ (in Mt. Wilson values 0·002″) was added, as the reduction to absolute parallaxes. Some of the curves are reproduced in the Memoir. The catalogue contains no dwarf stars of types M or late K, as the spectra available from which to draw curves are too few.

All the 500 stars are in the Mt. Wilson spectroscopic catalogue, and its results are printed for comparison, the agreement being very satisfactory, especially in view of the complete independence of method of measurement. The parallax found for Arcturus is 0·145″ as compared with 0·158″ at Mt. Wilson, and 0·100″ (trig.) at Yerkes; its absolute magnitude is 1·0; it therefore appears to be less remarkable for size and speed than was formerly thought. The brightest absolute magnitude in the catalogue is ϵ Geminorum, −1·5; the faintest are seven stars of mag. 6·0 and 6·1.

YERKES OBSERVATORY: TWENTY-FIFTH ANNIVERSARY.—The Yerkes Observatory celebrated its twenty-fifth anniversary last September; the address delivered on the occasion by the director, Prof. Edwin B. Frost, has recently been printed. He emphasises the paramount part played by Prof. G. E. Hale in its establishment. The spectroheliograph had recently been invented, and work with that instrument has been throughout a principal feature. The original spectrograph being inadequate for this work, part of the funds bequeathed by Miss C. W. Bruce were devoted to the spectroscope called after her, and more than 8000 stellar spectrograms have been obtained with it. These have already yielded many important results, though the information contained in them has not yet been fully investigated.

The 60-inch mirror was offered to Yerkes Observatory, but it was felt that it would have a wider field of usefulness at Mt. Wilson.

Visual work with the 40-inch refractor included Prof. Burnham's measures of double stars, and Prof. Barnard's work on clusters, nebulæ, comets, faint satellites, etc. It was also found that the instrument could be efficiently used for photography, by placing a yellow filter in front of the plate, which must be isochromatic. Successful photographs have been made of the moon, planets, nebulæ, and clusters; 6700 plates were taken for star-parallax. Allusion is made to Barnard's splendid series of photographs of comets, and the Milky Way; the Atlas of the latter is stated to be nearly ready for publication.

The total solar eclipses of 1900 and 1918 were observed by members of the staff, and arrangements are being made to observe that of next September in California. It is pleasant to learn that the observing conditions at Yerkes are probably the best that could be obtained within 500 miles of Chicago; the 40-inch instrument can be used for some 1700 hours per year.

The record of work is one of which the Observatory may well be proud.

Research Items.

THE QUIPU MYSTERY.—Twenty years ago the method of counting by the knotted Quipu was one of the mysteries of Peruvian archæology. Since that time several explorers have found them in use by shepherds in keeping account of their flocks. More modern Quipus are easily understood and can be used by any one. Prof. L. Leland Locke, to whom we are largely indebted for the solution of the problem, has now prepared for the American Museum of Natural History an elaborate, well-illustrated monograph in which all available evidence concerning the use of the Quipu as a means of counting has been carefully collected.

TATTOOING IN THE MARQUESAS.—In Bulletin No. i. of the Bernice P. Bishop Museum, Mr. W. G. Handy publishes an elaborate, well-illustrated monograph on tattooing in the Marquesas. The operation was extremely painful, and after each sitting local inflammation, followed by fever or swellings, persisted for a period of eight or ten days. The practice has now ceased, and the facts have been collected from an examination of about a hundred and twenty-five of the older generation. The designs, of which numerous illustrations are given, show much artistic taste. It cannot now be ascertained how far the practice possessed a magical significance, but in one case a woman seems to have been marked to protect her from evil spirits. But at the time of the cessation of the art it had become purely decorative.

STONE YOKES FROM MEXICO AND CENTRAL AMERICA.—Excavations in Mexico and Central America have disclosed certain objects of unusual and definite shape and of wide distribution, the function of which is unknown. The stone yoke is shaped like the letter U and is about two feet in height, with the bevelled outer surface often carved with elaborate designs. It has been impossible to identify these objects either in native manuscripts or in the many available examples of sculpture in stone and clay. The evidence now collected by Mr. S. K. Lothrop in the July issue of *Man* shows that the stone yoke was worn round the waist and that it served no utilitarian purpose. The suggestion now made is that the yoke may represent the underworld, because the outline resembles the Mexican symbol for that region, and also because the yoke is associated with death and sacrifice in the Santa Lucia sculptures. But the proof of this theory must await the presentation of new facts.

AIR SURVEY AND ARCHÆOLOGY.—Mr. O. G. S. Crawford has reprinted his paper on "Air Survey and Archæology," read before the Royal Geographical Society in March last. The main purpose of the paper was to distinguish by the aid of ground-plans and aerial photographs of camps like Cissbury and the Soldier's Ring near Martin, now in Hants, two varieties of the shelves and banks, known as lynchets. The first, or Celtic type, he attributes to the first wave of the Celtic-speaking peoples about 700 B.C., who introduced finger-tip pottery, new types of bronze implements, the use of iron, square camps, and the Celtic system of lynchets, boundary-ditches, and roads. The Saxon or "open-field" system was quite different from the Celtic type, and this is instructively illustrated by sketch maps of the Celtic and Saxon villages on Salisbury Plain. Mr. Crawford writes: "I find it difficult to express in suitable words my sense of the importance of air-photographs for archæological study. They provide a new instrument of research comparable only to that provided by excavation. They are second only to excavation in the results they will achieve. Their invention will prove as valuable to archæology as that of the telescope has proved to astronomy. They are not a substitute for field work, but they are the most powerful ally of the field archæologist."

THE PRESENT POSITION OF DARWINIAN THEORY.—In an article on this subject in the current number of *Science Progress*, Prof. E. W. MacBride first outlines Darwin's own position as developed in the first five chapters of the "Origin of Species." Among the points he emphasises are Darwin's belief that modifications due to use and disuse are inherited, and his view that acclimatisation and the inheritance of its effects must have played a part in evolution. After stating eight "laws" of Darwin, Prof. MacBride concludes that they are reducible to two: (1) the Lamarckian factor, (2) an indefinite tendency to vary to an unlimited extent in all directions. The second factor he discards after a discussion of mutations in several of their aspects. To reach this conclusion he relies upon the principle of regulatory balance, and states that the doctrine of the survival of the fittest implies that all the organs of an animal (or plant) shall be useful, meaning that the particular specific form or character of every organ must be useful. The article concludes with a discussion of recent evidence concerning the inheritance of acquired characters, a criticism of the age and area hypothesis, and a short reference to recapitulation.

BIO-CLIMATIC STUDY IN THE EGYPTIAN DESERT.—Bulletin No. 29 published by the Ministry of Agriculture, Egypt, gives a short discussion on the above by Mr. C. B. Williams, senior entomologist. The discussion is carried out to show that the statistics gathered by meteorologists relative to desert conditions greatly ignore the conditions for biological studies. The author, while approving of the Stevenson screen for meteorological purposes, suggests that there is a strange lack of Stevenson screens for sheltering purposes in the desert. An expedition was made for a week in August 1922, all the time that could be then spared, to get at the actual facts of local variation. The locality chosen was in the Wadi Digla, 12 miles south-east of Cairo and 7 miles in a direct line from the Nile. Observations were made at the camp on the south side of the wadi, mostly shaded from the sun; also just alongside the camp, on the rock, beneath a large piece of which was a cavity into which it was possible to crawl, and on a large flat-topped rock in the middle of the wadi, completely exposed, where black and white bulb thermometers *in vacuo* were observed. Other observations were made in a body of sand, in a burrow, in a bush, in a hole under stone, and in ant-lion pits. During the week the temperature of the surface sand showed a change from 17·5° to 58·2° C., while the air shade varied from 21·2° to 35·9° C., and twelve metres in a cave from 24·0° to 25·4° C. only. There was a great range of humidity and other conditions in the various positions.

COWS' MILK FOR HUMAN CONSUMPTION.—A conference on the milk question was held at the meeting of the Royal Society of Arts on April 25, of which an account is given in Journ. Roy. Soc. Arts, June 29. Prof. Stenhouse Williams maintained that it is not an impossible proposition to provide the public with a clean raw milk from cows which do not react to tuberculin, at a price which consumers ought to be, and are, willing to pay. Prof. Drummond, Dr. Zilva, and Capt. Golding dealt with the changes which take place in cows' milk on heating to various temperatures—

digestibility, influence on vitamins and enzymes—suggesting that it is inadvisable to employ heated, such as pasteurised, cows' milk for infant feeding. They seem to have overlooked the fact that cows' milk is not the natural food for the human infant, and that clinical evidence does not support the view that good fresh heated cows' milk is less satisfactory for infant feeding than the raw milk.

LANCASHIRE SEA-FISHERIES.—In his introduction to the report for 1922 on the Lancashire Sea-Fisheries Laboratory, Prof. James Johnstone has given an interesting summary, in non-technical language, of the present state of knowledge concerning the problems under investigation. Mr. Daniel's third and concluding paper on the seasonal changes in the chemical composition of the mussel (*Mytilus edulis*) deals with the distribution of fat and glycogen in the tissues, and he shows that it is the rôle of the connective tissue to store up these substances as reserve food-materials, afterwards to be used up by the rapidly growing sexual follicles during the time of preparation for reproduction. The study of the Irish Sea cod-fishery of 1921–23 by Messrs. Johnstone, Smith, and Fleming has led to the conclusion that there is no such definite seasonal variability in the metabolism of Manx cod as one finds in the herrings from the same district. Mr. Birtwistle and Miss Lewis conclude their report on scale investigations of shoaling herrings from the Irish Sea with a pertinent question :—" How are we going to reconcile these two positions, namely, that we can construct a curve from a sample of herrings which suggests that variations in length and scale rings are due to chance and do not indicate age, and at the same time we can construct a similar type of curve from a sample of plaice in which we do definitely know that the variations in length and otolith rings do indicate four different age groups ? "

LACE-WING FLIES.—Memoir 58 of the Cornell University Agricultural Experimental Station is devoted to an account of the biology of the Chrysopidæ written by Mr. Roger C. Smith. The insects included in this family are of particular interest in view of their predaceous habit of destroying various soft-bodied insects, etc., particularly Hemiptera. About sixty species of lace-wing flies are known in the United States, and the life-histories of eleven are described and illustrated with evident care. The general discussion of the family, which runs to about 50 pages, is particularly interesting, and should be read by all who study these insects. In discussing the function of the long pedicel, upon which each egg is laid, the author points out that it only affords partial protection from enemies. Only certain species of the larvæ carry debris on their backs and have specially modified setæ for retaining the material in position. The debris is used as a method of concealment, and consists of varied substances, including particles of plant tissues, exuviæ, and other insect remains. This material is placed by the larva on its back, but no silk is utilised in building it together. The larval food consists chiefly of eggs and small aphids and scale insects, but the larvæ are sometimes cannibalistic. It has also been observed that they frequently derive sustenance from plant tissues. The average number of aphids eaten by one of these insects during its larval life is about 170. Certain of the adult insects are also noted to devour aphids very readily. Chrysopids are subject to various insect enemies, and one of the most remarkable is a small blood-sucking midge, which attaches itself to the wings of the lace-wing and, burying its proboscis in a vein, sucks up the blood of its host.

JAPANESE TERTIARY FOSSILS.—Prof. M. Yokoyama, to whose valuable papers on the fossils of the Musashino beds we have previously directed attention (NATURE, August 26, 1920, p. 836, and November 11, 1922, p. 646), has now published a note " On some fossil Mollusca from the Neogene of Izumo " (*Japan. Journ. Geol. and Geogr.*, vol. ii. No. 1). The exact horizon of the beds is uncertain ; they are older than the Musashino formation, and if Pliocene should be referred to the Lower and not to the Upper division. Out of 19 species described, setting aside three as possibly obtained from beds not belonging quite to the same formation, there are seven species referable to existing forms and seven not known living which are here described as new. The relative proportion may, however, be modified on the acquisition of additional specimens.

THE GIGANTIC HORNLESS RHINOCEROS. — Prof. H. F. Osborn has followed up his scientific description of the skull of Baluchitherium, to which we referred recently (NATURE, July 14, p. 67), by a popular article on it and other rhinoceroses living and extinct (*Natural History*, vol. xxiii.). Well written and abundantly illustrated, this article is worthy of attention by more advanced students than those for whom it is obviously designed. So far as we are concerned the most interesting feature is the evolution of the idea as to Baluchitherium's size and form as expressed in three successive restorations. In the first it appears like an exaggerated rhinoceros with a proportionately slightly longer neck, while the last exhibits a slighter limbed, more upstanding animal, with elongate, horse-like neck, its height at the shoulder being increased in terms of a modern rhinoceros from 1·8 to 2·5. Its affinities to other rhinoceroses is yet in doubt ; but for its powerful superior tusks it would be considered as simply a giant Aceratherium.

OIL-SHALE FROM THE ROCKY MOUNTAINS.—Mr. D. E. Winchester has recently contributed a useful addition to the oil-shale literature of the United States Geological Survey in Bulletin 729, wherein he describes the well-known occurrences of the Rocky Mountain region. This volume is noteworthy because the author discusses an aspect of the subject usually slurred over by most writers, namely, the detailed fauna and flora of certain stratigraphical horizons to which the oil-shales are referable. The fauna includes a long list of insects (in the broad sense) and other arthropods of the Green River Formation (Eocene), while an abundant and varied flora has been described by Mr. F. H. Knowlton, the late Dr. C. A. Davis's contribution on the study of the microorganisms being also incorporated in the text. The photomicrographs of thin sections of some of these oil-shales show an abundance of fossil vegetable-matter with which, presumably, the hydrocarbon content of the shale is connected. Some interesting data are recorded concerning methods of approximate evaluation of oil-shale in the field, the methods including simple retorting and test-tube experiments, the latter being especially useful. After all, even if there be millions of tons of shale-resources available for mining, the material is of little use unless it will yield oil in payable quantities. Hence field-tests, where definite, may save a great deal of unnecessary expense in initial development. This bulletin is profusely illustrated with photographs and maps, and a very complete oil-shale bibliography is appended ; it is, in fact, something more than a mere technical report, being a trustworthy handbook to the whole subject of oil-shale mining and exploitation.

WEATHER IN EGYPT.—The meteorological report for the year 1918 has recently been issued by the

Ministry of Public Works, Egypt. Daily observations are given for several elements at the principal stations, comprised by Helwan Observatory, which is the first-order station for Egypt, as well as Alexandria, Giza, and Khartoum. Monthly summaries are given for many other stations, and monthly rainfall results are added for several places. Weather conditions were generally unsettled from January to April and from October to December, but more settled weather was experienced from May to September. The temperature was much above the normal in the autumn months and about normal for the rest of the year, while atmospheric pressure was generally above the normal. Heavy rain of the thunderstorm type over Middle Egypt was a feature of the year. The Sudan rains were in considerable deficit. At Helwan, July was the hottest month of the year and the diurnal change of temperature was greatest; the mean temperature was 28·8° C., and at 5 A.M. the deficit of temperature was 6·7° C., while at 3 P.M. there was an excess of 6·7° C. The lowest mean temperature was 12·6° C. in January. The total rainfall for the year at Helwan was 36·7 mm. (1·45 in.), and no rain fell from June to September. Observations were commenced at Jerusalem in April 1918; the hottest month was July with a mean 22·8° C., while in December the mean was 10·0° C. No rain fell in June, July, and August; in December the total rain was 105·1 mm. (4·14 in.).

PECTIN IN COTTON.—Messrs. P. H. Clifford and R. G. Fargher have been examining the distillate from large-scale experiments upon the treatment of cotton with sodium hydroxide and superheated steam, conducted by the Bleachers' Association, Ltd. (Journal of the Textile Institute, vol. xiv. No. 5, May 1923). Methyl alcohol and acetone were the main volatile products isolated, a fact which supplies additional evidence for the presence of pectin in the cotton hair, as F. Tutin has shown (*Biochem. Journ.*, vol. 15, 1921) that the alkaline hydrolysis of pectin yields both these substances.

X-RAY INSTALLATION FOR VETERINARY WORK.—The Research Department, Woolwich, has published a description of an X-ray equipment, designed and constructed at Woolwich, which has been installed in the Army Veterinary School at Aldershot (R.D. Rep. No. 56). It consists of a large teak table-top to which the animal can be strapped while in the vertical position. The X-ray tube box is mounted on a carrier which enables it to be moved into any position relative to the animal, and the examination may be made or radiographs taken with the animal in the upright position. Alternatively, the table-top may be rotated and moved on rollers so as to bring the animal into the horizontal position over a supporting table. The X-ray tube used is of the standard Coolidge type, completely enclosed for protection in a lead box, and the generating set is designed to supply currents up to 20 milliamperes continuously at 150,000 volts. Full details of the apparatus are given.

INDUSTRIAL PSYCHOLOGY IN COAL MINING.—To attempt to teach a coal miner how to use a pick seems at first sight as valuable as taking coal from Dover to Newcastle; but a glance at two memoirs by Dr. C. S. Myers and Mr. E. Farmer in the June issue of the Memoirs and Proceedings of the Manchester Literary and Philosophical Society is sufficient to show how much is to be gained by investigating scientifically the best way of using such a tool. Mr. Adams and Mr. Stephenson, two post-graduate students of the Psychological Laboratory of the University of Manchester, have devoted twelve months of their time to the investigation, and have for much of this time lived the life and worked the hours of the miner. As a result, the wielding of the pick has been rendered more continuous and rhythmic and a greater output secured with less fatigue of the miner. The effects of improved lighting and more orderly arrangement of work so that less shovelling has to be done have also been investigated, and the miners themselves have taken a keen interest in the investigation.

A MERCURY FLASH-LIGHT FOR PHOTOGRAPHY.—In the Proceedings of the Physico-Mathematical Society of Japan for June there is reprinted a paper from the *Japanese Journal of Physics* by Kyoji Suyehiro on an "Electrically deflagrated Mercury Filament as a Flash-light for Instantaneous Photography." In investigations on the rolling of model ships and the vibration of structures, photographs of rapidly moving objects were desired. Prof. Anderson's experiments on electrically deflagrated wires as a source of light led to a trial of this method with fine tin and copper wires, but the results were not encouraging. Filaments of mercury were tried with success. Mercury is sucked up into a glass capillary tube, and in each end of the tube a "hair wire" is secured with sealing-wax. Thus filaments of any size are easily prepared. The duration of the flash is shorter as the filament is reduced in length and diameter, and it is also affected by the thickness of the wall of the tube. The most intense light is given out by the mercury arc lit just *after* the explosion. The paper is illustrated with photographs of flashes, results of testing their duration by means of a rotating disc with radial lines on it, and applications of the method.

MANUFACTURE OF WATER-GAS.—The Fuel Research Board of the Department of Scientific and Industrial Research has just issued, in its Technical Paper No. 6, a record of experiments at H.M. Fuel Research Station, Greenwich, on the "Comparison of some Methods of running Water-Gas Plant" (H.M.S.O., 2*s*. net). The manufacture of water-gas from coke is of great economic importance, and the accumulation of carefully ascertained data is correspondingly valuable. Observations were recorded on the behaviour of cokes of different origin when used in the generator (of the Humphreys and Glasgow pattern), and the paper deals also with four gasification tests with varying depths of fuel bed. The first three were made on the Dellwik-Fleischer system—with shallow beds of depth 3 ft. 6 in. to 4 ft. and varying rates of steaming. The fourth was made with a deeper bed on the system recommended by the makers. All tests were made on the same coke. The observations in the tests are given very fully in tables of weight and thermal balances, temperatures, and rates of gas production. The thermal efficiency of the generator was found to reach 59·9 per cent. in the Dellwik-Fleischer system and 57·8 per cent. under the normal regime, when no deduction was made for heat losses and expenditure in generating the power employed in the process. These deductions depend naturally on the efficiency of the auxiliary plant, and might depress the efficiency on certain conditions assumed, *e.g.* in the fourth test to 52·8 per cent. The greatest thermal loss occurred in the heat carried by the "blow gas" which lay in the four tests between 20 and 30 per cent. and sufficient theoretically to generate 80 to 130 lb. of steam per 1000 cu. ft. of water-gas made. This report may usefully be read in conjunction with the Sixth, Seventh, and Tenth Reports of the Gas Investigation Committee of the Institution of Gas Engineers published in 1921, 1922, and 1923, which give a more detailed study of the water-gas process in its various modifications, as operated in towns gasworks.

International Education.

"THERE is hardly any important national problem left in the world which has not an international relation and aspect." "The search for truth and its application to human need is a vast, world-wide co-operative task. . . . Every country should seek entangling alliances in a league for scientific progress." Of these quotations the first is from a speech made recently in London by Dr. Nicholas Murray Butler, the second from a report, published last year, by the president of the Rockefeller Foundation. Both indicate a point of view which has been adopted with enthusiasm since the War by a considerable number of people, especially in academic circles, in the United States. Both in America and on this side of the Atlantic, where it is more familiar, systematic efforts have been made to orientate higher education to some extent to this supra-national point of view.

In America two important organisations have been established expressly for the furtherance of International Education—the Institute of International Education by the Carnegie Endowment for International Peace, and the International Education Board by John D. Rockefeller, Jr. The Board, which only came into being this year and aims at promoting "education throughout the world," has made a grant of 100,000 dollars a year for ten years to Teachers College, Columbia University, to aid in establishing, as an integral part of the College, an International Institute for the instruction of foreign students (of whom there are already some 250 in the College) and of Americans engaged in teaching in foreign countries, and for research and investigation into foreign educational conditions and the adaptation to those conditions of American systems and methods of education. The Board aims at establishing mutually helpful relations with other countries in regard to selected specific educational problems, and has already arranged for a study of co-operative farming methods in Denmark. Many of the activities of the Rockefeller Foundation, with which the Board is closely associated, have an international educational character: of the 157 individuals who held the Foundation's fellowships in 1921 only 71 were Americans, the others belonging to 17 other nationalities.

The Institute of International Education began work in 1919, and its director, Dr. S. P. Duggan, has recently presented its fourth annual report. Among its varied achievements during 1922 was an agreement with the Commissioner of Immigration at Ellis Island, designed to mitigate in its application to students the new American immigration law limiting to specified quota the number of immigrants from foreign countries, the director undertaking to act as sponsor for properly certificated students and the commissioner agreeing to admit such students provisionally on parole. Among its other enterprises may be mentioned: arranging for the selection and distribution of 45 fellowship-holders from France for study in the United States and 35 from the United States for study in France; acting as agent for the Spanish Junta para Ampliación de Estudios, which sent 6 fellowship holders to the United States, and for the Czechoslovakian Government, which sent 5; assisting the French authorities to select French girls for training, partly in France and partly in America, in library work and public health nursing; securing fellowships in American institutions for foreign students; promoting resort by Americans to summer sessions in foreign universities; organising student tours in Italy, France, England, and Scandinavia; arranging exchanges of professors; and promoting the formation of International Relations Clubs for the discussion of international questions. The Institute has now an established place as one of the most influential of existing organs for the development of intellectual intercourse among the nations of the world.

In Great Britain the most important single endowment of international education is that provided by the Rhodes Scholarship Trust. Provision is now made under the trust for the continuous residence at Oxford of 190 scholars selected from English-speaking countries outside the United Kingdom. A peculiarity of the method of selection for these scholarships is an insistence on moral force of character, capacity for leadership; in short, all-round ability, as well as literary and scholastic attainments. A similar principle is prescribed for selecting candidates for the 6 Henry P. Davison scholarships founded this year to provide for Oxford and Cambridge men spending a year at Harvard, Princeton, or Yale. A few scholarships similarly designed to draw students from abroad are offered by certain Cambridge Colleges, the Imperial College, and the universities of Liverpool, Manchester, McGill, Harvard, Princeton, and Yale, most of them being open only to students of countries within the British Empire.

Conversely, many universities have endowments, such as the Craven Fund and Radcliffe travelling fellowships fund, which encourage students to go abroad for study or research, generally in some specified field, such as modern languages and institutions, classical studies, or the fine arts, in which sufficient facilities are not available at home. Similarly various governments and voluntary associations, such as the federations of university women, the Anglo-Swedish Society, and the Canadian Imperial Order Daughters of the Empire, have instituted scholarships enabling students to travel to distant countries for educational purposes. The Government of Panama, for example, periodically sends two carefully selected students to universities in Great Britain for complete degree courses of study. The Albert Kahn travelling fellowships, open to British graduates of universities of the United Kingdom, are remarkable for their breadth of aim—"to enable men . . . to enter into personal contact with men and countries they might otherwise never have known; to issue from the world of books . . . into the broader world of . . . all such human interests, struggles, and endeavours as go to the making up of general civilisation."

Apart from endowments for encouraging international education by scholarships and fellowships there are many influences, some of quite recent origin, having a similar tendency. The universities of the United Kingdom have instituted a new doctorate, the Ph.D., open to graduates of foreign universities as well as to their own, and have organised in connexion therewith instruction in research methods; their laboratories and other equipment for advanced study and research have been greatly developed; their representatives have taken part in missions to American, French, Belgian, and Swiss universities; they have established a standing committee of their executive heads with the Universities Bureau as its secretariat, and a separate committee for promoting interchange of students and teachers with universities in other lands—a purpose which has been greatly furthered by the constitution of the British divisions of the American University Union and the Office National des Universités et Écoles Françaises, both of which have offices in the house belonging to the Universities Bureau. There

has also been a notable development of short summer-vacation courses (mainly in London) for foreign students as well as of other summer courses, to which, although not planned expressly for them, foreigners are admitted. Interchange of school teachers (for periods not exceeding one year) between England and Wales and the Dominions overseas has been organised by the League of the Empire on a large scale, and other bodies such as the Overseas Educational League and the Fellowship of the Maple Leaf, are engaged in similar enterprises.

Several European countries participate in exchanges financed by American educational endowments. The Commission for Relief in Belgium Educational Foundation of New York arranges, in concert with the Fondation Universitaire of Brussels, grants for study in American Universities to Belgian graduates and vice versa (in 1921–22, 34 and 24 respectively). The American-Scandinavian Foundation similarly allots 40 travelling fellowships, each of 1000 dollars, and the Franco-American Scholarship Exchange, administered by the American Council on Education, provides 50 scholarships for French women in American colleges, 28 for American women in French lycées and écoles normales, and 22 fellowships for American graduates in French universities.

In France the Doctorat d'Etat has been made more accessible to foreign graduates, a system of exchanges of professors has been arranged with certain American universities, and the summer-vacation courses for foreign students in vogue before the War have been re-established and extended. In 1919 a Franco-Swiss interuniversity conference took place, and in 1921 a convention was concluded, between the French and Belgian ministries of public instruction, to encourage and regulate the exchange of professors and students and to establish a permanent technical commission for the study of questions regarding the scientific, literary, artistic, and scholastic relations between the two countries.

In the same year, 1921, were formed the Netherlands Committee for International Academic Relations and the Office Central Universitaire Suisse.

The Confédération Internationale des Étudiants, formed in 1919, has contributed substantially in co-operation with its affiliated national unions, towards familiarising students with the idea of migration. The National Union of Students of England and Wales, constituted in 1922, has been very active in promoting visits by students to universities in foreign countries.

In the nineteenth century one of the most powerful influences making for migration of students was the great reputation of the German universities for profound learning and for primacy in scientific research, together with their liberal conditions of entrance. In the United States especially a German doctorate came to be looked upon as a normal culmination of the studies of an ambitious youth. The tradition was fostered by the system of exchange of professors arranged by the Prussian ministry of education with American universities. Before the War, however, a reaction had set in, due in part to the rapid development of the American graduate schools.

The League of Nations decided last year to enter the field of International Education, and a Committee on Intellectual Co-operation, having a sub-committee on Interuniversity Relations, is actively engaged in devising ways and means of stimulating movements and enterprises such as those mentioned in this article, including the establishment of an international bureau of university information.

The question of interchange of students has an economic aspect which deserves study. At the present time students from abroad constitute about eight per cent. of the full-time students in the universities and university colleges of the United Kingdom. Statistics showing the number of students from the United Kingdom in universities and colleges in all other countries are not available, but those in the United States in 1920–21 numbered 181, and those in other parts of the world are certainly very few compared with the total of more than four thousand students from abroad in the British Isles. Is the fact that our imports so largely exceed our exports to be accounted economically advantageous to us or the reverse? The fees paid by students represent, of course, only a fraction of the costs of maintenance of the institutions where they study, and in universities such as Oxford, Cambridge, London, and Edinburgh, which are frequented by students from abroad in large numbers, the additional expenditure necessitated by their attendance is probably not compensated by their fees; but there is a more important question in regard to the students who come to Great Britain to study technology. When they go back to their own countries they take with them knowledge which is used so as to make the competition of their countries' industries with our own more formidable. On the other hand, they are likely to recommend the placing of orders for stores and machinery in the country in which they have studied rather than in other countries, and if they had not come to Great Britain for their knowledge they would probably have obtained something very like it elsewhere. It may be that such students do British industries more good than harm. The matter is one on which it is desirable that further light should be, if possible, obtained.

Botanical Surveys.

THE Department of Agriculture of South Africa has recently issued two memoirs (Nos. 3 and 4) on the botanical survey of South Africa. The former, by S. Schonland, entitled "Introduction to South African Cyperaceæ," is a systematic account of a selection of the indigenous sedges, many of which play an important part in the prevention and cure of soil erosion, and a knowledge of which is essential in the study of the relations of sour and sweet veld. A description of the general structure of the vegetative organs, the inflorescence, the difficulties in the interpretation of which are discussed in some detail, the flower and the fruit, is followed by notes on all the South African genera, including representative species of each. The species are illustrated by seventy carefully drawn plates, which show the habit of the plant and enlarged details of flower and fruit, and will enable the student to identify any species included in the limits of the book. The general arrangement is the one adopted in the "Flora Capensis" by the late Mr. C. B. Clarke, to the thoroughness of whose work Dr. Schonland pays high tribute. The critical remarks included in the notes on the genera render the work of value to others than the South African student of this family.

Memoir No. 4, entitled "A Guide to Botanical Survey Work," is a series of chapters, by different experts, which will be helpful to those engaged in the South African survey. Dr. Pole Evans reiterates the organisation and aims of the survey, and describes briefly the characteristics of the two main botanical regions, the true Cape region, with a vegetation resembling in its general aspect that of the Mediterranean area, and the South African region, which

comprises the remainder of the country under review, extending northwards to include a strip of Southern Rhodesia and the southern part of Portuguese East Africa. There are also chapters on the physical features and climate, on methods of survey, with instructions to collectors and observers, and a bibliography. Dr. Marloth writes on the use of the common names of plants, which, though sometimes not trustworthy, may be very useful if accepted with care and discretion.

The Report of the Canadian Arctic Expedition 1913–18 (vol. v., Botany, part B) by Theo. Holm ("Contributions to the Morphology, Synonymy, and Geographical Distribution of Arctic Plants") contains some interesting notes on the methods of growth and reproduction, manner of hibernation and other characteristics, of many of the species collected by the expedition. Certain biological types are absent from the polar regions; there are no climbers, no saprophytes, and no true parasites. Pedicularis alone represents the partial parasites. The great majority of the herbs are perennial. The chapter on geographical distribution contains a table showing the general distribution of the species collected, which indicates that the vegetation of the north coast of America is composed of types from various parts of the northern hemisphere of both worlds, and bears out the view that the present arctic flora consists to a great extent of remnants of the alpine floras of the tertiary period. These alpine floras were principally those of the European Alps, Altai and Baikal, the Rocky Mountains, and perhaps also Caucasus and Scandinavia.

Memoir 126, issued by the Canadian Department of Mines ("A Botanical Exploration of the North Shore of the Gulf of St. Lawrence," by Harold St. John), includes an annotated list of all the flowering plants and ferns recorded from this area, in all 622 species, and some discussion of the soil-relations of the various ecological plant groups. A comparison of the habitats of 103 species along the north shore of the gulf and in other regions, especially Europe, indicates an agreement the more surprising considering that the data have been gathered by many botanists at widely separated places and times. Mr. St. John also gives an account of botanical exploration in the same area previous to his own visit in 1915.

"A Flora of the Shetlands," by Dr. G. C. Druce, forms a supplement to the recently issued report of the Botanical Society and Exchange Club for 1921. The total land surface of the islands, which number more than a hundred, is rather more than that of the Faroes, but the hills are lower and lack the marked alpine element found in the flora of the Faroes. The population of the islands since the glacial period has been explained alternatively by the existence of a land-bridge and immigration by means of birds, ocean-currents, and wind. The latter view would seem the more probable. There are practically no endemic species, and many species found in the islands are extremely local. The flowering plants and ferns number about 500 species, 59 of which have probably been introduced by man. Dr. Druce remarks on the size and brilliancy of some of the flowers, and suggests the feeble intensity of sunlight as a cause; clouds are absent from the sky only on a few days in the year, and mists are very frequent. There are few Lepidoptera; many plants are self-pollinated, and others never ripen seed. The flora approximates most closely to that of the Faroes, and is distinctly poorer than that of the Orkneys.

The Gas Industry and Coal Conservation.

THE annual coal output of Great Britain is about 300 million tons, of which approximately 20 million tons are carbonised annually in gasworks for the production of towns' gas. The reserves of British coal within 4000 feet of the surface were estimated in 1915 at 197,000 million tons. In something like 600 years the coal measures of this country will be probably exhausted, and what then? The world's scramble for oil to-day indicates that a coal age will certainly not be succeeded by an oil age. Possibly we shall have learnt to tap atomic sources of energy, or perhaps the earth's internal heat may be available to us, after the manner suggested by Sir Charles Parsons.

There are those who hold that how posterity will provide itself with supplies of energy is posterity's own concern and need cause us no uneasiness; the gas industry takes a wider view. Its processes are continually being examined with a view to effecting greater conservation of coal. In a Report to the Institution of Gas Engineers in 1919, by Sir Dugald Clerk, Profs. Cobb and Smithells, it is shown that the thermal efficiency of the process of carbonisation of coal achieved to-day in the United Kingdom is from 70 to 80 per cent., and that debiting gas with the whole of the thermal losses of the process and allowing for transmission and other losses, at least 45 per cent. of the heat of the coal carbonised is delivered to the consumer as inflammable gas. This is a high figure, but it can be considerably improved upon if the heat content of the coke produced, amounting to more than 10 cwt. per ton of coal carbonised, is made available to the consumer by the conversion of the coke into gas. The Gas Regulation Act, 1920, had this point among others in view when it conferred upon individual gas undertakings freedom to declare the calorific value of the gas each would supply. As there appears to be considerable confusion of thought on this matter, perhaps it were as well if we explained briefly the nature of the component mixtures constituting towns' gas.

> "We see all sights from Pole to Pole,
> And glance and nod and bustle by,
> And never once possess our soul,
> Before we die."

Blue water gas is produced from coke by passing air and steam alternately over an incandescent bed of this fuel. Its calorific value is about 300 B.Th.U. per cubic foot, and its composition is approximately represented by CO_2, 4·5 per cent.; CO, 43 per cent.; H_2, 48 per cent.; methane, 0·5 per cent., and nitrogen, 4 per cent. Sometimes this gas is mixed direct with coal gas in a towns' gas supply, a customary proportion being 80 per cent. of coal gas and 20 per cent. of water gas, the percentage of carbon monoxide in the resulting mixture being approximately 14 per cent. and the resulting calorific value about 500 B.Th.U. per cubic foot. More commonly, however, carburetted water gas, produced by enriching blue water gas with gaseous hydrocarbons derived by "cracking" various oils at high temperatures, is used for this purpose. The carbon monoxide content of carburetted water gas is on the average about 27 per cent., and, when admixed to the extent of about 20 per cent. with straight coal gas, a mixture containing approximately 11 per cent of carbon monoxide results. Straight coal gas produced by the high temperature distillation of coal has a calorific value of about 560 B.Th.U. per cubic foot and contains about 7 per cent. of carbon monoxide.

The thermal and chemical efficiencies of manufacture of different grades of gas by various processes have been the subject of three reports by a Joint Committee of the University of Leeds and the Institution of Gas Engineers. The first Report dealt with the process of steaming the charge in continuous vertical retorts, and the results showed that the thermal efficiency of gas production increased from 54·5 per cent. without steam to a maximum of 62·1 per cent. with moderate steaming, and at the same time increased yields of tar and ammonia were obtained. These results were later confirmed by work carried out about the same time by the Fuel Research Board. The second Report showed that the efficiency of production of blue water gas as ordinarily practised in a plant without waste heat boilers, taking into account the steam required for the operation of the plant, averaged 46 per cent. In the third Report on the subject (contained in the Committee's Seventh Report, a copy of which has just been received, presented to the Institution of Gas Engineers in June 1922), the Committee shows that the percentage thermal efficiency of production of carburetted water gas of calorific value about 485 B.Th.U. per cubic foot, taking into account all steam required, was increased from 59·5 per cent to 68 per cent., by the use of waste heat boilers employed for steam raising by means of waste heat in the flue gases. The efficiency of production of blue water gas was 53 per cent. and of the production of gas from oil for carburetting 90 per cent. The percentage thermal efficiency of the waste heat boilers averaged only about 46 per cent.

The problem foremost in the mind of the gas industry to-day is the production and distribution of the Therm at the cheapest price. The maximum conservation of coal within the industry will be achieved when that problem has been settled. While the Fuel Research Board could not, from the nature of the problem, specify any one grade of towns' gas as being under all conditions most suitable for production and distribution, its recommendations, embodied in the Gas Regulation Act, 1920, do, for the first time in the history of the industry, enable the relative efficiencies of gas production by various processes and in different parts of the kingdom to be compared on a scientific basis. The work of the Committee to which reference is here made is evidence of the quickened interest on the part of the gas industry in these matters and an earnest of higher efficiencies yet to be realised, and a cheaper Therm still to be distributed. J. S. G. T.

Optical Works of Messrs. Adam Hilger, Ltd.

THE show-rooms of Messrs. Adam Hilger, Ltd., 75A Camden Road, London, N.W.1, contain a very interesting exhibition of optical instruments, to the inspection of which visitors are cordially invited. A short account of some of the devices and operations seen during a recent visit to the works may be of interest to readers of NATURE.

In a room devoted to the grinding and polishing of lenses and mirrors, a recently silvered mirror was being coated with a thin varnish to preserve the surface of the film which was not in contact with the glass, and was to be used to reflect light in an optical instrument in the same way that a silvered mirror is used in an astronomical telescope. The mirror was circular and about 4 inches in diameter, cathodically silvered. It was mounted by soft wax on a wooden mandril which revolved on a vertical shaft at some thousand revolutions per minute with its silvered surface uppermost. Dust was brushed from the surface by means of a fine camel's hair brush, and then a weak solution of celluloid in amyl acetate was poured upon it and left to dry, while the mirror was rapidly revolving. This left a thin film of celluloid on the mirror, which preserves its brightness. Films which are thick compared with a wave-length of light protect the silvered surface almost indefinitely, but these do not allow of the highest definition. On the other hand, films which are thin compared with a wave-length of light do not preserve the silver so well, but do not, however, in any way adversely affect the optical performance of the mirror. Films of intermediate thickness would tend to produce colours on the principle of Newton's rings.

Several prisms of rock salt were seen in process of manufacture; these cannot be ground with water as in the case of glass, owing to its dissolving action on the substance, so paraffin is used instead, and the accuracy of the rough grinding is tested by steel sets of 60° angle. All finished optical surfaces are, of course, tested by interference methods, the source of light being the mercury vapour arc. A Lummer plate was being tested by this means. Newton's rings were used, and they were plainly visible in spite of the thickness of the plate.

In another room the thickness of a piece of plain parallel quartz some $1\frac{1}{4}$ in. × $1\frac{1}{4}$ in. × $\frac{1}{8}$ in. was being measured on a Michelson interferometer. The half-coating of silver had been removed from one of the mirrors of the instrument, and the specimen was then "contacted on" to this mirror so as to cover one half of it. The whole was then half silvered, and the distance between the two surfaces was measured in air. What appeared to be a slight scratch in the centre of the specimen was in reality a slit in the glass, of width only 16 wave-lengths of light (λ5461). This slit was made in the manner illustrated in the accompanying diagram (Fig. 1). It will be seen that the quartz plate was in reality built up of four pieces, all optically finished with extreme accuracy. Starting with 1, 2 and 3 were contacted on and heated sufficiently to make these three join up into one piece, but, of course, not too much, or the optical perfection of the surfaces would be spoilt. The protruding edges of 2 and 3 where they meet 4 were then ground and polished so that they extended beyond 1 a distance equal only to 16 wave-lengths. This distance was measured with the Michelson interferometer, and then 4 was contacted on and the heating process repeated.

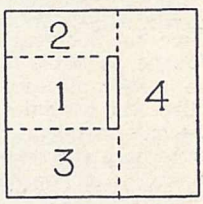

FIG. 1.

In the workshops an accurate screw was being cut similar to that which is used in the Fabry and Perot interferometer. This was done on an automatic electrically controlled lathe. Whenever the cutting tool reached the end of its stroke, electrical contacts were made, which moved the tool away and brought it back to the beginning of the next cut. The screw, when turned, is rotated from end to end through a long split nut, driven by an electric motor with an automatic reversing gear. The nut contains a thermometer, the temperature of which is read from time to time to avoid over-heating, and this is apparently sufficient for the purpose, though one might have thought that an oil-bath would have kept the temperature more constant. Great care has to be

taken with the end thrust bearing of this screw, so that no periodic error may occur when it is in the instrument. To ensure this, the end of the screw has a small flat surface optically ground and polished. This rests against a ruby plate to take the end thrust of the screw. The plate is capable of adjustment, and there will be no periodic error when the system of interference fringes which can be observed between the ruby plate and the end of the screw remain unchanged while the screw is revolved. The screw is said to be true to 1/100,000 mm.

Among other things seen were the testing of a camera lens for non-axial rays by the interference method recently perfected by Mr. Twyman, and fully described by him in one of the catalogues and elsewhere,[1] and some extremely delicate thermo-junctions for spectro-bolometric work.

Mr. Twyman states that the large majority of those who come to inspect Hilger's showrooms, or apply to be shown over the works, are foreigners, and it is with the hope of bringing this exhibition to the knowledge of British men and women who are interested in optical design and spectrographic work in general, that the foregoing has been written.

C. C. L. GREGORY.

1 "An Interferometer for testing Camera Lenses." Read before the Optical Society, April 14, 1921.

Biometry and Mathematical Statistics.

IN the new double number of *Biometrika* (vol. 14, Parts 3 and 4, Cambridge University Press. Price 30*s*. net) ample evidence is provided to show how groundless is the charge that the interest of modern statistical work is wholly mathematical. Of the ten memoirs published, only three require for their intelligent perusal more than a very moderate knowledge of algebra. The three mainly mathematical papers are Mr. Egon Pearson's evaluation of the probable error of a Class-index correlation, Prof. Pearson and Miss Elderton's paper on the Variate-difference method of determining correlation —a valuable contribution to the controversy which has arisen over the applicability of this method to various kinds of data—and Mr. E. C. Rhodes' paper on a particular type of Skew Correlation surface.

The most important of the biometric papers is Mr. Morant's careful study of the Tibetan skull. Mr. Morant concludes that there are in Tibet at least two distinct races—one closely allied to the Southern Chinese, Malayans, and Burmese, the other not showing any close affinity to any other oriental race, but resembling most the Burmese B and C types. He conjectures that he may here be dealing with widely scattered fragments of a fundamental primitive human type, with a long-headed, broad-faced, rugous and massive cranium.

Dr. Lucy Cripps, Dr. Major Greenwood, and Miss E. M. Newbold contribute a study of the inter-relations of "vital capacity," stature, stem length, and weight, based upon data furnished by the medical department of the Royal Air Force. They conclude that, so far as these data are concerned, Prof. Dreyer's modifications of Hutchinson's methods, in particular the substitution of stem length for height, are not marked improvements. Miss Elderton's memoir on the present position with regard to the inheritance of intelligence concludes with the words: "To each of us a limit is set, a limit, as far as one can see at present, due to heredity rather than to opportunity, and to the intelligence of our parents and ancestors rather than to the educational system under which we were reared."

Dr. Percy Stocks describes—giving a pedigree—a facial spasm inherited through four generations. Two other papers—one a short addendum to a memoir on the sesamoids of the knee-joint, the other on a digital anomaly—are of medical interest. Dr. G. D. Maynard discusses the fertility statistics of the New Zealand census. The *miscellanea* contain two notes on points of method and reviews of two recent contributions to mathematical statistics.

There must be very few students of pure or applied statistics who will fail to find anything of interest to them in this issue of *Biometrika*.

Glacial Deposits and Palæolithic Cultures in East Anglia.

AT a meeting of the Royal Anthropological Institute held on June 19, Mr. H. J. E. Peake in the chair, Prof. P. G. H. Boswell and Mr. J. Reid Moir presented a paper on "Flint Implements at Foxhall Road, Ipswich." Prof. P. G. H. Boswell dealt with the geology of the deposits. The site lies in an oval hollow about 120 ft. above Ordnance datum, 1¼ miles E.N.E. of Ipswich station. The surrounding plateau of glacial sand and gravel lies at about 130 to 140 ft. above Ordnance datum. The succession of general sequence of deposits from bottom to top down to a depth of 31 ft. 4 in. is as follows: Dark Chalky-Kimmeridgic Boulder Clay (bored to 2 ft. 6 in.), loamy sand and shingle (6 ft. 9 in.), sandy boulder clay and loam (3 ft.), gravelly and sandy brick-earths passing up into laminated brick-earths (15 ft. 3 in.), gravel and subsoils, etc. (3 ft. 10 in.). Mechanical analyses of the respective beds have been made, and as a result suggestions were offered regarding conditions of deposition. The mineralogical characters have also been worked out, the assemblage being of typically glacial character. Reasons for referring the lowermost deposits to the Chalky-Kimmeridgic Boulder Clay were given, and the evidence that the uppermost gravel indicated a recrudescence of cold or even glacial conditions after a period of amelioration were discussed. Finally, tentative correlations with the glacial sequence in Lincolnshire and Yorkshire were attempted.

Mr. J. Reid Moir described the implements found in the excavations. The number of humanly-flaked flints totals 545: the latest artefacts in Beds Nos. 2 and 3 being referable to the Mousterian epoch; the unrolled hand-axes of Beds Nos. 4 to 6 are of late Acheulean date; while those recovered from Bed No. 7 appear to represent examples of early Acheulean workmanship. Associated with the well-finished implements in the beds mentioned were found a number of simply-made artefacts, such as scrapers, points, and borers. Burnt flints were also recovered from each implementiferous horizon; while quartzite hammer-stones occurred in Bed No. 7. With the exception of one small and unidentifiable piece of bone, no organic remains were found during the excavations. An examination of the artefacts recovered shows that the specimens were flaked differently at the different horizons mentioned, and that a large proportion of the flints are considerably striated; the pressure to which

the specimens have been subjected has not, so far as can be seen, resulted in the removal of flakes. Several rostro-carinates—representing partly finished hand-axes—were found in the Acheulean strata.

In the discussion which followed the paper, Prof. W. J. Sollas said that we now have convincing evidence that the greater part of the Mousterian was glacial, and late glacial—Würm—at that. It is possible that the earlier Mousterian implements of the type of La Micoque belong to the interglacial Riss-Würm. The Upper Acheulean implements found at the top of the lower loess must therefore be referred to the Riss glaciation. There are difficulties, however, and while it might be expected that something intervened between Acheulean and Mousterian, there is no evidence that anything did. Mr. Bury pointed out that while on this site there is a separation between Chelles and Acheulean types, such separation does not occur in the gravels south of the Thames. Curiously, the site also shows a gradual climatic change working up from Acheulean to Mousterian, while south of the Thames the implements occur at different levels—the Acheulean at 100 to 150 ft., and the Mousterian, if occurring in gravels at all, at lower levels. It was this apparently to which Prof. Sollas referred.

Mr. Peake said that this investigation appears to clear up the difference between monoglacialists and polyglacialists. One point, however, has not been cleared up, and that is the relative position of the different industries. On the Continent it is generally held that the Mousterian equated with the Würm, but in America Prof. Osborne at least appears to have abandoned this position. The question arises, which of the four glaciations recognised on the Continent equate with the three glaciations for which there is evidence here? Prof. Boule has maintained that he is unable to find marked evidence for the Gunz glaciation in Western France. This suggests that the centre of glaciation was farther east, and that similar conditions prevailed in this country. In this case our three glaciations would equate with the three later of the Continental glaciations.

University and Educational Intelligence.

LEEDS.—One of the most important departments of the University is that which deals with agriculture, for, while the University is situated in a great industrial city, it is also the centre of the largest agricultural county in England. A new building for the department is about to be commenced. This has been made possible by the generous help received by the University from several sources. The late Mr. Walter Morrison gave a sum of 10,000*l.*, a donation which, by his wish, remained anonymous during his lifetime; a Treasury grant through the Ministry of Agriculture and Fisheries of 12,000*l.*, promised in 1914, has been increased to 15,000*l.*; the Yorkshire Council for Agricultural Education has contributed approximately 10,000*l.*; and there have been numerous other donations. The University is providing the site and the balance of the money required. The building will be located in University Road, west of the buildings of the Textile (Clothworkers) group, and will occupy a plot 190 feet long by 125 feet deep.

LONDON.—The following doctorates have been awarded, the subject of the thesis presented appearing after the name:

Ph.D. (*Science*):—H. E. M. Barlow (University College): "An Investigation of the Friction between Sliding Surfaces, with special reference to the Effects produced by Electric Currents passing across such Surfaces"; Miss F. E. Barnett (Northern Polytechnic Institute): "Some Problems of the Endodermis—The Distribution of the Endodermis in Angiosperms, with some Observations on the Function of the Endodermis"; W. A. P. Challenor (Imperial College, Royal College of Science): "Conditions underlying Carbon Ring Formation"; B. W. Clack (Birkbeck College): "A Research on Diffusion in Liquids"; P. W. Cunliffe (King's College): "(*a*) Studies in Photo-Chemical Light Sources; (*b*) Studies on the Photolysis of Aqueous Solutions of Hypochlorous Acid and of Chlorine"; F. Dickens (Imperial College, Royal College of Science): "The Conditions of Formation of Four- and Five-membered Rings from Substituted and Unsubstituted Open Carbon Chains"; Miss C. H. Griffiths (Birkbeck College): "(1) Diffraction Patterns in the presence of Spherical Aberration; (2) Co-efficients of Diffusion of Potassium Chloride, Sodium Chloride, and Potassium Nitrate determined from the published experimental data of Mr. B. W. Clack by a method due to Dr. Albert Griffiths"; A. A. S. El Kirdany (Imperial College, Royal College of Science): "The Calculation of the Motion of an Inviscid Fluid round an Aerofoil when Cyclicity is assumed to be present"; Miss I. E. Knaggs (Imperial College, Royal College of Science): "The Relation between the Crystal Structure and Constitution of Carbon Compounds, with special reference to simple Substitution Products of Methane"; K. C. Pandya (Imperial College, Royal College of Science): "The Influence of Groups on Carbon Valency Direction"; H. A. Piggott (Imperial College, Royal College of Science): "A Study of the Conditions which determine the Mobility (or otherwise) of certain Potential Tautomeric Systems of the Glutaconic Acid Type in the Aromatic Series"; H. H. Potter (King's College): "Some Experiments on the Proportionality of Mass and Weight"; L. Rebekoff (King's College): "(*a*) Studies in the Photolyses of Formic and Oxalic Acids; (*b*) Studies in some Photochemical Light Sources"; D. O. Shiels (King's College): "The Adsorption of Water Vapour and other Vapours by Charcoal"; B. Singh (Imperial College, Royal College of Science): "Formation and Stability of Cyclic Compounds derived from B Substituted Glutaric Acid"; I. W. Wark (University College): "Some Copper Complexes with Hydroxy-Acids"; A. F. A. Young (King's College): "The Thermionic and Photo-Electric Properties of the Electro-positive Metals"; F. Arnall (Chelsea Polytechnic): "Studies in the Nitration of Phenol"; G. R. Clemo (Queen's College, Oxford): "The Introduction of the B-chloro-ethyl Group into Phenols, Thio-phenols, Aromatic Amines, etc."; J. W. Cook (Sir John Cass Technical Institute): "Some Derivatives of Anthracene"; B. S. Evans: "An Investigation into the Chemistry of the Reinsch Test for Arsenic and Antimony, and its Extension to Bismuth"; P. T. Freeman: "On the Binaural Location of a Source of Sound of Low Frequency, and its Application"; S. I. Levy: (1) "Studies on Cyclic Ketones, Parts II. and III."; (2) "An Attempt to resolve an Oxonium Salt"; (3) "The Action of Amino-Acid Esters on Ethyl Dicarboxyglutaconate"; (4) "(4'-Methoxy-1'-naphthyl)-2-chromon"; A. H. Stuart: "The Problem of securing Rigidity in an Aeroplane Wing"; and C. L. Withycombe (Imperial College, Royal College of Science): "Neuroptera, their Biology and Anatomy."

APPLICATIONS are invited for the Drapers' Company's research scholarship in dyeing at the Technical College, Huddersfield. The scholarship includes re-

mission of fees, together with a maintenance grant of 100*l.* per year. Further particulars and forms of application may be obtained from the Secretary of the College.

A REPORT on "Health for School Children" prepared by the National Child Health Council's advisory committee on health education has been published by the United States Bureau of Education as School Health Studies No. 1. Its keynote is given in the following words: "It is essential that health shall not be regarded as an isolated subject. . . . Health motives and practices should permeate the whole school life and work. Methods of teaching health, of illustrating health, and of living health cannot be torn out or set apart from the child's life, but should be woven into its very fabric." It follows that all elementary-school teachers must be indoctrinated with proper health ideals and principles and inspired with an active appreciation of their importance; and likewise that the active co-operation of parents must be sought. Normal schools must give all students a grounding in general science (chemistry, physiology, bacteriology, and biology), personal hygiene, community and social hygiene, and nutrition, including fundamental instruction regarding foods and normal growth; but even more essential than instruction in these subjects is attention to the health of the students themselves, for "better far a young teacher thoroughly well and with some enthusiasm for health and no methods, than one who is even a little neurotic, a trifle hollow-chested, but method-perfect." In summer sessions normal schools should make health courses obligatory. The committee is considering the publication of a bibliography.

"PHILANTHROPY in the history of American higher education" is the subject of a bulletin (1922, No. 26) of the United States Bureau of Education prepared by Prof. Sears, of Stanford University, California. The writer, summing up the results of his researches, observes that although the "dead hand" may be said to rest in some degree upon most of the institutions of higher education, their vitality is not appreciably affected thereby. This is attributed partly to colleges and universities refusing gifts to which undesirable conditions are attached, and partly to the good sense generally evinced by benefactors. A description is given of a new type of foundation which is said to be coming rapidly into favour. It combines some of the characteristics of a joint-stock company with those of a public trustee. The Cleveland Foundation, the first of this type, has for its object "the mental, moral, and physical improvement of the inhabitants of the city." It receives gifts and bequests, however small, and whether accompanied by any expression of wishes as to their disposition or not, but undertakes to respect such wishes only in so far as shall seem to the board of directors wise and beneficial. The members of the administrative committee are appointed partly by the mayor, the judge of the probate court, and the federal district judge, and partly by the trustee company which manages the principal as a single trust. Prof. Sears does not allude to the injurious effects on college administration of the habit of looking to philanthropists for gifts, yet it is notorious that college presidents have sometimes been chosen mainly on the ground of their supposed efficiency as soliciting agents; nor does he mention the all-important consequence of so-called benefactions—that they must, in the end, to use the words of another writer on this subject, "involve a personal responsibility and a personal scrutiny: somebody must sweat blood with gift money if its effect is not to do more harm than good."

Societies and Academies.

PARIS.

Academy of Sciences, July 16.—M. Albin Haller in the chair.—L. C. **Jackson** and H. **Kamerlingh Onnes**: The magnetic properties of gadolinum ethylsulphate at low temperatures. The determination of the magnetic susceptibility of the powdered salt at temperatures ranging between 14°·56 K. (the lowest temperature obtainable with liquid hydrogen) and 291°·5 K., showed that gadolinum ethylsulphate obeys Curie's law, the product of the molecular susceptibility and the absolute temperature was constant. A single large crystal, the salt, although crystallising in the hexagonal system, was found to be magnetically isotropic.—J. B. **Senderens** and J. **Aboulenc**: The catalytic preparation of the amino-cyclohexanols. Para- and ortho-nitrophenol are reduced by hydrogen under pressure (50 atmospheres) in the presence of nickel as catalyst. The reduction takes places in stages; at 90° C. aminophenol is produced, but if the temperature is raised to 180° C., additional hydrogen absorption occurs and amino-cyclohexanol is obtained.—Charles **Nicolle** and E. **Conseil**: New facts concerning measles. Preventive vaccination. Conditions of contagion. The serum of convalescents confers a temporary immunity from infection: serovaccination, an injection of serum from a convalescent, followed 24 hours later by injection of blood from a patient with measles, confers a longer immunity. Contrary to the accepted view, the author maintains that one attack of measles does not confer permanent immunity, but a recurrence of the disease may be so mild (a rise of temperature only without eruption) that the nature of the disease on the second attack may escape recognition.—Philip **Fox**: Measurements of stellar parallax at the Dearborn Observatory. Data for 31 stars are given; each figure is derived from measurements of from 11 to 21 photographs.—M. **Holweck**: A high-power lamp for wireless telegraphy with removable parts. Diagram and description of a triode lamp of 10 kilowatt type now in use for postal service at the Eiffel Tower station. The lamp can be taken to pieces, the joints being either rubber or ground glass. For maintaining the vacuum, the lamp is permanently connected with the helicoidal molecular pump, described in an earlier communication (*Comptes rendus*, 177, p. 43).—A. **Dauvillier**: An experimental verification of the theory of Röntgen ray spectra due to a multiple atomic ionisation.—Pierre **Auger**: The secondary β-rays produced in a gas by the X-rays. By a modification of C. T. R. Wilson's method, taking simultaneous photographs in two perpendicular directions, information has been obtained about the trajectories of the electrons torn from the atoms of a gas by a bundle of X-rays.—M. **Escher**: The polonium carried down with bismuth hydrate in soda solution. When an acid solution containing bismuth and polonium is precipitated with soda, the polonium is distributed between the precipitate and the solution. The distribution of the polonium between the two phases is a function of the number of molecules of bismuth and of soda present in a given volume of the mixture. Two sets of experimental results are given in graphical form.—N. **Yannakis**: The vapour pressures of mixtures of hydrochloric acid and water.—P. Mondain **Monval**: The allotropic transformation of ammonium nitrate at 32° C. From the law of solubility given by Le Chatelier, it follows that two varieties of the same salt having different latent heats of solution should have different solubility curves, and at their point of

intersection, the two curves having different directions, should show an angular point. Determinations of the solubility of ammonium nitrate at eleven temperatures between 26·7° and 39·2° C. and calorimetric experiments on the same salt at 28° C. and 36° C. give results confirming the views of Le Chatelier. —P. **Laffitte**: The propagation of the explosive wave. A study by the photographic method of the explosion of mixtures of carbon bisulphide and oxygen in spherical glass vessels.—Mlle. **Chamié**: The ionisation produced by the hydration of quinine sulphate.—Albert **Colson**: The range of the displacement of equilibrium.—E. **Decarrière**: The catalytic oxidation of ammonia by air in contact with pure palladium. The yield of oxidised nitrogen is a function of the temperature of the catalyst, the percentage of ammonia in the gas entering, and also of the physical state of the metal. The results of experiments on the effects of the last factor are given.—André **Job** and André **Samuel**: Oxidation phenomena in the complex nickel cyanides: valence, co-ordination, coloration.—M. **Marange**: The identification of cocoa butter by miscibility curves.—M. **Haehl**: *p*-Chlorodiphenylsulphone. The chlorodiphenylsulphone prepared by Beckurts and Otto has been prepared by another method and is shown to be the para compound.—L. **Bert**: The chloride of cumylmagnesium.—Mlle. N. **Wolff**: The furfural- and difurfural-γ-methylcyclohexanones.—R. **Fosse** and A. **Hieulle**: Xanthyl-allantoin. The precipitation of this compound from an acetic acid solution serves to identify allantoin, and to precipitate it from solution containing very small proportions.—A. **Mailhe**: The preparation of petroleum starting from vegetable oils. Dry distillation of rape oil with zinc chloride gave more than 50 per cent. of hydrocarbons consisting of paraffins and unsaturated ethylene derivatives.—André **Helbronner** and Gustave **Bernstein**: The action of the antioxygens on rubber. Crude depolymerised rubber is preserved from oxidation by the presence of small proportions of antioxygens, such as tannin or hydroquinone. Vulcanised rubber thus treated does not show the usual effects of ageing.—Paul **Woog**: Direct observation of the hydration of hydrocarbons.—A. **Loubière**: A new genus of Pyrenomycetes.—Emile F. **Terroine**, R. **Bonnet**, and P. H. **Joessel**: The influence of temperature on the energy yield in germination.—A. **Polack**: The correct form of the experiment on the chromatism of the eye by the partial closing of the pupil.—R. **Faillie** and J. P. **Langlois**: The vertical oscillation of the centre of gravity of the body while walking down an inclined plane.—Mme. Anna **Drzewina** and Georges **Bohn**: The influence of light on the activating power of the sperm of the sea urchin.—Ch. **Dejean**: Rôle of the middle layer in the assemblage of the first beginnings of the eye.—P. **Lecène** and H. **Bierry**: The demonstration of the presence of sucrase in the wall of the mucoid cysts of the ovary.

CALCUTTA.

Asiatic Society of Bengal, July 4.—J. Coggin **Brown**: On the occurrence of *Ostrea gryphoides* Schlotheim in Calcutta. Specimens were found near the surface in excavations for a new building in Calcutta. They provide no new evidence on the question of a former extension of the sea over the present site of Calcutta. —H. C. **Das-Gupta**: On the fossil Pectinidæ from Hathab, Bhavanagar State (Kathiawar).—P. N. **Missra**: Lakshman Samvat. Calculation of European equivalent dates for 16 Lakhsman Samvat dates on various assumptions as to the beginning of the era.—H. C. **Ray**: Allusions to Vāsudeva Kṛishṇa Devakīputra in Vedic literature. Vāsudeva Kṛishṇa is mentioned not only in the Epic and the Purānas but also in at least two works of the Vedic literature.

CAPE TOWN.

Royal Society of South Africa, May 16.—Dr. A. Ogg, president, in the chair.—P. A. **van der Bijl**: Notes on some South African Xylarias.—A. **Ogg**: The crystalline structure of the alkaline sulphates. In conjunction with Mr. Lloyd Hopwood it was shown that the *crystal unit* of alkaline sulphates contains four molecules. With sulphur atoms at the corners and the face centres, and with the nitrogen atoms at the centres of each of the eight rhombs into which the unit can be divided by planes through the centre of the unit at right angles to one another and parallel to the faces, we can build up a structure which explains the structure of the ammonium sulphate crystal. The nitrogen atoms lie at the centre of a tetrahedron of hydrogen atoms, each hydrogen connecting up to an oxygen atom, which in turn connects up to a sulphur atom. In the structure for potassium, rubidium, and cæsium sulphates, if the metals with sulphur lie along the diagonal of the 100 face of the unit, the length of the diagonal, assuming Bragg's values for the atomic diameters, agrees with those found from X-ray measurements.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 9, No. 6, June).—L. P. **Eisenhart**: Another interpretation of the fundamental gauge-vector of Weyl's theory of relativity.—G. Y. **Rainich**: Tensor analysis without co-ordinates. A method of deriving the theory of surfaces without introducing notions having no intrinsic significance such as transformations, covariants, and contravariant quantities, the fundamental tensor g_{ij} etc.—A. B. **Coble**: Geometric aspects of the Abelian modular functions of genus four (III.).—H. D. **Curtis**: On irregularities in the velocity curves of spectroscopic binaries. The spectrographic velocity curves of some of the Cepheid variable stars seem to fit elliptical velocity curves, each with a single oscillation or hump which occurs near the time of maximum velocity of approach. This is in agreement with Duncan's theory of a large and tenuous star rotating about a darker companion in a slightly resisting medium.—W. J. **Luyten**: On the form of the distribution law of stellar velocities. The distribution and space velocities of the stars which have been observed within a sphere with the sun as centre and of radius 10 parsecs seem to fall on a simple logarithic error curve.—C. G. **Abbot** and colleagues: The solar prelude of an unusual winter. The mean monthly values of the solar constant determined at Mount Harqua Hala, Arizona, and Mount Montezuma, Chile, decreased throughout 1922 and the early part of 1923. This seems to have been related to unusual weather conditions in the United States.—C. E. **Mendenhall** and M. **Mason**: The stratified subsidence of fine particles. Suspensions of rock particles were allowed to settle in rectangular tubes across which a temperature gradient was maintained. Stratification occurred in the tubes where the amount of suspended material increases appreciably with depth, but too great a temperature gradient destroys any strata. The effect seems to be due to convection currents which circulate in definite layers.—M. **Mason** and C. E. **Mendenhall**: Theory of the settling of fine particles. An expression giving the position of layer boundaries is derived.

Experiments on two groups of tubes of suspensions show that the rate of fall of the layer boundaries is independent of the temperature gradient within wide limits, and the position of the layers is a function of concentration, time of settling, and thermal gradient. —E. H. **Hall**: The quasi-equation $P = T dV/dT$. If two plates of dissimilar metals are connected through wires made of the same metals, the plates show opposite charges. If unit charge is made to pass from the positive to the negative plate, heat is absorbed; this includes the Peltier effect at the junction. Assuming a mass-law of equilibrium between the ions and electrons of the metals, heat-energy is absorbed at the free surface of the metals in addition. This added to the Peltier effect gives nearer accordance with experimental results.—E. F. **Nichols** and J. D. **Tear**: Joining the infra-red and electric wave spectra. A Hertzian doublet with minute platinum cylinders acted as the source of the waves. The receiver consisted of a Nichols radiometer in which the vanes were mica strips carrying thin deposits of bright platinum. A new form of reflecting echelon analyser was used for the wave-length measurements. By these means electric waves of lengths varying from 7 mm. to 0·220 mm. were produced and detected, thus overlapping previous measurements for infra-red radiation (*e.g.* Rubens and Von Baeyer, 0·320 mm.).

(Proc. Vol. 9, No. 7, July).—A. E. **Kennelly**: On the constant ratio of mean-to-mid potential or current at successive equidistant points along a uniform electric conducting line, real or artificial, in the steady state. The theorem also applies to tables of hyperbolic sine or cosine functions where the angle increases in uniform arithmetical progression, and to tables of $\epsilon^{\pm\theta}$ where θ increases in uniform arithmetical progression.—R. **Brown**: Some recent measurements of transatlantic radio transmission. A high-power vacuum tube transmitter with an output of 200-300 amperes of 57,000 cycle alternating current is used at Rocky Point, Long Island, producing continuous radiation of about 5250 metres wave-length. A receiver in London evaluates the absolute root mean square of the electric field produced. The field rises sharply to a maximum during the period when the route is in darkness, but does not exceed the value calculated from the Austin-Cohen radio-transmission formula. Good night transmission seems to be due to a diminution of losses by absorption rather than to focussing effects.—C. B. **Davenport**: Body build and its inheritance. The ratio, chest girth to stature, or alternatively weight to stature, was used as an index of build in man. A solid figure generated by combining the variability curves with developmental curves shows two main ridges, indicating two main types, medium build and fleshy; the latter seems to refer to the progeny of fleshy and slender strains, showing dominance of fleshiness.—G. C. **Evans**: A Bohr-Langmuir transformation. Mathematically, Langmuir's completely static atom can apparently be shown to be equivalent to the Bohr atom with a circular orbit.—G. A. **Miller**: Form of the number of the subgroups of a prime power number.—G. **Breit**: (1) The interference of light and the quantum theory. Assuming that radiation momenta are transferred in quanta, expressions are derived which represent the effect of (*a*) a diffraction grating of infinite width, (*b*) a finite number of narrow, parallel, co-planar and equal slits, and (*c*) a slit of finite width. (2) Note on the width of spectral lines due to collision and quantum theory. The amounts of the broadening appear to be nearly equal to those given on the wave theory of light and can be accounted for similarly.—P. A. **Ross**: Change in wave-length by scattering. Experiments were made to detect the change in frequency of X-rays and γ-rays on scattering by paraffin, aluminium, and graphite suspected by Compton. Relevant equations indicate that the change of wave-length is independent of the primary wave-length. No such shift was observed by scattering the green mercury line at 180° from paraffin. Using photographic methods and X-rays, the required displacement (about 0·025 Å.) was observed by scattering the α_1 and α_2 lines from calcite at 90° from paraffin. Another unshifted line was recorded.—E. L. **Nichols**: Notes on germanium oxide. The powdered oxide was heated, side by side with a uranium oxide surface, in an oxyhydrogen flame. The radiation of uranium oxide being practically equivalent to black-body radiation, a comparison of the two gives approximately the radiation of germanium oxide in terms of black-body radiation. Preponderance of blue at lower temperatures and of red near fusing point are the characteristics. The reversal point is 1225° C. and melting point 1400° C.—C. **Wissler**: The correlation of respiratory and circulatory data for adult males. Pulse rates in men before and after exercise show a high correlation (+0·73); pulse rate correlates with respiration rate (+0·45) but not with blood pressure and chest mobility. Breathing rate and chest mobility appear to be complementary (correlation −0·46), *i.e.* a man with a mobile chest automatically breathes deeply.—T. W. **Vaughan**: Studies of the larger tertiary foraminifera from tropical and subtropical America. There appears to be no evidence of deposits of Lower Cretaceous age at relatively shallow depths in Florida. Deposits of middle and upper Oligocene age occur in northern Colombia. An evolutionary sequence from ancient Eocene forms of Lepidocyclina with meridional chambers, pointed inner ends, and curved outer walls, to species with hexagonal and rhomboid chambers, is suggested.—S. O. **Mast**: Mechanics of locomotion in Amœba. Three regions are differentiated in *Amœba proteus*: (*a*) a central elongated fluid portion (plasmasol); (*b*) a granular layer surrounding the fluid (plasmagel), and (*c*) a thin elastic surface membrane (plasmalemma); (*b*) and (*c*) are semipermeable and (*a*) is hypertonic. Local swelling of the plasmagel occurs at the tip of pseudopodia with liquefaction on the inner surface at the posterior end. Gelation of plasmasol occurs at the outer posterior border of the swelling. Thus a forward flow is produced which is translated into motion by the adhesion of the plasmalemma to the substratum.

Official Publications Received.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1922. Pp. 12. (Perth: F. W. Simpson.)

Department of the Interior: Bureau of Education. Bulletin, 1922, No. 42: Analytic Survey of State Courses of Study for Rural Elementary Schools. By Prof. Charles M. Reinoehl. Pp. v+116. 20 cents. Bulletin, 1923, No. 1: Diagnosis and Treatment of young School Failures. By Helen Thompson Woolley and Elizabeth Ferris. Pp. vi+115. 10 cents. Bulletin, 1923, No. 18: Medical Education, 1920–1922. By Dr. N. P. Colwell. Pp. 17. 5 cents. (Washington: Government Printing Office.)

University of Cambridge: Solar Physics Observatory. Tenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, April 1, 1922–March 31, 1923. Pp. 8. (Cambridge.)

Department of Commerce: Technologic Papers of the Bureau of Standards. No. 237: Aeronautic Instruments. By Franklin L. Hunt. Pp. 447-511. (Washington: Government Printing Office.) 20 cents.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 18, 1922. No. 6: Proceedings of the Ninth Indian Science Congress. Pp. xi+197. (Calcutta: Asiatic Society.) 13 units.

The Rockefeller Foundation. A Review for 1922: a Summary for the First Decade. By George E. Vincent. Pp. 59. (New York.)